2018 HALIFAX

June 10 -14 | du 10 au 14 juin 2018

Halifax Convention Centre

52nd CMOS Congress | 52e Congrès de la SCMO

2018 CONGRESS THEME I THÉMATIQUE DU CONGRÈS

Marine and Environmental Risks and Impacts

Risques et Impacts Maritimes et Environnementaux

PRIME MINISTER · PREMIER MINISTRE

June 10–14, 2018

Dear Friends:

I am pleased to extend my warmest greetings to everyone attending the 52nd annual Canadian Meteorological and Oceanographic Society (CMOS) Congress.

This annual congress brings together scientists and professionals from across Canada and abroad to share ideas on atmospheric, ocean, climate and earth sciences. I am certain that everyone in attendance will benefit from this experience, and will leave inspired to put what they have learned into practice.

I would like to thank the CMOS and the Marine Environmental Observation Prediction and Response Network for putting together an informative program that is sure to stimulate a great deal of thoughtful discussion.

On behalf of the Government of Canada, I offer my best wishes for a productive and enjoyable congress in Halifax.

Sincerely,

The Rt. Hon. Justin P.J. Trudeau, P.C., M.P.
Prime Minister of Canada

Premier's Message

On behalf of the Province of Nova Scotia I am pleased to extend a warm welcome to participants of the 52nd annual Canadian Meteorological and Oceanographic Society Congress.

There could be no better place to come together and share information and knowledge about the interaction of climate with our oceans. Nova Scotia is defined by the sea. It has been a pillar of our economy throughout our history and it remains one of our strongest competitive advantages. Generations of Nova Scotians have made their living from the ocean.

Increasing our knowledge and understanding of the impact of climate change on our oceans is critically important for the long-term sustainability of our coastal communities and the traditions that underpin our way of life in Nova Scotia. That is why we were excited when the federal government announced earlier this year that our region would be home to an Ocean Supercluster to encourage research and innovation focused on our interactions with the ocean. That is also why we are pleased to welcome the CMOS Congress to our capital city on the shores of the Atlantic Ocean.

I hope you enjoy your time in Nova Scotia and the opportunity to network and share new ideas that can help to protect and strengthen our oceans. Working together we can ensure that the decisions we make in the interest of ocean management are grounded in sound science.

Sincerely,

Stephen McNeil

Honourable Stephen McNeil, M.L.A.
Premier

The Minister of Environment and Climate Change, Catherine McKenna, welcomes you!

I am very pleased to welcome you to the 52nd Annual Congress of the Canadian Meteorological and Oceanographic Society.

The combined congress of the Canadian Meteorological and Oceanographic Society (CMOS) and the Marine Environmental Observation Prediction and Response (MEOPAR) Network represents an opportunity to share information among those who are passionately committed to the future of atmospheric, ocean, climate, and earth sciences.

This year's theme, "Marine and Environmental Risks and Impacts," is extremely important and relevant to Environment and Climate Change Canada. The theme explores the different risks to our physical environment and their impacts on the safety, security, and livelihood of Canadians. The effective assessment of environmental risks and impacts is fundamental to ensuring the well-being of all Canadians and the integrity of our environment.

Improving our understanding on how the earth's atmosphere, oceans, and land interact and sharing earth observations and research knowledge will help us better predict, plan, and prepare for marine and environmental risks and impacts.

Sound scientific monitoring and research are not only the foundation of Environment and Climate Change Canada's policies, programs, and services: they are also fundamental to the good work being advanced by the participants and sponsors of this event.

I thank you for your valued contributions and wish you all the best for a successful and productive congress.

Sincerely,

Catherine McKenna
Minister of Environment and Climate Change

français

Welcome to Halifax NS

Welcome to the Canadian Meteorological and Oceanographic Society's 52nd Congress and the annual meeting. The congress will be held from 10 June to 14 June, 2018 at the new Halifax Convention Centre in Halifax NS, Canada. This year's congress theme is "marine and environmental risks and impacts". The congress will bring together a wide range of scientists and other professionals from across Canada and other countries with a focus on topics in atmospheric, ocean and earth science.

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On-Line Registration and payment is available here

Welcome to the registration information for the **52nd CMOS Congress** being held at the Halifax Convention Centre (HCC) in Downtown Halifax, NS, Sunday – Thursday, June 10 – 14, 2018. Note that the science program for Thursday will be a full day program.

Registration desk hours

During Congress the desk will be open as follows:

Sunday	14.00 - 18.30
Monday	07.00 - 17.30
Tuesday	07.00 - 17.00
Wednesday	07.30 - 17.00
Thursday	08.00 - 14.00

Registration Fees

Full Congress fees include **one** ticket for each of the East Coast Icebreaker, the Patterson-Parson's Luncheon and the East Coast Lobster Feast Awards Banquet. Please order extra tickets only for your invited guests.

Associate member organizations are the American Meteorological Society (AMS), the Royal Meteorological Society (RMetS) or the Canadian Geophysical Union (CGU). Consider becoming a CMOS member or renewing your CMOS membership here.

For the Full Congress

Early Bird – Until May 25, 2018

Member:

CMOS / CMOS Associate	$635
CMOS Student	$290
Retired / Life	$290

Non-member:

Regular	$715
Student	$310

After May 25, 2018

Member:

CMOS / CMOS Associate	$790
CMOS Student	$360
Retired / Life	$360

Non-member:

Regular	$870
Student	$380

Single Day Fees

Member:

CMOS / CMOS Associate	$355
CMOS Student	$165
Retired / Life	$165

Non-member:

Regular	$395
Student	$175

Workshops

GOES-R (details available here)	$50

Extra Tickets for your guests

East Coast Icebreaker	June 10 (Sunday)	$40
Patterson-Parson`s Lunch	June 12 (Tuesday)	$50
East Coast Lobster Feast Awards Banquet	June 13 (Wednesday)	$80

Additional Information

GOES-R Workshop: A workshop is being held on Sunday June 10 for an additional fee of $50.00. Further details are available here. You may register to attend this workshop without registering for the Congress.

Social Activities: Many activities are planned during the Congress including Student Events to which MEOPAR students are welcome. Further information on these activities will be available soon.

Accommodation: Excellent hotel rates are available here. Indicate "**CMOS**" when you make your booking. MEOPAR attendees are encouraged to book at the Hampton Inn.

MEOPAR: The Annual Training Meeting (June 12-13) and Annual Science Meeting (June 14-15) are being held in parallel with the CMOS Congress. These meetings are only open to MEOPAR personnel.

Abstracts: The CMOS Congress APP will link to the sessions and abstracts and speaker bios. Abstracts will be available on-line at http://www.cmos.ca before, during and after the congress.

Special Needs: If you have any special needs (e.g. meals, allergies, mobility), please indicate it on your on-line registration form. Please note that the CMOS Awards East Coast Lobster Feast on Wednesday evening features a seafood meal. Please specify on the registration form if you do not want lobster. Alternatives are chicken or vegetarian.

Cancellation Policy: Notices of cancellation for the complete meeting or a specific event must be **received at the CMOS office** by email or mail at least 14 days prior to the event **(Not later than May 25th)**, in which case approximately 90% of the amount involved will be reimbursed. Cancellation between **May 26 and June 5** will result in approximately **50% of amount involved being reimbursed**. We regret that cancellations at a later date or failure to attend will not qualify for a refund.

Notices must be addressed as follows:
By e-mail: accounts@cmos.ca
By mail: CMOS, P.O. Box 3211, Station D, Ottawa, ON, Canada K1P 6H7

Privacy Policy: All of the information that you will be submitting is subject to the CMOS Privacy Policy. For further information, please consult the CMOS Privacy Policy page at http://www.cmos.ca

Local Arrangements Committee (LAC)

Chair LAC	Dave Wartman
Facilities	Steve Beauchamp
AV - Primary	Doug Steeves
AV - alternate	Ken Kirkwood
Scientific Program	Clark Richards
Student Program	Chris Gordon
MEOPAR Research Coordinator	Alexa Reedman
MEOPAR Training	Laura Avery
Volunteer Coordinator	Jinyu Sheng
Volunteer Coordinator - Alternate	
MEDIA / Promotion	Heather Desserud
Sponsors/Exhibitors	Jim Abraham
Exhibitors	Mac MacLeod
Registration	David Waugh
Registration Alternate	Colleen Farrell
Social Program	Claire McIntyre
Social - Alternate	Shannon Nudds
Public Lecture	Blair Greenan
CMOS HQ _ ED	Gordon Griffith
Website & APP	Simon Higginson
Budget	Cindy Vallis

Science Program Committee (SPC)

Desjardins, Serge (EC)
Clark Richards (Chair)
Alexa Reedman
Teakles, Andrew (EC)
Blair Greenan
Chris Algar
Dave Barclay
Dave Wartman
Doug Wallace
Emmanuel Devred
Ritchie, Hal (EC)
Ian Folkins
Jim Abraham
Kim Davies
Laura Avery
Chisholm, Lucy (EC)
Mélany Belzile

Code of Conduct

The CMOS Centre - Halifax is committed to providing an environment of safety and respect for employees, contractors, board members, committee members and volunteers. We endeavour to ensure no one will be subject to discrimination, harassment, abuse or any other conduct that diminishes dignity and worth of the individual. We endeavour to ensure no one will be subject to discrimination, harassment, abuse or any other conduct that diminishes dignity and worth of the individual.

What is discrimination?

Discrimination is differential treatment based on one of the following grounds that has an adverse impact on an individual or group: race, ancestry, place of origin, colour, ethnic origin, citizenship, creed, sex, sexual orientation, gender identity, gender expression, age, record of offences, marital status, family status and disability.

What is harassment?

Harassment refers to any abusive or unwelcome behaviour, conduct, talk and/or written correspondence that is directed at and is offensive to any person. Harassment may be based on the grounds listed above, or may be personal harassment.

Examples

The following are examples of inappropriate conduct that may be in violation of this Code of Conduct:

- Derogatory or inappropriate comments, teasing, bullying, innuendoes or taunting.
- Display or circulation of inappropriate, derogatory or offensive written materials, cartoons or pictures.
- Stalking.
- Inappropriate physical contact.
- Physical or verbal abuse.
- Refusing to communicate, converse or work with an individual.
- Sexual assault/abuse.

- Suggestive looks, leering, staring or gestures.
- Unwelcome and unsolicited sexual advances.
- Reprisal or threat of reprisal for the rejection of a sexual advance.

How may I contribute to an environment free of discrimination and harassment?

- Treat all people fairly and with dignity and in the manner you wish to be treated.
- If you are unsure whether a remark, action or written comment may be considered offensive, do not make it.
- Don't make jokes at another person's expense.
- Speak up against harassment and do not tolerate conduct or comments of a discriminatory nature.

What is the process for reporting misconduct?

The CMOS Centre - Halifax wants everyone to feel safe at meetings, sessions and work place settings. If you encounter misconduct of any nature, please report it immediately.

Any breach of this code of conduct may result in immediate suspension of duties and privileges.

The chain of reporting is as follows:
1. Chair - CMOS Centre - Halifax - Jim Abraham (email: yhzweatherguy@gmail.com)

2. Chair of the CMOS Congress 2018 Local Arrangements Committee - Dave Wartman (email: wartmandave@gmail.com)

Poster Presentation Guidelines

There are two poster sessions . Poster Session 1 (1810010) is on Monday, Poster Session 2 (1810011) is on Wednesday.

The Exhibits Floor Plan will show the poster board areas.

The maximum poster size is 105 cm x 105 cm (3' 6'' x 3' 6"). Poster

presenters are responsible for hanging and removing their own posters. Velcro fastener supports will be provided. Be sure to hang your poster on the assigned numbered board to allow grouping by theme and avoid confusion. Volunteers will be available to help finding board locations.

Posters should be up by 11:00 am on Monday for the first poster session and 10:30 am Wednesday for the second poster session. Any posters not removed by 15:30 on Thursday will be discarded.

Prizes will be awarded by CMOS for the best student posters. Student poster presenters wishing to be considered for these prizes must sign up on the list BEFORE 12.00 on the day of their poster session. The list will be at the Registration Desk. Including your photo in the poster is a good plan. Judges may want to discuss your poster with you.

Oral Presentation Guidelines

Each oral presentation has been allotted 15 minutes, including 12 minutes for presenting and 3 minutes for questions/comments. Some invited speakers have been allotted 30 minutes total and plenary speakers have been allotted 45 minutes.

Please arrive well ahead of time (30 minutes is suggested) to your session to ensure your presentation can be loaded on to the session computer from your USB drive before the session begins. Please be sure to have your presentation on a standard USB Thumb drive to ensure compatibility with session computers. Session computers will not be able to load from DVDs. You should also bring a pdf version of your presentation in case there are any compatibility issues with your presentation software.

Lecture room screens will be best suited to slides with the 16:9 aspect ratio (widescreen) but the older (standard) 4:3 ratio slides should be projected satisfactorily.

Naming presentation files

All file and folder names should contain your Last Name followed by First Name and Abstract ID. File types acceptable for oral presentations: PowerPoint (.ppt, .pptx), Adobe Reader (.pdf).

Computer and A/V Equipment

Using your own computer will not be possible. All meeting rooms will be equipped with a Windows PC with MS Office 2010 and Adobe Acrobat Reader. Please remember to verify proper performance of your presentation in advance, particularly if it includes audio, video, or animation files. Internet access will not be available during your presentation. Each session room will be equipped with a screen, LCD projector, timer, laser pointer and lectern with a microphone.

Week at a glance

The provisional outline for the week is as follows. For a more detailed view please see here.

Time	Week at a glance					Time
	Sunday	Monday	Tuesday	Wednesday	Thursday	
0800-0830		Opening Ceremony				0800-0830
0830-0900	Workshops and meetings	Opening Ceremony Plenary 1	Plenary 1	Science Communication Plenary	MEOPAR plenary	0830-0900
0900-0930		Plenary 2	Plenary 2	Plenary 2	CMOS plenary	0900-0930
0930-1000						0930-1000
1000-1030	Coffee Break					1000-1030
1030-1100	Workshops and meetings	Parallel session 1	Parallel session 1	Parallel session 1	CMOS/MEOPAR Town Halls	1030-1100
1100-1130						1100-1130
1130-1200						1130-1200
1200-1230	Lunch		Parsons-Patterson Lunch	Lunch		1200-1230
1230-1300						1230-1300
1300-1330						1300-1330
1330-1400	Workshops and meetings	Parallel session 2	Parallel session 2	Parallel session 2	CMOS/MEOPAR Parallel session 1	1330-1400
1400-1430						1400-1430
1430-1500						1430-1500
1500-1530	Coffee Break					1500-1530
1530-1600	Workshops and meetings	Poster session 1	Parallel session 3	Poster session 2	CMOS/MEOPAR Parallel session 2	1530-1600
1600-1630						1600-1630
1630-1700						1630-1700
1700-1730						1700-1730
1730-1800						1730-1800
1800-1830	Icebreaker		Student night	Reception and Banquet		1800-1830
1830-1900						1830-1900
1900-1930						1900-1930
1930-2000						1930-2000

Scientific Program

The APP for the 52nd CMOS Congress is now available for download on all platforms, Apple, Android and BlackBerry, just search for "CMOS". It contains all the information you will need to have an enjoyable experience in Halifax!

The full scientific program is also available here. Clicking this link will take you to the Congress agenda, housed on the main CMOS website, in a new window.

TIME	ROOM	SESSION	CHAIR

June 10, 2018	Day 0		
08:30-16:30	Room 108	CMOS Workshop: Next-Generation GOES-R Weather Satellites	
10:00-12:00	Room 107	CNC-SCOR meeting	
12:00-17:00	Room 107	CMOS SCIENTIFIC COMMITTEE meeting	
12:00-15:00	Room 109	CMOS PUBLICATIONS COMMITTEE meeting	
12:00-15:00	Room 105	CMOS CENTRE	
12:00-17:00	Room 101	PEARL/CANDAC meeting	
13:00-16:00	Room 102	Software Communities of Practice	
15:00-17:00	Room 109	CMOS COUNCIL	
15:00-17:00	Halifax Discovery Centre	Student Pitch Talk and Meet & Greet	
18:00-20:00	Room C5	EAST COAST ICEBREAKER	
June 11, 2018	**Day 1**		
07:00-07:45	Convention Centre	Wellness Sessions - Good Morning Yoga	
08:30-09:00	Room C1	Opening Ceremony	Wayne Richardson, David Wartman, Clark Richards
09:15-10:00	Room C1	1801010 Plenary	Clark Richards
10:00-10:30		COFFEE BREAK	
10:30-12:00	Room 101	1803060 Air Quality: Modeling and Monitoring of Cumulative effects	Xin Qiu
10:30-12:00	Room 109	1804010 High Latitude Systems and Climate Change	Will Perrie
10:30-12:00	Room 104	1803090 ABL Composition, Processes and Surface-Atmosphere Exchange - Part 1	Aldona Wiacek, Alexander Moravek
10:30-12:00	Room C3	1802020 Acoustics in oceanography and marine sciences - Part 1	David Barclay
10:30-12:00	Room 105	1809080 Numerical Methods and Model Development	Christopher Subich
10:30-12:00	Room C4	1802100 Coastal Oceanography and Inland Waters - Part 1	Jinyu Sheng
10:30-12:00	Room 103	1803040 The Canadian Climate and Atmosphere Research (CCAR) Program - Part 1	James Drummond
12:00-13:30		LUNCH	
13:30-15:00	Room C3	1802021 Acoustics in oceanography and marine sciences - Part 2	David Barclay

13:30-15:00	Room 109	1804020 Advancements in the in situ measurement of solid precipitation	Craig Smith
13:30-15:00	Room 105	1809020 Integrated Predictions for Best Responses	Gordon McBean
13:30-15:00	Room C4	1802101 Coastal Oceanography and Inland Waters - Part 2	Jinyu Sheng
13:30-15:00	Room 104	1803091 ABL Composition, Processes and Surface-Atmosphere Exchange - Part 2	Aldona Wiacek, Alexander Moravek
13:30-15:00	Room 103	1803041 The Canadian Climate and Atmosphere Research (CCAR) Program - Part 2	James Drummond
13:30-15:00	Room 102	1807030 Earth System Models: Assessing Earth's State and Fate from Regional to Planetary Scales - Part 1	Paul Kushner
13:30-15:00	Room 101	1809090 Atmosphere, Ocean, and Climate Dynamics	Adam Monahan
15:00-15:30		COFFEE BREAK	
15:30-17:00		1810010 POSTER SESSION - PART 1	Clark Richards
17:00-21:00	Room 108	CMOS AGM	
20:30-23:59		Trivia Pub Night	
June 12, 2018	**Day 2**		
08:00-12:00	Room 106	MEOPAR HPC	
08:00-12:00	Room 108	MEOPAR NETWORKING	
08:30-10:00	Room C1	1801011 Plenary	Clark Richards
10:00-10:30		COFFEE BREAK	
10:30-12:00	Room C4	1803080 General Session - Atmosphere	Serge Desjardins, Lucy Chisholm
10:30-12:00	Room 105	1804030 General Session - Cryosphere	Clark Richards
10:30-12:00	Room 109	1809120 Climate Change and Indigenous Communities	Eriel Deranger
10:30-12:00	Room 103	1807010 Climate Variability and Predictability - Part 1	Bin Yu
10:30-12:00	Room 104	1809060 Satellite Remote Sensing: Vital Information on the Health of the Planet - Part 1	Kaley Walker
10:30-12:00	Room C3	1802090 Physical Oceanography - Part 1	David Straub
10:30-12:00	Room 101	1803020 GOES-16 – Activities and Applications - Part 1	Louis Garand, Hong Lin, David Bradley
12:00-13:30	Room C1	PATTERSON - PARSONS LUNCHEON	
13:30-15:00	Room 102	1803070 Convection and Cloud Physics	Ian Folkins
13:30-15:00	Room C4	1809010 Big Data and Artificial Intelligence in Meteorological, Oceanographic, and Environmental Applications - Part 1	Bertrand Denis

13:30-15:00	Room C3	1802091 Physical Oceanography - Part 2	David Straub
13:30-15:00	Room 101	1803021 GOES-16 – Activities and Applications - Part 2	Hong Lin, Louis Garand, David Bradley
13:30-15:00	Room 103	1807011 Climate Variability and Predictability - Part 2	Gilbert Brunet
13:30-15:00	Room 105	1802070 Development, performance, and implementation of oceanographic sensors and instrument platforms - Part 1	Mark Halverson
13:30-15:00	Room 104	1809061 Satellite Remote Sensing: Vital Information on the Health of the Planet - Part 2	Kaley Walker
13:30-17:00	Room 106	MEOPAR PYTHON	
13:30-17:00	Room 108	MEOPAR WELLNESS	
15:00-15:30		COFFEE BREAK	
15:30-17:00	Room 105	1802071 Development, performance, and implementation of oceanographic sensors and instrument platforms - Part 2	Mark Halverson
15:30-17:00	Room 104	1809062 Satellite Remote Sensing: Vital Information on the Health of the Planet - Part 3	Kaley Walker
15:30-16:15	Room 103	1807020 Processes and Impacts of climate change in the Arctic realm: from past to future	Paul Myers
15:30-17:00	Room C4	1809011 Big Data and Artificial Intelligence in Meteorological, Oceanographic, and Environmental Applications - Part 2	Bertrand Denis
15:30-17:00	Room 101	1807060 General Session - Climate	Clark Richards
15:30-16:15	Room 102	1809110 General Session - Interdisciplinary	Clark Richards
15:30-21:00		Student Night - Employer Networking and Boat Tour on the Tall Ship Silva	
15:30-17:00	Room C3	1802120 Operational Oceanography	Fraser Davidson
16:15-16:30	Room 102	1805010 General Session - Hydrology	Clark Richards
16:15-17:00	Room 103	1809050 Changing Arctic: Science and Policy Studies	David Fissel
16:15-17:00	Room 101	1807040 Science for Canadian Climate Services	Patti Edwards
16:30-17:00	Room 102	1809100 Societal Applications: Transforming Weather, Marine and Climate Communication through Policy, Research and Practice	Jennifer Spinney
17:00-21:00	Room 105	UNIV PROF EDUCATION COMM	
17:00-21:00	Room 108	ARCTIC SIG	David Fissel
19:00-21:30	Halifax's new Public Library	Public Lecture: Right Stuff for the Right Whales	
June 13, 2018	**Day 3**		
07:00-07:45		Wellness Sessions - Harbour Front Walk/Run	

07:00-08:30	Room 105	1809130 ARRCU / Space SIG Open Meeting	Paul Kushner
08:00-17:00	Room 108	MEOPAR COMMUNITY OF PRACTICE	
08:30-10:00	Room C1	1801012 Plenary	Clark Richards
10:00-17:00	Room C1/C2A	MEOPAR COMMS	
10:00-10:30		COFFEE BREAK	
10:30-12:00	Room C3	1808030 Risks and impacts relating to the insurance industry	Laura Twidle
10:30-12:00	Room C4	1802102 Coastal Oceanography and Inland Waters - Part 3	Jinyu Sheng
10:30-12:00	Room 105	1802030 Ocean Observing Programs and Coordinated Ocean Information Management	Richard Dewey
10:30-12:00	Room 101	1806010 General Session - Weather - Part 1	Serge Desjardins, Lucy Chisholm
10:30-12:00	Room 102	1809070 Research and operational activities supporting the Year of Polar Prediction - Part 1	Paul Pestieau
10:30-12:00	Room 104	1807031 Earth System Models: Assessing Earth's State and Fate from Regional to Planetary Scales - Part 2	Neil Swart
10:30-12:00	Room 103	1807050 Regional Climate Analysis and Projections - Part 1	J.P. René Laprise
12:00-13:30		LUNCH	
13:30-15:00	Room 104	1807032 Earth System Models: Assessing Earth's State and Fate from Regional to Planetary Scales - Part 3	Karen Smith
13:30-15:00	Room C3	1802040 Go with the flow: managing marine life in a dynamic ocean	Kimberley Davies
13:30-15:00	Room 101	1806011 General Session - Weather - Part 2	Serge Desjardins, Lucy Chisholm
13:30-15:00	Room C4	1802060 Collaboration in development, evaluation and analysis of ocean circulation and biogeochemical models - Part 1	Youyu Lu
13:30-15:00	Room 103	1807051 Regional Climate Analysis and Projections - Part 2	J.P. René Laprise
13:30-15:00	Room 102	1809071 Research and operational activities supporting the Year of Polar Prediction - Part 2	Paul Pestieau
13:30-15:00	Room 105	1803050 Fog or Low Visibility - Part 1	Rachel Chang
15:00-15:30		COFFEE BREAK	
15:30-17:00		1810011 POSTER SESSION - PART 2	Clark Richards
18:00-22:00	Room C1	EAST COAST LOBSTER FEAST AWARDS BANQUET	
June 14, 2018	**Day 4**		
08:30-10:00	Room C1	1801013 Plenary	Clark Richards
10:00-10:30		COFFEE BREAK	

10:30-12:00	Room C4	1808040 Risk Communication at the Local Level: Towards Meaningful Community Collaborations on Environmental Hazards (Town Hall)	Joel Finnis
10:30-12:00	Room 104	1802010 Toward a Canadian Integrated Ocean Observing System: Current Status and Next Steps (Town Hall)	Mike Smit
10:30-12:00	Room 101	1809030 Atmosphere Related Research in Canadian Universities - Education, Training, Communication and Outreach (Town Hall)	Paul Myers
10:30-12:00	Room 104	1802050 Blueprint for Atlantic Ocean Observing (For Joint Town Hall with MEOPAR)	Brad de Young
10:30-12:00	Room 103	1808010 Weather, shipping and subsistence activities in Arctic regions	Laura Eerkes-Medrano
12:00-13:30		LUNCH	
13:30-15:00	Room C4	1802061 Collaboration in development, evaluation and analysis of ocean circulation and biogeochemical models - Part 2	Youyu Lu
13:30-15:00	Room 105	1803051 Fog or Low Visibility - Part 2	Rachel Chang
13:30-15:00	Room 102	1809040 Coupled Environmental Prediction	C. Harold Ritchie
13:30-15:00	Room C3	1802110 History of Canadian Oceanography	Cristina Tollefsen
13:30-14:15	Room 104	1808020 Integrated approaches of climate change impacts on marine fisheries - Part 1	Travis Tai
14:15-15:00	Room 104	1808050 General Session - Risks and Impacts - Part 1	Clark Richards
15:00-15:30		COFFEE BREAK	
15:30-16:00	Room 104	1808021 Integrated approaches of climate change impacts on marine fisheries - Part 2	Travis Tai
15:30-17:00	Room C3	1802080 Ocean Acidification in Canadian Waters	Debby Ianson
15:30-17:00	Room 104	1808051 General Session - Risks and Impacts - Part 2	Clark Richards
15:30-17:00	Room C4	1802062 Collaboration in development, evaluation and analysis of ocean circulation and biogeochemical models - Part 3	Youyu Lu

Alternate Printable Version of the Program has been added at the end of this document

Plenary Sessions

Monday June 11

8.30-9.00 Opening Ceremonies

9.15-10.00 Timothy Merlis: Radiatively driven robust atmospheric circulations changes: Results from the "diabatic hierarchy" of climate models

Abstract: Changes in the atmospheric circulation under global warming scenarios play a critical role in determining the regional expression of climate change. In this talk, I discuss the important role that radiation-circulation coupling plays in determining the large-scale atmospheric circulation response to increased carbon dioxide. In both the tropics and extratropics, the climatological distribution of clouds and its effect on radiation provides robust mechanisms for circulation changes. These mechanisms have been isolated using a hierarchical approach to climate simulation, where cloud radiative effects are (de-)activated using different atmospheric model configurations that comprise a "diabatic hierarchy".

Biography: Timothy Merlis has been a professor in McGill University's Atmospheric & Oceanic Sciences department since 2013. He is a Canada Research Chair (Tier II) in Atmospheric and Climate Dynamics. Following the completion of his Ph.D. at the California Institute of Technology and post-doctoral fellowship at Princeton University and the Geophysical Fluid Dynamics Laboratory, he was awarded the 2014 American Geophysical Union James Holton Award for outstanding scientific research and accomplishments of early-career atmospheric scientists. His research aims to expose the physical mechanisms underlying climate changes.

Tuesday June 12

8.30-9.15 James Drummond: Atmospheric Research at the Polar Environment Atmospheric Research Laboratory (PEARL)

Abstract: The Polar Environment Atmospheric Research Laboratory (PEARL) at Eureka, Nunavut is located about halfway up Ellesmere Island, right on the 80N North latitude line and 1,100km from the

pole. Eureka has been home to an Environment and Climate Change Canada (ECCC) weather station since 1947. In 2005, a group of university and government researchers operating as an informal group called the Canadian Network for the Detection of Atmospheric Change (CANDAC) substantially expanded both the equipment and the research domain of an existing facility at the site, renaming it PEARL. PEARL operates as an all-year atmospheric observatory and hosts upwards of 25 research instruments with considerable capacity for remote operations as well as on-site activities. The large number of contemporaneous measurements at PEARL offers some unique opportunities to spot linkages between atmospheric phenomena which might be missed by a smaller, more focussed effort. The cross-support provided by the various teams and the on-site resources and technical support enhances the success of the overall enterprise, and also provides a very effective learning environment for students and other young researchers for what might otherwise be a very challenging location for measurements. PEARL is currently mainly involved with the "Probing the Atmosphere of the High Arctic" (PAHA) network of the Canadian Climate and Atmospheric Research (CCAR) program of the Natural Sciences and Engineering Research Council (NSERC) and there has recently been a ministerial announcement in November 2017 of 18 months of continued funding into the Fall of 2019. This talk will present some of the research conducted at PEARL, highlighting some of the unique challenges and successes with some segues into the history and other challenges of running a 365/24 research observatory near the top of the world. PEARL is currently supported by NSERC, ECCC and the Canadian Space Agency.

Biography: Prof. James R. Drummond, M.A., D.Phil. FRSC graduated from the University of Oxford in England, was a faculty member of the Department of Physics, Toronto University for 27 years and then a Canada Research Chair in Remote Sounding of Atmospheres in the Department of Physics and Atmospheric Science at Dalhousie University until his recent "retirement". He is the currently the Principal Investigator for the Measurements Of Pollution in The Troposphere (MOPITT) instrument on the Terra satellite; a Co-Investigator for the instruments on the Canadian SciSat satellite; Principal Investigator of the Polar Environment Atmospheric Research Laboratory (PEARL) at Eureka, Nunavut; the founding president of the Canadian Network of Northern Research Operators (CNNRO); the Chair of the Forum of Arctic Research Operators (FARO); and the Canadian representative to several international organisations.

9.15-10.00 Eriel Tchekwie Deranger: Inidigenous Climate

Action

Abstract: From the grassroots to the UNFCCC, Indigenous peoples are working to ensure the recognition of their inherent rights are included, upheld and respected in the development of policies and solutions to address the climate crisis. Indigenous peoples represent 5% of the global population, yet their recognized Indigenous lands and territories represent 80% of the world's biodiversity, biodiversity that is critical for climate stabilization. While Indigenous communities are often viewed as the first to be impacted by the climate crisis, many of these communities house invaluable knowledge and understanding of the natural world that is now being viewed as critical for building solutions to our changing planet. This session will explore how Indigenous knowledge, expertise and rights can serve as a catalysts to changing how we define solutions, mitigation and adaptation strategies to climate change and the parametres of western science.

Biography: Eriel Tchekwie Deranger is a mother of two and a proud Denesuline Indigenous women and member of the Athabasca Chipewyan First Nation, Treaty 8 Northern Alberta. Deranger is the Executive Director and co-founder of Indigenous Climate Action (ICA) - Canada's premier Indigenous-led climate justice organization. She also sit on the Board of Bioneers and the UK Tar Sands Network. Prior to her work with ICA, Deranger worked with her First Nation to build out one of the largest intersectional and powerful keep in the ground campaigns on the planet - the international Indigenous Tar Sands campaign challenging the expansion of Alberta's Tar Sands. Deranger is recognized for her role in interventions at UN Climate Summits; lobbying government officials in Canada, the US, the UK and the EU; developing the the Tar Sands Healing Walk in the heart of Alberta's tar sands; spring boarding one of the first Internationally recognized Indigenous rights-based divestment movements; and working to develop and lead mass mobilizations highlighting the mass inequity of the impacts the fossil fuel industry and climate change on the rights of Indigenous peoples. Her experience working within the Environmental Justice and Indigenous Rights field is demonstrated through her with organizations like the Indigenous Environmental Network (IEN), Rainforest Action Network (RAN), Federation of Saskatchewan Indian Nations (FSIN), and with her home Nation the ACFN.

Wednesday June 13

8.30-9.15 Roberta Hamme: Observing the ocean take a breath

Abstract: Ocean oxygen and carbon concentrations control fundamental and societally important questions from how much anthropogenic carbon the ocean takes up to which organisms thrive in which locations. The ocean's annual cycle of uptake and release of these gases is, in a sense, like the ocean breathing. However, that "breath", the gases absorbed by the ocean, can only reach the deep sea in a few regions where wintertime conditions allow surface waters to become very dense. Those same wintertime conditions make directly observing this "breathing" process a real challenge. I will present observations from new technologies being deployed to overcome this observational gap powerfully supplemented by shipboard measurements. I will focus on the Labrador Sea, one of the world's few deep-water formation regions, and the object of intense Canadian research. Measurements of oxygen from sensors carried on profiling BGC-Argo (Biogeochemical-Argo) floats demonstrate that water in the winter does not spend enough time in contact with the atmosphere to absorb oxygen to its full potential and that the Labrador Sea is a region of net oxygen uptake, primarily in the winter. Participation in a major international program to deploy these BGC-Argo floats throughout the world's oceans is being proposed in Canada. Measurements of carbon dioxide from profiling (SeaCycler) and traditional moorings demonstrate that the Labrador Sea is also a region of net carbon uptake primarily in the summer. Efforts are underway to deploy SeaCycler to collect multi-year observations. Combining these novel technologies with shipboard noble gas, oxygen, and carbon measurements made from the annual Fisheries and Oceans Canada survey across the Labrador Sea is providing insight into how the ocean takes a breath.

Biography: Roberta Hamme is a chemical oceanographer who studies the marine carbon cycle. She works on understanding and quantifying the natural mechanisms that transport carbon from the surface ocean to the deep, reducing atmospheric carbon dioxide levels. Her main tools are high precision measurements of dissolved gases, both bioactive gases like oxygen and inert gases like neon, argon, and krypton. Ongoing projects include developing methods to quantify how closely gases equilibrate with the atmosphere before surface water moves into the interior ocean, using oxygen to measure ocean productivity, and determining amounts of ocean denitrification (the transformation of bioavailable nitrate to unavailable nitrogen gas). She holds a Canada Research Chair in Ocean Carbon Dynamics at University of Victoria's School of Earth and Ocean Sciences.

9.15-10.00 Amy Mathews Amos: Breaking Through the

Barriers: Communicating Science in the Post-Truth Era

Abstract: Simply sharing your scientific knowledge with others doesn't necessarily mean they will understand or care about your work. Grounded in the latest research on science communication, this session will explore common mistakes scientists make in communicating their work, and provide practical tools and guidance on how to make scientific findings meaningful to diverse audiences. Topics covered include understanding your audience, the importance of listening, and how to use the COMPASS Message Box for distilling and framing complex scientific topics. Discussion and opportunity for Q&A.

Biography: As Science Communication Coach for COMPASS, Amy helps scientists navigate the alien world of journalism, giving them the tools and confidence necessary to share their expertise effectively with those outside the ivory tower. In doing so, she draws on her decades of professional experience at the interface of environmental science and public policy. That experience began with her undergraduate degree from the Department of Natural Resources at Cornell University, and graduate degrees in environmental science and public affairs from Indiana University. It continued to grow over 25 years as she worked in Washington D.C. for the congressional Government Accountability Office, conservation groups, a scientific society, and charitable foundations. In 2013, she completed her M.A. in Science and Medical Writing at Johns Hopkins University and began a new phase in her career as a freelance writer. Her stories on the environment and health have appeared in The Washington Post, Pacific Standard, High Country News, Ensia and other outlets. She also hones her storytelling skills each year as a selector and board member for the American Conservation Film Festival. When not pounding away at the computer, she spends as much time as possible outside hiking, kayaking, and wildlife-watching.

Thursday June 14

8.30-9.15 Kim Davies: An Uncertain Future: The Right Whales' Fight Against Environment, Biology and Ocean Urbanization

Abstract: North Atlantic right whales (*Eubalaena glacialis*) are iconic Canadian animals that have become globally recognized as a poster

child for the impacts of human activities on coastal environments. In this plenary I discuss biological adaptations right whales use to cope with a patchy and ephemeral zooplankton prey resource. These adaptations make right whales extremely susceptible to harm from certain human activities such as fishing and shipping, apparently more so that other large whales. I will explain how recent changes in the ocean environment within Canada have put the future of these animals in peril through impacting both their population biology and risk from human activities. Looking to the future, unprecedented collaborative efforts are underway that hope to improve the outlook for this species.

Biography: Kim is a postdoctoral research associate in Oceanography at Dalhousie University. She received her BSc in biology from the University of Victoria and a PhD in Oceanography from Dalhousie. She has received several awards for her work, including the Liber Ero Postdoctoral Fellowship in conservation research in 2015, followed up in 2017 by the CNC-SCOR Early Career Ocean Scientist Award. She began researching right whales in 2007 with the goal of improving our understanding of the environmental and biological processes affecting their habitat use in Canadian waters. Her research and publications cover a range of areas, including environmental factors structuring right whale prey aggregations and habitat connectivity, universal energy content relationships, processes controlling whale migration, and using new sampling tools to better quantify whale-habitat relationships. In 2014 she began the Whales, Habitat and Listening Experiment, an 8-year collaborative research program co-funded by government, NGOs and industry that seeks to improve knowledge of baleen whale – habitat relationships as well as adaptive conservation management of right whales through real-time acoustic monitoring. This project was instrumental in the discovery of a new right whale habitat in the Gulf of St. Lawrence. Her work has produced new oceanographic, marine-ecological and marine-mammal insights and has led to effective and practical conservation policy. She is committed to engaging the public and policymakers on science-based decision-making and ocean conservation.

9.15-10.00 Kevin Quigley: Risk Analysis at the Science-Policy Interface: From narrow and naïve to clunky and ambiguous

Abstract: The study of risk is dominated by scientists, engineers, economists, and decision analysts. Their views are often underpinned by a rational actor paradigm (RAP). In this talk, we summarize the RAP view of risk and consider the important and contrasting contributions of psychology, sociology, and anthropology to the risk debate. Each field brings its own

assumptions, tools, and perspectives, contributing to a much richer understanding of risk. For policy analysts working at the science-policy interface of coastal research, using one approach is narrow and naive; using all approaches is clunky and the conclusions are always ambiguous. We conclude by introducing holistic risk frameworks that accommodate – however awkwardly - competing risk rationales, and lead to a more robust response to coastal risks.

Biography: Kevin Quigley is the Scholarly Director of the MacEachen Institute for Public Policy and Governance and a professor in the School of Public Administration, Dalhousie University. He specializes in public sector risk and crisis management, strategic management and critical infrastructure protection. Dr. Quigley founded the Critical Infrastructure Protection Initiative, an interdisciplinary research team seeking to enhance collaboration for the management of Canada’s critical infrastructure. Dr. Quigley has published an acclaimed book on critical infrastructure, numerous articles in academic journals and his newest book, 'Too Critical to Fail: How Canada Manages Threats to Critical Infrastructure' was published in November 2017 and shortlisted for the Donner Prize.

THE RIGHT STUFF FOR THE RIGHT WHALE:

A public lecture with Dr. Chris Taggart, Dalhousie University

Tuesday June 12th, 7pm
Halifax Central Library - Paul O'Regan Hall
Admission: Free

Canadian Meteorological and Oceanographic Society
La Société Canadienne de Météorologie et d'Océanographie

Presented by the 52nd Congress of the Canadian Meteorological and Oceanographic Society (CMOS), June 10-14 2018, Halifax NS

The North Atlantic right whale is at risk for extinction within our lifetimes, and human-caused deaths are behind the decline. Hear from a leading expert in right whale research about what we can do to prevent these deaths in Canadian waters

MEOPAR

WHaLE
Whales, Habitat and Listening Experiment

OCEAN TRACKING NETWORK

Canadian Whale Institute

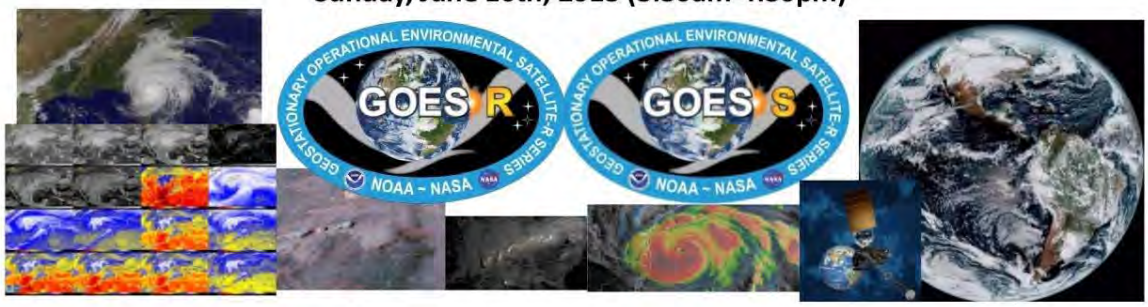
Dalhousie University 1818 2018

Environment and Climate Change Canada
Environnement et Changement climatique Canada

Fisheries and Oceans Canada
Pêches et Océans Canada

CMOS Workshop: Next-Generation GOES-R Weather Satellites

Sunday, June 10th, 2018 (8:30am-4:30pm)



The next-generation GOES-R weather satellites (https://www.goes-r.gov) are here! GOES-16 is now operational in the East, and GOES-17 has just launched and will soon cover the West. Instructors from the NOAA GOES-R program along with ECCC meteorologists will communicate the new capabilities of the Advanced Baseline Imager (ABI), Geostationary Lightning Mapper (GLM) instruments and derived products which are used detect potential threats, and enhance forecasts and warnings to save lives and protect property.

- **The workshop will consist of a balanced mix of presentations, case studies and hands on exercises demonstrating the many applications of the GOES-R satellites.**
- **Participants are expected to bring their laptops or tablets for the hands-on exercises.**
- **Registration fee is $50 per person. You don't have to be signed up for the Congress to take this workshop, it's open to all!**
- **We have limited space; it will be first come first serve. Once registration is opened, it will fill up fast!**

Social program

We have a number of social events planned for the congress to encourage networking with colleagues and offer a taste of good ol' east coast atmosphere.

Student Pitch Talk - Sunday, June 10th, 3PM-5PM

The 3rd annual CMOS Pitch Talk Competition, plus a student meet and greet, to be held at Halifax's Discovery Centre. Please RSVP (whether you plan to present, or just attend!) no later than Friday June 8th by completing the form at this link.

East Coast Icebreaker - Sunday, June 10th, 6PM-8PM

Welcome to the East Coast! The ice breaker will be held at the Convention Centre with entertainment from one of Halifax's very

talented Celtic duos, The Fine Tuners. Appetizers will be served featuring Nova Scotia oysters. Don't know how to shuck an Oyster? Our local expert will show you how it's done. Cash bar will be open, but be sure to bring the drink ticket included in your registration package and have one on us.

Trivia Pub Night - Monday June 11th (8.30PM)

Join us for pub night at Murphy's on the Water. Don't forget your thinking cap. Trivia will start at 9PM with prizes available to those who really know their stuff. Munchies will be provided and beverages available at happy hour prices all night.

Public Lecture - Dr Chris Taggart - Right Stuff for the Right Whales - Tuesday June 12th (7PM)

It's been a tough year for the North Atlantic Right Whales. Come find out what Right Whale expert, Chris Taggart, has to say about it, and what scientist and government are doing to help these endangered animals. The public lecture will be hosted at Halifax's new Public Library on Spring Garden Rd. which itself is a sight to see as a winner of the Governor General's architecture medal, winner of the Mayor's prize in architecture, and voted one of the top 10 most beautiful libraries in the world.

Student Night - Tour of the Bedford Institute of Oceanography, Employer Networking & Panel Discussion, and Boat Tour on the Tall Ship Silva - Tuesday June 12th (3.30PM - 9PM)

Chartered buses will bring students from the Halifax Convention Centre (leaving at 3:30PM) to the Bedford Institute of Oceanography. Participants will partake in a 1 hour tour of BIO as well as a panel discussion with potential government and industry employers. Pizza dinner (including salad and beverages) will be served.

Then, *all aboard* the Tall Ship Silva for a tour of Halifax Harbour from 7:30-9PM. Cash bar will be open for the duration of the tour.

If you are unable to attend the BIO portion of the evening, you are still welcome to join the boat tour. Just meet at the dock (near the Maritime Museum of the Atlantic, 1655 Lower Water St.) to board the ship at 7:15pm.

This event is offered to students and MEOPAR trainees only. The event is free but space is limited so please register at the registration desk.

Banquet, East Coast Lobster Feast – Wednesday June 13th (6PM)

Join us for a classic East Coast Lobster Feast. Meal options are available for those who do not fancy crustacean. Musical entertainment by the Fine Tuner's Trio. Cash bar open in the exhibitor area 6-7pm, and in the banquet area 7-9pm. Each banquet table will have 1 complimentary bottle of red and 1 bottle of white wine.

Please follow the links for more on:
- Family program
- Wellness program
- Sightseeing/dining discounts

Wellness Sessions

Rise and Shine Yoga with Joanne Cusack - Monday June 11th (7-7:45AM)

Get your blood flowing with a guided Yoga Class. The class will be held at the convention centre.

Free to all, including spouses/guest. Space is limited so please register in advance by emailing andraabraham@gmail.com or at the conference registration desk.

MEC Waterfront Run/Walk - Wednesday June 13th (7:00-7:45AM)

What better way to start the day than a brisk walk or run along the Halifax waterfront.

Participants will meet at the front entrance of Mountain Equipment Co-op (1550 Granville Street), a stone's throw from the Halifax Convention Centre, and then follow the leader on one of two routes: a 5km run or a 3km walk.

Registered participants will receive a 10% discount on in-store purchases made on June 13.

This is free to all, including spouses/guests. Please register at http://events.mec.ca/node/222271 or at the registration desk.

Please follow the links for more on:
- Social program
- Family program
- Sightseeing/dining discounts

Family Program

Consider making the trip to Halifax fun for the whole family. Get your CMOS Family Pass and receive discounts on some of the best Halifax has to offer:

2 for 1 admission to The Board Room Game Cafe

The Board Room Game Café (1256 Barrington Street) is a great place to spend an afternoon or evening. Choose from over 500 games. Enjoy a classic, or have the game bosses guide you through something new! Click here for more info and to explore their menu.

$5 off Ghost Walk of Historic Halifax

This very popular Ghost Walk is an informative and entertaining 1-1/2 hour gentle walk through Halifax's historic downtown area. Along the way, participants learn about a haunted restaurant, a troubled Titanic victim, the spirit of a famous British general and much more. The tours are filled with intriguing stories, little known facts and lots of local gossip. Tours start at 7:30PM at the Old Town Clock on Sunday June 10th, Wednesday June 13th and Friday June 15th.

10% off admission to Maritime Museum of the Atlantic

Located in the heart of Halifax’s waterfront, there’s no better place to immerse yourself in Nova Scotia’s rich maritime heritage than the Maritime Museum of the Atlantic. From small craft boatbuilding

to World War Convoys, the Days of Sail to the Age of Steam, the Titanic to the Halifax Explosion, discover the stories, events and people that define Nova Scotia and its relationship to the sea.

15% off all Ambassatour tours

Congress registrants receive 15% off all Ambassatour tours using the promo code ' CMOS2018' . We highly recommend taking a ride on the Harbour Hopper, and amphibious vehicle that tours land and sea! Visit the Ambassatour website here for all tour and event options.

20% off Segway tours

Save energy, ride a Segway! Segway Nova Scotia offers 20% off all Segway tours. You'll find them on the Halifax Waterfront at 1521 Lower Water Street or book your tour online at www.segwayns.com using promo code 'SHOWBADGE'.

15% off at The Wooden Monkey

A farm to table style restaurant in the heart of the city. There is something on the menu for everyone at The Wooden Monkey (1707 Grafton Street). Receive 15% off when you show your CMOS badge or Family Pass. You won't be disappointed!

More for Less at Red Stag

SOCIALABLE!!! Join in one of our favourite East Coast pastimes. Receive a large draft beer for the price of a small at the Red Stag (1496 Lower Water Street). Please drink responsibly.

In addition, Discover Halifax's "Show Your Badge" program is a conference delegate appreciation program Simply show your CMOS badge or Family Pass at any participating venue and receive a discount. Find more details about the program and the offers here.

We highly recommend:

The Discovery Centre - 20% off admission
Museum of Immigration at Pier 21 - 15% off admission and gift shop
East Coast Outfitters Sea Kayaking – 15% off Sea Kayak Tours and Rentals
Timber Lounge - 20% off pre-booked Axe-Throwing (19+)
Antojo - 15% off food
The Stubborn Goat - 15% off food
The Carlton - 15% off all menu items (not valid during happy hour)

Must See and FREE!

The following is a list of great attractions in and around Halifax that are free to explore (click on the attraction for a Google Map):

Halifax Public Library
Halifax Citadel National Historic Site
Point Pleasant Park
Halifax Public Gardens
Halifax Waterfront
Halifax Seaport Farmers' Market
Peggy's Cove *Transportation required

Please follow the links for more on:
- Social program
- Wellness program
- Sightseeing/dining discounts

Sightseeing and Dining Discounts

We hope you find time to take advantage of these great offers.

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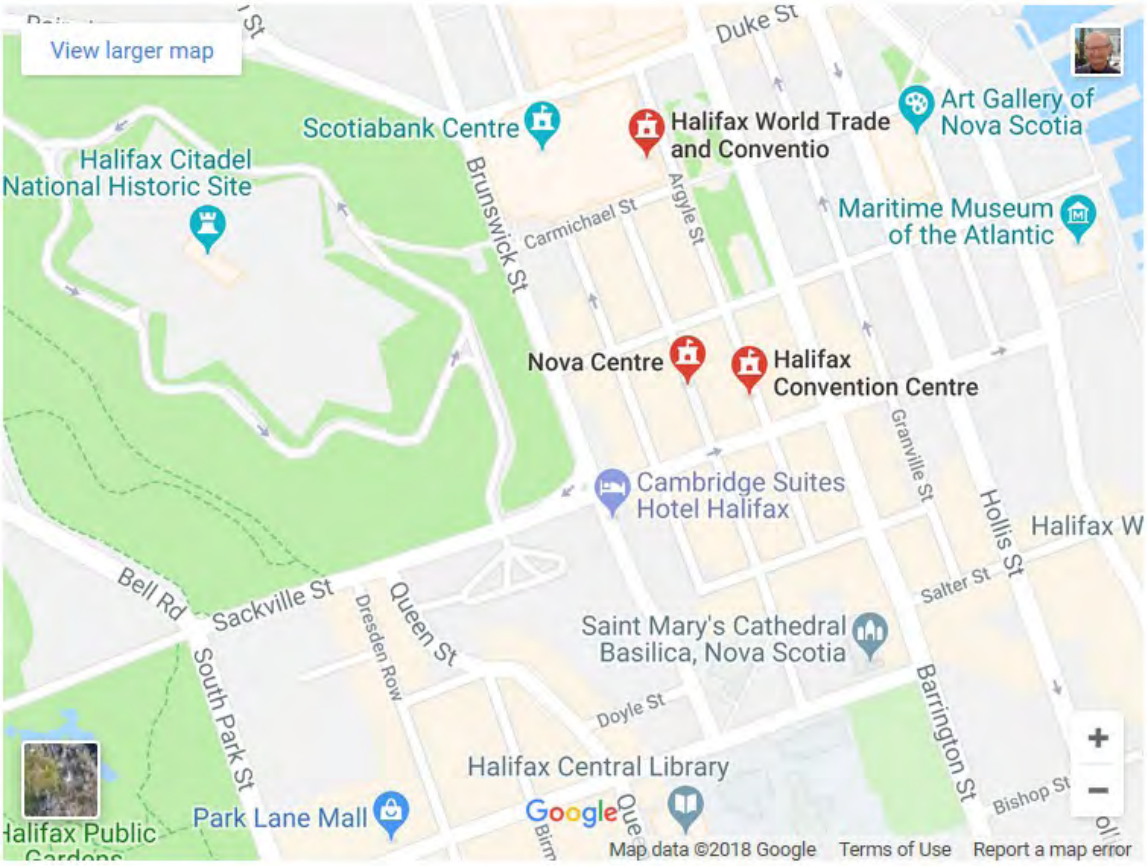
View larger map
Duke St
Scotiabank Centre
Halifax World Trade and Conventio
Art Gallery of Nova Scotia
Halifax Citadel National Historic Site
Brunswick St
Carmichael St
Argyle St
Maritime Museum of the Atlantic
Nova Centre
Halifax Convention Centre
Granville St
Cambridge Suites Hotel Halifax
Hollis St
Halifax W
Bell Rd
Sackville St
Dresden Row
Queen St
Salter St
Saint Mary's Cathedral Basilica, Nova Scotia
South Park St
Doyle St
Barrington St
Halifax Central Library
Park Lane Mall
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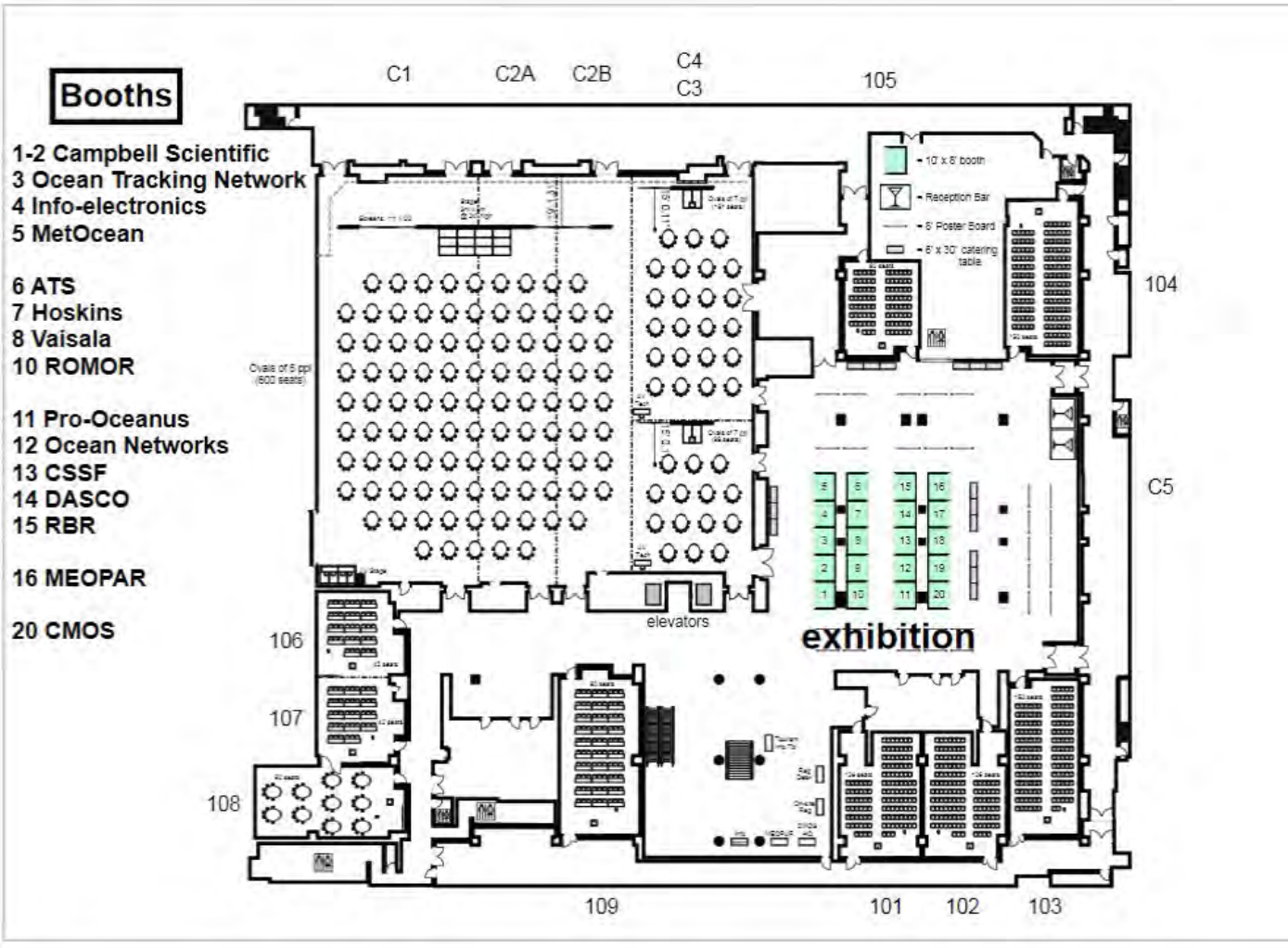
Click here for a floorplan of the convention centre (opens in a new window).



Accommodation

We have arranged for competitive rates for rooms in 2 hotels and in 2 Dalhousie University residences. Plea se be sure to indic ate that you are booking your room for the CMOS Congress so the block can be properly credited. Attendees are res ponsible for maki ng their own hotel arrangements. We recommend that you book your room early.

Hampton Inn by Hilton Halifax - Downtown - Standard Guest room: $174/night plus tax

Address: 1960 Brunswick St, Halifax, Nova Scotia B3J 2G7

Tel: 1 855 331 0334 (Please ask for the CMOS2018 room block - group code CMO)

Or book your room online at this link: http://group.hamptoninn.com/CMOS2018

Room block cut-off date: Wednesday May 9, 2018

Distance from Congress: 600m

Cambridge Suites Hotel Halifax - Sold Out!

Address: 1583 Brunswick St, Halifax, Nova Scotia B3J 3P5

Tel: 1 800 565 1263

Distance from Congress 200m

Dalhousie University, Risley Hall - Single room: Sold out, other options available from $30/night plus tax for students

Address: 1233 LeMarchant St., Halifax, Nova Scotia

Book your room online at this link: http://stay.dal.ca (Promotion code STUDENT for students)

Distance from Congress: 2km

Dalhousie University, LeMarchant Place - Two single rooms, shared private bathroom: $83.50/night plus tax for students

Address: 1246 LeMarchant St., Halifax, Nova Scotia

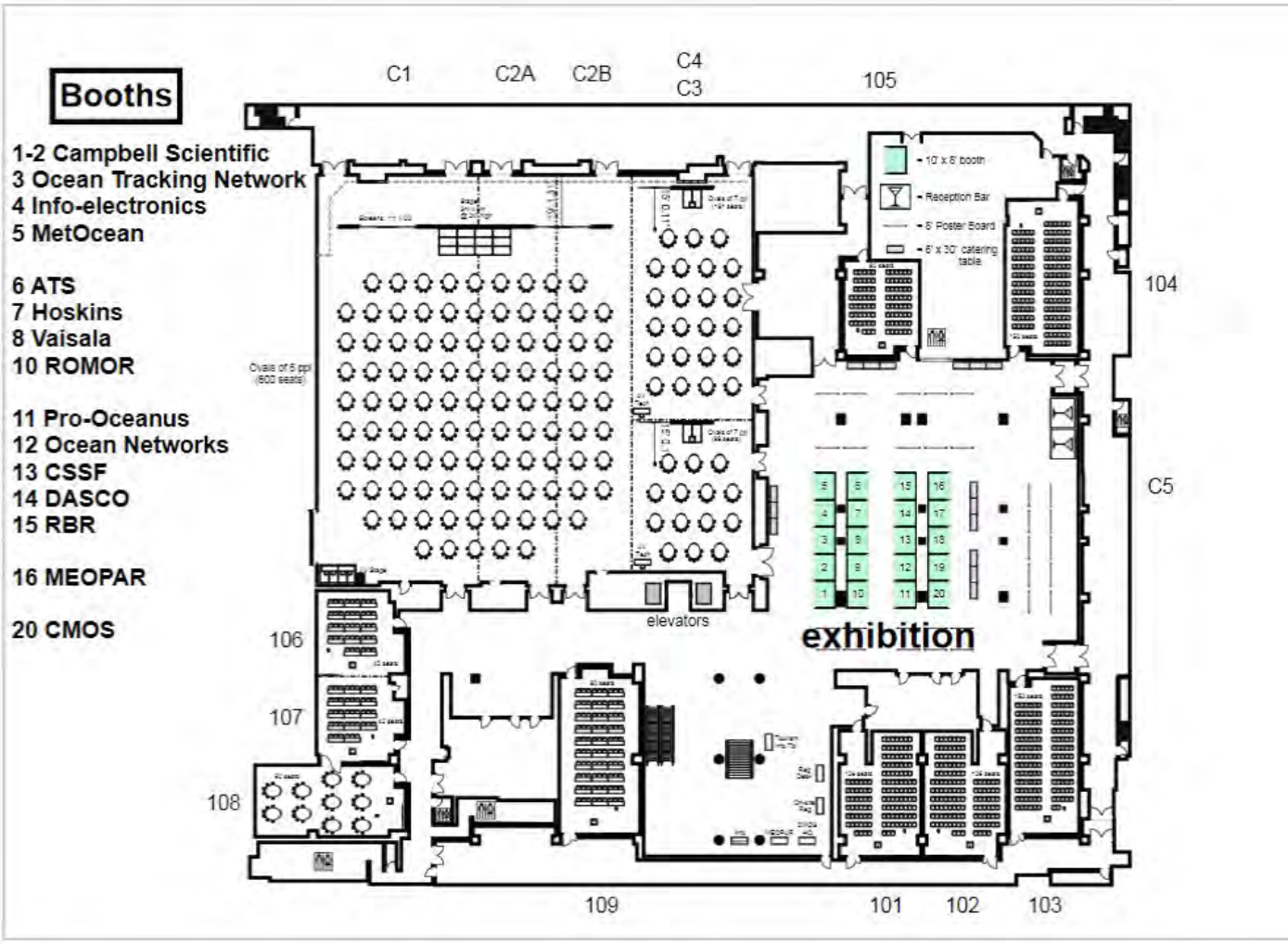
Book your room online at this link: http://stay.dal.ca (Promotion code STUDENT for students)

Distance from Congress: 2km

Exhibitors

Booth 1: Campbell Scientific
Booth 3: Ocean Tracking Network
Booth 4: Info-Electronics Systems Ltd
Booth 5: MetOcean
Booth 6: ATS Services
Booth 7: Hoskins Scientific
Booth 8: Vaisala
Booth 10: ROMOR Ocean Solutions
Booth 11: Pro-Oceanus
Booth 12: Ocean Networks Canada
Booth 13: ROPOS (Canadian Scientific Submersible Facility)
Booth 14: DASCO Equipment
Booth 15: RBR-Global
Booth 16: MEOPAR
Booth 20: CMOS

Click here for a floorplan showing the location of the booths (opens in new window)



Room	Session	Date	Time	Presenter	Title
Room C1	801010 Plenary Plénière	Monday, June 11	9:15 AM	Timothy Merlis	Radiatively driven robust atmospheric circulations changes: results from the "diabatic hierarchy" of climate models
Room C3	802020 Acoustics in oceanography and marine sciences - Part 1 L'acoustique en océanographie et sciences de la mer - Partie 1	Monday, June 11	10:30 AM	Dale Ellis	Analysis of spatial and temporal measurements of reverberation, noise, target echo, and feature scattering in a coastal environment
			10:45 AM	Hansen Johnson	Probability of passive acoustic detection of right whales from autonomous platforms equipped with a real-time monitoring system
			11:00 AM	David Barclay	The measurement of muddy seabed properties using passive acoustics
			11:15 AM	Clark Richards	Real-time passive acoustic monitoring in Canada's Northwest Passage
			11:30 AM	Vladislav Petrusevich	Patterns of winter diel vertical migration under sea ice in Hudson Bay.
			11:45 AM	Alexandria McTamney	Detecting Fish with a Doppler Current Profiler in Southern Newfoundland
Room C4	802100 Coastal Oceanography and Inland Waters - Part 1 L'océanographie côtière et les eaux intérieures - Partie 1	Monday, June 11	10:30 AM	Peter Taylor	Modeling Lake Erie circulation and thermal structure and the potential impact of wind farms.
			10:45 AM	Shiliang Shan	Circulation at a triple junction in the Kitimat Fjord
			11:00 AM	Rich Pawlowicz	Seasonal cycles, hypoxia and renewal in Barkley Sound, British Columbia
			11:15 AM	Entcho Demirov	Model study of the impact of hydropower developments on the physical oceanography of Hudson Bay.
			11:30 AM	Kyoko Ohashi	Development of a nested-grid coastal circulation modelling system for the eastern Canadian seaboard using ROMS
			11:45 AM	Ben Moore-Maley	Topographic influences on wind-driven upwelling in a semi-enclosed, temperate sea
Room 101	803060 Air Quality: Modeling and Monitoring of Cumulative effects La qualité de l'air : modélisation et surveillance des effets cumulatifs	Monday, June 11	10:30 AM	Rebecca Saari	Applying large ensembles to filter out natural variability in air quality health impacts of climate change and climate policy
			10:45 AM	weiqing Zhang	The impacts of lake –breeze circulation on ground ozone (O3) concentration
			11:00 AM	Ian Ashpole	Spatial and temporal trends in atmospheric Carbon Monoxide over Canadian cities
			11:15 AM	Leiming Zhang	Development and Evaluation of Polycyclic Aromatic Compound Emissions in the Athabasca Oil Sands Region
			11:30 AM	Leiming Zhang	Deposition Mapping of Polycyclic Aromatic Compounds in the Athabasca Oil Sands Region and Links to Cumulative Ecosystem Effects
Room 103	803040 The Canadian Climate and Atmosphere Research (CCAR) Program - Part 1 Le programme canadien Recherche sur les changements climatiques et l'atmosphère (RCCA) - Partie1	Monday, June 11	10:30 AM	Jon Abbatt	The NETCARE Project: Studying the relationships between aerosol particles and climate in remote Canadian environments
			10:45 AM	James Drummond	Probing the Atmosphere of the High Arctic (PAHA)
			11:00 AM	Paul Kushner	Overview of the Canadian Sea Ice and Snow Evolution Network (CanSISE)
			11:15 AM	Bernardo Stephan Teufel	Investigation of the mechanisms leading to the 2017 Montreal flood
			11:30 AM	Laxmi Sushama	Advances made in understanding, representing and communicating earth system processes in weather and climate within CNRCWP
			11:45 AM	Gulilat Tefera Diro	Improving seasonal forecasts via dynamical downscaling
Room 104	803090 ABL Composition, Processes and Surface-Atmosphere Exchange - Part 1 La composition et les processus de la couche limite atmosphérique et les échanges surface-atmosphère - Part 1	Monday, June 11	10:30 AM	Patrick Lewis Hayes	Characterization of aerosol size distributions and optical properties in the Canadian High Arctic
			11:00 AM	Betty Croft	Processes Controlling Summertime Arctic Aerosol Size Distributions
			11:15 AM	Jacob Sommers	Evaluating volatility basis set approach for modeling secondary organic aerosols in 3-D air quality models
			11:30 AM	Brendan Byrne	Monitoring trace gases in downtown Toronto using open-path Fourier transform infrared spectroscopy

Room	Session	Date	Time	Presenter	Title
			11:45 AM	Adam Monahan	Structure of observable meteorological state variables during transitions in the stably stratified nocturnal boundary layer
Room 105	809080 Numerical Methods and Model Development Les méthodes numériques et le développement de modèles	Monday, June 11	10:30 AM	Motoyoshi Ikeda	Guideline for high-resolution ocean models, using a model with probability distribution functions (PDF) of a thermohaline circulation
			10:45 AM	Francois Roy	Semi-Lagrangian Advection in the NEMO Ocean Model
			11:00 AM	David Deepwell	Spectral refining and coarsening of a numerical simulation
			11:15 AM	Christopher Subich	Higher-order finite volume with selective upwinding on the sphere
			11:30 AM	Timothy Chui	Leveraging public cloud infrastructure to produce affordable and reliable numerical weather forecasts
Room 109	804010 High Latitude Systems and Climate Change Les systèmes des hautes latitudes et les changements climatiques	Monday, June 11	10:30 AM	Kent Moore	Collapse of the winter Beaufort High associated with the pan-Arctic intrusion of North Atlantic cyclones: A response to thinning sea ice?
			10:45 AM	Yi Huang	Radiative control of the interannual variability of Arctic sea ice
			11:00 AM	Shiming Xu	Sea Ice Thickness and Snow Depth Retrieval with Data Synergy of Satellite Altimetry and Passive Radiometry
			11:15 AM	André April	Linking of the open water area of the North Open Water polynya to climatic parameters using a multiple linear regression prediction model.
			11:30 AM	Arlan Dirkson	Impact of improved sea ice initialization on real-time Arctic sea ice forecasts from CanSIPS
			11:45 AM	Zhenxia Long	Impacts of climate change in the Arctic Ocean
Room C3	802021 Acoustics in oceanography and marine sciences - Part 2 L'acoustique en océanographie et sciences de la mer - Partie 2	Monday, June 11	1:30 PM	Len Zedel	Design and testing of a swath Doppler sonar system to provide 2-component velocity measurements for sediment transport studies
			1:45 PM	Jenna Hare	Acoustic Transmission Loss and Reflection Coefficient within Water-Saturated Granular Materials at MHz Frequencies
			2:00 PM	Emma Shouldice	An acoustic backscatter model used to simulate Doppler sonar measurements in turbulent flows
			2:15 PM	Rachel Horwitz	Estimating Reynolds stresses and dissipation rates from a non-stationary platform in fast tidal flows
			2:30 PM	Alex Hay	Turbulence in a high-flow tidal channel: A comparison of results from a standard divergent-beam Doppler profiler and a developmental wide-baseline bi-static acoustic Doppler instrument
			2:45 PM	Craig Hamm	New capabilities in underwater acoustic communications modelling and analysis
Room C4	802101 Coastal Oceanography and Inland Waters - Part 2 L'océanographie côtière et les eaux intérieures - Partie 2	Monday, June 11	1:30 PM	Natacha B. Bernier	Recent Progress and Plans for Total Sea Level Forecasting at Environment and Climate Change Canada
			1:45 PM	Li Zhai	Storm surge hindcast in the northeast Pacific
			2:00 PM	Pengcheng Wang	Tidal Modulations of Surface Gravity Waves in the Gulf of Maine
			2:15 PM	Urs Neumeier	Long-term monitoring of waves associated with coastal erosion in the Gulf of St. Lawrence
			2:30 PM	Christoph Renkl	Using Overtides to Evaluate Ocean Model Predictions of Mean Dynamic Topography in Shallow, Tidally-Dominated Regions
			2:45 PM	Andrew Hamilton	Impact of a mine tailings breach on the physical limnology and turbidity of Quesnel Lake, British Columbia: baseline to two years post-breach
Room 101	809090 Atmosphere, Ocean, and Climate Dynamics La dynamique de l'atmosphère, des océans et du climat	Monday, June 11	1:30 PM	David Straub	Stimulated Loss of Balance and the Wave-Vortex Decomposition
			1:45 PM	Dustin Gamblin	Characterizing gravity waves using PASI and SATI at PEARL in Eureka, Nunavut
			2:00 PM	Boualem Khouider	Northward Propagation, Initiation, and Termination of Boreal Summer Intraseasonal Oscillations in a Zonally Symmetric Model

Room	Session	Date	Time	Presenter	Title
			2:15 PM	Yujuan Sun	Performance assessment of a new high-resolution global reanalysis (FIO-COM) on temperature-derived simulations in tropical oceans
			2:30 PM	Eric Oliver	Longer and more frequent marine heatwaves over the past century
			2:45 PM	Stephanie Waterman	The interplay of model resolution, eddy geometry and eddy-mean flow feedbacks
Room 102	807030 Earth System Models: Assessing Earth's State and Fate from Regional to Planetary Scales - Part 1 Les modèles du système terrestre : évaluation de l'état présent et de l'avenir de la Terre aux échelles régionale à planétaire - Partie 1	Monday, June 11	1:30 PM	John Scinocca	Unified Earth System Modelling at the Canadian Centre for Climate Modelling and Analysis
			2:00 PM	Neil Swart	The ocean climate and carbon cycle in the Canadian Earth System Model 5
			2:15 PM	Ali Asaadi	An improved parameterization of leaf area index (LAI) seasonality in the Canadian Terrestrial Ecosystem Model (CTEM) v.2.1.1
			2:30 PM	Christopher G. Fletcher	Quantifying the influence of snow parameterizations on climate in the Canadian LAnd Surface Scheme (CLASS)
			2:45 PM	Boualem Khouider	Using a stochastic convective parametrization to improve the simulation of tropical modes of variability in a GCM
Room 103	803041 The Canadian Climate and Atmosphere Research (CCAR) Program - Part 2 Le programme canadien Recherche sur les changements climatiques et l'atmosphère (RCCA) - Partie 2	Monday, June 11	1:30 PM	Julie Thériault	The Changing Cold Regions Network: Atmospheric, Cryospheric, Ecological and Hydrological Change in the Saskatchewan and Mackenzie River Basins, Canada
			1:45 PM	Jai Prakash Chaubey	Cloud Condensation Nuclei over remote Canadian Arctic ocean during Summer: Results from Amundsen ship cruise of 2016
			2:00 PM	Christopher Fletcher	The role of terrestrial snow in climate variability and change: emerging insights from the CanSISE network
			2:15 PM	Paul Myers	VITALS - Ventilation, Interactions and Transports Across the Labrador Sea
			2:30 PM	Susan Allen	Modeling 230Th as an approach to study the intermediate circulation in the Arctic Ocean
			2:45 PM	Yarisbel Garcia Quintana	Sensitivity of Labrador Sea Water formation to changes in model resolution, atmospheric forcing and freshwater input
Room 104	803091 ABL Composition, Processes and Surface-Atmosphere Exchange - Part 2 La composition et les processus de la couche limite atmosphérique et les échanges surface-atmosphère - Part 2	Monday, June 11	1:30 PM	Morgan Mitchell	Examining the Role of Local Precursors and Long-Range Transport in Halifax Ground Level Ozone Formation
			1:45 PM	Herb Winston	Combining gradient and profile fit method for an advanced ceilometer-based boundary layer height detection algorithm
			2:00 PM	Nicolas GASSET	Toward a 35-years North American Precipitation and Surface Reanalysis
			2:15 PM	George Burba	CO2/H2O Flux Measurements Using New Open-Path Low-Power Standardized Automated System
			2:30 PM	John Kochendorfer	Eddy covariance fluxes using a new low-cost relative humidity sensor
			2:45 PM	Alexander Moravek	Volatilization and uptake of ammonia by a urea-fertilized corn field: eddy covariance flux measurements over the growing season
Room 105	809020 Integrated Predictions for Best Responses Les prévisions intégrées au service des interventions éclairées	Monday, June 11	1:30 PM	Gordon McBean	Informing Canadians to Best Address Global Agenda 2030
			1:40 PM	Wendy Watson-Wright	Safe and Sustainable Development of the Ocean Frontier
			2:00 PM	Shawna Peddle	FloodSmart Canada: Communication that Motivates and Drives Flood Risk Management in Canada
			2:15 PM	Michel Jean	Future Seamless Data-Processing and Forecasting System : Improving Nations Readiness through Continuous Global Science and Technology Advancements
			2:30 PM	james abraham	A prediction challenge: making our cities resilient

Room	Session	Date	Time	Presenter	Title
			2:45 PM	Paul Kovacs	Communicating hurricane risk in Eastern Canada: Enhancing the communication lines between the Canadian Hurricane Centre, municipalities and insurers
Room 109	804020 Advancements in the in situ measurement of solid precipitation Les progrès de la mesure in situ des précipitations solides	Monday, June 11	1:30 PM	Michael Earle	WMO-SPICE: overview, methods, and Canadian perspective
			2:00 PM	John Kochendorfer	The testing and development of transfer functions for tipping-bucket precipitation gauges in WMO-SPICE
			2:15 PM	Amandine Pierre	Snowy opportunities at the NEIGE site, Montmorency Forest, Québec, Canada.
			2:30 PM	Craig D. Smith	Post-SPICE transfer function validation
			2:45 PM	Amandine PIERRE	Validation and adjustment of snowfall measurement biases for hydrological purposes in a snowy and cold boreal environment at Forêt Montmorency, Québec
Room C1	801011 Plenary Plénière	Tuesday, June 12	8:30 AM	James Drummond	Atmospheric Research at the Polar Environment Atmospheric Research Laboratory (PEARL)
Room C1			9:15 AM	Eriel Deranger	Indigenous Climate Action
Room C3	802090 Physical Oceanography - Part 1 L'océanographie physique - Partie 1	Tuesday, June 12	10:30 AM	Clark Pennelly	Influence of Atmospheric Forcing on processes within the North Atlantic Sub-Polar Gyre
			10:45 AM	David Deepwell	Multi-scale phenomena of rotation modified mode-2 internal waves
			11:00 AM	Stephanne Taylor	Extraction of balanced energy from a geostrophic flow due to near-inertial forcing
			11:15 AM	Sandy Gregorio	Forced and intrinsic interannual AMOC variability: an OGCM-based frequency-latitude analysis
			11:15 AM	Francis Poulin	Investigating the Dynamics of the Beaufort Gyre
			11:30 AM	Daisuke Hasegawa	Mixing processes of the Oyashio and Tsugaru Warm Current in the Northwestern Pacific
			11:45 AM	Guoqiang Liu	Surface Wave Impacts on the Ocean Responses to a Moving Storm
Room C4	803080 General Session - Atmosphere Séance générale : L'atmosphère	Tuesday, June 12	10:30 AM	Christopher Perro	Satellite Retrievals of Total Column Water Vapour During Arctic Winter
			10:45 AM	Paul Jeffery	Water Vapor Retrievals from the PARIS-IR Arctic Springtime Dataset
			11:00 AM	Taylor Gray	Sensitivity Analysis of Spectroscopic Retrievals of Atmospheric Composition
			11:15 AM	John Gyakum	Analysis and Prediction of a Large-scale Atmospheric Circulation Regime in the eastern North Pacific Basin
			11:30 AM	G.S. Strong	Variation of Precipitation with Elevation on Vancouver Island
			11:45 AM	Toshihisa Itano	Optimal excitation of perturbations on a cylindrical shear region around an axial flow
Room 101	803020 GOES-16 – Activities and Applications - Part 1 GOES-16 activités et applications - Partie 1	Tuesday, June 12	10:30 AM	Matt Arkett	GOES-R for the Meteorological Service of Canada
			10:45 AM	James McNitt	The GOES-16 and GOES-S Direct Broadcast Services
			11:00 AM	Wayne MacKenzie	GOES-16 & GOES-17 Operational Product Status and Validation Plans
			11:15 AM	Geoffrey Stano	Early Operational Activities with the Geostationary Lightning Mapper
			11:30 AM	R Ford	GOES-R User Training in ECCC
			11:45 AM	Janel Thomas	GOES-R Series International Training Working Group
Room 103	807010 Climate Variability and Predictability - Part 1 La variabilité et la prévisibilité du climat - Partie 1	Tuesday, June 12	10:30 AM	Gilbert Brunet	Identifying wave processes associated with predictability across time scales: An empirical normal mode approach
			10:45 AM	Song Yang	Selective Monsoon-ENSO Interaction: Active Role of the Southeast Asian Monsoon
			11:00 AM	Karen Smith	Beyond the annual mean: ENSO-driven interannual wintertime AMOC variability

Room	Session	Date	Time	Presenter	Title
			11:15 AM	Barrie Bonsal	Hydro-Climatic Variability and Extremes over the Athabasca River Basin: Historical Trends and Projected Future Occurrence
			11:30 AM	Yaheng Tan	Characteristics of Atmospheric Rivers and Their Association with Extreme Precipitation in a Changing Climate
			11:45 AM	Sarah Hyatt	Influence of Internal Variability on the Northern Extratropical Climate Response to External Forcing
Room 104	809060 Satellite Remote Sensing: Vital Information on the Health of the Planet - Part 1 La télédétection par satellite : des informations vitales sur la santé de la planète - Partie 1	Tuesday, June 12	10:30 AM	Francois Montagner	EUMETSAT Meteorological and Environmental Satellite Services
			10:45 AM	James Drummond	Carbon Monoxide as Seen from the MOPITT instrument
			11:00 AM	Ellen Eckert	Using Atmospheric Trace Gases like CCl_4 to derive key Parameters of the Brewer-Dobson Circulation
			11:15 AM	Kaley Walker	Validation and Scientific Results from the Canadian Atmospheric Chemistry Experiment (ACE) Satellite Mission
			11:30 AM	Patrick Sheese	Estimations of natural variability between satellite measurements of trace species concentrations
			11:45 AM	Daniel Zawada	The SAGE II/OSIRIS/OMPS-LP USask 2D Ozone Data Record and its use Within the LOTUS Initiative
Room 105	804030 General Session - Cryosphere Séance générale : La cryosphère	Tuesday, June 12	10:30 AM	Thomas Newman	Parameterizing the radar-scale roughness of snow on sea ice: a wavelet-based approach
			10:45 AM	Alex Cabaj	Comparison of regionally-averaged Arctic snowfall rates from CloudSat and reanalysis products
			11:00 AM	Dany Dumont	Propagation and attenuation of short waves in the marginal ice zone
			11:15 AM	Richard Dewey	A Sea-Ice Forecast Model for Cambridge Bay, Nunavut
Room C3	802091 Physical Oceanography - Part 2 L'océanographie physique - Partie 2	Tuesday, June 12	1:30 PM	Zeliang Wang	What we can know about the North Atlantic Ocean from satellite data
			1:45 PM	Benjamin Richaud	Surface and bottom temperature and salinity climatology along the continental shelf off the Canadian and U.S. East Coasts
			2:00 PM	Andrew Hamilton	Propagation of subsurface Atlantic Water into the Canadian Arctic and its potential to trigger retreat of outlet glaciers
			2:15 PM	Bash Toulany	Testing TSA performance with ST4 physics over Global grid
			2:45 PM	Louis-Philippe Nadeau	Barotropic and baroclinic equilibration of the Antarctic Circumpolar Current
			2:45 PM	Junde Li	The salinity anomalies and its impact on the Equatorial Undercurrent in the tropical Indian Ocean during the IOD
Room C4	809010 Big Data and Artificial Intelligence in Meteorological, Oceanographic, and Environmental Applications - Part 1 L'application des mégadonnées (big data) et de l'intelligence artificielle à la météorologie, à l'océanographie et à l'environnement - Partie 1	Tuesday, June 12	1:30 PM	Thomas Trappenberg	Artificial Intelligence and Deep Learning: a mini workshop demystifying the current techniques in the field
Room 101	803021 GOES-16 – Activities and Applications - Part 2 GOES-16 activités et applications - Partie 2	Tuesday, June 12	1:30 PM	Louis Garand	Assimilation of GOES-16 Atmospheric Motion Vectors into the ECCC Global Deterministic Prediction System
			1:45 PM	Victor Kwok K Chung	A qualitative verification of the performance of a Convective Cloud Mask using GOES-16 and GOES-13 data
			2:00 PM	Prasamsa Singh	Terrestrial and Marine fog detection over Canada
			2:00 PM	Hong Lin	Exploration of Geostationary Lightning Mapper Products for Canadian Applications
			2:15 PM	Kathryn Mozer	GOES-R Series ABI Mesoscale Domain Sector Request Process for International Users

Room	Session	Date	Time	Presenter	Title
			2:30 PM	Lewis Poulin	GOES-16 in the CCMEP environment and some post processing examples of L1b and L2 data
Room 102	803070 Convection and Cloud Physics La convection et la physique des nuages	Tuesday, June 12	1:30 PM	Chun-Chih Wang	Convection initiation by lake breeze convergence during the 2015 Environment Canada Pan Am Science Showcase
			1:45 PM	Liviu Ivanescu	SACIA investigation into UTLS aerosol-cloud interactions during the polar winter
			2:00 PM	Jean-Pierre Blanchet	Advancing Cloud Microphysics Observations in Cold Polar Air Formation
			2:15 PM	Peter Taylor	Mesoscale Boundaries and Convective Storm Development in Southwestern Ontario
			2:30 PM	Emily McCullough	Lidar measurements of thin layers at high resolution within Arctic clouds
			2:45 PM	Ian Folkins	Tropical rainfall variance in a modified version of the Community Atmosphere Model
Room 103	807011 Climate Variability and Predictability - Part 2 La variabilité et la prévisibilité du climat - Partie 2	Tuesday, June 12	1:30 PM	Rachel Altman	Statistical Modelling of Annual Rainfall Pattern in Guanacaste, Costa Rica
			1:45 PM	Marc De Benedetti	Impact of Resolution on the Representation of Precipitation Variability Associated With the ITCZ
			2:00 PM	Hai Lin	Eastern Canada flooding 2017 and its subseasonal predictions
			2:15 PM	Lei Wang	Subseasonal Climate Predictability over the United States assessed from ECMWF and NCEP models
			2:30 PM	Nicholas Soulard	Tropical Forcing of the Circumglobal Teleconnection Pattern
			2:45 PM	Yang Zhou	Effects of the Madden Julian Oscillation on 2 m Air Temperature Prediction over China during Winter in the S2S Database
Room 104	809061 Satellite Remote Sensing: Vital Information on the Health of the Planet - Part 2 La télédétection par satellite : des informations vitales sur la santé de la planète - Partie 2	Tuesday, June 12	1:30 PM	Alexander Trishchenko	Does all the snow melt in the Canadian Arctic Archipelago during summer?
			1:45 PM	Matthew Cooper	Assessing snow extent data sets over North America to inform trace gas retrievals from solar backscatter observations
			2:00 PM	Fraser King	Using CloudSat snowfall estimates to evaluate gridded snow products
			2:15 PM	Hui Shen	Remote Sensing of Waves Propagating in the Marginal Ice Zone by SAR
			2:30 PM	Christopher Schmidt	Fire Detection and Monitoring with GOES-16
			2:45 PM	Pedro Campos	Evaluation des Méthodes d'Interpolation Spatiale et des Techniques de Télédétection dans la Caractérisation Bathymétrique du Plateau Continental de l'État Rio Grande do Norte, Brésil.
Room 105	802070 Development, performance, and implementation of oceanographic sensors and instrument platforms - Part 1 Le développement, le fonctionnement et la mise en œuvre de capteurs et de plateformes d'instruments océanographiques - Partie 1	Tuesday, June 12	1:30 PM	Douglas Wallace	Towards Process Understanding with Advanced, Multidisciplinary Ocean Time-Series Sites.
			1:45 PM	Mark Halverson	Dynamic corrections for the RBR inductive conductivity cell: Results from an autonomous profiling float
			2:00 PM	Cédric Chavanne	Do high-frequency radars measure the wave-induced Stokes drift?
			2:15 PM	Meghan Troup	An Autonomous Hovercraft for Bathymetric Surveying in Shallow Waters
			2:30 PM	Jude Van der Meer	Lessons learned operating autonomous ocean vehicles
Room C3	802120 Operational Oceanography L'océanographie opérationnelle	Tuesday, June 12	3:30 PM	Jean-Philippe Paquin	Development of nearshore circulation model for Saint John Harbour based on NEMO
			3:45 PM	Francois Montagner	Satellite data for operational oceanography at high latitudes
			4:00 PM	Yimin Liu	Development of a Pan-Canadian Operational Regional Ocean Data Assimilation System
			4:15 PM	Ian Thompson	Using wave hindcast data for ship structure and stability assessment
			4:30 PM	Steven Beale	Ensemble Approaches to Marine Forecasting
			4:45 PM	Zhigang Xu	On Virtual Tide Gauges

Room	Session	Date	Time	Presenter	Title
Room C4	809011 Big Data and Artificial Intelligence in Meteorological, Oceanographic, and Environmental Applications - Part 2 L'application des mégadonnées (big data) et de l'intelligence artificielle à la météorologie, à l'océanographie et à l'environnement - Partie 2	Tuesday, June 12	3:30 PM	Fraser Davidson	A novel approach for improving accessibility, understanding and performance of Ocean Prediction Systems
			3:45 PM	Hossein Ghannadrezaii	FHSS-BFSK JANUS-Based protocol for Underwater Hybrid Cellular-Ad hoc Network
			4:00 PM	Mingshi Chen	Development of Vegetation Products With Multiple Spatial-temporal Resolutions From SNPP and JPSS VIIRS For Environmental Modeling and Monitoring
			4:15 PM	Andrew Snauffer	SWE data fusion by machine learning: an examination of performance by physiographic region
			4:30 PM	Christian Saad	PROGNOS: A renewed statistical post-processing infrastructure and opportunity for AI applications for the Meteorological Service of Canada (MSC)
			4:45 PM	Fabio Frazao	MERIDIAN is Listening to the Sounds of the Ocean with Deep Learning
Room 101	807060 General Session - Climate Séance générale : Le climat	Tuesday, June 12	3:30 PM	Kenneth Devine	The Not So Simple Tipping Bucket
			3:45 PM	Francisco José Cuesta-Val	Long-term Surface Temperature (LoST) Database as a Complement for GCM Preindustrial Simulations
			4:00 PM	Richard Harvey	Observed and modelled above-canopy, subcanopy and ground energy budgets at a Quebec boreal forest site: a comparison between EVAP data and CLASS
Room 101	807040 Science for Canadian Climate Services La science pour les services climatologiques canadiens	Tuesday, June 12	4:15 PM	Diane Chaumont	EASE OF PRODUCTION AND USE VERSUS SCIENTIFIC NOVELTY IN A CLIMATE PRODUCT: OURANOS' EXPERIENCE IN THE EVALUATION OF ADDED VALUE FROM AN END-USER PERSPECTIVE
			4:30 PM	Trevor Smith	PAVICS: A platform for the Analysis and Visualization of Climate Science - toward inter-operable multidisciplinary workflows
			4:45 PM	Alex Cannon	Future rainfall Intensity-Duration-Frequency curves in Canada from convection-permitting climate model simulations: a Generalized Extreme Value simple scaling approach
Room 102	809110 General Session - Interdisciplinary Séance générale : Les travaux interdisciplinaires	Tuesday, June 12	3:30 PM	Sandrine Edouard	Les services de données du SMC: vers une forum de données ouvertes en 2019
			3:45 PM	Chad Mahoney	Variable Energy Resources: Operational Energy Forecasting Approaches
			4:00 PM	David Anselmo	CMC Operations: Implementing Operational Weather and Environment Prediction Systems and the Advent of a New HPC Infrastructure
Room 102	805010 General Session - Hydrology Séance générale : L'hydrologie	Tuesday, June 12	4:15 PM	Charles Curry	Twenty-First Century Hydrologic Change and Extreme Streamflow in the Fraser River Basin of British Columbia
Room 102	809100 Societal Applications: Transforming Weather, Marine and Climate Communication through Policy, Research and Practice L'utilité pour la société de la transformation des communications liées à l'atmosphère, aux océans et au climat grâce aux politiques, à	Tuesday, June 12	4:30 PM	Rebecca Segal	Combining remote sensing and community sea ice information to inform safe travel in the Kitikmeot region of Nunavut, Western Canadian Arctic
			4:45 PM	Blair Greenan	Educating coastal communities on sea level rise
Room 103	807020 Processes and Impacts of climate change in the Arctic realm: from past to future Les processus et les impacts des changements climatiques dans l'Arctique : du passé à l'avenir	Tuesday, June 12	3:30 PM	Diane Chaumont	CLIMATE SCENARIOS FOR CANADIAN ARCTIC BASED ON REANALYSIS PRODUCTS AND REGIONAL CLIMATE MODEL OUTPUTS
			3:45 PM	Natasha Ridenour	Modelling High Frequency Variability in Hudson Strait Outflow
			4:00 PM	Anne de Vernal	seasonnally sea ice free eastern Arctic Ocean during the early-mid Holocene
Room 103	809050 Changing Arctic: Science and Policy Studies L'évolution de l'Arctique : études scientifiques et politiques	Tuesday, June 12	4:15 PM	David Fissel	Spatial Variability of the Ice Drift Response to Wind Forcing in the Canadian Beaufort Sea as Revealed from a Dense Array of Moored Upward Looking Sonar Instruments

Room	Session	Date	Time	Presenter	Title
			4:30 PM	Motoyoshi Ikeda	Circulation patterns in and origins of the lower Arctic Ocean shown in geochemical data
			4:45 PM	Ronald Saper	A COMPARISON OF THE STATISTICAL AND DETERMINISTIC APPROACHES TO FORECASTING SHORT TERM ICEBERG DRIFT ON THE GRAND BANKS
Room 104	809062 Satellite Remote Sensing: Vital Information on the Health of the Planet - Part 3 La télédétection par satellite : des informations vitales sur la santé de la planète - Partie 3	Tuesday, June 12	3:30 PM	Lewis Poulin	A new era in monitoring the earth's atmosphere, land and ocean surface from geostationary satellite with GOES-R
			3:45 PM	Jeff Langille	Spatial Heterodyne Observations of Atmospheric Water Vapour from the NASA ER-2 airplane
			4:00 PM	Zhipeng Qu	Using high-resolution NWP model and satellite data to understand the injection of water vapor into the mid-latitude lower stratosphere by convective clouds
			4:15 PM	Kristof Bognar	Validation of ACE and OSIRIS ozone and NO2 measurements using ground-based instruments in Eureka
			4:15 PM	Doug Degenstein	The Raven Mission
			4:30 PM	Kaley Walker	The proposed Chemical and Aerosol Sounding Satellite (CASS) Mission
			4:45 PM	William Ward	An Ozone-Dynamics mission for the middle atmosphere
Room 105	802071 Development, performance, and implementation of oceanographic sensors and instrument platforms - Part 2 Le développement, le fonctionnement et la mise en œuvre de capteurs et de plateformes d'instruments océanographiques - Partie 2	Tuesday, June 12	3:30 PM	Rich Pawlowicz	The Salish Sea CitSci dataset 2015-2018
			3:45 PM	Chris L'Esperance	A Novel, Underway Gas Chromatography System: Realized Application in the Eastern Tropical South Pacific
			4:00 PM	Mark Barry	A new gas tension instrument for oceanography: one measurement parameter, a myriad of applications and solutions
			4:15 PM	Bruce Johnson	Development of a submersible dissolved inorganic carbon (DIC) sensor
			4:30 PM	Christopher Gordon	Observing Biogeochemical Processes in the Gulf of Mexico using a set of Uniquely-Equipped Autonomous Floats
			4:45 PM	David Lemon	Ocean Glider Mounted Echo Sounders for Monitoring Fish and Zooplankton Populations
Room C1	801012 Plenary Plénière	Wednesday, June 13	8:30 AM	Roberta Hamme	Observing the Ocean Take a Breath
			9:15 AM	Amy Mathews Amos	Breaking Through the Barriers: Communicating Science in the Post-Truth Era
Room C3	808030 Risks and impacts relating to the insurance industry Les risques et les impacts : la perspective du secteur de l'assurance	Wednesday, June 13	10:30 AM	Jonathan Gadoury	Using machine learning to create a wildfire risk map
Room C4	802102 Coastal Oceanography and Inland Waters - Part 3 L'océanographie côtière et les eaux intérieures - Partie 3	Wednesday, June 13	10:30 AM	Susan Allen	Properties of the Exchange through a Tidal Mixing Hotspot at an Estuary Constriction
			10:45 AM	DanLing Tang	"Wind Pump" Effects on Marine Ecosystems
			11:00 AM	Jing Tao	Variability of suspended particle properties and distribution using optical measurements within the Columbia River Estuary
			11:15 AM	Kent Moore	The May 2017 Collapse of the Lincoln Sea Ice Arch in response to thin ice and wind forcing
			11:30 AM	Gonzalo Saldias	On subsurface cooling associated with the Biobio River Canyon (Chile)
			11:45 AM	Samantha Jones	An integrated look at carbon cycling in Freshwater Creek and Cambridge Bay, Nunavut
Room 101	806010 General Session - Weather - Part 1 Séance générale : Les phénomènes météorologiques - Partie 1	Wednesday, June 13	10:30 AM	Lucy Chisholm	An Overview of the Forecasting and Impacts of the January 2017 New Brunswick Freezing Rain Event

Room	Session	Date	Time	Presenter	Title
			10:45 AM	Carmen Hartt	Recent work in the Analysis & Prognosis Section of the Canadian Centre for Meteorological and Environmental Prediction
			11:00 AM	Ujjwal Tiwari	Regional modelling of weather conditions surrounding a tragic disaster in Mount Everest
			11:15 AM	Yingkai Sha	The post-processing of gridded numeric weather forecast with Extreme Learning Machine in British Columbia, Canada
			11:30 AM	Guosheng Zhang	Spaceborne Synthetic Aperture Radar Applications on Tropical Cyclone Studies
			11:45 AM	Eyad Atallah	A Simple Definition of Flow Regimes and its Relationship to High Impact Weather Events
Room 102	809070 Research and operational activities supporting the Year of Polar Prediction - Part 1 La recherche et les activités opérationnelles en soutien à l'Année de la prévision polaire - Partie 1	Wednesday, June 13	10:30 AM	Paul Pestieau	The Year of Polar Prediction: International and Canadian perspectives
			11:00 AM	Gabrielle Gascon	Pre-Year of Polar Prediction Evaluation of Numerical Weather Prediction Models for the Canadian Arctic
			11:15 AM	Fraser Davidson	Evaluation of an Argo equivalent float deployment on the Labrador Shelf: for better understanding of ocean circulation and prediction systems on the shelf.
			11:30 AM	Gregory Smith	Impact of small-scale coupled atmosphere-ice-ocean interactions: Results from the Canadian high-resolution forecasting system for YOPP
			11:45 AM	Gilbert Brunet	Model process-based evaluation using high-frequency multi-variate observations at the Arctic supersites during the Year of Polar Prediction
Room 103	807050 Regional Climate Analysis and Projections - Part 1 Les analyses et les projections du climat régional - Partie 1	Wednesday, June 13	10:30 AM	Peter Taylor	An Ontario Jet Stream Core Climatology
			10:45 AM	Housseyni Sankare	Sensitivity study of available potential energy budget to optically thin ice clouds during the Arctic polar night
			11:00 AM	Lei Wang	The impact of climate change on the wave climate in the Gulf of St. Lawrence
			11:15 AM	J.P. René Laprise	Towards a Canadian Coupled Atmosphere-Ocean Regional Climate Model
			11:30 AM	Philippe Gachon	Future changes in wintertime occurrence and intensity of extratropical cyclones over the eastern coast of North America
Room 104	807031 Earth System Models: Assessing Earth's State and Fate from Regional to Planetary Scales - Part 2 Les modèles du système terrestre : évaluation de l'état présent et de l'avenir de la Terre aux échelles régionale à planétaire - Partie 2	Wednesday, June 13	10:30 AM	Karen Smith	The Impact of Stratospheric Circulation Extremes on Minimum Arctic Sea Ice Extent
			10:45 AM	Thomas Oudar	Northern Hemisphere climate response to anthropogenic aerosols in the CanESM2 large ensemble
			11:00 AM	Haruki Hirasawa	Role of Atmospheric and Oceanic Forcing in the Climate Response to Anthropogenic Aerosols
			11:15 AM	Lei Wang	Large impacts, past and future, of ozone depleting substances on Brewer-Dobson circulation trends: A multi-model assessment
			11:30 AM	Andrew MacDougall	Should we abandon the 1% experiment for evaluating carbon cycle feedbacks to climate change?
			11:45 AM	Yann Chavaillaz	Heat stress and labour productivity loss due to cumulative CO2 emissions
Room 105	802030 Ocean Observing Programs and Coordinated Ocean Information Management Les programmes d'observation des océans et la gestion coordonnée de l'information océanographique	Wednesday, June 13	10:30 AM	Anne-Sophie Ste-Marie	Collaboration and network consolidation: enabling ocean observing data discovery and dissemination
			10:45 AM	Katja Fennel	Biogeochemical Argo as an essential component of a North Atlantic Ocean Observing System
			11:00 AM	Kimberley Davies	Using gliders to monitor North Atlantic right whales and their habitat in the Gulf of St. Lawrence

Room	Session	Date	Time	Presenter	Title
			11:15 AM	Melany Belzile	Glider measurements on the Scotian Shelf as part of a monitoring program
			11:30 AM	Brad Covey	Managing Data from Autonomous Underwater Vehicles
			11:45 AM	Doug Wallace	LabSea2020 – A new, “bottom-up”, international cooperative research initiative in the Labrador Sea
Room C3	802040 Go with the flow: managing marine life in a dynamic ocean Suivre son cours : la gestion de la vie marine dans un océan dynamique	Wednesday, June 13	1:30 PM	Wendy Gentleman	Currently misdirected: Big steps toward improving random walk modelling
			1:30 PM	Rich Pawlowicz	An Expendable Drifter Study of Dispersion in the Salish Sea
			1:45 PM	Janelle M. Hrycik	Estimating dispersal in aquatic systems using a new technology and comparisons with conventional methods
			2:00 PM	Krysten Rutherford	Residence times and transport pathways on the northwestern North Atlantic continental shelf: Results from a numerical tracer analysis
			2:15 PM	Tara Howatt	A Physical Perspective on Zooplankton Distributions in Roseway Basin
			2:30 PM	Remi Daigle	Marxan Connect: Operationalizing ecological connectivity in spatial conservation planning
			2:45 PM	Arieanna Balbar	The use of connectivity in the design of networks of marine protected areas
Room C4	802060 Collaboration in development, evaluation and analysis of ocean circulation and biogeochemical models - Part 1 La collaboration liée au développement, à l’évaluation et à l’analyse des modèles biogéochimiques et de circulation océanique - Partie 1	Wednesday, June 13	1:30 PM	Paul Myers	NEMO modelling with the Arctic Northern Hemisphere Atlantic Configuration
			1:45 PM	Frederic Dupont	Latest hindcast of the 1/12th degree resolution Arctic-North Atlantic ice-ocean configuration at ECCC
			2:00 PM	Xianmin Hu	Preliminary results of ocean and sea-ice hindcasting during 1993-present for North Atlantic, Arctic and North Atlantic Oceans
			2:15 PM	John Smith	Applications of 129I and gas ventilation tracers in transit time distribution (TTD) circulation models in the Arctic Ocean
			2:30 PM	Li Zhai	Sea level and meso-scale eddy variability during 2007-2016 in the Northeast Pacific simulated by a high-resolution regional ocean model
			2:45 PM	Yuan Wang	The role of tidal circulation in the regional circulation and hydrographic distribution in the eastern Canadian shelf
Room 101	806011 General Session - Weather - Part 2 Séance générale : Les phénomènes météorologiques - Partie 2	Wednesday, June 13	1:30 PM	Herb Winston	Automated continuous water vapor profile measurements in Iqaluit, Nunavut, using a new ground-based DIAL lidar.
			1:45 PM	Mateusz Reszka	Error characterization and data assimilation experiments using surface observations over North America
			2:00 PM	Michael Palmer	Weather Research Forecast Data Ingestion for Renewable Energy Applications
			2:15 PM	Ahmed Mahidjiba	Towards a new Canadian weather radar network and the roll-out of modern operational radar products for end-users
			2:30 PM	Michael Folmer	Addressing Marine Weather Challenges using the Next Generation of Weather Satellites
			2:45 PM	John MacPhee	Renewal of E-based training course - Atmospheric Monitoring
Room 102	809071 Research and operational activities supporting the Year of Polar Prediction - Part 2 La recherche et les activités opérationnelles en soutien à l’Année de la prévision polaire - Partie 2	Wednesday, June 13	1:30 PM	Ji Lei	Ice verification across the CCMEP forecast systems
			1:45 PM	Erik Johnson	Fram Strait winter sea-ice areal export as a preconditionner the summer sea ice minimum extent: Global Climate Models vs observations
			2:00 PM	Charles Brunette	Winter coastal divergence as a predictor for the minimum sea ice extent in the Laptev Sea
			2:15 PM	Arlan Dirkson	Multi-model Probabilistic Seasonal Forecasts of Regional Arctic Sea Ice Coverage
			2:30 PM	Bertrand Denis	Forecasting Regional Arctic Sea Ice from a Month to Seasons (FRAMS)

Room	Session	Date	Time	Presenter	Title
			2:45 PM	Rachel Chang	Improving visibility forecasting in summer time polar fog
Room 103	807051 Regional Climate Analysis and Projections - Part 2 Les analyses et les projections du climat régional - Partie 2	Wednesday, June 13	1:30 PM	Almudena García-García	Simulated air-ground temperature coupling and extreme events: the role of the Land Surface Model
			1:45 PM	Magdalena Mittermeier	Detecting the Dynamics of Heavy Precipitation Weather Patterns under Climate Change using a Machine Learning Algorithm
			2:00 PM	Faron Anslow	Objective Analysis of Observational Network Sufficiency in BC's Complex Topography
			2:15 PM	Sebastien Biner	Validation of the Ouranos Reconstructed Climate for the Province of Québec (CROQ)
			2:30 PM	JINLIANG (JOHN) LIU	High Resolution Regional Climate Modelling in Support of Adaptation In Ontario
Room 104	807032 Earth System Models: Assessing Earth's State and Fate from Regional to Planetary Scales - Part 3 Les modèles du système terrestre : évaluation de l'état présent et de l'avenir de la Terre aux échelles régionale à planétaire - Partie 3	Wednesday, June 13	1:30 PM	Gerhard Krinner	Bias-corrected regional climate projections with a stretched-grid AGCM
			1:45 PM	Laxmi Sushama	State-of-the-art and knowledge gaps in Arctic terrestrial modelling
			2:00 PM	Gulilat Tefera Diro	Snow-precipitation coupling and related atmospheric feedbacks over North America
			2:15 PM	Bernardo Stephan Teufel	Northern Hemisphere Terrestrial Cryosphere in 1.5, 2 °C warming scenarios
			2:30 PM	Paul Kushner	Canadian Snow and Sea Ice: Assessment of Snow, Sea Ice, and Related Climate Processes in Canada's Earth-System Model and Climate-Prediction System
			2:45 PM	Bimochan Niraula	Vorticity Input and the partitioning of Ocean Heat between the Fram Strait and the Barents Sea Gate
Room 105	803050 Fog or Low Visibility - Part 1 Le brouillard ou la faible visibilité - Partie 1	Wednesday, June 13	1:30 PM	Terry Bullock	The Application of Monitoring and Forecasting to Harsh Marine Environment Decision Making
			1:30 PM	Joelle Dionne	Examining the sensitivity of the radiative properties of modelled low clouds in the summer Arctic to cloud droplet number concentration
			2:00 PM	Wensong Weng	Boundary layer and WRF-SCM modelling of marine fog
			2:15 PM	George Isaac	Microphysical Characteristics of Marine Fog Offshore Newfoundland
			2:30 PM	Rachel Chang	Fog and aerosol microphysics on the coast of Nova Scotia
			2:45 PM	Jonathan Izett	Observing Shallow Fog at Very High Resolution
Room C1	801013 Plenary Plénière	Thursday, June 14	8:30 AM	Chris Fogarty	Impacts of Tropical and Post-tropical Cyclones in Eastern Canada
			9:15 AM	Kevin Quigley	Risk Analysis at the Science-Policy Interface: From narrow and naïve to clunky and ambiguous
Room 103	808010 Weather, shipping and subsistence activities in Arctic regions La météo, la navigation et les activités de subsistance dans les régions	Thursday, June 14	10:30 AM	Alec Casey	Continuous, ship-based sea ice thickness surveys in Hudson Strait
			10:45 AM	Adrienne Tivy	Implementation of an Arctic Polar Regional Climate Centre
Room C3	802110 History of Canadian Oceanography Histoire de l'océanographie canadienne	Thursday, June 14	1:30 PM	Eric Mills	"TOO LATE FOR ACTION." M.L. FERNALD, A.G. HUNTSMAN AND THE BELLE ISLE STRAIT EXPEDITION OF 1923
			2:00 PM	CarolAnne Black	Defining territorial waters: the role of science in policymaking
			2:15 PM	Oksana Schimnowski	Vessel traffic in Canada's Arctic historic to present: examining trends, voyage patterns and extent (with a focus on oceanographic and research ships)
			2:30 PM	Cristina Tollefsen	Early Oceanographic Research at the Naval Research Establishment, Dartmouth
Room C4	802061 Collaboration in development, evaluation and analysis of ocean circulation and biogeochemical models - Part 2 La collaboration liée au développement, à l'évaluation et à l'analyse des modèles biogéochimiques et de circulation océanique - Partie 2	Thursday, June 14	1:30 PM	Timothee Bourgeois	From the North Pacific to the North Atlantic: Modelling the Arctic Ocean biogeochemical connectivity
			1:45 PM	Arnaud Laurent	An intercomparison of regional versus global biogeochemical models in Atlantic Canadian shelf waters

Room	Session	Date	Time	Presenter	Title
			2:00 PM	Elise Olson	Salish Sea Model Ecosystem - Lower Trophic: Evaluation and episodic nutrient supply in the Northern Strait of Georgia
			2:15 PM	Fabian Grosse	Quantifying the relative importance of anthropogenic nutrients in coastal marine ecosystems through element tracing: A case study for the northern Gulf of Mexico
			2:30 PM	Jonathan Izett	Estimating the Cross-Shelf Export of Riverine Materials
			2:45 PM	Liuqian Yu	Simulating deep-water hydrocarbon plumes with a data-assimilative model of the Gulf of Mexico
Room 102	809040 Coupled Environmental Prediction La prévision environnementale couplée	Thursday, June 14	1:30 PM	C. Harold Ritchie	Overview of CONCEPTS Coupled Environmental Prediction Systems
			1:45 PM	Dorothy Durnford	A comparison of the net basin supply of the Great Lakes as simulated and as derived from observations
			2:00 PM	Doug Latornell	SalishSeaCast: Coupled bio-chem-physical Ocean Model with downstream Waves, Near-shore Circulation and Oil Spill Model
			2:15 PM	Jean-Pierre Auclair	Dynamical modeling of the marginal ice zone: a process study in one dimension
			2:30 PM	Minghong Zhang	Air-sea-ice interactions during the Great Arctic Cyclone of August 2012
			2:45 PM	Lei Wang	Subseasonal Forecast of Arctic Sea Ice Concentration via Statistical Approaches
Room 103	802130 General Session - Oceans Séance générale — Les océans	Thursday, June 14	1:45 PM	Suqing Xu	Variation of summer oceanic partial pressure of carbon dioxide in the Prydz Bay using a self-organizing map analysis approach
			2:00 PM	Yarisbel Garcia Quintana	A new source for Denmark Strait Overflow Water?
Room 104	808020 Integrated approaches of climate change impacts on marine fisheries - Part 1 Une approche intégrée face aux impacts des changements climatiques sur les pêches marines - Partie 1	Thursday, June 14	2:15 PM	Tyler Wilson	Socioeconomic risk from ocean acidification and climate change impacts on Atlantic Canadian fisheries
			2:30 PM	Travis Tai	Biophysical responses to ocean acidification and impacts on global fisheries
			2:15 PM	Habiba Ferchichi	Modeling future scenarios of water temperature in the coastal environment and implications for potential infections with Vibrio Parahaemolyticus and Vibrio Vulnificus: application to shellfish beds in the Estuary and Gulf of St. Lawrence
			2:30 PM	Trevor Hadwen	The 2017 Northern Great Plains Drought
			2:45 PM	Vanessa McFadden	Simulations of the ice storm in the Maritime Provinces on 24-26 January 2017
Room 105	803051 Fog or Low Visibility - Part 2 Le brouillard ou la faible visibilité - Partie 2	Thursday, June 14	1:30 PM	Carol McClellan	Use of Geographic Information Systems in the assessment of potential for highway blowing and drifting snow
			1:45 PM	Saša Gaberšek	Marine Fog Prediction at the Naval Research Laboratory – Current Status, Challenges and Way Forward
			2:00 PM	Patrick Duplessis	Observation of a decreasing marine and coastal fog frequency in Atlantic Canada over the past six decades due to possible changes in large-scale atmospheric features
			2:15 PM	Clive Dorman	Fog Trend and Interannual-to-Decadal Variability
			2:30 PM	Vida Khalilian	Fog and Low-Visibility Climatology and Regional Controls at Inuvik and Aklavik, Mackenzie Delta, Northwest Territories
			2:45 PM	Rick Danielson	Mapping fog in regional climate change simulations based on shared true variance in ICOADS ship observations and ERA Interim visibility estimates
Room C3	802080 Ocean Acidification in Canadian Waters L'acidification des océans en eaux canadiennes	Thursday, June 14	3:30 PM	Alfonso Mucci	Spatial variability of surface-water pCO2 in the world's largest estuarine system: Distinguishing between physical and biological controls in the St. Lawrence Estuary and Gulf (Canada)

Room	Session	Date	Time	Presenter	Title
			3:45 PM	Tereza Jarníková	Spatial and Temporal Variation of pH and Aragonite Saturation in the Salish Sea : A Modelling Approach
			4:00 PM	WANYING JI	A study of Inorganic Carbon Cycling in Scotian Shelf Waters Using Stable Carbon Isotopes
			4:15 PM	Lin Cheng	A transatlantic section of shipboard δ13C-DIC measurements and results from a worldwide inter comparison study.
			4:30 PM	Stefanie Mellon	Investigating the 13C Suess effect in foraminiferal calcite: A history of ocean acidification in the NW Atlantic during the last 4000 years
			4:45 PM	Cecilia Engler	Ocean Acidification Post-Paris: Gauging Law and Policy Responses in Light of Emerging Scientific Projections
Room C4	802062 Collaboration in development, evaluation and analysis of ocean circulation and biogeochemical models - Part 3 La collaboration liée au développement, à l'évaluation et à l'analyse des modèles biogéochimiques et de circulation océanique - Partie 3	Thursday, June 14	3:30 PM	Yi Sui	Numerical Study of the storm-induced circulation in the South China Sea during typhoon Linfa using a nested-grid ocean model
			3:45 PM	Michael Casey	Evaluating hydrography variations in the Scotian Shelf and Gulf of Maine as simulated by a high-resolution regional ocean model.
			4:00 PM	Simon Higginson	An evaluation framework for the comparison of two high-resolution coastal models
			4:15 PM	Hauke Blanken	Estimating uncertainty in ocean surface drift trajectories using fuzzy numbers
			4:30 PM	Nancy Soontiens	A Framework for Drift Evaluation and Prediction in Ocean Models
			4:45 PM	Youyu Lu	Discussions on development, evaluation and analysis of ocean circulation and biogeochemical models
Room 104	808051 General Session - Risks and Impacts - Part 2 Séance générale : Les risques et les impacts - Partie 2	Thursday, June 14	4:00 PM	Tristan Hauser	Development of Fuzzy Rules Based Systems for Hazard Forecasting
			4:15 PM	Mike Gibbons	A framework to incorporate climate change in the extreme climatic variables in the National Building Code of Canada
			4:30 PM	Émilie Bresson	Quebec mining industry adapting to climate change
			4:45 PM	David Dégardin	New concepts using Numerical Environmental Prediction to assist the Canadian Armed Forces.

Bienvenue au 52 e congrès de la Société canadienne de météorologie et d'océanographie et à l'assemblée générale annuelle. Le congrès se déroulera du 10 au 14 juin 2018 au nouveau Halifax Convention Centre à Halifax, en Nouvelle-Écosse (Canada). Le thème du congrès de cette année sera le suivant : «Risques et impacts pour la mer et pour l'environnement». Ce congrès réunira tout un éventail de scientifiques et d'autres spécialistes professionnels des différentes régions du Canada et d'autres pays, pour des discussions portant sur différents sujets relevant des sciences de l'atmosphère, de l'océan et de la Terre.

Bienvenue aux informations d'inscription pour le 52 e congrès de la Société canadienne de météorologie et d'océanographie et à l'assemblée générale annuelle. Le congrès se déroulera du 10 au 14 juin 2018 au nouveau Halifax Convention Centre à Halifax, en Nouvelle-Écosse (Canada).

Heures de bureau d'inscription

Pendant le Congrès, le bureau sera ouvert comme suit:

Dimanche	14 h - 18 h 30
Lundi	07 h - 17 h 30
Mardi	07 h - 17 h
Mercredi	07 h 30 - 17 h
Jeudi	08 h - 14 h

Frais d'inscription

Les frais pour le Congrès complet incluent **un** billet pour la réception Brise-glace «East Coast», le Lunch Patterson-Parson`s et le Festin de homard «East Coast» (le Banquet des récompenses). Veuillez commander des billets extra seulement pour vos invité(e)s.

Congrès complet

Date limite d' inscription hâtive – jusqu'au 25 mai, 2018

Membre:

CMOS	$635
CMOS étudiant	$290
Retraité / À vie	$290

Non-membre:

Régulier	$715
Étudiant	$310

<u>Après le 25 mai, 2018</u>

Membre:

CMOS	$790
CMOS étudiant	$360
Retraité / À vie	$360

Non-membre:

Régulier	$870
Étudiant	$380

Tarifs pour un jour

Membre:

CMOS	$355
CMOS/UGC étudiant	$165
Retraité / À vie	$165

Non-membre:

Régulier	$395
Étudiant	$175

Atelier

GOES-R (Plus de détails sont disponibles ici)	$50

Billets supplementaires pour vos invité(e)s

Reception brise-glace «East Coast»	10 juin (dimanche)	$
Dîner Patterson-Parson`s	12 juin (mardi)	$
Festin de homard «East Coast» (Banquet des récompenses)	13 juin (mercredi)	$

Information additionnelle

Atelier GOES-R: Un atelier aura lieu le dimanche 10 juin pour un coût additionnel de 50,00 $. Plus de détails sont disponibles ici. Vous pouvez vous inscrire pour participer à cet atelier sans vous inscrire au Congrès.

Activités sociales: De nombreuses activités sont prévues pendant le congrès. De plus amples informations sur ces activités seront bientôt disponibles.

Résumés: Les résumés sont disponibles en ligne à http://www.scmo.ca avant, durant et après le congrès. Cette année, dans l'intérêt de la protection de l'environnement, nous vous encourageons à imprimer avant le congrès tous les résumés qui vous intéressent.

Hébergement: Nous avons obtenu pour votre hébergement des tarifs compétitifs de deux hôtels. Veuillez mentionner que

vous participez au Congrès de la SCMO. Les participants au MEOPAR sont invités à réserver au Hampton Inn.

Besoins spéciaux: Si vous avez des besoins spéciaux (repas, allergies, mobilité), s'il vous plaît l'indiquer sur votre formulaire d'inscription en ligne ou imprimé. Le festin de homard «East Coast» propose un repas de fruits de mer. S'il vous plaît préciser sur le formulaire d'inscription si vous ne voulez pas de homard. Les alternatives sont le poulet ou végétarien.

Politique sur les annulations: Les avis d'annulation pour la réunion au complet ou pour une activité en particulier doivent parvenir au bureau de la SCMO au moins 14 jours ouvrables avant le début de la réunion ou de l'activité, auquel cas nous rembourserons approximativement 90% du montant en cause. Pour l'annulation entre le 26 mai et le 5 juin, nous rembourserons approximativement 50% du montant en cause. Nous regrettons de ne pouvoir vous rembourser en cas d'une annulation plus tardive ou du défaut d'assister.

Les avis doivent être adressés comme suit:

Par courriel: affaires@scmo.ca
Par la poste: SCMO, C.P. 3211, succ. D, Ottawa, ON, Canada K1P 6H7

Politique sur la protection des renseignements personnels: toute l'information que vous soumettrez sera sujette à la politique sur la protection des renseignements personnels de la SCMO. Veuillez consulter cette politique sur le site web http://www.scmo.ca

Directives de présentation d'une affiche

Il y a deux séances de présentation par affiche : 1re séance (1810010), lundi, et 2e séance (1810011), mercredi.

Le plan de l'exposition montrera l'emplacement des tableaux d'affichage.

L’affiche ne doit pas mesurer plus de 105 cm sur 105 cm. Le présentateur est responsable de la pose et du retrait de son affiche. Des attaches Velcro seront fournies. Assurez-vous d’installer votre affiche sur le tableau numéroté indiqué, afin de respecter le regroupement par thème et d’éviter la confusion. Des bénévoles vous aideront à trouver le tableau qui vous a été assigné.

L’installation des affiches de la première séance s’effectuera avant 11 h lundi et celle de la seconde séance, avant 10 h 30 mercredi. Nous mettrons au rebut toute affiche toujours fixée aux tableaux après 15,30 h jeudi.

La SCMO décernera des prix aux étudiants ayant présenté la meilleure affiche. Les étudiants souhaitant concourir pour ces prix doivent s’inscrire sur les listes AVANT 12 h le jour de leur séance de présentation par affiche. Les listes se trouveront au kiosque d’inscription. L’ajout de votre photo sur l’affiche est un atout. Les juges pourraient vouloir vous rencontrer.

Directives de présentation orale

Chaque présentation orale durera 15 minutes, soit un exposé de 12 minutes et une période de questions ou de commentaires de 3 minutes. Certains conférenciers disposent de 30 minutes en tout et les conférenciers des séances plénières disposent de 45 minutes.

Nous vous conseillons d’arriver 30 minutes avant le début de la séance, afin de garantir le transfert adéquat de votre présentation sur l’ordinateur de la séance à partir de votre clé USB, avant le début des présentations. Assurez-vous que votre présentation est enregistrée sur une clé USB de format standard pour garantir sa compatibilité avec l’ordinateur de la séance. Les ordinateurs de séances n’acceptent pas les DVD. Vous devriez aussi apporter une version PDF de votre présentation au cas où un problème de compatibilité empêcherait son bon fonctionnement.

Les écrans de la salle de conférence seront mieux adaptés aux diapositives de format 16:9 (écran large), mais les diapositives de format 4:3 (normal) devraient projeter de manière satisfaisante.

Nom des fichiers de présentation

Le nom des fichiers et des répertoires doit se composer de votre nom de famille, suivi de votre prénom et du numéro du résumé. Les types

de fichiers acceptables en soutien aux présentations orales sont : PowerPoint (.ppt, .pptx) et Adobe Reader (.pdf).

Ordinateur et équipement audiovisuel

Il vous sera impossible d'utiliser votre propre ordinateur. Toutes les salles de présentation comprendront un PC exploitant Windows et équipé de MS PowerPoint et d'Adobe Acrobat Reader. N'oubliez pas de vérifier bien à l'avance le fonctionnement de votre présentation, notamment si elle comprend des fichiers audio/vidéo ou des animations. Vous n'aurez pas accès à Internet durant votre présentation. Chaque salle est équipée d'un écran, d'un projecteur ACL, d'un minuteur, d'un pointeur laser et d'un lutrin avec microphone.

Quand	Où	Quoi	Président
juin 10, 2018	**Jour 0**		
08:30-16:30	Room 108	Atelier SCMO: Satellites météorologiques de la prochaine génération GOES-R	
10:00-12:00	Room 107	CNC-SCOR meeting	
12:00-17:00	Room 107	Réunion du comité scientifique de la SCMO	
12:00-15:00	Room 109	Réunion du comité des publications de la SCMO	
12:00-15:00	Room 105	CMOS CENTRE	
12:00-17:00	Room 101	PEARL/CANDAC meeting	
13:00-16:00	Room 102	Software Communities of Practice	
15:00-17:00	Room 109	CMOS COUNCIL	
15:00-17:00	Halifax Discovery Centre	Argumentaire étudiant et Rencontre organisée	
18:00-20:00	Room C5	Reception brise-glace «East Coast»	
juin 11, 2018	**Jour 1**		
07:00-07:45	Convention Centre	Séances santé - Yoga matinal	
08:30-09:00	Room C1	Cérémonie d'ouverture	Wayne Richardson, David Wartman, Clark Richards
09:15-10:00	Room C1	1801010 Plénière	Clark Richards
10:00-10:30		PAUSE CAFÉ	

10:30-12:00	Room 101	1803060 La qualité de l'air : modélisation et surveillance des effets cumulatifs	Xin Qiu
10:30-12:00	Room 109	1804010 Les systèmes des hautes latitudes et les changements climatiques	Will Perrie
10:30-12:00	Room 104	1803090 La composition et les processus de la couche limite atmosphérique et les échanges surface-atmosphère - Part 1	Aldona Wiacek, Alexander Moravek
10:30-12:00	Room C3	1802020 L'acoustique en océanographie et sciences de la mer - Partie 1	David Barclay
10:30-12:00	Room 105	1809080 Les méthodes numériques et le développement de modèles	Christopher Subich
10:30-12:00	Room C4	1802100 L'océanographie côtière et les eaux intérieures - Partie 1	Jinyu Sheng
10:30-12:00	Room 103	1803040 Le programme canadien Recherche sur les changements climatiques et l'atmosphère (RCCA) - Partie1	James Drummond
12:00-13:30		DÉJEUNER	
13:30-15:00	Room C3	1802021 L'acoustique en océanographie et sciences de la mer - Partie 2	David Barclay
13:30-15:00	Room 109	1804020 Les progrès de la mesure in situ des précipitations solides	Craig Smith
13:30-15:00	Room 105	1809020 Les prévisions intégrées au service des interventions éclairées	Gordon McBean
13:30-15:00	Room C4	1802101 L'océanographie côtière et les eaux intérieures - Partie 2	Jinyu Sheng
13:30-15:00	Room 104	1803091 La composition et les processus de la couche limite atmosphérique et les échanges surface-atmosphère - Part 2	Aldona Wiacek, Alexander Moravek
13:30-15:00	Room 103	1803041 Le programme canadien Recherche sur les changements climatiques et l'atmosphère (RCCA) - Partie 2	James Drummond
13:30-15:00	Room 102	1807030 Les modèles du système terrestre : évaluation de l'état présent et de l'avenir de la Terre aux échelles régionale à planétaire - Partie 1	Paul Kushner
13:30-15:00	Room 101	1809090 La dynamique de l'atmosphère, des océans et du climat	Adam Monahan
15:00-15:30		PAUSE CAFÉ	
15:30-17:00		1810010 AFFICHES - PARTIE 1	Clark Richards
17:00-21:00	Room 108	SCMO AGA	
20:30-23:59		Jeu-questionnaire au Pub	
juin 12, 2018	**Jour 2**		
08:00-12:00	Room 106	MEOPAR HPC	
08:00-12:00	Room 108	MEOPAR NETWORKING	

08:30-10:00	Room C1	1801011 Plénière	Clark Richards
10:00-10:30		PAUSE CAFÉ	
10:30-12:00	Room C4	1803080 Séance générale : L'atmosphère	Serge Desjardins, Lucy Chisholm
10:30-12:00	Room 105	1804030 Séance générale : La cryosphère	Clark Richards
10:30-12:00	Room 109	1809120 Changement climatique et communautés autochtones	Eriel Deranger
10:30-12:00	Room 103	1807010 La variabilité et la prévisibilité du climat - Partie 1	Bin Yu
10:30-12:00	Room 104	1809060 La télédétection par satellite : des informations vitales sur la santé de la planète - Partie 1	Kaley Walker
10:30-12:00	Room C3	1802090 L'océanographie physique - Partie 1	David Straub
10:30-12:00	Room 101	1803020 GOES-16 activités et applications - Partie 1	Louis Garand, Hong Lin, David Bradley
12:00-13:30	Room C1	DÉJEUNER PATTERSON - PARSONS	
13:30-15:00	Room 102	1803070 La convection et la physique des nuages	Ian Folkins
13:30-15:00	Room C4	1809010 L'application des mégadonnées (big data) et de l'intelligence artificielle à la météorologie, à l'océanographie et à l'environnement - Partie 1	Bertrand Denis
13:30-15:00	Room C3	1802091 L'océanographie physique - Partie 2	David Straub
13:30-15:00	Room 101	1803021 GOES-16 activités et applications - Partie 2	Hong Lin, Louis Garand, David Bradley
13:30-15:00	Room 103	1807011 La variabilité et la prévisibilité du climat - Partie 2	Gilbert Brunet
13:30-15:00	Room 105	1802070 Le développement, le fonctionnement et la mise en œuvre de capteurs et de plateformes d'instruments océanographiques - Partie 1	Mark Halverson
13:30-15:00	Room 104	1809061 La télédétection par satellite : des informations vitales sur la santé de la planète - Partie 2	Kaley Walker
13:30-17:00	Room 106	MEOPAR PYTHON	
13:30-17:00	Room 108	MEOPAR WELLNESS	
15:00-15:30		PAUSE CAFÉ	
15:30-17:00	Room 105	1802071 Le développement, le fonctionnement et la mise en œuvre de capteurs et de plateformes d'instruments océanographiques - Partie 2	Mark Halverson
15:30-17:00	Room 104	1809062 La télédétection par satellite : des informations vitales sur la santé de la planète - Partie 3	Kaley Walker
15:30-16:15	Room 103	1807020 Les processus et les impacts des changements climatiques dans l'Arctique : du passé à l'avenir	Paul Myers
15:30-17:00	Room C4	1809011 L'application des mégadonnées (big data) et de l'intelligence artificielle à la météorologie, à l'océanographie et à l'environnement -	Bertrand Denis

		Partie 2	
15:30-17:00	Room 101	1807060 Séance générale : Le climat	Clark Richards
15:30-16:15	Room 102	1809110 Séance générale : Les travaux interdisciplinaires	Clark Richards
15:30-21:00		Soirée des étudiants : rencontre avec des employeurs et excursion en bateau sur le grand voilier Silva	
15:30-17:00	Room C3	1802120 L'océanographie opérationnelle	Fraser Davidson
16:15-16:30	Room 102	1805010 Séance générale : L'hydrologie	Clark Richards
16:15-17:00	Room 103	1809050 L'évolution de l'Arctique : études scientifiques et politiques	David Fissel
16:15-17:00	Room 101	1807040 La science pour les services climatologiques canadiens	Patti Edwards
16:30-17:00	Room 102	1809100 L'utilité pour la société de la transformation des communications liées à l'atmosphère, aux océans et au climat grâce aux politiques, à la recherche et à la pratique	Jennifer Spinney
17:00-21:00	Room 105	UNIV PROF EDUCATION COMM	
17:00-21:00	Room 108	ARCTIC SIG	David Fissel
19:00-21:30	Halifax's new Public Library	Conférence publique: présentera Right Stuff for the Right Whales	
juin 13, 2018	**Jour 3**		
07:00-07:45		Séances santé - Promenade ou course à pied sur le quai	
07:00-08:30	Room 105	1809130 Réunion ouverte des GIS « ARRCU » et « pour l'espace »	Paul Kushner
08:00-17:00	Room 108	MEOPAR COMMUNITY OF PRACTICE	
08:30-10:00	Room C1	1801012 Plénière	Clark Richards
10:00-17:00	Room C1/C2A	MEOPAR COMMS	
10:00-10:30		PAUSE CAFÉ	
10:30-12:00	Room C3	1808030 Les risques et les impacts : la perspective du secteur de l'assurance	Laura Twidle
10:30-12:00	Room C4	1802102 L'océanographie côtière et les eaux intérieures - Partie 3	Jinyu Sheng
10:30-12:00	Room 105	1802030 Les programmes d'observation des océans et la gestion coordonnée de l'information océanographique	Richard Dewey
10:30-12:00	Room 101	1806010 Séance générale : Les phénomènes météorologiques - Partie 1	Serge Desjardins, Lucy Chisholm
10:30-12:00	Room 102	1809070 La recherche et les activités opérationnelles en soutien à l'Année de la prévision polaire - Partie 1	Paul Pestieau
10:30-12:00	Room 104	1807031 Les modèles du système terrestre : évaluation de l'état présent et de l'avenir de la Terre aux échelles régionale à planétaire - Partie 2	Neil Swart

10:30-12:00	Room 103	1807050 Les analyses et les projections du climat régional - Partie 1	J.P. René Laprise
12:00-13:30		DÉJEUNER	
13:30-15:00	Room 104	1807032 Les modèles du système terrestre : évaluation de l'état présent et de l'avenir de la Terre aux échelles régionale à planétaire - Partie 3	Karen Smith
13:30-15:00	Room C3	1802040 Suivre son cours : la gestion de la vie marine dans un océan dynamique	Kimberley Davies
13:30-15:00	Room 101	1806011 Séance générale : Les phénomènes météorologiques - Partie 2	Serge Desjardins, Lucy Chisholm
13:30-15:00	Room C4	1802060 La collaboration liée au développement, à l'évaluation et à l'analyse des modèles biogéochimiques et de circulation océanique - Partie 1	Youyu Lu
13:30-15:00	Room 103	1807051 Les analyses et les projections du climat régional - Partie 2	J.P. René Laprise
13:30-15:00	Room 102	1809071 La recherche et les activités opérationnelles en soutien à l'Année de la prévision polaire - Partie 2	Paul Pestieau
13:30-15:00	Room 105	1803050 Le brouillard ou la faible visibilité - Partie 1	Rachel Chang
15:00-15:30		PAUSE CAFÉ	
15:30-17:00		1810011 AFFICHES - PARTIE 2	Clark Richards
18:00-22:00	Room C1	Festin de homard «East Coast» (Banquet des récompenses)	
juin 14, 2018	**Jour 4**		
08:30-10:00	Room C1	1801013 Plénière	Clark Richards
10:00-10:30		PAUSE CAFÉ	
10:30-12:00	Room C4	1808040 La communication du risque à l'échelle locale : la collaboration concrète des communautés face aux dangers environnementaux (rencontre générale)	Joel Finnis
10:30-12:00	Room 104	1802010 Le projet de système intégré d'observation des océans au Canada : état d'avancement et étapes à venir (rencontre générale)	Mike Smit
10:30-12:00	Room 101	1809030 La recherche reliée à l'atmosphère dans les universités canadiennes : éducation, formation, communication et sensibilisation (rencontre générale)	Paul Myers
10:30-12:00	Room 104	1802050 Le plan directeur pour l'observation de l'océan Atlantique (réunion conjointe avec MEOPAR)	Brad de Young
10:30-12:00	Room 103	1808010 La météo, la navigation et les activités de subsistance dans les régions arctiques	Laura Eerkes-Medrano
12:00-13:30		DÉJEUNER	
13:30-15:00	Room C4	1802061 La collaboration liée au développement, à l'évaluation et à l'analyse des modèles biogéochimiques et de circulation océanique - Partie 2	Youyu Lu

13:30-15:00	Room 105	1803051 Le brouillard ou la faible visibilité - Partie 2	Rachel Chang
13:30-15:00	Room 102	1809040 La prévision environnementale couplée	C. Harold Ritchie
13:30-15:00	Room C3	1802110 Histoire de l'océanographie canadienne	Cristina Tollefsen
13:30-14:15	Room 104	1808020 Une approche intégrée face aux impacts des changements climatiques sur les pêches marines - Partie 1	Travis Tai
14:15-15:00	Room 104	1808050 Séance générale : Les risques et les impacts - Partie 1	Clark Richards
15:00-15:30		PAUSE CAFÉ	
15:30-16:00	Room 104	1808021 Une approche intégrée face aux impacts des changements climatiques sur les pêches marines - Partie 2	Travis Tai
15:30-17:00	Room C3	1802080 L'acidification des océans en eaux canadiennes	Debby Ianson
15:30-17:00	Room 104	1808051 Séance générale : Les risques et les impacts - Partie 2	Clark Richards
15:30-17:00	Room C4	1802062 La collaboration liée au développement, à l'évaluation et à l'analyse des modèles biogéochimiques et de circulation océanique - Partie 3	Youyu Lu

les plénières

le lundi 11 juin

8 h 30 à 9 h Cérémonie d'ouverture

9 h 15 à 10 h Timothy Merlis: Les changements robustes dans la circulation atmosphérique entraînés par le rayonnement : résultats issus de la « hiérarchie diabatique » des modèles de climat.

résumé: La modification de la circulation atmosphérique dans les scénarios de réchauffement planétaire représente un facteur critique de la manifestation régionale des changements climatiques. Dans cet exposé, je discute du rôle important du couplage rayonnement-circulation pour déterminer la réaction de la circulation atmosphérique à grande échelle selon l'augmentation du dioxyde de carbone. Dans les régions tropicales et extratropicales, la distribution climatologique des nuages et ses effets sur le rayonnement fournissent des mécanismes robustes sous-tendant la modification de la circulation. Ces mécanismes ont été isolés à l'aide d'une approche hiérarchique de la

simulation du climat, dans laquelle l'effet radiatif des nuages est activé ou désactivé selon différentes configurations de modèles atmosphériques qui comprennent une « hiérarchie diabatique ».

biographie: Timothy Merlis est professeur au département des sciences atmosphériques et océaniques de l'Université McGill depuis 2013. Il est titulaire d'une chaire de recherche du Canada (niveau 2) en dynamique de l'atmosphère et du climat. Après avoir obtenu un doctorat du California Institute of Technology et une bourse de recherche postdoctorale de l'Université de Princeton et du Geophysical Fluid Dynamics Laboratory, il a reçu le prix James Holton de l'American Geophysical Union en 2014 pour ses travaux de recherche scientifique et ses réalisations exceptionnels en tant que scientifique en début de carrière dans le domaine de l'atmosphère. Ses travaux visent à exposer les mécanismes physiques qui sous-tendent les changements climatiques.

le mardi juin 12

8 h 30 à 9 h 15 James Drummond: La recherche atmosphérique au Laboratoire de recherche atmosphérique dans l'environnement polaire (PEARL)

résumé: Le Laboratoire de recherche atmosphérique dans l'environnement polaire (PEARL) à Eureka (Nunavut) se trouve à 80 degrés de latitude nord, ce qui correspond à peu près à la latitude centrale de l'île d'Ellesmere. Il se situe donc à 1100 km du pôle. Eureka abrite une station météorologique d'Environnement et Changement climatique Canada (ECCC) depuis 1947. En 2005, des chercheurs universitaires et gouvernementaux formant un groupe informel appelé Réseau canadien pour la détection des changements atmosphériques (CANDAC) ont considérablement augmenté l'équipement et le champ de recherche de l'installation existante et l'ont renommée PEARL. Le PEARL est un observatoire atmosphérique qui fonctionne toute l'année et abrite plus de 25 instruments de recherche exploitables à distance et sur place. Le grand nombre de mesures simultanées relevées au PEARL offrent la rare possibilité de détecter entre les phénomènes atmosphériques des liens qui passeraient inaperçus dans le cadre d'un programme ciblé et de petite envergure. Le soutien qu'offrent les diverses équipes, ainsi que les ressources et le soutien technique qu'on retrouve sur place contribuent au succès global de cette entreprise, et fournissent également un

environnement d'apprentissage très efficace pour les étudiants et les jeunes chercheurs travaillant dans un environnement autrement difficile à mesurer. Actuellement, le PEARL participe principalement au réseau Probing the Atmosphere of the High Arctic (PAHA) du Programme de recherche sur les changements climatiques et l'atmosphère (RCCA) du Conseil de recherches en sciences naturelles et en génie du Canada (CRSNG). En outre, l'annonce ministérielle de novembre 2017 confirme 18 mois de financement continu jusqu'à l'automne 2019. Cet exposé présentera des travaux menés au PEARL, tout en soulignant quelques embûches et succès concrets, et en faisant des liens avec l'histoire et avec d'autres problèmes liés à l'exploitation d'un observatoire de recherche, 365 jours par année, 24 heures sur 24, près du bout du monde. Le PEARL reçoit actuellement le soutien du CRSNG, d'ECCC et de l'Agence spatiale canadienne.

biographie: James R. Drummond, M. A., Ph. D., FRSC, est diplômé de l'Université d'Oxford en Angleterre. Il a été professeur au département de physique de l'Université de Toronto pendant 27 ans, puis titulaire d'une chaire de recherche du Canada en télédétection de l'atmosphère au département de physique et de sciences atmosphériques de l'Université Dalhousie jusqu'à sa retraite, prise récemment. Il est actuellement chercheur principal dans le cadre de la mesure de la pollution dans la troposphère (MOPITT) à partir d'un instrument embarqué sur le satellite Terra; co-chercheur en matière d'instruments embarqués sur le satellite canadien SciSat; chercheur principal au Laboratoire de recherche atmosphérique dans l'environnement polaire (PEARL) à Eureka (Nunavut); président-fondateur du Réseau canadien d'opérateurs de recherche nordique (RCORN); président du Forum of Arctic Research Operators (FARO); et représentant canadien au sein de diverses organisations internationales.

9 h 15 à 10 h Eriel Tchekwie Deranger: Inidigenous Climate Action

résumé: Que ce soit localement ou dans le cadre de la CCNUCC, les peuples autochtones s'efforcent de faire en sorte que la reconnaissance de leurs droits inhérents soit incluse, défendue et respectée dans l'élaboration de politiques et de solutions pour faire face aux changements climatiques. Les peuples autochtones représentent 5 % de la population mondiale, mais les terres et territoires autochtones reconnus représentent 80 % de la biodiversité mondiale, une biodiversité essentielle à la stabilisation du climat. Les communautés autochtones sont souvent considérées comme les

premières à être touchées par la crise du climat, parallèlement, bon nombre d'entre elles possèdent des connaissances et une compréhension inestimables du monde naturel, qui sont maintenant considérées comme essentielles pour trouver des solutions à notre planète en évolution. Cette séance explorera de quelle façon le savoir, l'expertise et les droits des Autochtones peuvent servir de catalyseurs pour changer la manière dont nous définissons les solutions, les stratégies d'atténuation et d'adaptation aux changements climatiques, et les paramètres de la science occidentale.

biographie: Indigenous Climate Action souhaite la bienvenue à Eriel Tchekwie Deranger, première directrice générale de l'organisation, depuis août 2017. Mme Deranger est membre fondatrice d'Indigenous Climate Action (ICA). Pendant deux ans, elle a occupé le poste de directrice par intérim et a contribué à définir l'orientation stratégique de l'organisation. Membre de la Première Nation des Chipewyans d'Athabasca, Mme Deranger est largement connue pour sa contestation de l'exploitation des combustibles fossiles et son soutien de la mise en œuvre de la Déclaration des Nations Unies sur les droits des peuples autochtones. Eriel possède une expérience considérable en matière de justice environnementale et de droits des autochtones au sein d'organisations comme l'Indigenous Environmental Network (IEN), le Rainforest Action Network (RAN), la Federation of Saskatchewan Indian Nations (FSIN) ainsi qu'au sein de sa propre Nation. Elle est également mariée et mère de deux enfants.

le mercredi juin 13

8 h 30 à 9 h 15 Roberta Hamme: Observer la respiration de l'océan

résumé: Les concentrations d'oxygène et de carbone dans l'océan touchent des enjeux fondamentaux et d'importance pour la société, par exemple, la quantité de carbone anthropique que l'océan absorbe, quel organisme se développe dans quel endroit, et bien plus. Le cycle annuel d'absorption et de rejet de ces gaz par l'océan est, en un sens, la respiration de l'océan. Cette « respiration », les gaz absorbés par l'océan, ne peut atteindre les profondeurs de la mer que dans les quelques régions où les conditions hivernales entraînent l'augmentation de la densité des eaux de surface. Toutefois, ces conditions hivernales rendent difficile l'observation directe de ce processus « respiratoire ». Je présenterai les observations issues des

nouvelles technologies déployées pour combler cette lacune en matière d'observation et renforcées par des mesures prises à partir de navires. Je me concentrerai sur l'une des rares régions de formation d'eau profonde au monde, la mer du Labrador, qui fait l'objet d'intenses recherches au Canada. Les mesures d'oxygène que relèvent les capteurs embarqués sur les flotteurs BGC-Argo (Argo-biogéochimique) montrent qu'en hiver l'eau ne reste pas assez longtemps en contact avec l'atmosphère pour absorber l'oxygène à son plein potentiel et que la mer du Labrador est une région d'absorption nette d'oxygène, principalement en hiver. Il a été proposé que le Canada participe à un important programme international visant à déployer des flotteurs BGC-Argo dans les océans du monde entier. Les mesures de dioxyde de carbone prises par un profileur (SeaCycler) et à partir de mouillages démontrent que la mer du Labrador est aussi une région d'absorption nette de carbone, principalement en été. Des initiatives visant à déployer SeaCycler sont en cours afin de recueillir des observations sur plusieurs années. La combinaison de ces nouvelles technologies avec les mesures de gaz rares, d'oxygène et de carbone que relève annuellement Pêches et Océans Canada dans la mer du Labrador, à partir de navires, donne un aperçu de la respiration de l'océan.

biographie: Roberta Hamme est une océanographe-chimiste qui étudie le cycle du carbone marin. Elle s'efforce de comprendre et de quantifier les mécanismes naturels qui transportent le carbone de la surface de l'océan vers les profondeurs et qui réduisent ainsi les niveaux de dioxyde de carbone dans l'atmosphère. Ses principaux outils sont des mesures de haute précision de gaz dissous, tant de gaz bioactifs comme l'oxygène que de gaz inertes comme le néon, l'argon et le krypton. Ses travaux actuels comprennent l'élaboration de méthodes permettant de quantifier le degré d'équilibre entre les gaz et l'atmosphère avant que l'eau de surface ne se déplace vers l'intérieur de l'océan, la mesure de la productivité de l'océan à partir de données d'oxygène et la détermination du degré de dénitrification de l'océan (transformation du nitrate biodisponible en azote gazeux non disponible). Elle est titulaire d'une chaire de recherche du Canada en dynamique du carbone océanique à l'École des sciences de la Terre et des océans de l'Université de Victoria.

9 h 15 à 10 h Amy Mathews Amos: Abattre les barrières : la communication de la science en ces temps de fausses vérités

résumé: Le simple fait de partager vos connaissances scientifiques ne

signifie pas que votre auditoire comprendra ou s'intéressera à votre travail. S'appuyant sur les plus récentes recherches sur la communication scientifique, cette séance explorera les erreurs courantes que les scientifiques commettent dans la communication de leurs travaux et fournira des outils pratiques et des conseils sur la façon de rendre les résultats scientifiques accessibles à divers publics. Les sujets abordés incluent : comprendre votre auditoire, l'importance de l'écoute et la façon d'utiliser la « boîte à messages » de COMPASS pour distiller et encadrer des sujets scientifiques complexes. Possibilité de discussion et de questions.

biographie: Amy Mathews Amos est une instructrice en communication scientifique chez COMPASS. Amy aide les scientifiques à naviguer dans les mondes mystérieux du journalisme et des politiques gouvernementales, en leur donnant les outils et la confiance nécessaires pour partager efficacement leur expertise avec le grand public. Pour ce faire, elle s'appuie sur des dizaines d'années d'expérience professionnelle à l'interface des sciences de l'environnement et des politiques gouvernementales. Cette expérience se fonde premièrement sur son diplôme de premier cycle du département de ressources naturelles de l'Université Cornell, puis sur des diplômes d'études supérieures en sciences de l'environnement et en affaires publiques de l'Université de l'Indiana. Son expertise s'est enrichie pendant plus de 25 ans, tandis qu'elle travaillait à Washington D.C. pour le Government Accountability Office du Congrès des États-Unis, des organismes de conservation, une société scientifique et des fondations caritatives. En 2013, Amy a obtenu une maîtrise en rédaction scientifique et médicale de l'Université Johns Hopkins et a entamé une nouvelle étape professionnelle en tant que rédactrice indépendante. Ses articles sur l'environnement et la santé ont paru dans The Washington Post, Scientific American, Pacific Standard, High Country News et d'autres publications. Amy perfectionne également ses talents de conteuse chaque année en tant que membre du comité de sélection de films pour l'American Conservation Film Festival. Lorsqu'elle ne tape pas frénétiquement sur son clavier d'ordinateur, Amy passe le plus de temps possible à l'extérieur, en randonnée, en kayak et à observer la faune.

le jeudi juin 14

8 h 30 à 9 h 15 Kimberley Davies: Un avenir incertain: la lutte

des baleines noires contre l'environnement, biologie et urbanisation des océans

résumé: Les baleines noires de l'Atlantique Nord (Eubalaena glacialis) sont des animaux emblématiques du Canada qui sont devenus mondialement reconnus en tant qu'enfant-vedette pour les impacts des activités humaines sur les milieux côtiers. Au cours de cette séance plénière, je discuterai des adaptations biologiques que les baleines noires utilisent pour faire face à une ressource éparse et éphémère de proies zooplanctoniques. Ces adaptations rendent les baleines noires extrêmement vulnérables à certaines activités humaines telles que la pêche et l'expédition, encore plus que d'autres grandes baleines. Je vais expliquer comment les changements récents dans l'environnement océanique au Canada mettre en péril l'avenir de ces animaux en influant à la fois la biologie de leur population et les risques associés aux activités humaines. En allant de l'avant, des efforts de collaboration sans précédent sont en cours pour tenter d'améliorer les l'avenir incertain de cette espèce.

biographie: Kimberley est une chercheuse postdoctorale en océanographie à l'université Dalhousie. Elle a obtenu un baccalauréat en biologie de l'université de Victoria et un doctorat en océanographie à Dalhousie. Elle a reçu plusieurs récompenses pour son travail, notamment la bourse postdoctorale Liber Ero en recherche sur la conservation en 2015, suivie par le prix du chercheur océanographique en début de carrière CNC-SCOR en 2017. Elle a entrepris des recherches sur les baleines noires en 2007 dans le but d'améliorer notre compréhension des processus environnementaux et biologiques qui influencent leur utilisation de l'habitat dans les eaux canadiennes. Ses recherches et publications couvrent divers domaines, notamment les facteurs environnementaux structurant les regroupements de proies des baleines noires et la connectivité des habitats, les relations de contenu énergétique universel, les processus contrôlant la migration des baleines et les nouveaux outils d'échantillonnage. En 2014, elle a lancé l'expérience Baleines, Habitat et Écoute, un programme de recherche collaboratif de 8 ans cofinancé par le gouvernement, les ONG et l'industrie qui vise à améliorer les connaissances sur les relations baleines-habitat et la gestion adaptative de la conservation des baleines noires à l'aide de surveillance acoustique dans le temps. Ce projet a contribué à la découverte d'un nouvel habitat de la baleine noire dans le golfe du Saint-Laurent. Son travail a produit de nouvelles idées océanographiques, marines-écologiques et marines-mammifères et a

conduit à une politique de conservation efficace et pratique. Elle s'est engagée à faire participer le public et les décideurs à la prise de décisions fondée sur la science et à la conservation des océans.

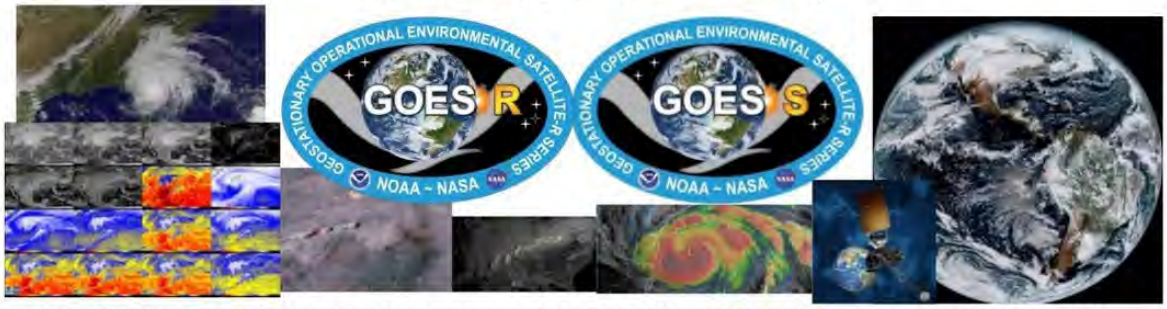
9 h 15 à 10 h Kevin Quigley: L'analyse des risques à l'interface science-politique : de limitée et simplette à peu commode et ambiguë

résumé: L'étude du risque est dominée par les scientifiques, les ingénieurs, les économistes et les analystes de décisions. Leurs points de vue se fondent souvent sur le paradigme d'un acteur rationnel. Dans cet exposé, nous résumons l'approche de l'acteur rationnel face au risque et nous examinons les contributions importantes et nuancées de la psychologie, de la sociologie et de l'anthropologie au débat sur le risque. Chaque domaine propose ses propres hypothèses, outils et perspectives, ce qui permet une compréhension enrichie du risque. Pour les analystes des politiques qui travaillent à l'interface science-politique de la recherche sur le littoral, l'utilisation d'une seule approche simplifie excessivement et limite les résultats. En revanche, la prise en compte de toutes les perspectives s'avère peu commode et les conclusions restent ambiguës. Nous concluons l'exposé en présentant des cadres holistiques de gestion des risques qui tiennent compte, bien que maladroitement, des justifications concurrentes relativement aux risques et conduisent à une réaction améliorée face aux risques touchant la côte.

biographie: Kevin Quigley est directeur scientifique du MacEachen Institute for Public Policy and Governance et professeur à l'École d'administration publique de l'Université Dalhousie. Il se spécialise dans la gestion des risques et des crises, la gestion stratégique et la protection des infrastructures essentielles dans le secteur public. M. Quigley a fondé la Critical Infrastructure Protection Initiative, une équipe de recherche interdisciplinaire qui cherche à améliorer la collaboration relativement à la gestion des infrastructures essentielles du Canada. M. Quigley a publié un livre réputé sur les infrastructures essentielles et de nombreux articles dans des revues spécialisées. Son plus récent livre, Too Critical to Fail: How Canada Manages Threats to Critical Infrastructure, a paru en novembre 2017 et a été présélectionné pour le prix Donner.

Atelier SCMO : Satellites météorologiques de la prochaine génération GOES-R

Dimanche, le 10 juin 2018 (8h30 – 16h30)



Les satellites météorologiques de la prochaines génération GOES-R (https://www.goes-r.gov) sont arrivés! GOES-16 est désormais opérationnel dans l'est des Amériques et GOES-17 vient d'être lancé et couvrira bientôt l'ouest. Des instructeurs du programme NOAA GOES-R, accompagnés de météorologistes d'ECCC, communiqueront les nouvelles capacités des instruments "Advanced Baseline Imager" (ABI) et "Geostationary Lightning Mapper" (GLM) instruments ainsi que celles des produits dérivés qui sont utilisés pour détecter des menaces potentielles et bonifier les prévisions et avertissements afin de sauver des vies et protéger les propriétés.

- **L'atelier sera composé d'un mélange équilibré de présentations, études de cas et exercices pratiques démontrant les multiples applications des satellites GOES-R.**
- **Les participants devraient apporter leurs propres ordinateurs portatifs ou tablettes pour les exercices pratiques.**
- **Les frais d'inscription sont de $50 par personne. Il n'est pas nécessaire d'être inscrit au congrès de la SCMO afin de participer à cet atelier, il est ouvert à tous!**
- **Les places sont limitées; elles seront accordées sur la base du principe "premier arrivé, premier servi". Lorsque l'inscription sera ouverte, ça se remplira rapidement!**

Programme des activités sociales

Nous avons prévu des activités sociales parallèles au congrès afin d'encourager les rencontres entre collègues et de vous offrir un aperçu de l'atmosphère conviviale de la côte Est.

Argumentaire étudiant et Rencontre organisée : dimanche 10 juin (15 h à 17 h)

Le 3e concours annuel « Argumentaire étudiant » de SCMO et la rencontre organisée avec les étudiants aura lieu au *Discovery Centre* de Halifax. Merci de confirmer votre présence (que vous ayez l'intention de présenter ou de simplement participer!) et ce, au plus tard le vendredi 8 juin en remplissant le formulaire à l'adresse suivante : https://goo.gl/forms/XqVGKWNlbkYcF09B3.

Soirée d'accueil sur la côte Est : dimanche 10 juin (18 h à 20 h)

Bienvenue sur la côte Est! La soir ée d'accueil aura lieu au Centre des congrès et sera animée par l'un des duos celtes très talentueux de Halifax, The Fine Tuners. Les hors-d'œuvre servis mettront en vedette les huîtres de la Nouvelle-Écosse. Vous ne savez pas comment ouvrir une huître? Notre expert local vous l'apprendra. Le bar payant sera ouvert, mais n'oubliez pas d'apporter le billet de boisson inclus da ns votre trousse d'inscription... c'est notre tournée!

Jeu-questionnaire au Pub : lundi 11 juin (20 h 30)

Participez à la soirée « pub » chez Murphy's on the Water. Huilez vos méninges! Le jeu-questionnaire commencera à 21 h. Il y aura des prix pour ceux qui se distinguent. Des grignotines seront servies et des boissons seront offertes toute la soirée au prix du 5 à 7!

Conférence publique : Chris Taggart (Ph. D.) présentera *Right Stuff for the Right Whales*, mardi 12 juin (19 h)

L'année a été franchement difficile pour les baleines franches de l'Atlantique Nord. Venez découvrir ce que Chris Taggart, expert en baleines franches, a à raconter à ce sujet, et ce que les scientifiques et le gouvernement ont entrepris pour aider ces animaux en voie de disparition. La conférence publique se tiendra à la nouvelle bibliothèque publique d'Halifax, sur Spring Garden Rd. Cet édifice est une œuvre en soi. Il est récipiendaire de la médaille du Gouverneur général en architecture, gagnant du Prix du maire en architecture et élu l'une des 10 plus belles bibliothèques au monde.

Soirée des étudiants : Visite de l'Institut Océanographique de Bedford, discussion de groupe sur le réseautage des employeurs et visite du port de Halifax sur le *Tall Ship Silva* - le mardi 12 juin (15 h 30 à 21 h)

Des autobus amèneront les étudiants inscrits du *Halifax Convention Centre* (départ à 15h30) à l'Institut Océanographique de Bedford (IOB). Les participants assisteront à une visite d'une heure de l'IOB, ainsi qu'à une table ronde avec des employeurs potentiels du gouvernement et de l'industrie. Dîner pizza (y compris la salade et les boissons) sera servi.
Ensuite, tous à bord du *Tall Ship Silva* pour une visite du port de Halifax de 19 h 30 à 21 h. Le bar payant sera ouvert pour la durée de la visite. Si vous n'êtes pas en mesure d'assister à la partie IOB de la soirée, vous êtes toujours les bienvenus de participer à la visite en bateau. Pour ce faire, veuillez-vous rendre au quai (près du Musée

maritime de l'Atlantique, 1655, rue Lower Water) pour embarquer à 19h15.
Cet événement est offert aux étudiants et aux stagiaires « MEOPAR» seulement. L'événement est gratuit mais l'espace est limité, veuillez-vous inscrire au bureau d'inscription.

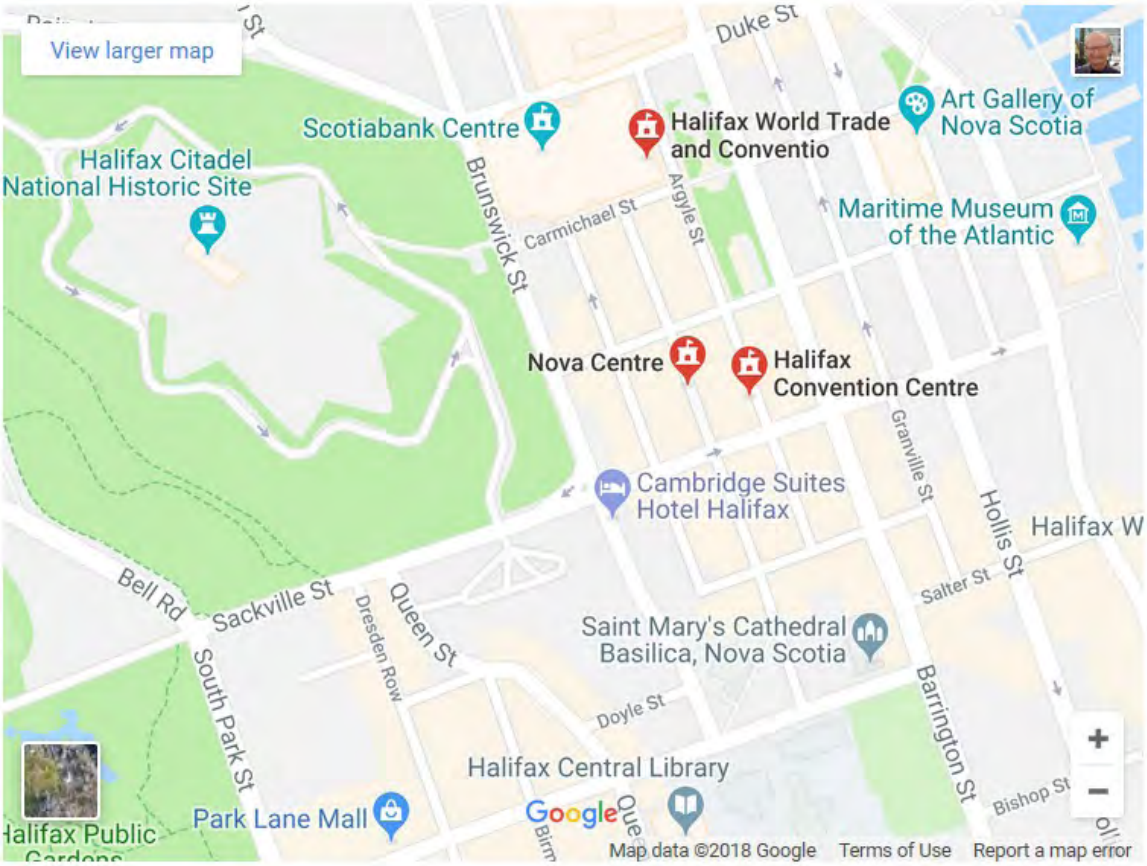
Banquet - festival du homard de la côte Est : mercredi 13 juin (18 h)

Venez déguster un festin classique de homard de la côte Est. D'autres repas sont offerts à ceux qui n'aiment pas les crustacés. Animation musicale par le trio Fine Tuners. Bar payant ouvert dans la zone des exposants de 18h à 19h et dans la zone de banquet de 19h à 21h. Chaque table de banquet aura une bouteille de vin rouge et une bouteille de vin blanc.

Le lieu du congrès

Le congrès se déroulera du 10 au 14 juin 2018 au nouveau Halifax Convention Centre à Halifax, en Nouvelle-Écosse (Canada).

Cliquez ici pour un plan du centre du congrès.



Hébergement

Nous avons obtenu pour votre hébergement des tarifs compétitifs de deux hôtels et deux résidences de Dalhousie University. Veuillez mentionner que vous participez au Congrès de la SCMO, afin que votre chambre soit associée au bon forfait. Les participants sont responsables de leur propre réservation d'hôtel. Nous vous recommandons d'effectuer cette réservation le plus tôt possible.

Hampton Inn by Hilton Halifax - Downtown - chambre standard : 174 $/nuit plus taxes

Adresse : 1960, Brunswick St, Halifax (Nouvelle Ecosse) B3J 2G7

Tél. : 1 855 331 0334 (S'il vous plaît demander le bloc de chambres CMOS2018 - code CMO)

Réservation en ligne : http://group.hamptoninn.com/CMOS2018

Date limite du bloc de chambres: mercredi 9 mai 2018

À 600 m du Congrès

Cambridge Suites Hotel Halifax

Adresse : 1583, Brunswick St, Halifax (Nouvelle Ecosse) B3J 3P5

Tél. : 1 800 565 1263

À 200 m du Congrès

Dalhousie University, Risley Hall - chambre simple : complet, mais d'autres options à partir de 30 $ /nuit plus taxes pour les étudiants

Adresse : 1233 LeMarchant St., Halifax (Nouvelle Ecosse)

Réservation en ligne : http://stay.dal.ca (code promotionnel STUDENT)

À 2km du Congrès

Dalhousie University, LeMarchant Place - 2 chambres simple, salle de bain privée partagée : 83.50 $/nuit plus taxes pour les étudiants

Adresse : 1246 LeMarchant St., Halifax (Nouvelle Ecosse)

Réservation en ligne : http://stay.dal.ca (code promotionnel STUDENT)

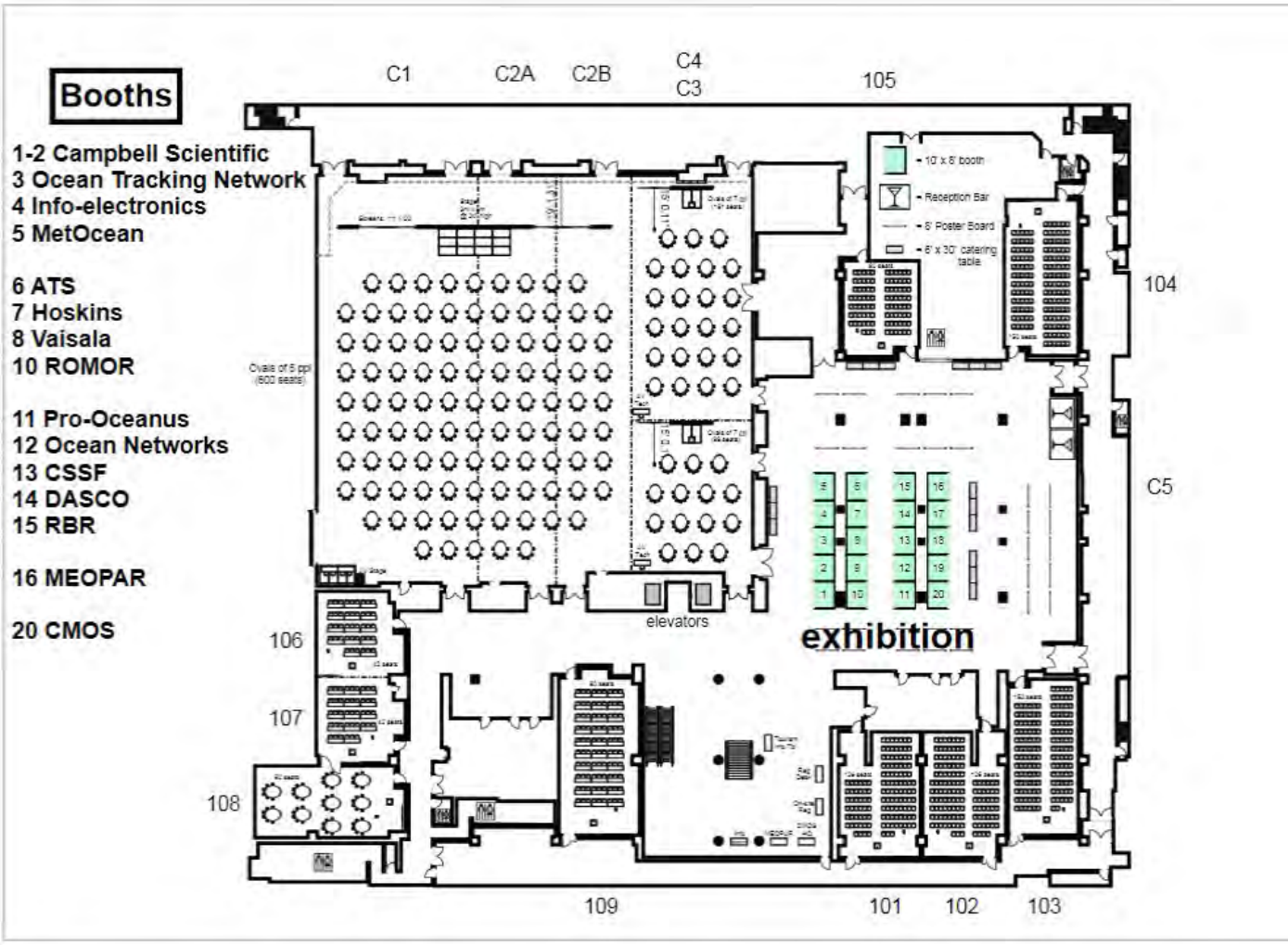
À 2km du Congrès

Exposants

kiosque 1: Campbell Scientific
kiosque 3: Ocean Tracking Network
kiosque 4: Info-Electronics Systems Ltd
kiosque 5: MetOcean
kiosque 6: ATS Services
kiosque 7: Hoskins Scientific

kiosque 8: Vaisala
kiosque 10: ROMOR Ocean Solutions
kiosque 11: Pro-Oceanus
kiosque 12: Ocean Networks Canada
kiosque 13: ROPOS (Canadian Scientific Submersible Facility)
kiosque 14: DASCO Equipment
kiosque 15: RBR-Global
kiosque 16: MEOPAR
kiosque 20: CMOS

Cliquez-ici pour un plan des exposants.



Session Entcho - Demirov
entcho@mun.ca
Ray Roche
Memorial University of Newfoundland

Over the past several decades, some of the largest rivers which discharge into Hudson Bay (Nelson, Churchill, Moose, La Grande Rivière) have been affected by dams, diversions, and reservoirs constructed for generation of electricity. The talk presents results from a model study of this development on the oceanography of Hudson Bay. An eddy-permitting model of the North Atlantic forced with NCEP atmospheric forcing over the period from 1948 to 2005 is used in this study. The model results suggest that there two significant effects of the hydropower development which affected the freshwater input into Hudson Bay. Firstly there was a change in the seasonal cycle of the freshwater flux into the basin. Secondly, the diversions caused a change in the spatial distribution of the rivers discharge. The simulated effects of these changes on salinity and vertical stratification in Hudson Bay are discussed.

Session 1801010 - Plenary
Radiatively driven robust atmospheric circulations changes: results from the diabatic hierarchy of climate models
Merlis, Timothy
McGill University
timothy.merlis@mcgill.ca
Changes in the atmospheric circulation under global warming scenarios play a critical role in determining the regional expression of climate change. In this talk, I discuss the important role that radiation-circulation coupling plays in determining the large-scale atmospheric circulation response to increased carbon dioxide. In both the tropics and extratropics, the climatological distribution of clouds and its effect on radiation provides robust mechanisms for circulation changes. These mechanisms have been isolated using a hierarchical approach to climate simulation, where cloud radiative effects are (de-)activated using different atmospheric model configurations that comprise a diabatic hierarchy.

Les changements robustes dans la circulation atmosphérique entraînés par le rayonnement : résultats issus de la « hiérarchie diabatique » des modèles de climat.

La modification de la circulation atmosphérique dans les scénarios de réchauffement planétaire représente un facteur critique de la manifestation régionale des changements climatiques. Dans cet exposé, je discute du rôle important du couplage rayonnement-circulation pour déterminer la réaction de la circulation atmosphérique à grande échelle selon l’augmentation du dioxyde de carbone. Dans les régions tropicales et extratropicales, la distribution climatologique des nuages et ses effets sur le rayonnement fournissent des mécanismes robustes sous-tendant la modification de la circulation. Ces mécanismes ont été isolés à l’aide d’une approche hiérarchique de la simulation du climat, dans laquelle l’effet radiatif des nuages est activé ou désactivé selon différentes configurations de modèles atmosphériques qui comprennent une « hiérarchie diabatique ».

Session 1801011 - Plenary
Indigenous Climate Action
Deranger, Eriel

Indigenous Climate Action
etchekwied@gmail.com
From the grassroots to the UNFCCC, Indigenous peoples are working to ensure the recognition of their inherent rights are included, upheld and respected in the development of policies and solutions to address the climate crisis. Indigenous peoples represent 5% of the global population, yet their recognized Indigenous lands and territories represent 80% of the world's biodiversity, biodiversity that is critical for climate stabilization. While Indigenous communities are often viewed as the first to be impacted by the climate crisis, many of these communities house invaluable knowledge and understanding of the natural world that is now being viewed as critical for building solutions to our changing planet. This session will explore how Indigenous knowledge, expertise and rights can serve as a catalysts to changing how we define solutions, mitigation and adaptation strategies to climate change and the parametres of western science.

Que ce soit localement ou dans le cadre de la CCNUCC, les peuples autochtones s'efforcent de faire en sorte que la reconnaissance de leurs droits inhérents soit incluse, défendue et respectée dans l'élaboration de politiques et de solutions pour faire face aux changements climatiques. Les peuples autochtones représentent 5 % de la population mondiale, mais les terres et territoires autochtones reconnus représentent 80 % de la biodiversité mondiale, une biodiversité essentielle à la stabilisation du climat. Les communautés autochtones sont souvent considérées comme les premières à être touchées par la crise du climat, parallèlement, bon nombre d'entre elles possèdent des connaissances et une compréhension inestimables du monde naturel, qui sont maintenant considérées comme essentielles pour trouver des solutions à notre planète en évolution. Cette séance explorera de quelle façon le savoir, l'expertise et les droits des Autochtones peuvent servir de catalyseurs pour changer la manière dont nous définissons les solutions, les stratégies d'atténuation et d'adaptation aux changements climatiques, et les paramètres de la science occidentale.

Session 1801011 - Plenary
Atmospheric Research at the Polar Environment Atmospheric Research Laboratory (PEARL)
Drummond, James Team, PEARL
Dalhousie University
james.drummond@dal.ca
The Polar Environment Atmospheric Research Laboratory (PEARL) at Eureka, Nunavut is located about halfway up Ellesmere Island, right on the 80N North latitude line and 1,100km from the pole. Eureka has been home to an Environment and Climate Change Canada (ECCC) weather station since 1947. In 2005, a group of university and government researchers operating as an informal group called the Canadian Network for the Detection of Atmospheric Change (CANDAC) substantially expanded both the equipment and the research domain of an existing facility at the site, renaming it PEARL. PEARL operates as an all-year atmospheric observatory and hosts upwards of 25 research instruments with considerable capacity for remote operations as well as on-site activities.

The large number of contemporaneous measurements at PEARL offers some unique opportunities to spot linkages between atmospheric phenomena which might be missed by a smaller, more focussed effort. The cross-support provided by the various teams and the on-site resources and technical support enhances

the success of the overall enterprise, and also provides a very effective learning environment for students and other young researchers for what might otherwise be a very challenging location for measurements.

PEARL is currently mainly involved with the “Probing the Atmosphere of the High Arctic” (PAHA) network of the Canadian Climate and Atmospheric Research (CCAR) program of the Natural Sciences and Engineering Research Council (NSERC) and there has recently been a ministerial announcement in November 2017 of 18 months of continued funding into the Fall of 2019.

This talk will present some of the research conducted at PEARL, highlighting some of the unique challenges and successes with some segues into the history and other challenges of running a 365/24 research observatory near the top of the world.

PEARL is currently supported by NSERC, ECCC and the Canadian Space Agency.

Session 1801012 - Plenary
Breaking Through the Barriers: Communicating Science in the Post-Truth Era
Amos, Amy Mathews
COMPASS
amy.mathews@compassonline.org
Simply sharing your scientific knowledge with others doesn’t necessarily mean they will understand or care about your work. Grounded in the latest research on science communication, this session will explore common mistakes scientists make in communicating their work, and provide practical tools and guidance on how to make scientific findings meaningful to diverse audiences. Topics covered include understanding your audience, the importance of listening, and how to use the COMPASS Message Box for distilling and framing complex scientific topics.

Discussion and opportunity for Q&A.

Abattre les barrières : la communication de la science en ces temps de fausses vérités

Le simple fait de partager vos connaissances scientifiques ne signifie pas que votre auditoire comprendra ou s’intéressera à votre travail. S’appuyant sur les plus récentes recherches sur la communication scientifique, cette séance explorera les erreurs courantes que les scientifiques commettent dans la communication de leurs travaux et fournira des outils pratiques et des conseils sur la façon de rendre les résultats scientifiques accessibles à divers publics. Les sujets abordés incluent : comprendre votre auditoire, l’importance de l’écoute et la façon d’utiliser la « boîte à messages » de COMPASS pour distiller et encadrer des sujets scientifiques complexes.

Possibilité de discussion et de questions.

Session 1801012 - Plenary
Observing the Ocean Take a Breath
Hamme, Roberta
University of Victoria
rhamme@uvic.ca

Ocean oxygen and carbon concentrations control fundamental and societally important questions from how much anthropogenic carbon the ocean takes up to which organisms thrive in which locations. The ocean's annual cycle of uptake and release of these gases is, in a sense, like the ocean breathing. However, that "breath", the gases absorbed by the ocean, can only reach the deep sea in a few regions where wintertime conditions allow surface waters to become very dense. Those same wintertime conditions make directly observing this "breathing" process a real challenge. I will present observations from new technologies being deployed to overcome this observational gap powerfully supplemented by shipboard measurements. I will focus on the Labrador Sea, one of the world's few deep-water formation regions, and the object of intense Canadian research. Measurements of oxygen from sensors carried on profiling BGC-Argo (Biogeochemical-Argo) floats demonstrate that water in the winter does not spend enough time in contact with the atmosphere to absorb oxygen to its full potential and that the Labrador Sea is a region of net oxygen uptake, primarily in the winter. Participation in a major international program to deploy these BGC-Argo floats throughout the world's oceans is being proposed in Canada. Measurements of carbon dioxide from profiling (SeaCycler) and traditional moorings demonstrate that the Labrador Sea is also a region of net carbon uptake primarily in the summer. Efforts are underway to deploy SeaCycler to collect multi-year observations. Combining these novel technologies with shipboard noble gas, oxygen, and carbon measurements made from the annual Fisheries and Oceans Canada survey across the Labrador Sea is providing insight into how the ocean takes a breath.

Observer la respiration de l'océan

Les concentrations d'oxygène et de carbone dans l'océan touchent des enjeux fondamentaux et d'importance pour la société, par exemple, la quantité de carbone anthropique que l'océan absorbe, quel organisme se développe dans quel endroit, et bien plus. Le cycle annuel d'absorption et de rejet de ces gaz par l'océan est, en un sens, la respiration de l'océan. Cette « respiration », les gaz absorbés par l'océan, ne peut atteindre les profondeurs de la mer que dans les quelques régions où les conditions hivernales entraînent l'augmentation de la densité des eaux de surface. Toutefois, ces conditions hivernales rendent difficile l'observation directe de ce processus « respiratoire ». Je présenterai les observations issues des nouvelles technologies déployées pour combler cette lacune en matière d'observation et renforcées par des mesures prises à partir de navires. Je me concentrerai sur l'une des rares régions de formation d'eau profonde au monde, la mer du Labrador, qui fait l'objet d'intenses recherches au Canada. Les mesures d'oxygène que relèvent les capteurs embarqués sur les flotteurs BGC-Argo (Argo-biogéochimique) montrent qu'en hiver l'eau ne reste pas assez longtemps en contact avec l'atmosphère pour absorber l'oxygène à son plein potentiel et que la mer du Labrador est une région d'absorption nette d'oxygène, principalement en hiver. Il a été proposé que le Canada participe à un important programme international visant à déployer des flotteurs BGC-Argo dans les océans du monde entier. Les mesures de dioxyde de carbone prises par un profileur (SeaCycler) et à partir de mouillages démontrent que la mer du Labrador est aussi une région d'absorption nette de carbone, principalement en été. Des initiatives visant à déployer SeaCycler sont en cours afin de recueillir des observations sur plusieurs années. La combinaison de ces nouvelles technologies avec les mesures de gaz rares, d'oxygène et de carbone que relève annuellement Pêches et Océans Canada dans la mer du Labrador, à partir de navires, donne un aperçu de la respiration de l'océan.

Session 1801013 - Plenary
An Uncertain Future: The Right Whales' Fight Against Environment, Biology and Ocean Urbanization
Davies, Kimberley
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kim.davies@dal.ca
North Atlantic right whales (Eubalaena glacialis) are iconic Canadian animals that have become globally recognized as a poster child for the impacts of human activities on coastal environments. In this plenary I discuss biological adaptations right whales use to cope with a patchy and ephemeral zooplankton prey resource. These adaptations make right whales extremely susceptible to harm from certain human activities such as fishing and shipping, apparently more so that other large whales. I will explain how recent changes in the ocean environment within Canada have put the future of these animals in peril through impacting both their population biology and risk from human activities. Looking to the future, unprecedented collaborative efforts are underway that hope to improve the outlook for this species.

Un avenir incertain: la lutte des baleines noires contre lenvironnement, biologie et urbanisation des océans

Les baleines noires de lAtlantique Nord (Eubalaena glacialis) sont des animaux emblématiques du Canada qui sont devenus mondialement reconnus en tant quenfant-vedette pour les impacts des activités humaines sur les milieux côtiers. Au cours de cette séance plénière, je discuterai des adaptations biologiques que les baleines noires utilisent pour faire face à une ressource éparse et éphémère de proies zooplanctoniques. Ces adaptations rendent les baleines noires extrêmement vulnérables à certaines activités humaines telles que la pêche et lexpédition, encore plus que dautres grandes baleines. Je vais expliquer comment les changements récents dans lenvironnement océanique au Canada mettre en péril lavenir de ces animaux en influant à la fois la biologie de leur population et les risques associés aux activités humaines. En allant de l'avant, des efforts de collaboration sans précédent sont en cours pour tenter d'améliorer les l'avenir incertain de cette espèce.

Session 1801013 - Plenary
Risk Analysis at the Science-Policy Interface: From narrow and naïve to clunky and ambiguous
Quigley, Kevin
Dalhousie University
Kevin.Quigley@dal.ca
The study of risk is dominated by scientists, engineers, economists, and decision analysts. Their views are often underpinned by a rational actor paradigm (RAP). In this talk, we summarize the RAP view of risk and consider the important and contrasting contributions of psychology, sociology, and anthropology to the risk debate. Each field brings its own assumptions, tools, and perspectives, contributing to a much richer understanding of risk. For policy analysts working at the science-policy interface of coastal research, using one approach is narrow and naive; using all approaches is clunky and the conclusions are always ambiguous. We conclude by introducing holistic risk frameworks that accommodate – however awkwardly - competing risk rationales, and lead to a more robust response to coastal risks.

L’analyse des risques à l’interface science-politique : de limitée et simplette à peu commode et ambiguë.

L’étude du risque est dominée par les scientifiques, les ingénieurs, les économistes et les analystes de décisions. Leurs points de vue se fondent souvent sur le paradigme d’un acteur rationnel. Dans cet exposé, nous résumons l’approche de l’acteur rationnel face au risque et nous examinons les contributions importantes et nuancées de la psychologie, de la sociologie et de l’anthropologie au débat sur le risque. Chaque domaine propose ses propres hypothèses, outils et perspectives, ce qui permet une compréhension enrichie du risque. Pour les analystes des politiques qui travaillent à l’interface science-politique de la recherche sur le littoral, l’utilisation d’une seule approche simplifie excessivement et limite les résultats. En revanche, la prise en compte de toutes les perspectives s’avère peu commode et les conclusions restent ambiguës. Nous concluons l’exposé en présentant des cadres holistiques de gestion des risques qui tiennent compte, bien que maladroitement, des justifications concurrentes relativement aux risques et conduisent à une réaction améliorée face aux risques touchant la côte.

Session 1802020 - Acoustics in oceanography and marine sciences - Part 1
The measurement of muddy seabed properties using passive acoustics
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The autonomous passive acoustic lander Deep Sound was deployed five times during the Seabed Characterization Experiment, a multi-institutional field effort held at the New England mud patch. Ambient noise data on four hydrophones, arranged in an inverted ‘T’ shape, with three spaced in the horizontal and two in the vertical were collected. The lander was deployed with the bottom-most phones approximately 30 cm above the seafloor, recording over an acoustic bandwidth of 5 Hz - 30 kHz. Pressure time series, vertical and horizontal noise coherence (directionality), and the local temperature and conductivity were recorded continuously for periods of 9 hours. Wind-driven surface ambient noise coherence was used to estimate bulk acoustic seabed properties. An analytical Pekeris waveguide noise model was fitted to the data in order to determine the bulk sound speed, density, and frequency dependent attenuation in the bottom fluid half-space. (Research supported by ONR)

Session 1802020 - Acoustics in oceanography and marine sciences - Part 1
Analysis of spatial and temporal measurements of reverberation, noise, target echo, and feature scattering in a coastal environment
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The Target and Reverberation Experiment (TREX13) was organized by the US Office of Naval Research (ONR) and conducted in the Gulf of Mexico, off Panama City, Florida. Reverberation, noise, and target echo measurements were carried out for more than a month during April and May 2013, using a fixed source and fixed horizontal array receiver deployed in about 20 m of water. To support modelling efforts, a considerable number of ancillary environmental and transmission loss measurements were made. Various pulses in the 1.8–3.6 kHz frequency band were transmitted day and night, and have produced a rich data set. The horizontal array with triplet elements allows scattering from various azimuths to be determined. It is a good way to survey an area, and abnormally

high scattering from the troughs of sand dunes on the bottom has been observed. The fixed source and receiver means any variability of the received signals is due to temporal changes in the ocean environment, and not to changes in the source or receiver location. Among other things, the motion of fish schools and other objects can be tracked. Initial results from various research groups were published in a Special Issue (April 2017) of the IEEE Journal of Oceanic Engineering. The focus of the author has been on reverberation model-data comparisons, and to a lesser extent the echoes from various scattering objects and a towed echo-repeater. The main features are persistent over time, but there are fluctuations and overall trends that are not yet understood.

[Work supported by ONR, Ocean Acoustics, Code 22.]

Session 1802020 - Acoustics in oceanography and marine sciences - Part 1
Probability of passive acoustic detection of right whales from autonomous platforms equipped with a real-time monitoring system
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Mitigation of anthropogenic impacts on North Atlantic right whales and other at-risk species is critical, but challenging given the cryptic nature of whale behaviour and the limitations of conventional visual surveys. Using passive acoustic monitoring (PAM) to alert ocean users to whale presence in near real-time can provide an effective mitigation option. The Woods Hole Oceanographic Institution (WHOI) has developed the digital acoustic monitoring (DMON) instrument and low-frequency detection and classification system (LFDCS) to detect and classify baleen whales in near real-time from autonomous platforms (e.g., buoys and gliders). A limitation of many PAM systems, including the DMON/LFDCS, is the uncertainty in acoustic detection range from the monitoring platform. The main goal of this study was to determine the range-dependent accuracy of the DMON/LFDCS on mobile and fixed platforms. Over a 4 week period (28 Feb to 30 Mar) in the spring of 2017, we deployed a DMON/LFDCS-equipped Slocum glider and a hydrophone array alongside an extant DMON/LFDCS buoy at a shallow (30m) site approximately 15 km Southwest of Martha’s Vineyard, USA. We applied a normal mode back-propagation technique to the array data to localize right whale upcalls, then conducted a call-by-call comparison between calls detected on the array and those detected by the glider or buoy to determine the probability of detection for each platform. We also assessed the possibility of applying these results to other areas of importance for right whale monitoring. The results help us to better understand and improve the performance of our monitoring system, which in turn allows us to disseminate more accurate information about whale distribution to research, government, and industry stakeholders.

Session 1802020 - Acoustics in oceanography and marine sciences - Part 1
Detecting Fish with a Doppler Current Profiler in Southern Newfoundland
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From November 2016 until September 2017, Acoustic Doppler Current Profilers were deployed in two neighbouring bays in Southern Newfoundland, East Bay and Cinq Island Bay. We set out to determine the influences that aquaculture farms had on fish abundance in surrounding ecosystems during fallow periods. It

was hypothesized that in a location where an aquaculture farm was newly inactive there would be a different abundance of fish than at a site with an active aquaculture farm. In our study, East Bay had an aquaculture farm that was no longer running while the one in Cinq Island Bay remained operational. The Doppler current profilers were configured to collect data without the typical averaging of acoustic pings into ensemble averages. This processing allowed for the instruments to act as fish detecting sonars in addition to providing measurements of current profiles. We calculated backscatter strength, counts and target strengths of detected fish. Preliminary analysis revealed the occurrence of frequent fish schools at certain times of the year and diurnal migration patterns. On some occasions, high backscatter intensities persisted for several hours. Both bays had similar trends of increased fish counts throughout January, May and from mid-June to September. During all times of the year, our results showed that Cinq Island Bay had a smaller amount of fish than East Bay.

Session 1802020 - Acoustics in oceanography and marine sciences - Part 1
Patterns of winter diel vertical migration under sea ice in Hudson Bay.
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A mooring equipped with two acoustic Doppler current profilers (ADCP) and a sediment trap was deployed in September 2016 in Hudson Bay at 59° 58.156’ N 91° 57.144’ W (~190 km north-east from the port of Churchill). The backscatter intensity and vertical velocity time series from the mooring ADCPs showed a pattern typical for the zooplankton diel vertical migration (DVM) under sea ice during winter. To correct for beam geometry, we derived volume backscatter strength from echo intensity. Actograms were built for the volume backscatter strength, vertical velocity and modelled lunar light. An upward looking ADCP was capable to record the ice thickness and periods of open water above the mooring. The sediment trap captured different types of zooplankton that allow identifying the scatters involved in DVM. From the acquired data we observed the interaction of vertical migration with lunar light, water and sea ice dynamics. The presented data constitutes a first-ever observed presence of DVM in Hudson Bay during winter.

Session 1802020 - Acoustics in oceanography and marine sciences - Part 1
Real-time passive acoustic monitoring in Canadas Northwest Passage
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Recent development for the DFO real-time Arctic observatory have included the addition of a passive hydrophone for acoustic monitoring in the Northwest Passage, combined with real-time water properties, water currents, and sea ice draft. The acoustic data are recorded every two hours, processed onboard into spectrograms, which are then transmitted along a sub-sea cable to a shore station which transmits back to the Bedford Institute of Oceanography via Iridium satellite. In this talk we will present the year-round Arctic ambient noise measurements, focusing on ship noise, ice noise, and other potential sources.

Session 1802021 - Acoustics in oceanography and marine sciences - Part 2
Acoustic Transmission Loss and Reflection Coefficient within Water-Saturated Granular Materials at MHz Frequencies
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Acoustic remote-sensing technologies represent particularly attractive - potentially breakthrough - approaches to measuring bedload transport in energetic oceanic conditions because the measurement can be made without disturbing the mobile bed material, or the near-bed flow. The challenge is how to account correctly for multiple scattering in the inversion from backscatter amplitude to particle concentration within the dense bedload layer. This challenge exists because the inversion is non-linear and the predictions of attenuation of sound by existing multiple scattering theories differ by an order of magnitude for the frequencies and particles sizes of interest (MHz frequencies and sand-sized particles). In order to validate and discriminate between multiple scattering theories, transmission loss, reflection loss and sound speed measurements within water-saturated granular material were made using a pair of broadband, calibrated transducers over 1 to 2.1 MHz. Natural sand and glass beads with median grain sizes ranging from 0.22 mm to 0.50 mm were used. In order to remove air bubbles trapped within the sediment, the samples were boiled under pressure before transferring them to the measurement chamber. The results are compared to existing multiple scattering theories as well as to previous experimental results reported in the literature.

Session 1802021 - Acoustics in oceanography and marine sciences - Part 2
Turbulence in a high-flow tidal channel: A comparison of results from a standard divergent-beam Doppler profiler and a developmental wide-baseline bi-static acoustic Doppler instrument
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Turbulence is of fundamental oceanographic importance. In the coastal ocean, with the increasing use of Large Eddy Simulation models, there is a need for time-series measurements that fully resolve the scales and statistics of turbulence in mid water column, well above the parameterized near-bed buffer layer in these models. In high-flow tidal channels, an additional need for this improved knowledge has arisen because of the high uncertainties in predicting the effects of turbulence on the performance and durability of in-stream tidal turbines. Obtaining the required measurements in flow speeds that can reach 7 m/s, however, is a significant challenge. Acoustic remote sensing represents an obvious approach, but the divergent-beam geometry of standard commercially-available acoustic Doppler profilers (ADCPs) precludes measurement of the three turbulent velocity components simultaneously. In order to overcome this limitation, a wide-baseline bi-static Doppler system – the Vectron, with beam intersection point ca. 8.5 m above bottom – has been developed for the Fundy Ocean Research Centre for Energy (FORCE). We report on measurements obtained with this system in Minas Passage, Bay of Fundy, in a trial deployment carried out June/July 2016 in which mean tidal current speeds at O(10 m) above bottom exceeded 4 m/s. Time-averaged results – i.e. current speed, vertical shear, turbulence dissipation rates – from the Vectron are compared to the values from a co-located Nortek 5-beam ADCP. Time series of 3-component turbulence velocity at the Vectron beam intersection point are used to investigate the turbulence kinetic energy balance, anisotropy, and higher-order turbulence statistics.

Session 1802021 - Acoustics in oceanography and marine sciences - Part 2

Estimating Reynolds stresses and dissipation rates from a non-stationary platform in fast tidal flows

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The Bay of Fundys high tides and fast flows are key resources for energy extraction but are also highly turbulent. They provide an opportune site to develop measurement techniques that succeed over a range of spatial scales in highly energetic conditions. Dissipation rates affect the fatigue of turbine components and Reynolds stresses control the shape of the velocity profile, and subsequently, power generation potential for tidal turbines at a specific height in the water column.

This work presents vertical profiles of dissipation rates and Reynolds stresses in Minas Passage, Nova Scotia measured with an ADCP on a subsurface buoy that was deployed mid-water-column, at the height where turbines will likely reside. The structure function method for estimating dissipation rates effectively removes buoy motion from the measurements. However, existing methods for calculating Reynolds stresses fail when the instruments are mounted on non-stationary platforms or located far from measurement volume of interest. A new analytic method is presented to estimate Reynolds stresses from the residuals of the structure functions used for dissipation rate estimates.

Session 1802021 - Acoustics in oceanography and marine sciences - Part 2
Design and testing of a swath Doppler sonar system to provide 2-component velocity measurements for sediment transport studies

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Doppler sonar systems normally provide profiles of 2 or 3 component velocities at a fixed location. Measuring the spatial structure of the flow requires either physically scanning with a single instrument, which requires flow stationarity, or the use of multiple instruments which can only provide measurements at discrete locations. We are interested in understanding sediment transport over bedforms where flow evolves continuously both in time and space. For this purpose, we are developing a swath Doppler system by combining a steerable receiver array with fan beam transmitters in a bistatic configuration. Operating at frequency of 500 kHz the system can measure 2-D velocities in a fan shaped region that is 40 cm wide at a range of 70 cm. We report on acoustic, physical and electronic design considerations for the system and present modelling results used through the design process. Laboratory trials of the system were performed at the Saint Anthony Falls Laboratory (Minneapolis) main flume; this facility provides a flow of order 1 m depth at a speed of order 1 m/s in a flume of width 2.75 m. Results from these trials are used to demonstrate the capabilities of the prototype system.

Session 1802021 - Acoustics in oceanography and marine sciences - Part 2
An acoustic backscatter model used to simulate Doppler sonar measurements in turbulent flows

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Accurate techniques for measuring oceanic turbulence are essential in understanding the processes of ocean mixing and turbulent stresses. Normally,

these turbulent velocity observations are collected using in situ instruments such as probes. These instruments are however difficult to position in regions with high current speeds, such as tidal channels where mean velocities can reach 5 m/s. Underwater acoustics is an alternative approach that allows for the remote measurement of turbulence and addresses the challenges of placing probes in environments with high current speeds. It can be difficult to quantify the accuracy of acoustic measurements in these turbulent environments, so we consider this problem with a 3D numerical model of acoustic backscatter. Modifications to the model were required for the present application including upgrading the signal processing to accurately simulate the latest generation of Doppler sonar instrumentation, the proper representation of time dilation, and the integration of an accurate model of 3D turbulence. These modifications or upgrades to the model have been implemented and tested. With results suggesting that the computational speed, accuracy, and performance of the model has increased. The improved model of acoustic backscatter has been used to simulate Nortek Signature 1000-kHz Acoustic Doppler Current Profiler measurements in dynamic regions of the interior ocean.

Session 1802030 - Ocean Observing Programs and Coordinated Ocean Information Management
Glider measurements on the Scotian Shelf as part of a monitoring program
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The Canadian Department of Fisheries and Oceans (DFO) started a monitoring program in 1998, the Atlantic Zone Monitoring Program (AZMP), to sample physical, biological, and chemical conditions in Atlantic Canada. The aim of the program was to increase DFO's capacity to understand, describe and forecast the state of the marine ecosystem and to quantify the changes in ocean physical, chemical and biological properties. One component of this program is biannual ship-based transects completed by our region at several locations across the Scotian Shelf. In 2011, the Ocean Tracking Network (OTN) started operating a Slocum glider along one of our sections, the Halifax Line, on an ad hoc basis. DFO plans to operate newly acquired SeaExplorer gliders along this section continuously as part of the AZMP. This will provide bi-weekly transects across the shelf and slope throughout the whole year giving information of temperature, salinity, oxygen, chlorophyll and CDOM fluorescence as well as optical backscattering at 700 nm. The data processing and quality control will use the SOCIB glider toolbox. Near real-time data will be distributed for ocean forecasters world-wide through the Global Telecommunications System (GTS) and both the near real-time and delayed mode data collected by the glider will be integrated in the government initiative of implementing a Canadian Integrated Ocean Observing System (CIOOS) to insure the availability of all the data. Additionally, the glider data will be transferred to the US IOOS and European glider centers for distribution. In this presentation, we will present some of the preliminary monitoring data along the Halifax Line, in the context of the previous glider monitoring, and discuss some of our early experiences in working with SeaExplorer gliders and preparing for operational glider data management.

Session 1802030 - Ocean Observing Programs and Coordinated Ocean Information Management
Managing Data from Autonomous Underwater Vehicles
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Managing ocean data has become increasingly complex as engineering innovation creates new platforms enabling scientists to capture incredible amounts of information very quickly. These innovative data streams bring a unique set of challenges for data management which need to be overcome if the data is to be discoverable and accessible to the largest audience possible. These challenges can be overcome by creating a formal data management plan prior to collecting the first byte of data. Modern data plans should use open source software tools and international standards to describe the data and properly capture metadata.

Autonomous vehicles, such as underwater profiling gliders, present their own unique challenges to proper data management. In addition to often being equipped with CTDs, fluorometers, and other less complicated instruments, they are also now being equipped with complex multidimensional instruments such as echo sounders and high-volume instruments like hydrophones. Autonomous vehicles collect data in a 3-D environment over time, requiring good metadata and a well-designed data structure to sufficiently provide context.

Open source tools and standards do an excellent job of organizing data from less complicated instruments such as CTDs but there is still work to be done for the ocean data community when using more complicated instruments. Multidimensional instruments such as echo sounders and ADCPs and large-volume data producers such as hydrophones present interesting problems for data management. These problems will need to be solved to make these new types of data available to scientists in a usable form.

Through experience we have learned which methods do not work well for managing challenging data types from modern instruments. Our current solution is to use an open format called NetCDF in conjunction with an open source data serving system called ERDDAP. These tools have allowed us to create a glider data assembly centre that is anticipated to be absorbed into the nascent Canadian Integrated Ocean Observing System (CIOOS).

Session 1802030 - Ocean Observing Programs and Coordinated Ocean Information Management
Using gliders to monitor North Atlantic right whales and their habitat in the Gulf of St. Lawrence
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The discovery of a geographically large high-use area for North Atlantic right whales in the southern Gulf of St. Lawrence in 2015 has prompted an unprecedented international collaborative effort to implement coordinated research, monitoring and management in the region. Our group contributes to this effort by operating a Slocum glider program in the region in collaboration with OTN, MEOPAR and DFO. The gliders carry a passive acoustic monitoring device and real-time audio processing software that detects and classifies the sounds of several species of baleen whales, including right whales. These data are transmitted to shore via Iridium satellite when the glider surfaces where they are validated by an analyst and distributed to partners via several data dissemination platforms. Acoustic and oceanographic data are also archived and used to model regional right whale habitat use. We discuss preliminary results of

these surveys within the contexts of both improving the state of knowledge right whale habitat in the Gulf, and contributing to adaptive conservation management. We discuss challenges to optimizing glider navigation and monitoring in this highly dynamic environment, highlighting a need for developing glider path planning models. The program is expanding and we will discuss future directions.

Session 1802030 - Ocean Observing Programs and Coordinated Ocean Information Management

Biogeochemical Argo as an essential component of a North Atlantic Ocean Observing System

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Abstract: We advocate for Biogeochemical Argo (BGC Argo) as an essential component of an efficient, integrated, and sustainable Atlantic Ocean Observing System. In addition to the core physical sensors of a typical Argo float, the profiling BGC Argo floats are equipped with sensors for pH, oxygen, nitrate, chlorophyll, suspended particles, and downwelling irradiance. BGC Argo observations will fill gaps in current measurement capabilities by extending satellite ocean color observations into the ocean interior and throughout the year in regions covered by clouds or ice, and by significantly expanding the suite of variables that can be observed. Regional programs employing BGC Argo floats, focussed on the Mediterranean Sea and the Southern Ocean, have driven the necessary developments in technology and infrastructure, and have produced exceptional scientific results. Following Argo protocols, the float measurements are available without restriction in near real time. A Science and Implementation Plan (http://biogeochemical-argo.org) for a global array has been developed by an international team and articulates the goals and path to implementation. With a target density of 1,000 BGC Argo floats distributed globally throughout the open ocean, the plan aims for about 150 floats in the North Atlantic. Key components of a sustainable system are a robust and evolving data management system that ensures real-time delivery of data for operational applications, delivery of delayed-mode, quality-controlled data of the highest standard, and a tight and synergistic integration with other observing system components that make measurements from ships, gliders, and satellites. In a workshop in 2017, Canadian scientists from academia and government laid out vision for Canadian participation in the BGC Argo initiative (http://doi.org/10.13155/52451). Profiling BGC Argo measurements will be essential for observing seasonal to decadal variability in the North Atlantic Ocean's uptake of carbon dioxide, ocean acidification, and de-oxygenation, as well as ecosystem changes. These observations are essential for an effective management of ocean resources in a shifting climate.

Session 1802030 - Ocean Observing Programs and Coordinated Ocean Information Management

Collaboration and network consolidation: enabling ocean observing data discovery and dissemination

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SLGOs portal disseminates data related to 18 oceanic variables (16 of them are identified as Core Variables in the CIOOS Observation and Data Investigative Evaluation), through raw data download and through various web applications allowing data discovery. While the data is provided by more than 23 member organizations, SLGOs network today accounts for a total of 42 members involved in and supporting the organizations mission. More than 10 end-users oriented web applications answer their needs and those of an even wider community of end-users. The complex system of the St. Lawrence, the primary outflow of the Great Lakes connecting to the Atlantic ocean, is home to a variety of uses and users in waters regulated by no less than 6 of the Canadian provinces (and the United States upstream of Cornwall). The various custom tools that SLGOs programmers develop are designed hand in hand with those end-users, to ensure tangible benefits on activities ranging from commercial navigation, fisheries, aquaculture, recreational uses, ecosystem-based management of natural resources and science-supported decision-making.

SLGO collaborates with national and provincial ministries, academia, native communities, citizen-science initiatives and various types of NGOs. Thus, the range of data types integrated on SLGO portal is unique and provides a wholesome portrait of the St. Lawrence ecosystem.

In the past weeks, SLGO has also been collaborating with OTN and MEOPAR, in order to develop an even more flexible data visualization platform with optimal use of standards, as identified in CIOOS IEs, that will ultimately be a building block on which any observing initiatives can build on.

Session 1802030 - Ocean Observing Programs and Coordinated Ocean Information Management

LabSea2020 – A new, “bottom-up”, international cooperative research initiative in the Labrador Sea

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The Labrador Sea is one of the most dynamic ocean regions on the planet where the combined action of convection and horizontal circulation redistributes nutrients and contaminants potentially affecting ocean productivity and marine ecosystem health. The complex interactions between the Labrador Sea and adjacent seas involve the interplay of physical, chemical, and biological processes with global-scale impacts. We are proposing a focused study on the Labrador Sea – LabSea2020 – bringing together researchers from a wide range of disciplines to study the Labrador Sea and its environs, coastal communities, and environment. We propose some key oceanographic questions and are encouraging other interested researchers to join this initiative and add to the questions. Key open questions include: What is the relationship between convection and the Meridional Overturning Circulation (MOC)? How is the uptake of CO2 changing with the possible slowdown of the MOC? Why is there a decline in nutrient concentrations and what are the implications? How will the Labrador Sea respond to changes in the cryosphere (e.g. Greenland and other high latitude glaciers) and changing sea-ice conditions in the Arctic Ocean?

Additional questions and topics are welcomed: the goal is to focus and link diverse research interests and resources in the region in order to maximize the potential for research synergies. The initiative is “bottom-up” and will encourage the linkage of independent proposals. LabSea2020 will address fundamental science and social science questions that contribute to the UN Decade of the Ocean for Sustainable Development (2021-2030) coordinated by the Intergovernmental Oceanographic Commission. More information is available at www.labsea2020.org and the Facebook page “LabSea2020”.

Session 1802040 - Go with the flow: managing marine life in a dynamic ocean
The use of connectivity in the design of networks of marine protected areas
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Marine protected areas (MPAs) are an area-based conservation strategy commonly used to safeguard marine biodiversity and ecosystem services. Population connectivity governs the exchange of individuals among spatially fragmented habitats and is an essential criterion in the design of MPAs. However, detailed computational methods for connectivity are inconsistently applied in management decisions. We reviewed the scientific and management literature to explore the use of connectivity in MPAs located in countries with advanced marine spatial planning. Only 9.1% of 739 MPAs considered connectivity as an ecological criterion, although it has been increasingly used since 2007, suggesting progress in spatial conservation planning towards the use of ecological conservation objectives. In most cases, connectivity was measured implicitly using either rules of thumb or size and spacing guidelines. Of the MPAs that considered connectivity, 66% were for state marine conservation areas or reserves in California and commonwealth marine reserves in Australia. This pattern indicates substantial geographic biases and significant differences in conservation planning and prioritization among countries. We suggest that the incorporation of connectivity in conservation planning needs to become more accessible to practitioners. Prioritizing connectivity as an ecologically important criterion in MPA design will more adequately address metapopulation persistence and recovery.

Session 1802040 - Go with the flow: managing marine life in a dynamic ocean
Marxan Connect: Operationalizing ecological connectivity in spatial conservation planning
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Globally, marine protected areas (MPA) are being established to protect biodiversity and to promote resilient fisheries. The typical Marxan-based spatial conservation planning process leading to the creation of these MPAs focuses on representation and replication of ecological features. Unfortunately, Marxan does not explicitly consider ecological connectivity, which is critical to metapopulation persistence and resilience, unless users manually input conservation features and targets related to connectivity. “Marxan Connect” is a new open source, open access Graphical User Interface (GUI) designed to assist conservationists in the systematic operationalization of ecological connectivity in protected area network planning. Marxan Connect is able to incorporate estimates of realized demographic connectivity (e.g. tracking data, dispersal model, genetics) or

structural landscape connectivity (e.g. isolation by resistance). This is accomplished by calculating metapopulation-relevant connectivity metrics (e.g. eigenvector centrality) and treating those as conservation features, or using the connectivity data as an ecological distance (i.e. boundary definition) to be minimized during the spatial annealing process. The least-cost conservation solutions provided by Marxan Connect are more likely to support persistent and resilient metapopulations (e.g. fish stocks) and provide better protection for biodiversity.

Session 1802040 - Go with the flow: managing marine life in a dynamic ocean
A Physical Perspective on Zooplankton Distributions in Roseway Basin
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High-traffic areas in Canadian coastal waters can be hazardous to whale populations due to vessel strikes and net entanglements. Previous work has been successful in identifying and protecting some critical zones containing locations of known whale habitats, but it has also revealed that there are many habitats left to be described, leaving endangered whales at risk of ship strike in many of their habitats. The Whale Habitat and Listening Experiment (WHaLE) strives to identify and examine key whale habitats on Canada’s coasts and work with the shipping fleet to protect them. Roseway Basin on the Scotian Shelf is a known habitat for humpback, fin, and sei whales, which feed on euphausiids. In 2014 through 2017, unique datasets were collected in Roseway Basin using underwater gliders equipped with specialized sensors to describe the hydrographic properties, zooplankton distribution, and whale presence. In this study, we use these data to explore water mass composition and variability, front presence and variability, zooplankton distributions, and whale presence within the basin in order to better understand the physical-biological coupling in a whale habitat.

Session 1802040 - Go with the flow: managing marine life in a dynamic ocean
Estimating dispersal in aquatic systems using a new technology and comparisons with conventional methods
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Early life-stage dispersal influences recruitment and is of significance in explaining the distribution and connectivity of aquatic species. Motivations for quantifying dispersal range from biodiversity conservation to the design of marine reserves and the mitigation of species invasions. We quantify particle dispersion at the scale of dispersing early-stage planktonic organisms (days to weeks, km to 100 km) using magnetically attractive particles (MAPs) and moored magnetic-collector arrays. This new technology provides a time-integrated estimate of dispersal from a given source location to a large set of potential “sink” locations. When normalized, the MAP captures represent a probability of dispersal from the source to the sink locations that can be considered an estimate of the dispersal kernel; the biological null model. Empirical estimates of dispersal achieved through the MAPs are compared to similar estimates of dispersal provided by a simple dispersion model, a 3D prognostic hydrodynamic modeling system, and concurrently deployed conventional drifters. Deviations between comparisons are used to assess the purely passive component of biological connectivity, as

well as the efficacy of conventional methods and the parameters (e.g., small-scale diffusivity) typically used when modeling dispersion and connectivity. Results are discussed in the context of issues surrounding the spread of invasive and (or) commercially valuable species, as well as potential concerns and implications when using these technologies to answer dispersal questions with the purpose of informing management decisions.

Session 1802040 - Go with the flow: managing marine life in a dynamic ocean
An Expendable Drifter Study of Dispersion in the Salish Sea
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Broadly speaking, the Salish Sea is an estuary in which fresh water from the Fraser River flows seaward to the Pacific Ocean, while saline water enters in a subsurface return flow. But how exactly do water parcels make their way from the river to the ocean? Recent commercially available advances in tracking technology make it feasible to construct and deploy expendable satellite-tracked drifters, which report positions in real time at meter-scale accuracy every 10 minutes for several weeks, at low cost (~$150 each). Over the past several years, we have deployed nearly 200 of these drifters in the Salish Sea. One initial finding is that drifters tend to wash up on shore. Only one of our drifters has actually drifted from the Salish Sea into the Pacific; most beach themselves in less than a week (however, because the shores of the Salish Sea are well populated, this means about 65% of our drifters are found, returned to us, and re-used). Drifter tracks also correspond well with the reported findings of co-deployed driftcards (which can be deployed in large numbers with little cost), but such driftcards may not be found for weeks. Finally, curvature statistics for our drifter tracks show that even in somewhat restricted coastal waters rightward curvature is more likely to occur than leftward curvature. A statistically typical track consists of long, broad, rightward-turning relatively high-speed segments interspersed with short periods during which motions are slow and tracks cover only a short distance, but track directions can change rapidly in any direction.

Session 1802040 - Go with the flow: managing marine life in a dynamic ocean
Residence times and transport pathways on the northwestern North Atlantic continental shelf: Results from a numerical tracer analysis
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The northwestern North Atlantic is a region undergoing rapid changes and characterized by complex circulation. We diagnosed retention times, transport pathways and transit times of different water masses with the use of dye and age tracers in a high-resolution regional circulation model. Analyses of transport paths and timescales have proven useful for estimating ventilation rates, describing circulation and mixing, characterizing the composition of water masses with respect to different source regions, and elucidating patterns of species dispersal and genetic connectivity. Model results show that retention times are shortest on the Scotian Shelf (about 3 months) as water is transported quickly to the south by the dominant alongshore currents with inshore (Nova Scotia Current) and offshore (Shelfbreak Current) branches. Larger retention times are simulated on the Grand Banks (~4 months), in the Gulf of St. Lawrence (~12 months) and the Gulf of Maine (~ 6 months). Source-water analysis shows that Scotian Shelf water is primarily comprised of waters from the Grand Banks and Gulf of St. Lawrence. Composition varies across different stations on the

shelf illustrating its heterogeneity. Inshore stations have larger contributions of Gulf of St. Lawrence waters, while stations near the shelfbreak have larger contributions of waters from the Grand Banks and the slope region. Deep slope waters have long transit times and small contributions to inshore stations because the shelfbreak current inhibits direct on-shelf transport. These findings suggest that Grand Banks and Gulf of St. Lawrence waters are dominant controls on setting and sustaining species populations on the Scotian Shelf as a whole, and that deep slope waters can influence populations located farther offshore.

Session 1802060 - Collaboration in development, evaluation and analysis of ocean circulation and biogeochemical models - Part 1
Latest hindcast of the 1/12th degree resolution Arctic-North Atlantic ice-ocean configuration at ECCC
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The Canadian Operational Network of Coupled Environmental Prediction Systems (CONCEPTS) has developed a 5km Regional Ice-Ocean Prediction System (RIOPS) based on NEMO-CICE. The system, run operationally with an experimental status, produces four 48h ice–ocean forecasts per day and provides hazard warnings in ice-infested regions. RIOPS includes in particular explicit tides and a landfast ice parametrization based on the effect of grounded ice ridges (Lemieux et al. 2015) and on an increased resistance to tension and shear in the ice rheology (Lemieux et al. 2016). In support of the physics used in the operationally-run model, we run regularly a 6 to 10 year hindcast of the model. This lastest hindcast forced by the Canadian Global ReForecast was run from October 2001 to December 2016 in order to test a series of innovations: 1) extended domain covering the North Pacific Ocean (hence, the three Canadian oceans are now covered), 2) higher vertical resolution in the deep ocean, 3) WOA2013 initialization, 4) an update of the NEMO code to v3.6, 5) effect of reducing the diffusion and viscosity to molecular values, 6) effect of switching off the GEWEX correction on downwelling radiations after 2010. In general, it was found that ice velocities are still a bit too slow. However, the ocean stratification in the Beaufort Sea is much improved, although the ratio of atmospheric to ocean drag does not allow for as much subduction of the upper ocean as observed in the Beaufort Gyre. The effect of switching off the GEWEX radiation correction in 2010 is dramatic and warrants further investigation of the radiation bias present in numerical weather prediction models used at ECCC.

Session 1802060 - Collaboration in development, evaluation and analysis of ocean circulation and biogeochemical models - Part 1
Preliminary results of ocean and sea-ice hindcasting during 1993-present for North Atlantic, Arctic and North Atlantic Oceans
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Coupled ocean and sea-ice models based on version 3.6 of the Nucleus for European Modelling of the Ocean (NEMO), with the sea-ice component being LIM3, are prepared to carry out hindcast simulations during 1993-present. The models cover the Pacific Ocean north of 42°N, the whole Arctic, and the North Atlantic with two horizontal resolutions: at nominally ¼-degree and 1/12-degree in latitude/longitude. In the North Atlantic, the southern extension of the model domains is located at 26°N and 7°N for the ¼-degree and 1/12-degree models,

respectively. The models are driven by surface forcing from atmospheric reanalysis products, climatological or inter-annually varying river runoff, lateral open boundary forcing from global ocean reanalyses, and tides, but do not include data assimilation. Several hindcasts using the ¼-degree model have been completed. Evaluation with available observations has identified the dependence of model solutions on the use of different atmospheric forcing products and various model parameters in particular the parameterization of sub-grid mixing. The hindcast results have been applied for several studies on circulation, sea level and sea-ice variations in the Arctic Ocean. The ¼-degree model has been applied for modelling the ocean biogeochemical processes. Preliminary results from the 1/12-degree model will also be presented.

Session 1802060 - Collaboration in development, evaluation and analysis of ocean circulation and biogeochemical models - Part 1
NEMO modelling with the Arctic Northern Hemisphere Atlantic Configuration
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Here we examine a suite of NEMO model simulations using the Arctic Northern Hemisphere Atlantic (ANHA) configuration run at 1/4 and 1/12 degree resolution. The 1/12 degree simulations include those with the AGRIF grid refinement package. Preliminary results with a 1/60 degree AGRIF nest for the Labrador Sea will also be shown. Questions examined include how NEMO represents the mixed layer depth in regions of deep convection (and how it can be improved), Labrador Sea Water formation rates, gateway transports between the Arctic and the North Atlantic and freshwater exchange processes between the boundary currents and the interior. The use of the TOP package for passive tracers and coupling to the biogeochemical model BLING will be discussed. Finally, planned future developments and studies will be highlighted.

Session 1802060 - Collaboration in development, evaluation and analysis of ocean circulation and biogeochemical models - Part 1
Applications of 129I and gas ventilation tracers in transit time distribution (TTD) circulation models in the Arctic Ocean
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The long-lived conservative tracer, 129I is discharged from nuclear fuel reprocessing plants in France and the UK and transported with Atlantic Water (AW) into the Arctic Ocean through Fram Strait and the Barents Sea where it circulates cyclonically on time scales of 10-30 y before re-entering the Nordic Seas. 129I measurements on samples collected during German, US and Canadian oceanographic missions in the Arctic Ocean in 2015 in the GEOTRACES program have provided the first detailed, synoptic 129I sections across the Eurasian, Canada and Makarov Basins. During the 1990s, discharges of 129I from European nuclear fuel reprocessing plants increased sharply resulting in a large, well resolved, tracer spike whose passage through the Arctic Ocean has been followed by time series measurements over the past 25 years. Elevated 129I levels over the Lomonosov, Mendeleyev and Alpha Ridges in 2015 are associated with boundary current transport of tracer-rich, AW bathymetrically steered by the ridge systems through the central Arctic while lower 129I levels appear in the poorly ventilated basin interiors. 129I concentrations > 500 x 10

exp7 at/l were measured in surface mixed layer water of Atlantic origin in contrast to 129I values of 1-2 x 10 exp7 at/l measured in surface mixed layer Pacific Water resulting in a steep 129I concentration gradient at the Atlantic-Pacific water mass interface. 129I levels of 200-400 x 10 exp7 at/l in Atlantic Intermediate Water have increased by a factor of 10 compared to measurements at the same locations in 1994-1996 owing to the circulation of the large 129I input spike from the 1990s. This robust tracer signal has been used in conjunction with other gas (e.g. CFC-11) and radionuclide tracers (e.g. 137Cs) to calculate transit time distributions (TTDs) and constrain water circulation and mixing time scales for a wide range of arctic water masses.

Session 1802060 - Collaboration in development, evaluation and analysis of ocean circulation and biogeochemical models - Part 1
The role of tidal circulation in the regional circulation and hydrographic distribution in the eastern Canadian shelf
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The interaction of tidal circulation with topography and stratification is one of important physical processes affecting the regional circulation in the eastern Canadian shelf. This study examines this interaction on the seasonal and interannual timescales using a coupled circulation-sea ice model. This coupled model is based on the Nucleus for European Modelling of the Ocean (NEMO) and LIM2. The model domain covers the northwest Atlantic Ocean, from the Labrador Shelf to the Cape Hatteras and from the eastern Canadian coast to the Mid-Atlantic Ridge. The model horizontal resolution is 1/12o, with 50 vertical z-levels. The model forcing at the sea surface includes 6-hourly fields of short wave and long wave radiation, surface wind, air temperature, relative humidity, and precipitation taken from the Climate Forecast System Reanalysis (CFSR). The monthly climatology of freshwater runoff from fifteen major rivers is used in the model. The tidal forcing in the model consists of (a) tidal surface elevation and depth-mean currents of five major constituents at open boundaries and (b) tide-generating potential specified at each model grid. The model results demonstrate that the tidal mixing can deepen the mixed layer depth by more than 40 m in the northwestern Gulf of St. Lawrence and the Bay of Fundy. Significant contribution to the general circulation from the tidal circulation is found in the Gulf of Maine, Scotian Shelf, and Gulf of St. Lawrence, which can exceed 50% in the top 200 m. Due to the seasonal stratification variability in the eastern Canadian shelf, the tidal residual circulation shows significant seasonal variability, which is relative strong in summer and weak in winter. The model results also indicate that the tidal residual circulation drives considerable transport at the shelf edge.

Session 1802060 - Collaboration in development, evaluation and analysis of ocean circulation and biogeochemical models - Part 1
Sea level and meso-scale eddy variability during 2007-2016 in the Northeast Pacific simulated by a high-resolution regional ocean model
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A regional model for the Northeast Pacific at nominal 1/36-degree horizontal resolution (NEP36) is produced based on version 3.6 of the Nucleus European Modelling of the Ocean (NEMO). A 10-year hindcast from 2007 to 2016 is generated using NEP36 forced by hourly Climate Forecast System Reanalysis wind, air pressure, heat and fresh water fluxes at the ocean surface. The initial

and open boundary conditions of sea surface height, horizontal velocities, temperature and salinity are provided by the daily 1/12-degree global ocean analysis (PSY4) from Mercator-Ocean, France. Tidal forcing of 8 constituents at open boundaries is provided by the WebTide tidal prediction model. The accuracy of hindcast is assessed using satellite altimeter and tide gauge observations. The hindcast is analysed to characterize the seasonal and inter-annual variations of sea levels, and mesoscales represented by the anomalies of sea levels, horizontal currents, temperature and salinity. The linkages of ocean variations in the region to local and remote atmosphere and ocean forcing are explored.

Session 1802061 - Collaboration in development, evaluation and analysis of ocean circulation and biogeochemical models - Part 2
From the North Pacific to the North Atlantic: Modelling the Arctic Ocean biogeochemical connectivity
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The Arctic Ocean is changing at a dramatic pace due to global warming, melting of multi-year ice and ocean acidification while the scientific community struggles to fully understand its biogeochemical dynamics. We know that the inflow of deep Pacific waters entering in the Arctic Ocean through the Bering Strait brings nutrient-rich waters but depleted in nitrate with respect to phosphate. One remaining knowledge gap is the contemporary role of the eastward Arctic throughflow from these Pacific waters in the modulation of the Arctic and North Atlantic primary production. Because of the Arctics harsh environment, observational data coverage is still insufficient to fully describe the strong regional and seasonal heterogeneity of this region. To overcome this issue, models allow us to interpret these sparse observations. Here we use a coupled physical-biogeochemical model based on NEMO (Nucleus for European Modelling of the Ocean) and PISCES (Pelagic Interactions Scheme for Carbon and Ecological Studies) with a horizontal resolution ranging from 10 to 20 km. Our model domain covers the whole Arctic Ocean and extends to 45˚N in the Pacific and to 25˚N in the Atlantic Ocean. This allows us to study the biogeochemical connectivity of the Arctic Ocean with the Pacific and the Atlantic Oceans. After presenting a model-data comparison, we will discuss our preliminary results on the models capacity to reproduce these Arctic connections. As a first step, we will focus our investigation on nitrogen transport, uptake and depletion from the nutrient-rich North Pacific waters to the North Atlantic Ocean.

Session 1802061 - Collaboration in development, evaluation and analysis of ocean circulation and biogeochemical models - Part 2
Quantifying the relative importance of anthropogenic nutrients in coastal marine ecosystems through element tracing: A case study for the northern Gulf of Mexico
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The coastal ocean is increasingly affected by eutrophication, i.e., the supply of excess nutrients, often from anthropogenic sources, with subsequent enhancement of productivity and potentially harmful occurrences of toxic algal blooms and hypoxia or anoxia. Hypoxia occurs when dissolved oxygen concentrations drop below 2 mg/L. In order to develop efficient strategies for managing anthropogenic nutrient sources, their importance relative to non-

anthropogenic sources from the adjacent open ocean has to be quantified. Coupled physical-biogeochemical models have proven as useful tools in this context, and can be combined with an element tracing technique to assess the impact of different nutrient sources and provide quantitative information on their influence on the process level. Here, we apply this technique to the northern Gulf of Mexico, a region affected by large-scale hypoxia (15,000 km2 on average) every summer. Our analysis of a 10-year hindcast simulation shows that the majority of summer oxygen consumption is supported by anthropogenic nitrogen inputs from the Mississippi/Atchafalaya River System. In addition, we compare the results of this hindcast simulation to two scenario simulations, one where anthropogenic nitrogen inputs are reduced by 60%, and one where 50% of the river water is diverted via the Atchafalaya, instead of the current fraction of 30%. The analysis focuses on the resulting changes in hypoxia and the source-specific contributions to productivity and oxygen consumption. Our study illustrates the value of combining physical-biogeochemical models and element tracing techniques to inform water quality management in coastal ecosystems.

Session 1802061 - Collaboration in development, evaluation and analysis of ocean circulation and biogeochemical models - Part 2
Estimating the Cross-Shelf Export of Riverine Materials
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Rivers deliver large amounts of fresh water, nutrients, and other terrestrially derived materials to the coastal ocean, but a global quantification of the fate of this delivery is lacking. Where inputs accumulate on the shelf, harmful effects such as hypoxia and eutrophication can result. In contrast, where export to the open ocean is efficient, riverine inputs contribute to global biogeochemical budgets. Assessing the fate of riverine inputs is, however, difficult on a global scale. Global ocean models are generally too coarse to resolve the relatively small-scale features of river plumes. High-resolution regional models have been developed for individual river plume systems, but it is impractical to apply this approach globally to all rivers. As a result, river inputs in global models are often parameterized using an all or nothing approach. Following the work by Sharples et al. (GBC, 2017), we used an idealized numerical model to perform a large number of numerical simulations under different forcing conditions in order to derive empirical relationships to estimate export in river plumes which are dependent only on the rivers discharge and latitude, as well as the local shelf width. We then applied these empirical functions to obtain global estimates for open-ocean export of fresh water and dissolved nutrients based on riverine inputs in the NEWS database. We show that at least half of the input material is retained on shelves globally, with efficient export only occurring within the tropics. Geographic differences in inputs further entail that dissolved silicate is the most efficiently exported nutrient, while dissolved inorganic nitrogen is least efficiently exported to the open ocean. Our results are consistent with previous estimates and provide a simple way to parameterize export to the open ocean in global models.

Session 1802061 - Collaboration in development, evaluation and analysis of ocean circulation and biogeochemical models - Part 2
An intercomparison of regional versus global biogeochemical models in Atlantic Canadian shelf waters
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The Atlantic Canadian coastal ocean includes diverse environments such as the Gulf of Saint Lawrence, the Gulf of Maine, the Scotian Shelf, the Grand Banks, and the adjacent open ocean. The region is biologically productive and characterized by a complex circulation influenced by the large-scale Gulf Stream and the Labrador Current systems. Global model projections from the Coupled Model Intercomparison Project Phase 5 (CMIP5) suggest that this region is particularly sensitive to climate change. However, the CMIP5 earth system models, with their coarse to intermediate spatial resolution, have difficulties in properly representing the complex circulation in the region. We compare simulated biogeochemical properties from the CMIP5 model ensemble with results from a regional physical-biogeochemical model of the Atlantic Canada region. The model uses an intermediate complexity ecosystem model that was optimized for the region. CMIP5 and regional model simulations will be presented and evaluated against satellite observations and regional datasets including the Atlantic Zone Monitoring Program and autonomous glider measurements.

Session 1802061 - Collaboration in development, evaluation and analysis of ocean circulation and biogeochemical models - Part 2
Salish Sea Model Ecosystem - Lower Trophic: Evaluation and episodic nutrient supply in the Northern Strait of Georgia
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Salish Sea Model Ecosystem - Lower Trophic (SMELT) is a three-dimensional biogeochemical model coupled to a NEMO-based physical model of the Salish Sea, run operationally at UBC as part of the SalishSeaCast system. We will present our evaluation of the models skill at reproducing seasonal nitrate and silicate concentrations through comparison with data from Pacific Salmon Foundation's citizen science program and Institute of Ocean Sciences repeat surveys. These comparisons shed light on the challenges associated with accurately representing silicate cycling in a 3-d domain as compared to our original 1-d framework. We will then discuss episodic nitrate supply to the surface waters of the northwest Strait of Georgia. This phenomenon is evident as a region of elevated mean (March-November) and standard deviation (April-September) of surface nitrate stretching from Discovery Passage to Baynes Sound in a monthly climatology based on simulations from fall 2014 to present. We will analyze the relative contributions of southward advection of nitrate supplied through tidally-enhanced mixing in Discovery Passage and of local upwelling. Further, we will interpret the importance of the phenomenon as a source of nutrients to the euphotic zone, fueling primary production in the northern Strait of Georgia.

Session 1802061 - Collaboration in development, evaluation and analysis of ocean circulation and biogeochemical models - Part 2
Simulating deep-water hydrocarbon plumes with a data-assimilative model of the Gulf of Mexico
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The 2010 Deepwater Horizon oil spill in the Gulf of Mexico released an unprecedented quantity of crude oil into the Gulf at an approximate water depth

of 1,500 m. The neutrally buoyant fraction of the oil formed deep-water hydrocarbon-enriched plumes at depths between 1,000 and 1,200 m. We have developed a data-assimilative physical-hydrocarbon model for the Gulf of Mexico using the Ensemble Kalman Filter (EnKF), which can be used to simulate the distribution, transport and decay of deep-water hydrocarbon plumes. The hydrocarbon model includes tracers for two hydrocarbon fractions and dissolved oxygen, and prescribes the net effect of hydrocarbon respiration in the water column by linear decay rates. The robustness of the data-assimilative system and the impact of assimilating different observation types (i.e. surface and profile data) are assessed through a series of twin experiments. The validated data-assimilative model is then used to assimilate real observations (i.e. satellite sea surface height, sea surface temperature, and temperature and salinity profiles). The simulation is validated by comparing the model-simulated and observed oxygen drawdown associated with hydrocarbon decay.

Session 1802062 - Collaboration in development, evaluation and analysis of ocean circulation and biogeochemical models - Part 3

Estimating uncertainty in ocean surface drift trajectories using fuzzy numbers

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Trajectory forecasts used in oil spill and emergency response applications are subject to considerable uncertainty due to the complexity of the governing Lagrangian dynamics with various forcing mechanisms, and a scarcity of representative observations. Here a novel scheme for predicting drift trajectories at the ocean surface and estimating the associated uncertainty is presented, which allows for consideration of forcing due to currents, wave - induced circulation, and wind, as well as the drag area ratio of the object being tracked. Uncertainty propagation is considered using fuzzy numbers, which are well suited for cases where observations are sparse and uncertainty is aggregated from multiple sources. Various methods for quantifying forcing uncertainty and implementing corresponding fuzzy numbers are discussed. Numerical examples based on conditions in the Salish Sea and comparison to Monte Carlo methods are presented, including a discussion of performance evaluation metrics.

Session 1802062 - Collaboration in development, evaluation and analysis of ocean circulation and biogeochemical models - Part 3

An evaluation framework for the comparison of two high-resolution coastal models

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As part of the Government of Canada’s Oceans Protection Plan (OPP), Fisheries and Oceans Canada has responsibility for the development of high-resolution ocean circulation models for use in drift prediction and electronic navigation applications. To assess the suitability of two modelling frameworks (NEMO and FVCOM) for these applications, one-year model hindcast runs have been produced for the port and approaches at Saint John, NB. In this talk we outline the evaluation framework that has been developed. This framework assesses how well each of the models perform for near-shore, high-resolution OPP applications, how well they compare to current operational systems, and what resources are required for each model.

Session 1802062 - Collaboration in development, evaluation and analysis of ocean circulation and biogeochemical models - Part 3
Discussions on development, evaluation and analysis of ocean circulation and biogeochemical models
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Ocean circulation and biogeochemical models are widely used for both research and operational forecasting. However, there are challenges for small research groups to handle the increasing complexity of the model codes, evaluation with various observational datasets, and analysis of the increasing amount of model output data.

This presentation aims to stimulate discussions on potential coordination and collaboration between Canadian government laboratories and universities in the development, evaluation and analysis of ocean circulation and biogeochemical models for hindcast and forecast at various time scales. Specific topics may include: 1) progress of model research and applications in various regions with different spatial resolutions; 2) new evaluation and analysis results that demonstrate the strength and weakness of the models; 3) improvements in model numerics and parameterization of sub-grid processes; 4) new analysis methods; 5) new forcing and evaluation datasets; 6) model inter-comparison; and 7) data presentation and visualization tools; etc.

Session 1802062 - Collaboration in development, evaluation and analysis of ocean circulation and biogeochemical models - Part 3
Evaluating hydrography variations in the Scotian Shelf and Gulf of Maine as simulated by a high-resolution regional ocean model.
the submitter,

EUMETSAT

This presentation will discuss the data needs of operational oceanography at high latitudes, the available satellite data products, and review the gaps and innovations in that area. The European Union Copernicus programme has started to implement a range of operational environment monitoring services and the supporting satellites. Through a set of case studies, the novel capabilities of the Copernicus Sentinel-3 satellites with regard to high latitudes will be introduced.

Session 1802062 - Collaboration in development, evaluation and analysis of ocean circulation and biogeochemical models - Part 3
A Framework for Drift Evaluation and Prediction in Ocean Models
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We present a framework for inter-comparison of drift prediction tools (e.g. Ariane, Open Drift) applied to several ocean models at varying degrees of resolution. This framework incorporates both drift prediction and evaluation into one system enabling a systematic evaluation of drift in ocean models. We explore and discuss several metrics used for evaluating drift. The results are used to identify strengths and weaknesses of several different drift prediction tools. Results are

categorized by region and ocean model resolution to identify which drift tools perform best and under what conditions. Drifters released in both the Pacific and Atlantic Oceans are used for evaluation. This framework can be used to generate regular maps of drift in Canadian waters which is useful for search and rescue planning and operations.

Session 1802062 - Collaboration in development, evaluation and analysis of ocean circulation and biogeochemical models - Part 3

Numerical Study of the storm-induced circulation in the South China Sea during typhoon Linfa using a nested-grid ocean model

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A nested-grid ocean circulation modelling system based on the Regional Ocean Modelling System (ROMS) is used to examine the ocean response of the South China Sea (SCS) to tropical cyclone Linfa in June 2009. The modelling system consists of a coarse-resolution (1/18°) outer model domain covering the northern South China Sea, and a fine-resolution (1/54°) inner model domain covering the area affected directly by Linfa. Three numerical experiments (Control, Vortex, and Smooth) are conducted with different combinations of wind fields and sea surface air pressures but with the same net heat flux at the sea surface to examine the impact of Linfa. In Run Vortex, a parametric vortex is inserted into the original coarse-resolution (0.3°) CFSR forcing to better represent the atmospheric pressure and wind stress associated with the tropical cyclone. In Run Smooth, the model is forced by the smoothed CFSR winds and air pressures that both have hurricane features eliminated, representing the ocean response to the large-scale atmospheric forcing. Analytical results of three different runs demonstrate the upper ocean response of the SCS to Linfa is characterized by large divergent surface currents forced by the local wind forcing under the storm, and intense near-inertial currents in the wake of the cyclone. The sea surface temperature (SST) cooling produced by the model is biased to the right of the storm track, which agrees well with a satellite-derived analysis. In comparison with the outer model results, the inner model captures more meso-scale structures, greater SST cooling and stronger near-inertial currents in the study region.

Session 1802070 - Development, performance, and implementation of oceanographic sensors and instrument platforms - Part 1

Do high-frequency radars measure the wave-induced Stokes drift?

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High-frequency (HF) radars remotely measure ocean near-surface currents based on the Doppler shift of electromagnetic waves back-scattered by surface gravity waves with half the electromagnetic wavelength, called Bragg waves. Since their phase velocity is affected not only by wave-current interactions with vertically-sheared mean Eulerian currents, but also by wave-wave interactions with all the other waves present at the sea surface, HF radars should measure a quantity related to the Stokes drift in addition to mean Eulerian currents. However, the literature is inconsistent, both theoretically and experimentally, on the specific expression and even on the existence of the Stokes drift contribution to the HF-radar measurements. Three different expressions that have been proposed in the literature are reviewed and discussed in light of the relevant published experimental results: (1) the weighted depth-averaged Stokes drift, (2)

the filtered surface Stokes drift, and (3) half of the surface Stokes drift. Effective measurement depths for these three expressions are derived for the Phillips wave spectrum. Recent experimental results tend to discard the second expression, but are not inconsistent with the first and third expressions. A definitive answer will require further experimental investigations.

Session 1802070 - Development, performance, and implementation of oceanographic sensors and instrument platforms - Part 1
An Autonomous Hovercraft for Bathymetric Surveying in Shallow Waters
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An autonomous hovercraft has been created to provide a method for collecting bathymetric data in very shallow waters (<1 m) and in environments with strong surface currents or large tidal ranges. The hovercraft has dimensions of 0.9 m by 1.9 m and is powered by a small gas engine attached to a fan, mounted at an angle to produce both both lift and forward thrust. Servo motors control twin rudders placed in the fan's exhaust, as well as the throttle, and a linear actuator controls an arm capable of raising and lowering an instrumented outrigger hull. The outrigger is a boat-shaped appendage mounted with high frequency (800 kHz) side-scan SONAR transducers and a single beam (675 kHz) echo sounder. The vehicle may be flown remotely via a radio-linked controller, or can be pre-programmed to travel between defined waypoints using an autopilot. A Global Positioning System (GPS) unit, set of three orthogonal gyros, three orthogonal accelerometers, and magnetometer are used to determine the instantaneous positions and orientations of the craft and SONAR instruments. The hovercraft is capable of flying over land or water, and can thus survey across the water line. Additionally, it has a very low hull drag, allowing efficient operation high-speed currents. [Work supported by Innovacorp]

Session 1802070 - Development, performance, and implementation of oceanographic sensors and instrument platforms - Part 1
Lessons learned operating autonomous ocean vehicles
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The Ocean Tracking Network (OTN) and the Marine Environmental Observation, Prediction and Response (MEOPAR) Network Centre of Excellence have jointly funded Dalhousie University's glider program since 2010. Our fleet of autonomous ocean vehicles (Teledyne Webb Slocum glider & Liquid Robotics wave glider) has traversed more than 50 000 km supporting a variety of research projects in collaboration with investigators across Canada and the USA. A portion of the data collected has gone towards extending federal monitoring programs on the Scotian Shelf; validating models of ocean temperature and salinity; aiding in environmental assessments of the effects of the Maritime Link on snow crab behaviour; relating ocean conditions to salmon migration; and understanding the movements of marine mammals on the east and west coasts of Canada. Through our experience we have had the opportunity and misfortune of observing and adapting to a range of setbacks and fascinating annoyances, such as freezing spray, heavy seas, biological interference, strong tidal currents and anomalous freshwater outflow. In this session we will reflect on successes and lessons learned while operating and maintaining Slocum and wave gliders. We will also discuss experiences with past, present and future instrument configurations and integrations as we highlight our current and future projects.

Session 1802070 - Development, performance, and implementation of oceanographic sensors and instrument platforms - Part 1
Towards Process Understanding with Advanced, Multidisciplinary Ocean Time-Series Sites.
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The presentation will make the case for the collection of continuous, high-frequency, ocean time-series of multiple parameters (physical, chemical and biological) at fixed locations as a key component of an ocean observation strategy. Ocean time-series are usually justified in terms of utility for determining trends and patterns of change, or for identification of periodic components in data. Increasingly, they are argued to be essential for detection of trends attributable to climate-change. I will argue that multidisciplinary ocean time-series may have their greatest value in generating understanding of complex processes and event-driven phenomena. This utilizes the power of time-series data to reveal “intervention”, where an event or unusual forcing leads to a change, and of cross-correlation which can reveal relationships between multiple variables in order to explore processes. Of potentially greatest value is the ability of multidisciplinary time-series, if they have an open architecture, to encourage “researcher aggregation” across disciplines as well as the integration and deployment of new sensors and measurement technologies. Notably, introduction of new measurement approaches (e.g. those involving advanced acoustics and/or “omics”, can benefit from building on a broad set of measurements.

The presentation will draw on lessons learned at a number of multidisciplinary time-series including: the Cape Verde Ocean Observatory off West Africa; the Bedford Basin Time-Series near Halifax, Canada; and an emerging observatory in the Central Labrador Sea. Some general principles to guide development of such time-series across Canada’s oceans and coastal seas, and to realise an expansion of the existing “standard” suite of measurements, will also be presented.

Session 1802071 - Development, performance, and implementation of oceanographic sensors and instrument platforms - Part 2
The Salish Sea CitSci dataset 2015-2018

Session 1802071 - Development, performance, and implementation of oceanographic sensors and instrument platforms - Part 2
A new gas tension instrument for oceanography: one measurement parameter, a myriad of applications and solutions
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The measurement of gas tension, also known as total dissolved gas pressure, in ocean waters is important for a range of applications, including measuring air-sea gas fluxes, de-coupling biological and physical processes, correcting shipboard dissolved gas measurements, detecting leaks, and measuring N2 excess in oxygen minimum zones (OMZ). Measurement of gas tension at sea relies on accurate and stable pressure measurement in a head space where gases have equilibrated across a semi-permeable membrane. Pressure sensors previously used for this measurement are fragile, expensive, slow in response, large and

power-hungry, which has limited the measurement of gas tension to a small number of scientists using few oceanographic platforms.

Herein, we describe a newly developed gas tension device that addresses many of the limitations of the previous designs, while maintaining a high level of accuracy and stability. Major modifications when compared to previous sensor designs include incorporation of a new semi-permeable membrane material, use of a MEMs-based pressure sensor, minimization of the gas head space where the pressure sensor is located, and improvement in the flow-through head design to maximize gas exchange at the membrane surface.

Results of comparison of the new sensor with the previously accepted gas tension device show that both the accuracy and stability of the new sensor is comparable to the most stable and accurate total dissolved gas sensor available. As well, the new sensor is lower in cost and much smaller in size. In addition, the response time and power consumption are dramatically reduced. The newly developed sensor is suited for use in both mobile and stationary platforms and provides a compact, accurate and cost-effective means for monitoring gas-fluxes at the seawater surface and correcting biological estimates of O2 production and consumption for changes in physical conditions.

Session 1802071 - Development, performance, and implementation of oceanographic sensors and instrument platforms - Part 2
Observing Biogeochemical Processes in the Gulf of Mexico using a set of Uniquely-Equipped Autonomous Floats
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In May 2017, 10 autonomous APEX floats were deployed in the Northern Gulf of Mexico, as a part of the Gulf of Mexico Research Initiative (GoMRI). These floats were equipped with a unique suite of physical and biogeochemical sensors, including a CTD, a bio-optical triplet measuring chlorophyll fluorescence, backscatter, and coloured dissolved organic matter (CDOM), an oxygen optode, and 2 current velocity/shear sensors. The two-way iridium satellite communication capability of the floats makes changes to mission parameters possible. During weather events, such as Hurricanes Irma or Nate, the floats' mission was altered to profile continuously rather than on 5- or 10-day intervals, offering more high-frequency measurements that may resolve shorter timescale processes. Results from this deployment will be presented. Challenges associated with the deployment and post-processing of data will be discussed, including the analysis of high-frequency measurements of biophysical interactions during storm events and a novel approach to addressing the slow oxygen sensor response. Additionally, the float results are presented in the context of a numerical model and possible qualitative improvements are discussed based on these subsurface data.

Session 1802071 - Development, performance, and implementation of oceanographic sensors and instrument platforms - Part 2
Dynamic corrections for the RBR inductive conductivity cell: Results from an autonomous profiling float
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Salinity is computed with simultaneous measurements of hydrostatic

pressure, water temperature, and electrical conductivity. Profiling through strong temperature and salinity gradients with a Conductivity-Temperature-Depth logger (CTD) introduces a handful of complications for the computation of salinity which do not afflict moored CTDs to the same degree. First, the conductivity sensor and thermistor must be aligned in time to account for the fact that they are separated physically, and therefore sample any one water parcel at a different time. Second, the conductivity, temperature, and pressure sensors are characterized by different time constants. Third, the flushing time of the sensing volume is finite. Finally, the conductivity cell exchanges heat with the water, thereby contaminating the measurement.

While the importance of making dynamic corrections was established decades ago, and implemented for many existing sensors, new CTD designs require that the dynamic corrections be tuned for a particular instrument or usage. In this talk, we assess lab and field data to derive the dynamic corrections required to accurately compute salinity with an RBR Ltd inductive conductivity sensor mounted on an MRV Systems Alamo autonomous profiling float.

Session 1802071 - Development, performance, and implementation of oceanographic sensors and instrument platforms - Part 2
Development of a submersible dissolved inorganic carbon (DIC) sensor
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Measurement of Dissolved Inorganic Carbon (DIC) can be used to inventory carbonate species in seawater and thereby assess the availability of CO_3^{2-} for precipitation by various organisms including corals, shellfish, pteropods, etc. However, to determine carbonate speciation, at least two of the four controlling variables, i.e., DIC, pCO_2, pH and alkalinity, must be measured. While considerable progress has been made in commercial development of submersible instruments for measuring particularly pCO_2 and pH, these are not yet mature technologies. Consequently, a third measurement, DIC or alkalinity, offers redundancy and thus, a check on the other two, but, perhaps more important, DIC measurements offer a particularly favorable complement to pCO_2 measurements for understanding the carbonate system. Despite this importance of measuring DIC, very few submersible DIC sensors have been developed and, to the best of our knowledge, none have yet been commercialized.

We at Pro-Oceanus Systems offer an accurate submersible pCO_2 sensor in our CO_2-Pro CV. Here, we will describe our efforts to develop a submersible DIC sensor suitable for monitoring water quality for aquaculture and will present some recent test results. Finally, we will describe some innovative ideas that we are incorporating into a more accurate submersible DIC sensor that can be used for in situ monitoring for ocean acidification.

Session 1802071 - Development, performance, and implementation of oceanographic sensors and instrument platforms - Part 2
Ocean Glider Mounted Echo Sounders for Monitoring Fish and Zooplankton Populations

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Low power, internally-recording multi-frequency echo sounders can acquire continuous profiles of echoes throughout the water column over long periods of time, thus providing a low-cost method to study the behavior and abundance of fish and zooplankton in the ocean. Ocean gliders are growing in importance as components of ocean observing systems, extending measurements of physical oceanography beyond those possible with moorings and expensive oceanographic research vessels. Payloads are typically composed of conductivity, temperature and pressure along with optical measures of chlorophyll reflectance and dissolved organics. The small size and low power consumption of echo sounders now makes it practical to install them in gliders, providing the means to simultaneously measure biological metrics through the water column over extended areas and linking physical properties and primary productivity to higher trophic levels such as zooplankton and fish. We have recently installed single-beam echosounders with up to four acoustic frequencies in gliders. In the initial case, a 200 kHz, single-beam echosounder was integrated and calibrated in a Slocum Webb electric ocean glider. Trial missions in the eastern Gulf of Mexico traveled over a submerged pipeline and a rocky reef. Acoustic backscatter signals attributed to mid-water plankton layers were co-located with oceanographic features and peaks in chlorophyll. Schools of pelagic and demersal fishes were detected and mapped over charted seafloor features. Applications to ecosystem and fisheries studies include inexpensive reconnaissance surveys that identify biological hotspots and high biomass scattering layers tied to oceanography and primary productivity. Preliminary results from a glider with a multifrequency echo sounder will also be discussed.

Session 1802080 - Ocean Acidification in Canadian Waters

A transatlantic section of shipboard δ13C-DIC measurements and results from a worldwide inter comparison study.

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A newly developed system based on Cavity Ring Down Spectroscopy (CRDS) for measurement of the stable carbon isotope composition of dissolved inorganic carbon (δ13C-DIC) was deployed on the research vessel Celtic Explorer during an occupation of the GO-SHIP A02 trans-Atlantic hydrographic section in 2017. The precision and accuracy of the system were shown to be ±0.12‰ (1σ) and ±0.12‰ (1σ) respectively and comparable to that of traditional, laboratory-based Isotope Ratio Mass Spectrometry (IRMS). Using deepwater samples collected during the cruise and a DIC Reference Material (RM), we organised a worldwide proficiency test for the measurement of δ13C-DIC in seawater samples. A total of 13 groups from USA, Canada, Europe, Australia, and Japan participated. The overall δ13C-DIC results from the groups showed excellent agreement (1σ of 0.12‰ and 0.13‰ for RM and the Atlantic deep water sample respectively). Normalization of results to the mean reported value of the RM analyses, increased the inter-laboratory precision of the deep water samples' δ13C-DIC even further (1σ of 0.05‰). We will present the δ13C-DIC data from the GO-SHIP A02 cruise in comparison with previously reported δ13C-DIC data from the same section collected over the past 20 years. The comparison reveals a clear

signal of the progressive uptake of anthropogenic CO2 in surface and interior water masses of the North Atlantic Ocean.

Session 1802080 - Ocean Acidification in Canadian Waters
Ocean Acidification Post-Paris: Gauging Law and Policy Responses in Light of Emerging Scientific Projections
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Scientific knowledge on the impacts of increased atmospheric CO2 on the ocean's biogeochemistry, marine species, and marine ecosystems has grown exponentially in the last decade. The emerging evidence and projections makes a strong case for precautionary and preventative mitigation and adaptation responses to ocean acidification (OA) at multiple levels, including substantive and urgent reductions in CO2 emissions. To date, however, the climate regime has only paid marginal attention to OA and its impacts. Several open questions remain on the adequacy of mitigation and adaptation efforts under the United Nations Framework Convention on Climate Change (UNFCCC) and the Paris Agreement to effectively address OA. Along with the "emission gap", as reflected in submitted nationally determined contributions (NDCs), a more fundamental question refers to the adequacy of the structure, targets and means of implementation of the Paris Agreement itself.

The presentation addresses the opportunities and challenges of incorporating the threat of OA into mitigation and adaptation actions under the UNFCCC and the Paris Agreement. For that purpose, it: a) provides a critical assessment of the role of OA in the climate negotiations leading to the Paris Agreement; b) assesses the opportunities of the Paris Agreement and its implementation mechanisms to address OA; c) provides a critical assessment of current mitigation efforts, as reflected in the submitted NDCs, and their potential impacts on oceans biogeochemistry; d) identifies gaps in the knowledge required to assess the international response to OA and to inform OA-relevant climate action; and e) suggests further legal and policy avenues for strengthening the international response to OA, both within and outside the climate regime.

Session 1802080 - Ocean Acidification in Canadian Waters
A study of Inorganic Carbon Cycling in Scotian Shelf Waters Using Stable Carbon Isotopes
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The stable carbon isotopes of dissolved inorganic carbon (DIC) can be used as a strong signal of biological processes in carbon cycling, however, so far, few, if any, studies have been conducted on Scotian Shelf (NW Atlantic) waters focusing on $^{13}C/^{12}C$ (^{13}C). In this study, the spatial-temporal distributions of DIC and ^{13}C in Scotian Shelf waters are investigated. The data were collected in April and October of 2014 as a part of Atlantic Zone Monitoring Program. Throughout the research period, a combination of biological processes such as photosynthesis, river input and air-sea exchanges resulted in the changes of DIC concentration and ^{13}C in the surface waters. From the vertical profiles of DIC and ^{13}C, the Deep Western Boundary Current signals are captured and discussed, as these deviate from the biologically dominated pattern of the remaining water masses observed at the Scotian Shelf. Based on this research, a proper baseline of carbon cycling in Scotian Shelf waters is presented.

Session 1802080 - Ocean Acidification in Canadian Waters
Spatial and Temporal Variation of pH and Aragonite Saturation in the Salish Sea : A Modelling Approach
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Recent observations have shown large spatial and temporal variations of pH and Aragonite Saturation (AS) in the Salish Sea and in other estuarine and coastal systems. These changes are significantly larger than the global anthropogenic change, and have far-reaching effects on regional biogeochemistry, ecosystem health, and regional stakeholders such as shellfish farmers. Here, we present the first version of a newly-developed three-dimensional carbonate chemistry model for the Salish Sea. The model is coupled to our existing biological-physical model of the Salish Sea (SalishSeaCast), and resolves dissolved inorganic carbon, total alkalinity, pH, and AS at hourly and daily resolution. In this talk, we use the model to identify distinct events within seasonal cycles of pH and AS and how they vary in different regions of the Sea. The results are then briefly discussed in the context of available observations, and future directions for the model are outlined.

Session 1802080 - Ocean Acidification in Canadian Waters
Investigating the 13C Suess effect in foraminiferal calcite: A history of ocean acidification in the NW Atlantic during the last 4000 years
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The increase of anthropogenic CO2 due to fossil fuel combustion and land use change is decreasing the carbon isotope signature of the atmosphere (δ13C_CO2). Ice cores and modern atmospheric measurements show a change in δ13C_CO2 since preindustrial times of -2.2 per mil. This negative δ13C excursion has been termed the 13C Suess Effect. Since the ocean absorbs a large portion of this CO2, it is expected that the Suess Effect is detectable in the dissolved inorganic carbon pool (δ13C_DIC) of waters that have been in recent contact with the atmosphere. Previous studies have modelled the full global ocean Suess Effect based on back calculations from modern measurements and tropical δ13C calcite records of corals and sclerosponges. However, very few historical records of δ13C_DIC exist from mid to high latitudes. This study presents five new records of δ13C measured on fossil foraminifera from sediment cores located in Atlantic Canadian shelf waters. Results show a negative δ13C excursion in the 20th century on the order of magnitude expected from aforementioned Suess effect models. We argue that the Suess effect is the most parsimonious way to explain the coherence between cores and between benthic and planktonic records. Unexpected discrepancies between the planktonic and benthic δ13C records of this event at two core sites will be discussed in the context of their local oceanographic and sedimentological setting.

Session 1802080 - Ocean Acidification in Canadian Waters
Spatial variability of surface-water pCO2 in the world’s largest estuarine system: Distinguishing between physical and biological controls in the St. Lawrence Estuary and Gulf (Canada)
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The incomplete spatial coverage of surface-water CO2 partial pressure (pCO2) measurements across estuary types represents a significant knowledge gap in current regional- and global-scale estimates of estuarine CO2 emissions. The Estuary and Gulf of St. Lawrence (EGSL), at the lower limit of the subarctic region in eastern Canada, comprise the largest estuarine system in the world, yet the first systematic study of its surface-water pCO2 distribution was only published a few months ago (Dinauer and Mucci, 2017). To fill this data gap, we (1) report a multi-year compilation of springtime and summertime surface-water pCO2 values calculated from field measurements of alkalinity and pH; (2) provide an area-averaged estimate of the air-sea CO2 gas flux; and (3) distinguish between the physical and biological controls on the spatial variability of pCO2. This work adopts an expanded version of optimum multiparameter (OMP) water mass analysis, an inverse modeling technique, to estimate the mixing fractions of predefined source water masses as well as the contribution of biological activity (respiration and photosynthesis) at a given observation point in the surface mixed layer. By applying the improved method to our hydrographic data set, biological activity is identified as the dominant control on surface-water pCO2 dynamics along the St. Lawrence land—ocean continuum, explaining the upstream to downstream shift from pCO2 supersaturation (net heterotrophy) to pCO2 undersaturation (net autotrophy).
Dinauer A. and Mucci A. (2017) Biogeosciences 14: 3221-3237.

Session 1802090 - Physical Oceanography - Part 1
Multi-scale phenomena of rotation modified mode-2 internal waves
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We present high resolution, three dimensional simulations of rotation modified mode-2 internal solitary waves at various rotation rates and Schmidt numbers. Rotation is seen to change the internal solitary-like waves observed in the absence of rotation into a leading Kelvin wave followed by Poincare waves. Mass and energy is found to be advected towards the right-most side wall (for Northern hemisphere rotation), leading to increased amplitude of the leading Kelvin wave and the formation of Kelvin-Helmholtz instabilities on the upper and lower edges of the deformed pycnocline. These fundamentally three dimensional instabilities are localized within a region near the side wall, and intensify in vigour with increasing rotation rate. Secondary Kelvin waves form further behind the wave from either resonance with radiating Poincare waves or the remnants of the K-H instability. The first of these mechanisms is in accord with published work on mode-1 Kelvin waves, the second is, to the best of our knowledge, novel to the present study. Both types of secondary Kelvin waves form on the same side of the channel as the leading Kelvin wave. Comparisons of equivalent cases with different Schmidt numbers indicate that while adopting a numerically advantageous low Schmidt number results in the correct general characteristics of the Kelvin waves, excessive diffusion of the pycnocline and various density features precludes accurate representation of both the trailing Poincare wave field and the intensity and duration of the Kelvin-Helmholtz instabilities.

Session 1802090 - Physical Oceanography - Part 1
Forced and intrinsic interannual AMOC variability: an OGCM-based frequency-latitude analysis
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The origin of low-frequency variability of the North Atlantic Meridional Overturning Circulation (AMOC) is investigated from 1/4° and 1/12° global ocean/sea-ice simulations. A 327-year climatological simulation, driven by a repeated seasonal cycle is shown to generate a significant fraction of low-frequency AMOC variability obtained in a 50-year fully-forced hindcast. AMOC variability is thus partly forced by the atmosphere and by oceanic non-linearities. While the main intrinsic AMOC variability source sits at 30°S (55% of the total variance), the intrinsic AMOC variance maximum in the North Atlantic is found close to the RAPID array latitude and in the Gulf Stream region, where it accounts for about 30-40% of the fully-forced low-frequency AMOC variance. The total and intrinsic AMOC variabilities exhibit some similarities in spectral peaks, depending on latitudes. Our results suggest that intrinsic variability processes should be taken into account for the investigation of low-frequency AMOC variability in the basin, at the RAPID array and potentially at the future SAMOC array.

Session 1802090 - Physical Oceanography - Part 1
Mixing processes of the Oyashio and Tsugaru Warm Current in the Northwestern Pacific
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In the western edge of the Northwestern Pacific, three major current systems, Oyashio, Kuroshio, and Tsugaru Warm Current merge and resulting in highly variable and complicated oceanographic conditions. In this study, we report preliminary results of our 2017 summer field campaign focusing on mixing processes at the front between the Oyashio and the Tsugaru Warm Current (O-T) by using the R/V Wakataka-maru (692t equipped with a shipboard 38 kHz ADCP, a turbulence profiler with a nitrate sensor attached, and Underway-CTD system) and Slocum G2 Glider (equipped with a turbulence sensor, ADCP, CTD and bio-optical sensors). We conducted zigzag surveys with the both platforms crossing the O-T front from the merging area: off the Cape Erimo to the downstream: off Sanriku. The observed hydrographic data indicate multiple intrusions at different layers across the O-T front. We will discuss the detailed mixing processes including water exchanges (heat, salt, nutrients and etc.) between the two water masses.

Session 1802090 - Physical Oceanography - Part 1
Surface Wave Impacts on the Ocean Responses to a Moving Storm
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Two gliders were deployed along the Halifax Line, from Chebucto Head to 250 km offshore from Nova Scotia. One of these captured the ocean temperature and salinity responses to Hurricane Arthur, a fast-moving tropical storm in 2014. The data includes spatial and temporal ocean vertical observations, providing the thermal structure in terms of current shear and wave-induced turbulence. Simulated winds and waves, as provided by WRF and WAVEWATCHIII, are shown to validate well against measurements from NDBC buoys 44258, 44137 and 44150, near the glider track. Based on the one-dimensional General Ocean Turbulence Model (GOTM) k-epsilon equations, with inclusion of effects for wave breaking, Coriolis-Stokes force (CSF) and Langmuir turbulence (Stokes shear in the Turbulent Kinetic Energy (TKE) equation), the temperature and salinity evolution is simulated and compared with glider observations. We show that

wave-breaking induced momentum and energy fluxes and Langmuir turbulence are essential in improving GOTM simulations. Without Langmuir turbulence, the SST cooling is underestimated by 0.7 degrees C, as detected by the data. Inclusion of Langmuir turbulence significantly improves the wave impacts to cool the upper ocean and warm the upper thermocline during the storm's forced-stage. Without Langmuir turbulence, temperature is underestimated by 0.5 degrees in the upper 25 meters, and overestimated by 0.7 degrees from 25 to 40 meters. Wave breaking is parameterized in terms of surface energy fluxes in the TKE equation, and as a body force. We show that the body force scheme is more effective than that of an energy flux, which is limited to the uppermost ocean layers. Simulations indicate that the CSF effect might be negligible in severe storms, since it takes more time to be effective. Sensitivity studies of drag coefficients show that model simulations of vertical entrainment of heat content and SST cooling are significantly improved by including waves.

Session 1802090 - Physical Oceanography - Part 1
Influence of Atmospheric Forcing on processes within the North Atlantic Sub-Polar Gyre
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The North Atlantic sub-polar gyre contains regions which experience intense air-sea exchange during convective winter periods. With large amounts of buoyancy loss via both latent and sensible heat, there are regions within the sub-polar gyre capable of deep convection. Numerical simulations are excellent tools to examine the effects of deep convection in these regions, though the atmospheric forcing datasets available to drive such simulations can differ significantly. We evaluated four atmospheric forcing datasets with different spatial and temporal resolution: Drakkar Forcing Set 5, ERA-Interim, Coordinated Ocean-Ice Reference Experiment 2, and the Canadian Meteorological Centres Global Deterministic Prediction System.

With variability between the four datasets, each prescribe different conditions over the oceans surface. This will result with varying levels of buoyancy removal from convective regions, changes in heat transport between the atmosphere and ocean, as well as precipitation minus evaporation differences. We would expect that numerical simulations driven by each dataset to vary as well. The NEMO model is used to perform these ocean simulations and our analysis focuses on the effects around the sub-polar gyre, including subduction and export of Labrador Sea Water, fluxes through multiple gateways, and even variability in the Meridional Overturning Circulation.

Session 1802090 - Physical Oceanography - Part 1
Extraction of balanced energy from a geostrophic flow due to near-inertial forcing
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The effect of forced near-inertial motion on the kinetic energy budget of a turbulent, geostrophic background flow is examined using a primitive equation ocean circulation model. Balanced and unbalanced parts of the flow are taken to be equivalent to low and high-passed filtered versions of the model fields, and the Reynolds stresses associated with the high-passed, predominantly near-inertial part of the flow are found to extract low frequency kinetic energy. Transfer spectra show that this transfer occurs at wavenumbers close to the deformation

wavenumber, ie, at mesoscale wavenumbers. A similar transfer of energy from balanced to unbalanced motion is seen in potential energy, with available potential energy being depleted as near-inertial forcing is added to the system. The ratio of kinetic to potential energy transfers are consistent with energy being extracted from baroclinic geostrophic flows for which the horizontal length scale is slightly larger than the deformation radius. Recent work by other groups have also presented similar transfers of energy in a range of regimes, including a distinction between loss of balanced energy due to stimulated imbalance as opposed to direct extraction. A comparison between this work and these recent results is presented to clarify the relationship between these mechanisms.

Session 1802091 - Physical Oceanography - Part 2
Surface and bottom temperature and salinity climatology along the continental shelf off the Canadian and U.S. East Coasts

Session 1802091 - Physical Oceanography - Part 2
Testing TSA performance with ST4 physics over Global grid
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In this work we describe improvements to the operational wave model, WAVEWATCHIII, which is used at ECCC in Canada, and also in the foremost operational marine forecasting offices, worldwide. We implemented the Two-Scale Approximation (TSA) for nonlinear wave-wave interactions (Resio & Perrie, 2008, Perrie & Resio, 2009 and Perrie et al., 2013) within the latest version of WAVEWATCHIII version 5.16, released in October 2016. The TSA code, optimized for maximum efficiency, is tested with the new advanced physics package for input and dissipation source terms ST4 by Ardhuin et al. (2010) for real storms (hurricanes) over the global ocean. We simulated several time periods in 2014 and 2015 in which significant hurricanes were present, forced by the Global Climate Forecast System Reanalysis winds (CFSR). We compared the TSA simulations with two other nonlinear wave-wave interaction formulations available in WW3: (1) the fastest (and hence most-commonly used) method, denoted the Direct Interaction Approximation (DIA), and (2) the most accurate (but costly and hence least used) method, denoted the Webb, Resio & Tracey (WRT) formulation.

The results from all three formulations were then compared to: (1) hourly wave observations from all available buoys (globally) that are within more than one grid point of the coast; (2) AVISO cross-calibrated merged altimeter daily-mean Significant Wave Height (SWH) data. The early results are very encouraging: on efficiency, the cost of running TSA is about 25 times of that of DIA and five times faster than WRT; on accuracy, the normalized-root-mean-squared error and the bias from TSA are comparable to those of WRT.

Session 1802091 - Physical Oceanography - Part 2
What we can know about the North Atlantic Ocean from satellite data
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Satellite altimeter data and GRACE data have a good coverage of the North Atlantic Ocean. The two datasets were analyzed using Empirical Orthogonal Function (EOF) approach for the North Atlantic Ocean. In this study, we attempt to use current meter data, transport data through Florida Strait, wind and heatflux

data from NECP to understand what current variability can be represented in the EOF modes of the satellite data. We find that the current at Labrador shelf break is more presented by the altimeter data EOF2. A Gulf Stream mode is found in the altimeter data EOF3. The different roles of wind vorticity and heatflux in the current variability are investigated in this study.

Session 1802100 - Coastal Oceanography and Inland Waters - Part 1
Model study of the impact of hydropower developments on

Session 1802100 - Coastal Oceanography and Inland Waters - Part 1
Modeling Lake Erie circulation and thermal structure and the potential impact of wind farms.
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There will be wind farms in the Great Lakes very soon. The presence of large wind farms could affect the thermal structure of the lake, particularly during summer when a thermocline develops. Temperature increases, caused by lowered wind speeds and reduced mixing in the upper part of the water column, may be small, but could still impact algal bloom development. Algal blooms absorb sunlight, causing added heating so there is a potential positive feedback.

The potential impact of a large wind farm on Lake Erie's hydrodynamic and thermal structure is investigated by using COHERENS (Coupled Hydro-dynamical Ecological model for Regional and Shelf Seas). Using meteorological data (winds, air temperatures, cloud cover) from 2005 the circulation and thermal structure in the open water season (May-October) is modeled and matches previous modeling studies and measurements reasonable well. The effects (reduced wind speeds in turbine wakes) of a large wind farm with 432 large (5MW) turbines, are then added, in a 12 km x 50 km region offshore from Cleveland, and the model is re-run to investigate potential changes. Surface water temperatures increase by 1 to 2ºC in and around the wind farm but the overall impact is relatively small in other parts of the lake.

Session 1802100 - Coastal Oceanography and Inland Waters - Part 1
Topographic influences on wind-driven upwelling in a semi-enclosed, temperate sea
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Wind-driven upwelling in coastal basins can lead to damaging ecological consequences. For example, fish kills periodically observed in Hood Canal, Washington have been linked to wind-driven upwelling of hypoxic deep water. The Strait of Georgia is an important Canadian fisheries resource with a near-surface, low-pH, inorganic carbon reservoir and a persistent, along-shore wind climatology. Using 3+ years of archived hourly hindcast results from the UBC SalishSeaCast NEMO configuration, we identify regions of enhanced wind-driven upwelling near the Strait of Georgias dominant shellfish aquaculture centres in Baynes Sound and the Discovery Islands. Using passive tracer experiments within the SalishSeaCast configuration for selected wind events, we find that surface upwelling plumes are generally advected offshore by wind but tidal advection may transport subsurface upwelled water onshore and into sensitive zones. Finally, using an idealized NEMO configuration, we determine the dominant topographic features that produce the regions of enhanced upwelling

that we observe in the SalishSeaCast configuration, and the underlying dynamics responsible for this enhanced upwelling.

Session 1802100 - Coastal Oceanography and Inland Waters - Part 1
Development of a nested-grid coastal circulation modelling system for the eastern Canadian seaboard using ROMS
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The coastal and shelf waters of eastern Canada, including the Scotian Shelf, the Gulf of St. Lawrence, and the Bay of Fundy-Gulf of Maine system, are influenced by many factors on different spatial and temporal scales. These factors include large-scale currents such as the Labrador Current and the Gulf Stream, weather systems passing through on the O(days) time scale, and tides. Nested-grid ocean circulation models offer a way to simulate the ocean state in a manner that includes the effects of these various spatiotemporal scales. In this talk we discuss the ongoing effort to update a nested-grid ocean circulation modelling system for the eastern Canadian seaboard. The updated modelling system uses the Regional Ocean Modeling System (ROMS), which is an open-source primitive-equation ocean circulation model. The outermost grid of the updated system covers the area from Cape Hatteras to Hamilton Inlet, and nested within it is a grid that covers the area from Cape Cod to the Strait of Belle Isle. Inputs for the modelling system include atmospheric forcing at the surface and oceanic forcing at the lateral open boundaries that are derived from reanalysis data, tides, and riverine freshwater input. The semi-prognostic method and the spectral nudging method, which were part of the previous version of the circulation modelling system, have been implemented in ROMS. We will present preliminary results of the updated modelling system and discuss comparisons between model simulations and observations.

Session 1802100 - Coastal Oceanography and Inland Waters - Part 1
Seasonal cycles, hypoxia and renewal in Barkley Sound, British Columbia
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Recent Chinook and Coho Salmon catches in the Strait of Georgia have been less than one-tenth of past levels. As part of the Salish Sea Marine Survival Project, a research program aimed at addressing this issue, a `Citizen Science project was developed. 10 volunteer teams, each with their own boat, were supplied with a CTD and other sampling equipment and a schedule of about 20 sampling dates between March and October, for years 2015-2018. CTD data is electronically transmitted back to the Ocean Networks Canada archive using custom tablet software. Water samples are gathered and analyzed elsewhere. Currently the dataset contains about 5000 CTD stations, along with a nutrient and phytoplankton information. One challenge has been in making sure that the data has been adequately vetted and processed. Oceanographic data has many challenges that are not always easily detected with automated Q/C checks.

Session 1802100 - Coastal Oceanography and Inland Waters - Part 1
Circulation at a triple junction in the Kitimat Fjord
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The Kitimat Fjord System in the northern British Columbia coast features a network of deep channels, islands and shallow sills. In particular, the fresh water leaving Gardner Canal bifurcates at a triple junction: 1) north through a shallow sill (100 m deep) to Devastation Channel and then out through Douglas Channel; 2) west along Verney Passage then passing over a shallow sill (35 m) to Wright Sound. The partitioning of the fresh water leaving Gardner Canal has substantial implications for interpreting estuarine circulation and water exchange of the system. In this study, the partitioning of the fresh water at the triple junction is quantified by using observations and circulation model. The model is based on FVCOM with ~100 m horizontal resolution in the narrow channels and forced by tides, winds and river discharges. The complex circulation pattern at the triple junction involves a semi-permanent eddy, which is identified from the model simulation and further supported by various observations including underway salinity, MERIS-derived freshwater plume, and drifter tracks. A passive tracer evolving with the advection and diffusion processes in the circulation model is used as a proxy to quantify the freshwater transport. The results show that the majority of low salinity water from Gardner Canal flows northward into the Devastation Channel.

Session 1802101 - Coastal Oceanography and Inland Waters - Part 2
Impact of a mine tailings breach on the physical limnology and turbidity of Quesnel Lake, British Columbia: baseline to two years post-breach

Session 1802101 - Coastal Oceanography and Inland Waters - Part 2
Recent Progress and Plans for Total Sea Level Forecasting at Environment and Climate Change Canada
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Sea level forecasting within ECCC has progressed significantly over recent years. In this presentation, recent progress and plans will be discussed on both global and regional scales. We begin with a description and evaluation of three major improvements of the new operational system for forecasting surges along the east coast of Canada: (i) ensemble forecasts, introduced to better represent the uncertainty in surge forecasts, (ii) an increase in horizontal resolution from 1/12 to 1/30 degree for the deterministic system, and (iii) an increase in forecast lead time from 2 days to 10 days. Preliminary results from a new global total water level (tide+surge) forecast system based on the NEMO code will be presented, including an assessment of the effect of baroclinicity. Finally, we briefly tackle visualization issues. We propose 2D regional maps of flooding probabilities to help rapidly identify regions at risk of flooding as a function of lead time. We also propose a new method for visualizing risk at the “street level” using DEMs and illustrate the method using Hurricane Juan as our flood generator.

Session 1802101 - Coastal Oceanography and Inland Waters - Part 2
Long-term monitoring of waves associated with coastal erosion in the Gulf of St. Lawrence
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Coastal erosion is part of shoreline dynamics and has recently received more attention from the scientific community and the media due to its relation to climate change. In the Gulf of St. Lawrence (GSL), this erosion is mainly

controlled by shoreline lithology, local wave climate, and sea-ice cover in winter that reduces wave energy. Since 2010, waves, currents, and sea-ice were monitored at several stations in the GSL, the St. Lawrence Estuary, and the Chaleur Bay with ADCPs moored at 30 to 40-m depth near the coastline. These multiyear records give important information about the recurrence of storm events, their force and direction of propagation. They are used to produce reliable wave-height return period for each monitored region. The biggest waves occurred in the months of December, January, and April, months that had strong sea-ice covered in the past. Sea-ice clearly no longer provides reliable protections for the coastline in winter. The most powerful storm was recorded in December 2016, with a significant wave height (H_{<small>m0}</small>) of 6.6 m measured at Cap dEspoir, south of Percé. This storm was stronger than the December 2010 storm, which produced major damages to roads and buildings in the estuary, but the peak of the latter occurred during spring tide high water. The Chaleur Bay is a relatively protected region (maximum recorded H_{<small>m0}</small> 2.7 m), nevertheless it has coastal erosion problems that are as serious as on more exposed GSL coasts. In fact, most coastlines are in relative equilibrium with the local wave climate, and an increase of storm waves due to winter sea-ice reduction will intensify coastal erosion in all regions.

Session 1802101 - Coastal Oceanography and Inland Waters - Part 2
Using Overtides to Evaluate Ocean Model Predictions of Mean Dynamic Topography in Shallow, Tidally-Dominated Regions
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The tilt of mean dynamic topography (MDT) along the coast can be used to make inferences about nearshore circulation, and through simple vorticity arguments, circulation occurring on regional scales. Recent comparison of tilts from ocean models (the hydrodynamic approach) and long-term means of geodetically-referenced hourly sea levels observed by coastal tide gauges (the geodetic approach) are encouraging. The good agreement increases our confidence in the realism of the models of both the ocean and the geoid. It also highlights the potential value of coastal tide gauge networks in terms of evaluating ocean models that downscale from regional to nearshore scales.

Direct comparison of results from the hydrodynamic and geodetic approaches can only be made at tide gauges with hourly records that exceed several years in length. This severely limits the locations at which both approaches can be compared as many records are only a few months long. The number of tide gauges with long records is insufficient for validation of small-scale processes. In shallow, tidally-dominated regions, MDT is dominated by nonlinear interactions involving tidal currents and sea level leading to higher tidal harmonics in these regions. We will show that in these regions it is possible to use overtides (e.g., M4) to independently assess the accuracy of the MDT predicted by ocean models. The advantage of this approach is that overtides can be estimated from relatively short (order one month) sea level records and this greatly increases the number of locations at which the ocean model can be evaluated. This approach also assesses the ability of the model to simulate correctly the underlying nonlinearities. In this presentation the mean tilts of sea level along the coast of Nova Scotia and the Gulf of Maine resulting from the hydrodynamic and geodetic approaches are compared. The then illustrate how observed amplitudes and phases of M4 can be used for evaluating a nested configuration of the NEMO

ocean model for the Gulf of Maine/Scotian Shelf system and the tidally-dominated Bay of Fundy system. The use of overtides in terms of specifying the horizontal resolution and the bathymetry of nested ocean models will be discussed.

Session 1802101 - Coastal Oceanography and Inland Waters - Part 2
Tidal Modulations of Surface Gravity Waves in the Gulf of Maine
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This study examines the tidal modulation of surface gravity waves in the Gulf of Maine (GoM) based on in-situ observations and numerical results. Analysis of observational data demonstrates significant semidiurnal tidal modulations in the mean wave variables in the region. The observed tidal modulation features significant spatial-temporal variabilities, with large magnitudes near the mouth of the GoM particularly during high sea states. The favorable conditions for the tidal modulation are found to be swell-dominated waves associated with relatively stable wave propagating directions. The large tidal modulation in the wave height occurs at several different tidal phases, indicating the effect of nonlocal tidal currents. The coupled wave-circulation model successfully reproduces the observed tidal modulation and associated spatial-temporal variabilities. Process-oriented numerical experiments demonstrate that the observed tidal modulation is associated with the current-induced advection, refraction, and wavenumber shift. The current-induced modulation of wave dissipation becomes as important as other three mechanisms during high winds by weakening the tidal modulation. Model results also demonstrate that the accumulated effects of nonlocal tidal currents across Georges Bank (GB) determine the observed unusual timing of the maximum tidal modulation in the wave height behind GB in the following tidal currents. Consequently, both amplitude and phase of the tidal modulation behind GB are indirectly controlled by the strong tidal currents on GB. The amplitude could reach ~0.4 m behind GB, and the phase propagates towards the inner GoM with a wavelength of ~40 km. Over GB, by comparison, the amplitude of the tidal modulation is relatively small (~0.2 m).

Session 1802101 - Coastal Oceanography and Inland Waters - Part 2
Storm surge hindcast in the northeast Pacific
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A 37-year storm surge sea level hindcast for the northeast Pacific has been generated using a 2-D nonlinear barotropic Princeton Ocean Model forced by hourly CFSR (Climate Forecast System Reanalysis) wind and air pressure. Validation of the hindcast water level anomalies using tide gauge records has indicated that there are extensive areas of the Pacific coast where the model does not capture the processes that determine the sea level variability. Some of the challenges may be linked to large-scale fluctuations, such as those arising from major El Niño and La Niña events, as well as effects of steric water level changes due to variations in water density. We have applied a correction to the storm surge hindcast using the ORAP5 ocean reanalysis (Zuo et al., 2015). Extreme value analyses of the corrected surge hindcast show that their Gumbel scale parameters are in good agreement with those calculated from tide gauge observations. The results provide an improvement for the Canadian Extreme Water Level Adaptation Tool (CAN-EWLAT). For the BC coast, the tool currently

relies on data from nearest tide gauge site to characterize the water level history, which can be problematic when a coastal site is located a significant distance from the tide gauge.

Session 1802102 - Coastal Oceanography and Inland Waters - Part 3
Properties of the Exchange through a Tidal Mixing Hotspot at an Estuary Constriction
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Deep estuaries are often separated from the open ocean by sills and constrictions. These constrictions are areas of intense mixing often dominating the total estuarine mixing. The amount and depth of the estuarine exchange depends sensitively on the mixing and the densities of the waters on the two sides of the mixing region. Thus, the density, nutrient concentration, oxygen saturation, and dissolved inorganic carbon content of the incoming estuarine flow depend on local tidal mixing processes and large scale buoyancy dynamics. We have investigated this process using a numerical model (SalishSeaCast) of the Salish Sea on the West Coast of North America, straddling the Canada/US border. The region receives considerable freshwater dominated by the outflow of the Fraser River. The Fraser River first flows into the deep Strait of Georgia but the freshwater must traverse the strongly tidally mixed passages through the San Juan/Gulf Islands before it reaches the Pacific Ocean. The model correctly reproduces the deep water flow into the Strait of Georgia as evaluated against Ocean Networks Canada (ONC) four bottom-mounted, continuously recording, conductivity-temperature instruments which capture this incoming flow. Using a quantitative Lagrangian technique on a three-year hindcast we characterize the exchange. In this talk, we focus on the depth, lateral position and water properties of the incoming and outgoing exchange flows and relate these to the controls on the exchange: notably, the buoyancy forcing and the tidal mixing.

Session 1802102 - Coastal Oceanography and Inland Waters - Part 3
An integrated look at carbon cycling in Freshwater Creek and Cambridge Bay, Nunavut
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Carbon cycling in the Arctic will continue to be impacted as climate changes. Increasingly ice-free waters may modify the exchange of carbon dioxide between the atmosphere and the ocean and inland waters and the potential increase in dissolved carbon dioxide sequestered in the marine environment could result in acidified conditions. This work presents data from our 2017 field campaign in Cambridge Bay, Nunavut. These data will contribute to a larger effort to characterize baseline carbon cycling in Cambridge Bay including the integration of contributions from Freshwater Creek, which discharges output from the Greiner Lake Watershed on Victoria Island into Cambridge Bay on the eastern edge of the hamlet. Time-series physical and chemical data were collected from Freshwater Creek and along a transect extending from the mouth of the creek to the center of Cambridge Bay. Dissolved inorganic carbon (DIC), total alkalinity (TA), and DIC stable carbon isotopes were measured in water samples collected from Freshwater Creek and selected marine/estuarine stations. Historical and real-time hydrometric data recorded by the Freshwater Creek gauging station (10TF001) were extracted from the Environment and Climate Change Canada Historical and Real-time Hydrometric Data web sites and used to investigate

temporal trends in creek break-up and peak discharge dates. Results show that break-up timing exhibits a cyclic character with alternating intervals of early and late melt and that during the last ten years, the average onset of break-up in Freshwater Creek has occurred 5.1 days earlier than the previous two decades. Understanding recent changes in Freshwater Creek hydrology in combination with an integrated picture of the local freshwater and marine carbon cycles will be important in anticipating and responding to future change in the region.

Session 1802102 - Coastal Oceanography and Inland Waters - Part 3
The May 2017 Collapse of the Lincoln Sea Ice Arch in response to thin ice and wind forcing
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One of the most dramatic indicators of climate change is the reduction in Arctic sea ice extent and thickness. One consequence is an increased sea ice mobility in response to surface wind forcing. In addition, the region has been undergoing an accelerated warming relative to the rest of the globe that is resulting in environmental and ecosystem stresses both regionally as well as in mid-latitudes. Recent winters in the Arctic have been unusually warm and in addition, the winter (January-March) of 2017 was characterized by a reversal in the seasonal surface winds and ice motion in the western Arctic that has not been observed previously. During April and May of 2017, satellite observations indicated that the ice arch that forms along the northern boundary of Nares Strait in the Lincoln Sea collapsed. Typically this arch collapses in July or August and its presence inhibits the southward transport of Arctic sea ice, especially thick multi-year, through Nares Strait. Here we use satellite and in-situ meteorological data as well as atmospheric model fields to argue that the early collapse during 2017 was due to thin ice cover in the Lincoln Sea that was the result of atmospheric circulation during the previous winter as well as an unusual wind regime along Nares Strait characterized by intermittent strong southerly flow.

Session 1802102 - Coastal Oceanography and Inland Waters - Part 3
On subsurface cooling associated with the Biobio River Canyon (Chile)
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Submarine canyons cutting across the continental shelf can modulate the cross-shelf circulation being effective pathways to bring water from the deep ocean onto the shelf. Here, we use 69 days of moored array observations of temperature and ocean currents collected during the spring of 2013 and winter-spring 2014, as well as shipboard hydrographic surveys and sea-level observations to characterize cold, oxygen poor, and nutrient-rich upwelling events along the Biobio Submarine Canyon (BbC). The BbC is located within the Gulf of Arauco at 36°50S in the Central Chilean Coast. The majority of subtidal temperature at 150 m depth is explained by subtidal variability in alongshore currents on the canyon with a lag of less than a day (r2=0.65). Using the vertical displacement of the 10° and 10.5°C isotherms, we identified nine upwelling events, lasting between 20 h to 4.5 days, that resulted in vertical isothermal displacements ranging from 29 to 137 m. The upwelled water likely originated below 200 m. Majority of the cooling events were related with strong northward (opposite Kelvin wave propagation) flow and low pressure at the coast. Most of these low pressure events occur during relatively weak local wind forcing

conditions, and were instead related with Coastal Trapped Waves (CTWs) propagating southwards from lower latitudes. These cold, high-nutrient, low-oxygen waters may be further upwelled and advected into the Gulf of Arauco by wind forcing. Thus, canyon upwelling may be a key driver of biological productivity and oxygen conditions in this Gulf.

Session 1802102 - Coastal Oceanography and Inland Waters - Part 3
“Wind Pump” Effects on Marine Ecosystems
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“Wind Pump” is an important concept that has drawn significant attention in the recent years. Wind Pump is defined as a series of wind-driven processes that influence ocean currents and water movement, which subsequently affect marine ecological conditions. Wind Pump can change the transport of nutrients and promote the cycling of major elements in the ocean. It thus drives primary production and marine ecosystem and affects carbon fixation and global fishery resources (Tang, 2004). This presentation will introduce “Wind Pump” effects on marine systems and take some examples in the South China Sea.

Algal bloom is defined as a rapid increase or accumulation in biomass in an aquatic system. It not only can increase the primary production but also could result in negative ecological consequence, e.g., Harmful Algal Blooms (HABs). According to the two classical theories of algal blooms “critical depth” and “eutrophication”, oligotrophic waters are difficult to form a large area of algal blooms. Cruise observations were only able to capture sporadically the existence of algal blooms. Due to limitations of in-situ observational methods, most of previous studies investigated occasional or regional blooms along coastal eutrophic waters, without much success of understanding of main processes responsible in the offshore deep-ocean oligotrophic waters. Based on previous studies by taking a full advantage of remote sensing technology and multiple satellite data, we proposed the mechanism model of “Wind Pump effects”, which represent the oceanic dynamic mechanism of the bloom growth. Except for the classical coastal Ekman transport, the Wind Pumping effects explain that wind forcing affects the formation of algal bloom through a variety of mechanisms, including Ekman pumping, clip volume, stirring and mixing, and transport by wind and wind-induced surface currents.

Session 1802102 - Coastal Oceanography and Inland Waters - Part 3
Variability of suspended particle properties and distribution using optical measurements within the Columbia River Estuary
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Correlations between particle properties and optical properties have been assessed and applied to understanding of the spatial and temporal variability of particle concentration, particle size distribution and particle composition within the Columbia River Estuary (CRE). Observations of optical properties in the CRE support the conceptual model that the river water brings more organic, smaller particles into the estuary, where they flocculate and settle into the salt wedge seaward of the density front. Large tidal currents resuspend mineral-rich, larger aggregates from the seabed, which accumulate at the density front. Variations of optical properties along a salinity gradient from fresh to salty water were investigated. The particulate backscattering b bp, a proxy of particle

concentration, decreased with increasing salinity in the transition from low- to medium-salinity waters. Sauter mean diameter D s of suspended particles increased from low- to medium-salinity waters as did the beam attenuation spectral exponent γ derived from a WET Labs ac-9, which indicates that the particle population dominating the ac-9 is decreasing in size. This coincident increase in D s and γ was opposite to the expected trend of smaller D s and higher γ caused by disaggregation or sinking. The most likely explanation is that flocculation acting at low-to-medium salinities transfers mass preferentially from medium size particles to large size particles that are out of the size range to which the ac-9 is most sensitive. Some of the newly flocculated mass is deposited at the same time. Our results illustrate the utility of optical proxies to study estuarine sediment processes.

Session 1802110 - History of Canadian Oceanography
Defining territorial waters: the role of science in policymaking
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In 2003, Canada ratified the United Nations Convention on the Law of the Sea. Under the convention, countries can propose extended continental shelf boundaries, and have them recognized internationally. The standard boundary, the exclusive economic zone, is 200 nm. If the continental shelf can be shown to extend beyond that distance, the country has sovereign rights over the natural resources of and below the seabed, as well as jurisdiction over activities, such as oceanographic research.

In areas of the Arctic and Atlantic oceans, Canada’s continental shelves extend beyond the 200 nm. Surveys are required to acquire data about the seafloor and underlying geological formations to determine if the regions are a natural prolongation of Canada’s land territory.

In 2006, Canada began taking almost yearly surveys of the Atlantic and Arctic Oceans, as part of the Extended Continental Shelf Program. The data collected over the following ten years supports Canada’s claim to extend our country’s boundaries into regions of economic importance.

This talk will tell the story of the research conducted to define Canada’s extended continental shelf, how the data and analysis have been used to inform policy, and the greater historical context of territorial boundaries under the sea.

Session 1802110 - History of Canadian Oceanography
“TOO LATE FOR ACTION.” M.L. FERNALD, A.G. HUNTSMAN AND THE BELLE ISLE STRAIT EXPEDITION OF 1923
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A. G. Huntsman’s Belle Isle Strait Expedition of 1923, the first oceanographic expedition organized by a Canadian, can be envisioned as modelled on the Canadian Fisheries Expedition of 1915, in which Huntsman had been a junior partner to the Norwegian fishery biologist Johan Hjort. Examination of Huntsman’s documents shows that this is too facile a view. For example, Huntsman hoped that one of the participants would be M.L. Fernald, a botanist from the Gray Herbarium at Harvard University. Huntsman’s unpublished manuscripts on the expedition, purportedly to give information about the oceanic

conditions leading to cod production, range from archaeology to botany. Although Fernald did take part, his reasons for being interested in the expedition were to document his hypothesis that the flora of northeastern North America had spread there along an emergent borderland after the last glaciation. Huntsman's aims were less transparent, but in addition to the oceanography they were early steps in in the development of his concept of biapocrisis, the response of organisms as a whole to their individual environments.

Session 1802110 - History of Canadian Oceanography
Vessel traffic in Canadas Arctic historic to present: examining trends, voyage patterns and extent (with a focus on oceanographic and research ships)
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The absence of a long-term, historic to modern dataset describing the complete history of marine traffic in Canadas Arctic currently results in limited and segmented inquiry into the legacy, effects, and impacts of maritime transportation. An accurate, accessible, and commensurable historic-to-modern dataset serves as a starting point to initiate investigations across a potentially broad range of disciplines examining social, cultural and/or environmental associations of marine traffic. This study analyses a recently constructed database of marine traffic in Canadas Arctic to describe and examine voyage and vessel trends, patterns and extent from the earliest possible record to 2017. The unique voyages of vessels with the specific purpose of oceanographic research will be highlighted. The legacy of marine exploration, exploitation, and development in Canadas Arctic is expansive, internationally, nationally and locally relevant, and is a revealing aspect of Canadas Arctic identity.

Session 1802110 - History of Canadian Oceanography
Early Oceanographic Research at the Naval Research Establishment, Dartmouth
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The onset of World War II and the significant threat to shipping posed by magnetic mines spurred the founding of the Naval Research Establishment (NRE) in Dartmouth, Nova Scotia. Before the war was over, research at NRE had expanded into acoustic mines and submarine detection. After the Royal Canadian Navy (RCN) observed that enemy submarines in waters off Canada's East Coast could escape detection simply by diving, an oceanographic research program was begun at NRE. The goal was to study the thermal structure of the ocean in order to understand the effects of oceanography on sonar performance. Two historical experiments will be discussed. The first, a 1950 multi-ship survey known as Operation Cabot, provided significant insight into Gulf Stream dynamics. The survey was conducted jointly with the Atlantic Oceanographic Group in St. Andrews, New Brunswick, and numerous American collaborators including Woods Hole Oceanographic Institution and Scripps Institution of Oceanography. The second, a 1954 drift bottle experiment, was among the first attempts to determine the surface circulation on the Scotian Shelf. The NRE scientists involved went on to distinguished careers, including J. R. Longard, who served as Scientific Adviser to the Commander, Maritime Command, and then as Scientific Liaison Officer in Washington, DC; W. L. Ford, who became director of the Marine Sciences Branch at Bedford Institute of Oceanography; R. E. Banks, who served as a Defence Science Liaison Officer in Washington, DC; and R. W. Trites, who had a long career at Bedford Institute of Oceanography.

Session 1802120 - Operational Oceanography
Satellite data for operational oceanography at high latitudes

Session 1802120 - Operational Oceanography
Ensemble Approaches to Marine Forecasting
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In order to make effective operational decisions in a harsh environments, it is necessary to know more than just the expected sea height. The probability, or risk, that the seas will exceed some operational limit is required to facilitate operational decisions about sea state. Ensemble techniques leverage multiple data sources in order to quantify risks for operational marine forecasting. This presentation will outline operational ensemble techniques, such as Bayesian Model Averaging and Fuzzy Logic approaches, employed at Amec Foster Wheeler to support offshore marine forecast clients. The presentation will illustrate the application of these approaches with examples in forecasting wind, sea and visibility risks in a marine environment as well as a look ahead to future work to further improve risk forecasting accuracy.

Session 1802120 - Operational Oceanography
Development of a Pan-Canadian Operational Regional Ocean Data Assimilation System
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In order to provide Canada with short-term ice-ocean predictions and hazard warnings in ice-infested regions the Government of Canada CONCEPTS initiative (Canadian Operational Network of Coupled Environmental Prediction Systems) has developed a Regional Ice-Ocean Prediction System (RIOPS). The domain covers the Arctic and North Atlantic regions at roughly 5km resolution and produces 48 hr forecasts 4 times a day. RIOPS uses the NEMO-CICE ice-ocean model and includes explicit tides, a landfast ice parametrization based on the effect of grounded ice ridges (for improved representation over shallow waters), and an increased resistance to tension and shear in the ice rheology (for improved representation in land-locked areas). The ocean analysis component of the system was originally based on a spectral nudging approach and is updated here to use a multivariate reduced-order Kalman filter that assimilates sea level anomaly, sea surface temperature and in situ profiles of temperature and salinity. The model domain is also extended to cover the Canadian west coast. The ocean analysis is blended with a 3DVar ice analysis that assimilates SSM/I, SSMIS, AMSR2, ASCAT, as well as manual analyses from the Canadian Ice Service (daily and regional ice charts, and Radarsat image analyses). Here we demonstrate the improvements in the analysis system as compared to both the spectral nudging approach as well as comparable global analysis systems, including the Canadian Global Ice Ocean Prediction System (GIOPS). Particular improvements with respect to GIOPS include the use of higher resolution error modes, a modified observation operator for online tidal filtering for SLA, and use of a 3DVar bias correction procedure for in situ temperature and salinity profiles.

Session 1802120 - Operational Oceanography

Development of nearshore circulation model for Saint John Harbour based on NEMO

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The oceanography sub-initiative of the Ocean Protection Plan requires more accurate forecasting of ocean currents, water levels, stratification, etc. in the coastal and nearshore waters to support electronic navigation and emergency response (at present focused on spills). In order for model development to meet the operational requirements, a decision was made to perform a comparative evaluation of two of the modelling systems used within DFO-Science, NEMO and FVCOM. Both models were deployed to cover Saint John Harbour, New Brunswick, where strong tides and significant river runoff are present. A strict experimental design was made to allow direct comparison of the two models with observational data.

In this talk, we present the model development based on NEMO, downscaling to fine scales using a three-level one-way nesting approach: from a 1/36o model partly resolving the Scotian Shelf and the Bay of Fundy, an intermediate 500m model of the Bay of Fundy to finally a very high resolution grid (~100m) covering Saint John Harbour, its approach and extending North of reversing falls to explicitly resolve the Saint John river system. We briefly present the main results and experiences learned from that comparison. After demonstrating the capability of the current version of NEMO, an outline will be provided on ongoing work of model improvement, testing on new features of the model, and plans for applications to other ports.

Session 1802120 - Operational Oceanography
Using wave hindcast data for ship structure and stability assessment

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Many ship structure and stability assessments require information on the seaways a ship is expected to encounter. Typically, wave statistics generated from visual observations are used. The accuracy of structural and stability assessments are limited by known errors in these statistics. This limits the use of these assessments. Mature wave modeling efforts (forecasts, hindcasts, reanalyses, etc.) provide an alternative to visual observations and also introduce wave data with spatial and temporal refinement. These improved wave data may advance ship structure and stability assessments so much that they can be used to inform owners and operators of risks that were otherwise difficult to quantify. The analyses may also be able to address questions that were not definitive without high-quality wave data. This presentation will address how wave hindcast data can be used in ship structure and stability assessments and some of the opportunities and challenges that arise.

Session 1802120 - Operational Oceanography
On Virtual Tide Gauges

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A virtual tide gauge (VTG) is a mathematical device which mimics the function of a physical tide gauge (PTG). The VTG indicates sea level changes caused by

astronomic and atmospheric forcing fields. Advantages of a VTG are numerous. Where maintaining a PTG in a remote area or harsh environment can be costly or infeasible, a VTG is a good substitute. A VTG is also a good backup for a PTG in case of instrument failure. A VTG can also predict future water levels whereas a PTG cannot.

Behind the VTG is a core technique called the All-Source Green's Function (ASGF; Xu, 2007, 2011). The ASGF is a matrix pre-calculated with a global numerical model. Each column of the matrix is a Green's function that corresponds to a source point, and all source points of the world ocean are included (hence the name of the function). Water levels at a POI are determined by convolutional effects of global forcing fields. The ASGF is used as a convolution kernel to quickly compute water levels on a POI in response to any kind of external forcing field, which can be isolated and impulsive or spatially continuous and long lasting. The ASGF has been used to predict tsunami arrivals (Xu and Song 2013; Mosher et al, 2010) and to simulate storm surges (Xu 2015a,b; Xu et al 2015).

The VTG is a new application of the ASGF, which converts global astronomic and atmospheric forcing fields into water response at a POI. The global astronomic forcing field for tide-generation is computed with NASA/JPL solar system ephemerids, and the global atmospheric forcing field for storm surge generation is computed with GEM4 model outputs for air pressures and winds issued daily by environment Canada. A VTG can be implemented anywhere.

Session 1803020 - GOES-16 – Activities and Applications - Part 1
GOES-R for the Meteorological Service of Canada
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The Meteorological Service of Canada (MSC) operates and maintains a satellite reception network to receive and process data which is broadcast directly from the geostationary GOES satellites, in order to provide near real-time imagery for the MSC weather and environmental forecasting programs.

GOES-R is program name for the next generation of the U.S. geostationary weather satellites. The first satellite was launched in 2016 and is now the operational GOES-East satellite, and the second satellite, called GOES-S, was launched in February, 2018. GOES-R has provided a major leap forward in terms of technology, observations, data delivery and derived products –requiring a level of preparation not experienced in over 20 years.

The MSC is in the midst of a "GOES-R Readiness" project which is coordinating, developing and implementing the activities necessary to ensure program readiness. The details of the overall 'MSC GOES-R Readiness Project' will be presented, with a focus on data access and data processing.

Session 1803020 - GOES-16 – Activities and Applications - Part 1
GOES-R User Training in ECCC
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This presentation briefly summarizes the national user training project in ECCC for the GOES-R series of satellites. In particular, it reviews the workshop held in October 2017 where operational ECCC meteorologists met with subject matter experts to design tailored training sessions for their home offices. The feedback from these local sessions is presented as are plans for ongoing GOES-R training.

Session 1803020 - GOES-16 – Activities and Applications - Part 1
GOES-16 & GOES-17 Operational Product Status and Validation Plans
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NOAA Geostationary Operational Environmental Satellite R-Series includes GOES-16 and GOES-17 launched in November 2016 and March 2018, respectively. The Advanced Baseline Imager on the two satellites provides enhanced spectral, temporal, and spatial information and with deployment of a new system with new capabilities, user readiness becomes an increasingly important activity. The GOES-R Product Readiness and Operations (PRO) team is tasked to work with our partners at the National Weather Service and within NESDIS to ensure products (both Level 1 and Level 2) are ready for operations and the user community is ready and are receiving and disseminating the various products to serve their needs and requirements.

GOES-16 has been the official GOES-East operational satellite since January 2018. GOES-17 launched on March 1, 2018 and is currently undergoing post-launch testing. In this presentation, we will discuss the operational status of the ABI and Geostationary Lightning Mapper (GLM) L2 products as well as post-launch product testing updates for GOES-17.

Session 1803020 - GOES-16 – Activities and Applications - Part 1
The GOES-16 and GOES-S Direct Broadcast Services
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The National Oceanic and Atmospheric Administration (NOAA) is providing significantly enhanced geostationary satellite Direct Broadcast (DB) capabilities with the new services provided by the Geostationary Operational Environmental Satellite-R (GOES-R) Series. GOES-R launched on November 19, 2016, and is now GOES-16, supporting Direct Readout (DRO) users from the GOES East position at 75.2° West through the GOES Rebroadcast (GRB), High Rate Information Transmission (HRIT)/Emergency Managers Weather Information Network (EMWIN), and Data Collection System (DCS). GOES-S is scheduled to launch in March 2018 and after the Post Launch Test (PLT) phase will assume the GOES West position at 137° West as GOES-17. GOES-16 data products are available through a variety of access methods that include the DB services, GEONETCast Americas (GNC-A), Product Distribution and Access (PDA), Comprehensive Large Array-data Stewardship System (CLASS), and the GOES-East Image Viewer on the Center for Satellite Applications and Research (STAR) website.

The GRB provides Level 1b data from each instrument and Level 2 data from the Geostationary Lightning Mapper (GLM). The GRB service significantly improves the DB capability provided by the legacy GOES VARiable (GVAR) and includes data from the Advanced Baseline Imager (ABI), GLM, space environment, and

solar instruments at a data rate of 31 Mbps. GRB users receive Level 1b products faster than through terrestrial distribution and can create Level 2 products using the Community Satellite Processing Package for Geostationary Data (CSPP Geo) software.

Detailed information about the GOES-R series users systems is available at: https://www.goes-r.gov/users/user-systems.html. Manufacturers, vendors, and system integrators are listed on the NOAA Satellite Information System (NOAASIS) website: http://www.noaasis.noaa.gov/NOAASIS/ml/manulst.html. Information about GNC-A is available at: http://www.geonetcastamericas.noaa.gov/.

This talk will provide an update of GOES-16 status and GOES-S plans for the use of GRB, HRIT/EMWIN, DCS, and GNC-A.

Session 1803020 - GOES-16 – Activities and Applications - Part 1
Early Operational Activities with the Geostationary Lightning Mapper
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The Geostationary Lightning Mapper (GLM) provides a completely new capability for severe weather decision support, situational awareness, aviation, and lightning safety. With near hemispheric coverage, the GLM provides total lightning observations (intra-cloud and cloud-to-ground observations) across the field of view. GLM provides observations for data sparse locations that typically would have limited coverage due to few, if any, ground sensors. GLM's ability to observe intra-cloud lightning is generally superior to existing ground-based networks aside from the short-ranged lightning mapping arrays. With these observations, GLM can provide an initial alert that a storm is becoming electrified as intra-cloud lightning typically precedes the first cloud-to-ground, remains electrified, and to monitor the storm's intensity. Lastly, the GLM can observe the spatial extent of a lightning flash, which can extend 100+ kilometers from the flash origin.

NASA's Short-term Prediction Research and Transition (SPoRT) center has been leading efforts in collaboration with the NWS to develop and produce GLM training and identify early use cases. This will form the background of training for a SPoRT-led assessment of the GLM with operational users this spring. The assessment will evaluate the day-to-day use of these data and gather operational cases for an applications library.

SPoRT has also collaborated with emergency managers to address lightning safety. The early results of this collaboration is the creation of a GLM "stoplight" product. This display synthesizes the location and extent of lightning and is color coded by age. Combined, this is being used by local emergency managers and the NASA Marshall Space Flight Center in Huntsville, Alabama to improve lightning safety efforts.

This presentation will focus on the initial results of the operational assessment and the use of the GLM "stoplight" product by emergency managers. SPoRT looks forward to sharing these results as our Canadian colleagues prepare to utilize GLM observations.

Session 1803020 - GOES-16 – Activities and Applications - Part 1

GOES-R Series International Training Working Group

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The GOES-R Series International Training Working Group (GITWG) was created to identify and coordinate international user training needs, currently focused throughout the Americas, with special attention on National Meteorological and Hydrological Services (NMHS) in the Caribbean and South America. Membership includes representatives from NESDIS, NWS, and NOAA Cooperative Institutes with NESDIS serving as the lead through the GOES-R Product Readiness and Operations (PRO) team. The GITWG meets regularly to evaluate the opportunities for GOES-R Series training involving the international community, serving as a clearinghouse for collecting individual training requests, identifying appropriate training materials, identifying the appropriate subject matter experts and training specialists to present material, and determining venues where training might best be conducted. Using knowledge from various offices and positions, the needs of international users can be better understood resulting in more effective planning for training efforts and events.

This presentation will detail the objectives of the GITWG and describe how user requests for training are addressed. It will also highlight the current status of GOES-R Series international training plans and discuss the outlook for future training opportunities and collaborations.

Session 1803021 - GOES-16 – Activities and Applications - Part 2

A qualitative verification of the performance of a Convective Cloud Mask using GOES-16 and GOES-13 data

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A simple satellite data post processing algorithm to generate a convective cloud mask (CCM) will be presented. This CCM, still under development, can help identify six types of convective clouds including water-cumulus, ice-cumulus, water-towering cumulus, ice-towering cumulus, cumulonimbus, and severe cumulonimbus. The CCM algorithm is based on a cloud top texture and thermal properties analysis similar to Mecikalski and Bedka (2006) but with some modifications. The CCM algorithm makes use of the characteristics of five of the GOES spectral channels (visible, near infrared, water vapour, infrared and CO2) to derive, through data training, a convective cloud type identification scheme. This CCM algorithm can be applied for both daytime and night-time convective cloud type detection.

The CCM algorithm has been tested for both goes-13 and goes-16 data during the summer of 2017. Preliminary verifications have shown that the CCM performs reasonably well for both goes-13 and goes-16 data when comparing CCM against radar and lightning observations. It is also found that the CCM generated from the goes-16 data is, generally speaking, better than that generated from the goes-13 data especially for early developing cumulus clouds. This is a direct result of the better spatial resolution data from the goes-16.

In this presentation, a brief description of the CCM algorithm will be given followed by a qualitative verification of the CCM using both radar and lightning

observations. Future plans on how to improve the CCM algorithm, how to carry out objective verifications, and how to incorporate it to enhance the thunderstorm nowcasting capabilities of the Canadian Centre for Meteorological and Environment Prediction's (CCMEP) Integrated Nowcasting System (INCS) will also be discussed.

Session 1803021 - GOES-16 – Activities and Applications - Part 2
Assimilation of GOES-16 Atmospheric Motion Vectors into the ECCC Global Deterministic Prediction System
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GOES-16, previously known as GOES-R, was successfully launched on 19 November 2016 and initially located at 89.5W. The satellite moved to 75W on 11 December 2017 to replace the operational GOES-13 satellite. GOES-13 was decommissioned on 8 January 2018 such that collocated observations from both satellites were available for a relatively short overlap period of 28 days for validation. Two products from GOES satellites are operationally assimilated in the Global Deterministic Prediction System (GDPS): Atmospheric Motion Vectors (AMV) and Clear Sky Radiances (CSR). AMV products, which are winds derived from a sequence of images in various bands, were immediately available after the satellite re-localization while the CSR products will be available in spring 2019.

AMV products from GOES-13 were available hourly for three bands: visible (VIS, 0.65 micron), infrared (IR, 10.7 micron) and water vapor (WV, 6.55 micron). Only a subset of observations every 3 hours was assimilated in the GDPS. The data were horizontally thinned to one AMV per box of 1.5 x 1.5 degrees. AMV products from GOES-16 are also available hourly but at higher spatial resolution and with 2 additional WV bands. The volume of AMV data from GOES-16 is roughly five times larger than that from GOES-13, which represents a challenge in terms of data continuity in an operational context. As initial implementation, in order to assimilate about the same volume of GOES-16 AMVs, the two additional WV bands are not assimilated and only the highest quality observations are selected to match the data volume of GOES-13.

The quality of the AMV products from both satellites was assessed over the 28 days overlap period against short-range GDPS forecasts. We found that the quality of the products above 400 hPa is similar, whereas the quality of the AMVs in the lower troposphere is better for GOES-16, especially for the VIS band. The impact of replacing GOES-13 by GOES-16 on short to medium-range forecasts is difficult to assess because of the short period of overlap (less than a month). Nevertheless, objective scores show an overall small but positive impact.

Session 1803021 - GOES-16 – Activities and Applications - Part 2
Exploration of Geostationary Lightning Mapper Products for Canadian Applications
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The Geostationary Lightning Mapper on board the new GOES-16 satellite, the first operational lightning mapper flown in geostationary orbit, measures total lightning activity over the Americas and adjacent ocean regions. Along with

weather radar and ground-based lightning observations, GLM has the potential to monitor the development of thunderstorms and further diagnose their severity.

ECCC's GLM Project Team has been evaluating GLM products for Canadian applications and developing GLM density display tools for operational users. This presentation will focus on the preliminary results of case studies and the performance of GLM relative to ground-based lightning networks such as the Canadian Lightning Detection Network and the Southern Ontario Lightning Mapping Array.

Session 1803021 - GOES-16 – Activities and Applications - Part 2
GOES-R Series ABI Mesoscale Domain Sector Request Process for International Users
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The GOES-R satellite series represents a leap forward in capabilities for the entire portfolio of GOES science products. The GOES-R Product Readiness and Operations (PRO) team is tasked to work with our partners at the National Weather Service (NWS) and within NESDIS to ensure the satellite products have reached a level of maturity for operations and the user community is ready to receive and disseminate the various products to serve their needs and requirements.

One new capability with the GOES-R series is the Flex Mode scanning strategy of the Advanced Baseline Imager (ABI) which produces mesoscale scans every 30 or 60 seconds. The PRO team has worked with many partners in the NWS, NESDIS, and the GOES-R Ground Segment to develop a comprehensive process for determining how these Mesoscale Domain Sectors (MDS) will be placed in an efficient manner for operations while also supporting research and international user requests. This presentation will focus on how the international community can make real-time operational and research MDS requests. A recent case study featuring a MDS request a cyclone in the North Atlantic will be presented highlighting the utility of the MDS for offshore analysis.

Session 1803021 - GOES-16 – Activities and Applications - Part 2
GOES-16 in the CCMEP environment and some post processing examples of L1b and L2 data
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First use of GOES-16 imagery and derived products in the CCMEP (Dorval) environment is presented . The imagery is received at CCMEP in NetCDF format and is then converted into the gridded in-house latitude-longitude format. Making it available in the in-house format allows users to easily access and process GOES-16 data using the extensive and familiar suite of CCMEP data processing tools. Products previously derived from GOES-13 such as cloud parameters (fraction, height) have been adapted to the GOES-16 L1b data and can be compared to corresponding L2 products from NOAA. The availability of gridded GOES-16 L2 products also allows users to compare these with corresponding NWP or Analysis variables. Examples will be presented, for example the NOAA Land Surface Temperature product against the Caldas surface analysis

temperature. An update on plans to modernize the Nowcasting system using GOES-16 data will also be presented.

Session 1803040 - The Canadian Climate and Atmosphere Research (CCAR) Program - Part 1
The NETCARE Project: Studying the relationships between aerosol particles and climate in remote Canadian environments
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The Arctic is widely recognized to be a bellwether for climate change, with a variety of amplification mechanisms leading to enhanced sensitivity to global warming. In the winter and spring, long range transport of pollution and slow deposition mechanisms prevail, giving rise to the Arctic Haze phenomenon. In the summer, the sea ice extent is severely reduced thus exposing wide expanses of open ocean. Funded by NSERCs Climate Change and Atmospheric Research program, NETCARE (The Network on Aerosols and Climate: Addressing Fundamental Uncertainties in Remote Canadian Environments) has been conducting research into the connections between aerosols and climate of the past five years, with a focus on Arctic and other marine environments. This presentation will provide an overview of the research activities within NETCARE. Emphasis will be given to key observations from in situ field campaigns conducted from icebreaker, aircraft and ground platforms, and from modeling efforts using both earth system and chemical transport models. Particular emphasis will be given to characterizing Arctic Haze pollution and identifying its sources, and on the profound influence exerted by biology on the summertime atmosphere when long-range pollution sources have relatively less impact.

Session 1803040 - The Canadian Climate and Atmosphere Research (CCAR) Program - Part 1
Improving seasonal forecasts via dynamical downscaling
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An early warning system, using skillful seasonal forecasts and with reasonable lead-time, could have enormous benefits for socio-economic sectors that are sensitive to weather and climate conditions. With this in mind, CanCM4 global ensemble seasonal summer forecasts are dynamically downscaled to produce ensemble of high resolution regional seasonal forecasts over North America using the Canadian Regional Climate Model (CRCM5). CRCM5 forecasts are initialized on May 1st of each year and are integrated for 4 months for the 1979-2012 period at 0.220 resolution to produce a one to three-month lead-time forecast. The global and regional ensemble forecasts are then verified to investigate the skill and economic benefits of dynamical downscaling. Results indicate that both global and regional climate models produce skillful temperature forecasts over western North America and northeastern Canada. In comparison to CanCM4 forecasts, CRCM5 forecasts improved the temperature forecast skill, by reducing the systematic warm bias over central U.S. and by improving the inter-annual variability. CRCM5 forecasts also yield better economic value compared to CanCM4 for both cold and warm categorical forecasts, for all ranges of cost-to-loss ratio. The improved downscaled forecasts are then applied for predicting energy demand over eastern Canada, using established relationship between energy demands and cooling degree days. We demonstrate that skillful

predictions of energy demands are achievable at one-month lead time. This implies that decision makers in energy sector can use this information for improved resource allocation.

Session 1803040 - The Canadian Climate and Atmosphere Research (CCAR) Program - Part 1
Probing the Atmosphere of the High Arctic (PAHA)
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The overall aim of the PAHA network of the Canadian Climate and Atmospheric Research (CCAR) program of the Natural Sciences and Engineering Research Council (NSERC) is to address the issue of the variability of the atmosphere in the Canadian High Arctic.

PAHA has three major themes: Composition Measurements (CM), Polar Night (PN) and Satellite Validation (SV). It strength is derived from the ability to use a comprehensive, well-calibrated set of measurements from the High Arctic in multiple ways to produce multiple outcomes. Many of the issues being looked at are complex with many facets, for example precipitation is a player in both composition and polar night.

Many of the scientific investigations of PAHA are conducted based on a measurement program at the Polar Environment Atmospheric Research Laboratory (PEARL) at Eureka, Nunavut. PEARL measurements and their analyses are unique in Canada and are of direct relevance to critical government programs in the area of High Arctic atmospheric research. These measurements also provide irreplaceable support for the validation of satellite instruments on Canadian and international platforms.

This talk will provide an overview of the research of PAHA as it wraps up its (first?) five-year program of research. It will highlight the successes and challenges of research involving the High Arctic, and also lay out the vision of the future of the network.

PAHA is funded by the CCAR program of NSERC and supported by Environment and Climate Change Canada (ECCC). PEARL is currently also supported by NSERC, ECCC and the Canadian Space Agency.

Session 1803040 - The Canadian Climate and Atmosphere Research (CCAR) Program - Part 1
Overview of the Canadian Sea Ice and Snow Evolution Network (CanSISE)
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The Canadian Sea Ice and Snow Evolution Network (CanSISE) is a climate research network focused on developing and applying state of the art observational data to advance dynamical prediction, projections, and understanding of seasonal snow cover and sea ice in Canada and the circumpolar Arctic. The CanSIS Network develops three themes focused on seasonal to multidecadal timescale climate prediction; process level understanding of snow, sea ice, and related climate variables; and climate impacts and event attribution for extremes related to snow and sea ice. The

deliverables of the network have included 1) an assessment of Canada's earth-system model and climate prediction system (CanESM2 and CanSIPS), 2) an analysis of past trends (1981-2015) and projected trends (2020-2050) in Canadian snow and sea ice, 3) a synthesis that seeks to attribute recent climate extremes to human and natural influences, and 4) an assessment of future observational needs to advance predictions in these areas. CanSISE demonstrates the strengths of the "climate-process team" framework in which a network of researchers bridging observational and modelling communities focus on a related set of processes in evaluation of earth-system models and climate-prediction systems. Our research highlights the benefits of updated multi-source observational datasets for climate prediction, monitoring, and assessment.

Session 1803040 - The Canadian Climate and Atmosphere Research (CCAR) Program - Part 1

Advances made in understanding, representing and communicating earth system processes in weather and climate within CNRCWP

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The Canadian Network for Regional Climate and Weather Processes (CNRCWP) led to significant advances and innovative research towards the ultimate goal of reducing uncertainty in numerical weather prediction and climate projections for Canada's Northern and Arctic regions. This talk will provide an overview of the Network achievements and selected results related to the assessment of the added value of high-resolution modelling that has helped fill critical knowledge gaps in understanding the dynamics of extreme temperature and precipitation events and the complex land-atmosphere interactions and feedbacks in Canada's Northern and Arctic regions. In addition, targeted developments in the Canadian regional climate model that facilitated direct application of model outputs in impact and adaptation studies, particularly those related to the water, energy and infrastructure sectors will also be discussed. The close collaboration between the Network and partners from federal government labs, industry and not-for-profit organizations, as well as end users contributed significantly to this effort.

Session 1803040 - The Canadian Climate and Atmosphere Research (CCAR) Program - Part 1

Investigation of the mechanisms leading to the 2017 Montreal flood

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Significant flood damage occurred near Montreal in May 2017, as flow from the upstream Ottawa river basin (ORB) reached its highest levels in over 50 years. Analysis of observations and experiments performed with the fifth generation Canadian Regional Climate Model (CRCM5) show that much above average April precipitation over the ORB, a large fraction of which fell as rain on an existing snowpack, increased streamflow to near record-high levels. Subsequently, two heavy rainfall events affected the ORB in the first week of May, ultimately resulting in flooding. This heavy precipitation during April and May was linked to large-scale atmospheric features. Results from sensitivity experiments with CRCM5 suggest that the mass and distribution of the snowpack

have a major influence on spring streamflow in the ORB. Furthermore, the importance of using an appropriate frozen soil parameterization when modelling spring streamflows in cold regions was confirmed.

Event attribution using CRCM5 showed that events such as the heavy April 2017 precipitation accumulation over the ORB are between two and three times as likely to occur in the present-day climate as in the pre-industrial climate. This increase in the risk of heavy precipitation is linked to increased atmospheric moisture due to warmer temperatures in the present-day climate, a direct consequence of anthropogenic emissions, rather than changes in rain-generating mechanisms or circulation patterns. Warmer temperatures in the present-day climate also reduce early-spring snowpack in the ORB, offsetting the increase in rainfall and resulting in no discernible change to the likelihood of extreme surface runoff.

Session 1803041 - The Canadian Climate and Atmosphere Research (CCAR) Program - Part 2
Modeling ²³⁰Th as an approach to study the intermediate circulation in the Arctic Ocean

Session 1803041 - The Canadian Climate and Atmosphere Research (CCAR) Program - Part 2
Cloud Condensation Nuclei over remote Canadian Arctic ocean during Summer: Results from Amundsen ship cruise of 2016
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Atmospheric particles which have the capability to act as a nucleus for condensation of water vapour, under specific conditions, are called cloud condensation nuclei (CCN). CCN characteristics within the atmospheric boundary layer have complex effects on microphysical processes within clouds and hence climate through aerosol-cloud interactions. In the Arctic, these CCN play a significant role, affecting regional climate in various ways, and hence investigation of its physical properties, possible sources and its climate impacts are more important over this region. In spite of this, CCN properties are not well studied over the Arctic, especially during the summer time, when the Arctic remains pristine with little advection from lower-latitude regions. With this perspective, in the current study we present CCN measurements carried out onboard the CCGS Amundsen cruise over the Canadian Arctic Archipelago during the summer of 2016 as a part of the NETCARE project. The spatial and temporal characteristics of CCN are presented and the results are compared with data available for the same oceanic region during the 2014 Amundsen cruise. Our study showed high CCN concentrations over the northern part of the Canadian Arctic Archipelago, and greater variability when compared with data from 2014. To identify the activation efficiency of ambient particles, and relative increase in the hygroscopic growth of particles in the study region, hourly averaged activation ratios (CCN/CN) at different supersaturations were also examined. Detailed analysis of the CCN data, number concentration, air parcel trajectories influencing the study area and CCN response to the new particle formation events will be presented.

Session 1803041 - The Canadian Climate and Atmosphere Research (CCAR) Program - Part 2

The role of terrestrial snow in climate variability and change: emerging insights from the CanSISE network

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Snow covers about 50 million km^2 (roughly 10%) of Earths surface during northern winter. The high albedo of snow relative to snow-free ground has profound implications for the surface energy budget. The terrestrial snowpack also provides a major storage term that controls the seasonal cycle, and long-term trends, in the surface water budget. Anthropogenic warming of the climate system is expected to cause dramatic reductions in the extent, and amount, of terrestrial snow during the 21st century. In this talk, I will review our contributions to the Canadian Sea Ice and Snow Evolution (CanSISE) network in furthering our understanding of the role of snow in climate variability and change. Specifically, I will focus on the snow albedo feedback mechanism, through the lens of several projects investigating the role of snow masking by evergreen forests. Key insights have emerged through systematic use of blended observational datasets, and through the development and interrogation of new and existing archives of simulations with earth system models (ESMs). Our work has led to demonstrable improvements in the simulation of snow and surface albedo over the northern extratropics in two leading land surface models, which are expected to yield improved global climate simulations in ESMs. I will conclude with a discussion of ongoing research in this area, and some of the remaining challenges to be addressed.

Session 1803041 - The Canadian Climate and Atmosphere Research (CCAR) Program - Part 2

Sensitivity of Labrador Sea Water formation to changes in model resolution, atmospheric forcing and freshwater input

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Labrador Sea Water (LSW) is one of the main contributors to the lower limb of the Atlantic Meridional Overturning Circulation (AMOC). In this study we explore the sensitivity of LSW formation to (i) model resolution, (ii) freshwater input from the Greenland Ice Sheet (GrIS), (iii) absence of high frequency atmospheric phenomena and (iv) changes in precipitation. We use five model simulations run with Nucleus for European Modelling of the Ocean (NEMO v3.4) at both, 1/4° and 1/12° resolution. A kinematic subduction approach is use to obtain the LSW formation rate over the period 2004 to 2016. The Control simulation, with 1/4° resolution, showed a total LSW formation rate of 1.9 Sv in the density range of 27.68 - 27.80 kg/m 3 for the period 2004-2016. Deep convection events that occurred during 2008, 2012 and 2014-2016, were captured. We found that with 1/4° resolution the LSW formation rate is 19% larger compared with its counterpart at 1/12° resolution. The presence of Greenland melt and an increase in the precipitation do not affect the LSW formation significantly, but rather decreases the density of the water formed. A dramatic response was found when filtering the atmospheric forcing which induced a decrease of 44% in heat loss over the Labrador Sea, strong enough to halt the convection and decrease the

LSW formation rate by 89%. A decrease in the storms crossing the Labrador Sea with a consequent reduction in the winter heat loss, might be a bigger threat to deep convection and LSW formation in the future than the expected increases in the freshwater input.

Session 1803041 - The Canadian Climate and Atmosphere Research (CCAR) Program - Part 2
VITALS - Ventilation, Interactions and Transports Across the Labrador Sea
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The VITALS (Ventilation, Interactions and Transports Across the Labrador Sea) research network was a funded NSERC CCAR project that is now winding down. Our goal was to answer fundamental questions about how the deep ocean exchanges carbon dioxide, oxygen, and heat with the atmosphere through the Labrador Sea. Our working hypothesis was that deep convection in the Labrador Sea, which allows for exchange of oxygen and natural and anthropogenic carbon to the deep ocean, is sensitive to the warming that is taking place at high latitudes. Evaluating and quantifying this sensitivity was central to our research network and also the broader community of climate change researchers and policy makers interested in characterizing, and possibly minimizing, the effects of global climate change. New observations, including biogeochemical, include those collected from a SeaCycler moored in the interior of the Labrador Sea, additional moorings, gliders and floats as well as ship-board measurements and remote sensing. Combined with numerical modelling at a variety of scales and resolutions, we examined what controls these exchanges and how they interact with a varying climate, in order to resolve the role of deep convection regions in the Carbon Cycle and Earth System. VITALs is a pan-Canadian initiative involving scientists from 11 Canadian universities as well as multiple federal government laboratories (Fisheries and Oceans Canada, as well as Environment Canada), industrial and foreign partners. This presentation will provide highlights of the project and some of its more interesting findings.

Session 1803041 - The Canadian Climate and Atmosphere Research (CCAR) Program - Part 2
The Changing Cold Regions Network: Atmospheric, Cryospheric, Ecological and Hydrological Change in the Saskatchewan and Mackenzie River Basins, Canada
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The interior of western Canada is a region on the forefront of rapid, widespread, and severe hydroclimatic and environmental change. The Changing Cold Regions Network (CCRN) is one of seven Canadian research networks funded under the NSERC Climate Change and Atmospheric Research (CCAR) initiative over the period 2013–18. CCRN has been devoted to addressing key challenges and globally-important issues facing cold regions by improving the understanding of past and ongoing changes in climate, land, vegetation, and water, and predicting their future integrated responses, with a geographic focus on the Saskatchewan and Mackenzie River Basins. Specifically, the network has advanced science on:

1. Documenting and evaluating observed Earth system change, including hydrological, ecological, cryospheric and atmospheric components over a range of scales from local observatories to biome and regional scales;

2. Improving understanding and diagnosis of local-scale change by developing new and integrative knowledge of Earth system processes, incorporating these processes into a suite of process-based integrative models, and using the models to better understand Earth system change;

3. Improving large-scale atmospheric and hydrological models for river basin-scale modelling and prediction to better account for the changing Earth system and its atmospheric feedbacks; and

4. Analyzing and predicting regional and large-scale variability and change, focusing on the governing factors for the observed trends and variability in large-scale aspects of the Earth system and their representation in current models, and the projections of regional scale effects of Earth system change on climate, land and water resources.

CCRN has worked collaboratively to apply and transfer the improved knowledge, modelling tools and results to Canadian government and other stakeholders, and to support land and water management in the context of changing climate and economic demands. CCRN has also been engaged internationally, including links to NASA, the National Center for Atmospheric Research, and the World Climate Research Programme (WCRP). It has led North America's contribution to WCRP's Global Energy and Water Exchanges (GEWEX) Project as the only current North American Regional Hydroclimate Project. This presentation will describe CCRN and its overarching achievements, as well as future directions following on from this work in the Global Water Futures programme and in engagement with WCRP and other partners.

Session 1803050 - Fog or Low Visibility - Part 1

The Application of Monitoring and Forecasting to Harsh Marine Environment Decision Making

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Working in a harsh marine environment with pervasive fog and high seas necessitates complex environmentally-dependent logistical planning. For example, visibility conditions and forecasts can impact helicopter operations and determine whether personnel will need to be transferred by ship. High sea state conditions can affect offshore oil and gas exploration and production operations, including drilling, logistics, crane operations and emergency response. Improved visibility and sea state forecasting directly translates into better decision making in this environment.

An open and collaborative multi-year Metocean Research and Development Project is presently in its fourth year. The goal of the project is to improve visibility and sea state forecasting for the Grand Banks of Newfoundland & Labrador. Some twenty government, academic, and industry agencies are participating in this project.

Detailed buoy and offshore installations-based scientific measurements have been collected where previously there has been a lack of good quality

observations. Work is presently underway to collect additional detailed monitoring data that can be used to improve the accuracy and consistency of existing and developing visibility and sea state prediction systems. A conceptual model of Grand Banks fog has been developed, that defines the physical conditions under which fog develops, is maintained, moves and dissipates. The conceptual model will be the basis for the development of new visibility prediction systems which currently are not well established or verified. Sea state prediction systems are being improved for severe ocean wave conditions where they have reduced predictive skill.

The paper will describe a theme of the Metocean Research and Development project, which is environmentally-dependent decision making in an offshore industrial context. The paper will illustrate why unique metocean monitoring data are being collected, and how the forecasting techniques being developed (e.g. numerical atmospheric and oceanic prediction models, satellite-based schemes, and rules based systems), will be used to improve offshore operational planning.

Session 1803050 - Fog or Low Visibility - Part 1
Fog and aerosol microphysics on the coast of Nova Scotia
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Fog reduces visibility, causing delays in transportation by land, sea and air. It is also a safety hazard that results in accidents that are sometimes fatal. Like cloud droplets, fog droplets form on cloud condensation nuclei, existing aerosol particles in the atmosphere that have the ability to activate into droplets. The interactions between aerosols and water vapour can determine the formation and persistence of fog, which makes fog forecasting challenging. In addition, visibility, or extinction, fundamentally depends on fog droplet size and number concentration, although various parameterizations exist that are dependent only on meteorological variables. This study presents results from fog studies conducted near Halifax, Nova Scotia during the spring of 2016. Observations of aerosol size distributions and chemical composition were conducted using a ground-based counter flow virtual impactor, which allowed the droplet residuals to be measured directly. Fog droplet size distributions, visibility and other meteorological variables were also measured at the same time. Aerosol and droplet microphysical parameters will be presented including the influence of air mass history. Preliminary results show that aerosol growth may be contributing to the dissipation of fog under some conditions, suggesting that despite the importance of atmospheric dynamics on fog formation and dissipation, aerosols can also play an important role in the life cycle of fog.

Session 1803050 - Fog or Low Visibility - Part 1
Examining the sensitivity of the radiative properties of modelled low clouds in the summer Arctic to cloud droplet number concentration
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Cloud droplet number concentrations (CDNC) typically found in the summer Arctic tend to be low, due to relatively clean regional conditions and a reduced influx of pollution from lower latitudes. At lower CDNC, the cloud liquid water content (LWC) may have a higher sensitivity to changes in CDNC. We examine

some uncertainties in the modelling of low clouds and fogs that are important for the radiative balance in the Arctic summer. We compare observations from the 2014 flight campaign conducted by the Network on Climate and Aerosols: Addressing Key Uncertainties in Remote Canadian Environments (NETCARE) to simulations from the Single Column Model of Arctic Boundary Layer Clouds (SCM-ABLC) and version 18 of the CCCma radiative transfer model. The model simulations are initialized by profiles from the observations. We quantify how three different autoconversion schemes, which parameterize the transition from cloud droplets to raindrops, affect the comparison of the modelled relationship between LWC and CDNC with that derived from observations. The responses of the cloud radiative balance to the three autoconversion parameterization schemes and CDNC are examined.

Session 1803050 - Fog or Low Visibility - Part 1
Microphysical Characteristics of Marine Fog Offshore Newfoundland
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Fog occurs frequently offshore of Newfoundland and Labrador reaching 50% of the time during the summer. In order to understand the formation and dissipation mechanisms of marine fog, measurements of the drop size distribution have been made from an offshore oil and gas platform. This includes measurements of the fog liquid water content and droplet number concentration. A Droplet Measurement Technology FM-120 instrument was used. The dependence of the fog microphysical characteristics on wind direction, wind speed, time of day, etc., will be given in this presentation for June and July of 2016 and 2017. Measurements of fog characteristics in the open ocean are rare and difficult to obtain, and it is believed that this data is very unique. The results from this location will be compared with other work which has been done around the world. Some comparisons with satellite measurements will be made. The importance of knowing fog characteristics will be discussed including how it impacts fog forecasting techniques. Future work will be outlined.

Session 1803050 - Fog or Low Visibility - Part 1
Boundary layer and WRF-SCM modelling of marine fog
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Together with boundary layer turbulence, radiational heating/cooling and cloud microphysics play an important role in the fog formation processes. In early nocturnal boundary-layer modelling studies, longwave radiation is often calculated using an emissivity or grey-body approximation (Barker, 1977; Garratt and Brost, 1981; Duynkerke and Driedonks, 1988). Models such as WRF (and WRF-SCM) however use radiation models with multiple wavelength bands, including the RRTM (Rapid Radiative Transfer Model). Over deep layers of the atmosphere where absorption by CO2 and water vapor are important the spectral treatment of long wave radiation is important while in shallow fog layers a grey body approach may suffice when water droplets are the main radiatively active element.

Over the Grand Banks a key factor in fog formation is the advection of moist air from over warm gulf stream waters to colder Labrador current water -an internal boundary-layer problem. Some basic fog properties and the sensitivity to model parameters, initial and boundary conditions, can be learned from 1-D time

dependent (z,t) and 2-D steady state (x-z) models. Results from our boundary-layer modelling will be compared with those obtained with WRF-SCM.

Session 1803051 - Fog or Low Visibility - Part 2
Fog and Low-Visibility Climatology and Regional Controls at Inuvik and Aklavik, Mackenzie Delta, Northwest Territories

Session 1803051 - Fog or Low Visibility - Part 2
Mapping fog in regional climate change simulations based on shared true variance in ICOADS ship observations and ERA Interim visibility estimates
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Parameterizations of visibility associated with marine fog in the North Atlantic and Arctic regions are evaluated with reference to International Comprehensive Ocean-Atmosphere Data Set (ICOADS) ship observations during 1979-2004. A reliable parameterization of visibility for the European Centre for Medium-Range Weather Forecasting (ERA Interim) reanalysis of temperature and dew point is sought by maximizing ERA-ICOADS shared truth, as given by a new regression model called INFERS. The selected parameterization is then applied to a dynamical regional downscaling system based on long-time simulations of the Weather Research and Forecasting (WRF) model. Because downscaling is based on coarse-resolution GCM estimates, systematic differences between ERA Interim and WRF visibility are addressed using cumulative distribution function (CDF) matching. A successful reproduction of seasonal and diurnal variations in WRF fog frequency (or visibility less than 1km) is found for 1979-2004. Subject to the caveat that an ERA/WRF visibility parameterization can capture about half of the variance seen in observations, an initial exploration of fog for downscaled regional climate change simulations through 2099 is given.

Session 1803051 - Fog or Low Visibility - Part 2
Fog Trend and Interannual-to-Decadal Variability
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An analysis is presented of the marine fog trends based upon the International Comprehensive Ocean-Atmosphere Data Set (ICOADS) ship observations taken during 1950–2007. The world’s two most frequent marine fog occurrences are at the NW Oceans centered on the Kuril Islands and the Grand Banks during the summer. These regions are covered by a high number of ship observations which allows an examination of fog trend as related to the interannual to decadal variability. Biannual mean and standard deviations show that trends and interannual-to-decadal variability are beyond the noise level of the observations. Climate indices and fog frequency data are related on long-term (10-year moving averages) and short-term (biannual) time scales. In the Kuril Islands region, fog frequency decadal variability is positively and strongly correlated (0.932) to the Pacific Decadal Oscillation (PDO) index. In the Grand Banks region, fog frequency decadal variability is positively correlated (0.792) to the North Atlantic Oscillation (NAO) index on a 10-year moving average. Also in the Grand Banks region, fog occurrence decadal variability is positively correlated (0.792) to the Atlantic Multidecadal Oscillation (AMO) index on a 10-year moving average. In this study, we postulate the weather and atmospheric dynamical reasons supporting such strong long-term relationships.

Session 1803051 - Fog or Low Visibility - Part 2

Observation of a decreasing marine and coastal fog frequency in Atlantic Canada over the past six decades due to possible changes in large-scale atmospheric features

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The main formation mechanism of marine and coastal fog is the cooling of warm and moist air advected over a colder sea surface. The proximity of cold and warm water currents that provides the required contrast makes Atlantic Canada one of the foggiest regions of the world. The frequent resulting low visibility notably disrupts off-shore operations and marine traffic, but also land and air transportation when the fog is transported over land. On a longer time-scale, fog can also impact agriculture, disease transmission and the global radiative budget. Clouds, including fog, are the greatest source of uncertainty in climate projections because of their complex feedback mechanisms. Meteorological records indicate that the occurrence of foggy conditions has been decreasing over the past six decades at most airports in Atlantic Canada, with large internal variability, including interannual and interdecadal variations. Using the observations, reanalysis data and climate model outputs, we investigate the various variabilities on the trend, at interannual and interdecadal scales, and attempt to address what caused these changes in fogginess. In addition, we also investigate predictions and projections of fog in the different climate scenarios. The influence of large-scale atmospheric features, such as the North Atlantic Subtropical High, as well as predominant atmospheric circulation modes, on fog in Atlantic Canada will be discussed.

Session 1803051 - Fog or Low Visibility - Part 2

Marine Fog Prediction at the Naval Research Laboratory – Current Status, Challenges and Way Forward

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A reduction of visibility by fog over bodies of water and coastal areas remains a formidable challenge for maritime operations. The ability to accurately forecast spatial and temporal characteristics of fog and related visibility is critical. Accuracy in fog prediction is a challenge for current-generation Numerical Weather Prediction (NWP) models in part because of the varied spatial scales and complex interaction of the governing processes in space and time.

Maritime fog is inherently an air-sea interaction problem. The formation, duration, and dissipation of fog, and its spatial extent, are closely linked to the processes at the air-sea interface. The state-of-the-science fully coupled air-sea system (COAMPS®) is a unique tool capable of representing the processes at the air-sea interface. Based on the International Comprehensive Ocean-Atmosphere Data Set (ICOADS) we identified two regions globally with the highest occurrence of the maritime fog. We have conducted deterministic simulations using both coupled ocean-atmosphere, and uncoupled (atmosphere only) COAMPS.

A new method for probabilistic forecast based on deterministic operational-like forecasts (non-ensemble) will be presented. The method is evaluated against in-

situ observations contained in ICOADS. We will discuss the results and the sensitivity to the input parameters when using the new method.

Session 1803051 - Fog or Low Visibility - Part 2
Use of Geographic Information Systems in the assessment of potential for highway blowing and drifting snow
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Blowing and drifting snow conditions in northern climates such as Canada, pose a significant low visibility risk to public safety and can incur costly maintenance fees particularly for the road transportation sector. The ability to estimate and forecast blowing or drifting snow conditions along a proposed or existing transportation corridor such as a highway is therefore imperative to reducing these risks and costs. In addition to reduced maintenance costs, indirect benefits include reduced accidents, fewer road closures and reduced environmental contamination by road salt spray and runoff.

This paper presents a case study of the use of GIS (Geographic Information Systems) to analyze publicly available open datasets, in conjunction with local historical meteorological data and snowdrift potential calculations, in the assessment of the potential for localized highway blowing and drifting snow hazards. The methodology used in the case study is applicable to both proposed and existing highway scenarios and can identify areas that are/will be susceptible to potentially high snow drifting conditions, even as early as during the initial design phase of projects. Once hazardous areas are identified, the design team can evaluate different mitigation options targeted at reducing the potential for blowing and drifting snow. Anticipative mitigation can help to reduce overall winter road maintenance requirements (snow clearing and deicing operations); which has direct (reduced capital cost) and indirect cost savings/benefits. This paper also evaluates other recent blowing snow and drifting studies, including methodologies and practices, as well as future research opportunities; how automated and localized blowing and drifting snow forecast/warning systems could be developed.

Session 1803060 - Air Quality: Modeling and Monitoring of Cumulative effects
Spatial and temporal trends in atmospheric Carbon Monoxide over Canadian cities
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We document spatial and temporal trends in Carbon Monoxide (CO) over Canadas 13 provincial/territorial capitals and selected other cities, based on observations from the MOPITT instrument since the start of the 21st century. There is significant variability in overall total column CO between cities. This is partially explained by the population of the city in question, although proximity/exposure to other polluting areas, both within and external to Canada, clearly also plays a role. All cities have experienced a decrease in observed total column CO this century, but the magnitude of this decrease varies by city and by season. Of particular note, the decline is weakest in the summer season, with some cities actually experiencing no change, or even a slight increase, in total column CO.

Next, we use MOPITT CO mixing ratio profile data, informed by metrics on the information content of the data at each of the 10 vertical levels that this is retrieved, to derive partial column CO amounts for the lower and upper troposphere. We use these two measures to determine whether the observed differences between cities (both in terms of overall total column CO and temporal trend) are due to differences in local CO emissions (lower partial column), or the amount of CO transported over them from other sources (upper partial column). This is supported by analysis of air parcel back trajectories from the HYSPLIT model.

Session 1803060 - Air Quality: Modeling and Monitoring of Cumulative effects
Deposition Mapping of Polycyclic Aromatic Compounds in the Athabasca Oil Sands Region and Links to Cumulative Ecosystem Effects
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Wildlife monitoring in the Athabasca oil sands Region (AOSR) has revealed that species are exposed to polycyclic aromatic compounds (PACs), some of which are known carcinogens and mutagens. Atmospheric deposition of PACs may be one of the major pathways; the understanding of this process is important towards assessing the impacts of the Alberta oil sands development on ecosystems. We mapped the dry and wet deposition fluxes of PACs including polycyclic aromatic hydrocarbons (PAHs), alkylated PAHs, and dibenzothiothenes (DBTs) over northeastern Albertain 2011 and monthly between November 2010 and June 2012. Dry deposition was estimated using an inferential approach based on surface air concentrations and modeled dry deposition velocities (Vd), and was previously applied to estimate dry deposition at three sites in the AOSR (Zhang et al., 2015, J. Adv. ModelEarth Sy.). We treated gas-phase and particulate-phase PACs separately by applying different algorithms for Vd. Wet deposition was derived from surface air concentrations, modeled precipitation amounts, and scavenging ratioscompiled from a previous study (Zhang et al., 2015, Atmos. Chem. Phys.). Scavenging ratios of PACs are treated separately for rain and snow scavenging. Gridded air concentrations were simulated using the CALPUFF dispersion model in a previous study (Qiu et al., 2018, Atmos. Chem. Phys.) and bias-corrected using passive air measurements. Our results show that dry and wet deposition fluxes in northeastern Alberta are dominated by alkylated PAHs. The deposition impact of alkylated PAHs is more widespread and higher overthe downstream northern Athabasca region than PAHs and DBTs.The median to average total deposition of ∑PACs in 2011was between 760 and 1,700 µg m-2yr-1 of which 64% was from wet deposition and 36% was from dry deposition. Analysis of speciation profiles, seasonal deposition, and comparison of near-field and far-field deposition impacts will be included in future results.

Session 1803060 - Air Quality: Modeling and Monitoring of Cumulative effects
Development and Evaluation of Polycyclic Aromatic Compound Emissions in the Athabasca Oil Sands Region
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The assessment of ecosystem impacts from the Athabasca oil sands regions (AOSR) requires identifying and quantifying the pollutant emissions in this region. We developed two emissions databases forpolycyclic aromatic

compounds(PACs)in the AOSR and evaluated eachdatabase by comparing air dispersion modelling results with passive measurements (Qiu et al., 2018, Atmos. Chem. Phys.). The first database was derived from volatile organic compound (VOC) emissions data from Cumulative Environmental Management Association (CEMA) and the second database was derived from additional data collected within the Joint Canada-Alberta Oil Sands Monitoring (JOSM) program.Unsubstituted polycyclic aromatic hydrocarbon (PAH) emissions were estimated from industrial sources including tailings ponds, mine face, mine fleet, and point sources, and from non-industrial sources (residential, commercial, airport and transportation). Alkylated PAH and dibenzothiothene (DBT) emissions were estimated from tailings ponds, mine fleet, and transportation. Comparison between CALPUFF modelledconcentrations and passive measurements show good agreement (model error of 17-30%) in the PAH concentrations near oil sands mines due to updated tailings pond emissions in the JOSM-derived emissions database. However, modelled PAH concentrationsderived from either emissions scenario were underestimated by a factor of 3 at remote locations. Given that the modelled concentrations from simulating emissions, transport and dispersion processes without deposition loss are lower than measurements, the results suggest that the emissions input are conservative or underestimated. This may be due to missing PAH emissions from wildfires, re-volatilization of previously-deposited PAHs and long-range transport, and an underestimation of VOC emissions. The model also significantly underestimated alkylated PAH and DBT concentrations at all sites, which is likely attributed to missing emissions for these compounds and uncertainties in the PAC emissions estimation methods and speciation profiles.

Session 1803060 - Air Quality: Modeling and Monitoring of Cumulative effects
Applying large ensembles to filter out natural variability in air quality health impacts of climate change and climate policy
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Future climate change has significant harmful impacts that policy can mitigate. However, simulations of these impacts and policy benefits are contaminated by noise due to natural variability. One significant impact is the intensifying effect of climate change on air pollution, and its resulting risks to human health. Our recent research has shown that the noise contamination of natural variability in health impacts is comparable to that of uncertainty in health responses, and is of comparable magnitude to policy cost. We filtered out this noise using a multiple-initialization, multi-decadal ensemble of annual fine particulate matter and ozone and assessed the resulting health and economic co-benefits of two global climate policies. However, the resulting thousands of simulations of the climate, atmosphere, and human health are computationally prohibitive for policy analysis. Here, we seek to ascertain the minimum ensemble size needed based on a variety of measures of accuracy. We average an increasing number of simulation years to estimate benefits, determining the minimum number for which various metrics are met. We use three categories of metrics. The first is a relative precision metric: the point at which the spread in estimates due to natural variability alone falls within the 95th confidence interval due only to health-related and economic-related uncertainty. The second relates to the distinguishing the policy signal: the point at which the policy scenarios can be distinguished from the reference (based on the combined range due to natural variability and health and economic uncertainty). The third is based on convergence: the point at which additional simulations yield diminishing returns in accuracy (compared to using

the full ensemble). We assess the variation of these results with location and timing. We use these findings to provide recommendations on modeling the pollution-related health impacts of climate change and climate policy.

Session 1803060 - Air Quality: Modeling and Monitoring of Cumulative effects
The impacts of lake –breeze circulation on ground ozone (O3) concentration
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This study is mainly focused on three high ozone episodes occurred in summer of 2015 and 2017. Besides the favourable meteorological conditions, it was suggested that the lake breeze circulation had a significant impact on O3 concentration. Despite the similar meteorological background, O3 levels at sites within the lake breeze circulation can be much higher than O3 levels outside of the lake breeze circulation due to the advection of O3 rich air from over the lake. The further studies about the quantitative relationship between the strength of lake breeze circulation and increase of O3 concentration can greatly improve the air quality operational forecast.

Session 1803070 - Convection and Cloud Physics
Mesoscale Boundaries and Convective Storm Development in Southwestern Ontario
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The relationship between low-level mesoscale boundaries and convective storm development was studied using data collected during summer 2001 in southwestern Ontario. This region presents a unique mesoscale boundary environment due to the frequent presence of lake-breeze fronts originating from surrounding lakes, including three Great Lakes.

Mesoscale boundaries were identified using an integrated data set including radar and satellite imagery and surface station observations. Radar data were run through storm cell identification (reflectivity threshold of 40 dBZ) and tracking algorithms. The distances between the storm cells and the closest mesoscale boundary were measured. When considering days with no influence from warm frontal zones, it was found that more than 75% of cells developed within 30 km of a low-level mesoscale boundary. When considering only moving boundaries and storm gust fronts it was found that cell initiations occurred most frequently just behind these boundaries. However, for lake-breeze fronts, the cell initiations occurred most frequently just ahead of these boundaries.

The findings of this study are similar to those from a previous study on mesoscale boundary-initiated storms in eastern Colorado, by Wilson and Schreiber in 1986, but it has revealed new findings related to lake-breeze fronts. These results can be used by forecasters and automated forecasting algorithms in order to aid and improve predictions of storm development.

Session 1803070 - Convection and Cloud Physics
Advancing Cloud Microphysics Observations in Cold Polar Air Formation
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Optically thin ice clouds (TIC) processes are still poorly represented in atmospheric models. It is now recognized that anthropogenic aerosols can alter cloud microphysics and precipitation. In addition to filling a cloud observation gap at high latitudes, the deployment of CloudSat and CALIPSO satellites also highlights the ubiquity of TIC and aerosols during the polar night. These missions are followed by a new generation of sensors that include EarthCARE, S5P-TROPOMI and ADM-ALADIN with active instruments for the characterization of aerosols and polar clouds. These clouds, sensitive to aerosols via ice nucleation, can significantly modulate the amount of far-infrared (FIR) radiation escaping the Earth, and consequently the temperatures in the upper and mid troposphere. Theoretical calculations demonstrated that the atmospheric FIR spectrum could provide, via data assimilation and climate simulations, valuable weather forecasting information on water vapour content, the microphysical characteristics of ice clouds and light precipitation, especially in dry and cold regions. In the context of the Year Of Polar Prediction (YOPP) and in collaboration with CSA, NETCARE, CANDAC, AVATARS and SACIA, we have, with the deployment of the Far IR Radiometer (FIRR), initiated new measurements in the mid and far-IR range (8-50 μm) to increase our knowledge of the water cycle in the High Arctic. FIRR observations have been made at 0PAL (PAHA) in Eureka and will soon, as part of YOPP, be complemented by a measurement program at the supersite in Iqaluit (ECCC). This is an overview of the FIRR results in support of a TICFIRE satellite instrument, a CSA mission project endorsed by YOPP, aimed at enhancing observations and predictions of cold air formation particularly around the Polar vortex, source of strong cold spells during recent winters over North America and Europe.

Session 1803070 - Convection and Cloud Physics
Tropical rainfall variance in a modified version of the Community Atmosphere Model
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One of the most important climate model diagnostics is the monthly mean precipitation pattern. There are, however, a wide variety of organized propagating rainfall modes in the tropics, and it is important that the rainfall modes that contribute to the observed rainfall climatology be properly represented in models. The rainfall dynamics of a climate model are mainly determined by its convective parameterization. This talk will discuss the current status of the implementation of a new convective parameterization in version 4 of the Community Atmosphere Model. In particular, it will focus on its representation of convectively coupled equatorially trapped shallow water modes, such as Kelvin waves. We show that the representation of these waves can be improved if the convective mass flux of a model column is explicitly coupled to the local grid scale vertical motion.

Session 1803070 - Convection and Cloud Physics
SACIA investigation into UTLS aerosol-cloud interactions during the polar winter
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The properties of aerosols, acting as CCN (cloud condensation nuclei) and IN (ice nuclei) in the formation of polar cloud particles, have a profound influence on the microphysical, optical and radiative forcing properties of clouds in this fragile environment. One of the objectives of the SACIA (Signatures of Aerosol-Cloud Interaction over the Arctic) project is the investigation of cloud formation

mechanisms in the Upper-Troposphere/Lower-Stratosphere. This will be accomplished using the CPR (Cloud Profiling Radar) aboard the CloudSat satellite and the CALIOP lidar aboard the CALIPSO satellite along with the ALADIN Doppler lidar on the ADM-Aeolus satellite and the TROPOMI imager on board the Sentinel-5P satellite for the identification and characterization of clouds and aerosols. ALADIN, a high spectral resolution lidar, will, in particular, provide a measurement of the lidar ratio, a parameter that is intrinsically related to aerosol and cloud types. TROPOMI is expected to provide better sensitivity and spatial resolution than its heritage sensor on the Aura satellite (the OMI UV spectrometer). Thanks to its bands in the visible spectrum, TROPOMI will also provide more reliable SSA (single scattering albedo) retrievals. This product will provide supplementary aerosol characterization information (a product that was previously only available using OMI/MODIS synergy). Since the TROPOMI data is not yet available and the ADM-Aeolus satellite is not yet launched, we currently use OMI/MODIS as a TROPOMI proxy and CALIOP instead of ALADIN. Our ALADIN proxy strategy exploits the CloudSat/Calipso DARDAR products, to estimate the lidar ratio. In addition, we employ the Raman lidar, cloud radar and radiosonde profiling measurements at the high latitude (80oN) PEARL (Polar Environment and Atmospheric Research Lab) to compare and evaluate the satellite measurements acquired during nearby overpasses. We will present an investigation into UTLS cloud formation processes over the Arctic during the stratospheric (Kasatochi) volcanic event of 2008.

Session 1803070 - Convection and Cloud Physics
Lidar measurements of thin layers at high resolution within Arctic clouds
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The Canadian Network for the Detection of Atmospheric Change (CANDAC) Rayleigh-Mie-Raman lidar (CRL) makes observations at the Polar Environment Atmospheric Research Laboratory (PEARL) at Eureka, Nunavut in the High Arctic at high time (1 minute) and altitude (7.5 metre) resolution from 500 m to 12+ km altitude.

During the 2016, 2017 and 2018 polar sunrise seasons, for more than one third of all measured days with instances of clouds below 4 km we observe sets of thin layers, each < 15 m vertical extent, stacked 7 or more together within a single cloud. These were found by carefully considering the simple parameter: range-scaled photocounts (counts*altitude^2).

We usually produce depolarization parameter and backscatter coefficient, which are physically-meaningful quantities and are comparable between instruments but these require co-adding and so we are limited to 10 min. x 35.5 m resolution.

Range-scaled photocounts profiles are not comparable between lidars, and do not account for laser power variation, but they do allow cloud features to be examined at very high resolution (2 min x 15 m, or better).

Detecting thin layers is important to the interpretation of an atmospheric scene. A layered cloud and the smooth cloud we would infer it to be when measuring or modelling it at lower resolution (i.e. a homogenous cloud having an average of the optical properties of the layered cloud) would contribute differently to the

radiation budget. Further, layers are indicative of multivariate cloud particle distributions, providing insight into microscale processes by which clouds form and evolve: cloud-aerosol interactions, cloud condensation, particle growth, and precipitation. By combining CRLs high and low resolution derived products we can provide necessary context and constraints on cloud interpretations.

This research is currently supported by the Natural Sciences and Engineering Research Council, Environment and Climate Change Canada and the Canadian Space Agency.

Session 1803070 - Convection and Cloud Physics
Convection initiation by lake breeze convergence during the 2015 Environment Canada Pan Am Science Showcase
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Summer lake breezes generated by the Great Lakes often initiate deep moist convection over nearby land areas. To gain insight into the processes underlying the initiation of such convection, two cases of isolated, lake-breeze-forced convection over the Niagara Region during the 2015 Environment Canada Pan Am Science Showcase (ECPASS) are studied (18 July and 15 August 2015). In both events, afternoon deep moist convection was locally initiated by the convergence of Lake Ontario and Lake Erie lake breezes. However, the intensity and depth of the convection differed between the cases, with the August case producing significantly more precipitation than the July case. The two cases are investigated in detail using high-resolution (200 m horizontal grid spacing) Weather Research and Forecasting (WRF) simulations.

Overall, the simulations adequately reproduce the observed diurnal cycle of surface flow, lake breeze convergence, and local convection initiation. Based on the observations and simulations, the two cases exhibited similarly large moist instability (CAPE) in the morning, but the July case experienced strong midlevel warming from large-scale subsidence and warm advection. As a result, a midlevel inversion developed in the afternoon that enhanced convective inhibition and suppressed moist convection. Analysis of the simulated lake breezes suggests that the July case had stronger surface flow convergence than the August case, while the subcloud layer updraft strength was similar between the cases. However, because the July case had increased convective inhibition owing to the aforementioned midlevel warming, convection vigor was reduced. To further evaluate the processes influencing the strength of lake breeze convergence and cloud-layer convection more generally, complementary idealized simulations that systematically vary key environmental parameters are presented.

Session 1803080 - General Session - Atmosphere
Optimal excitation of perturbations on a cylindrical shear region around an axial flow

Session 1803080 - General Session - Atmosphere
Sensitivity Analysis of Spectroscopic Retrievals of Atmospheric Composition
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The Tropospheric Remote Sensing Laboratory (TRSL) uses a Fourier transform infrared (FTIR) spectrometer to record atmospheric trace gas absorption spectra in a horizontal segment of the troposphere at the Earths surface, so called open-path FTIR spectroscopy. Spectra acquired in this way are analyzed using a nonlinear least squares (NLLS) fitting routine implemented using a Levenberg-Marquardt cost function minimization algorithm. A forward model of atmospheric transmittance is used to iteratively adjust the concentration of trace gases and instrumental parameters such that a best fit between measured and forward modeled spectra is achieved. In atmospheric physics, this process is called a retrieval (as opposed to an inversion). The MALT forward model was used to characterize the behaviour of transmittances of NO2, which is an important atmospheric trace gas involved in tropospheric O3 production. Forward model parameters such as NO2 spectral band, spectral window width, interfering water vapour concentration, and atmospheric path length impact the information content of the transmittance spectra with respect to the target gas (NO2) and the stability of the computational retrieval process itself. After finding optimal conditions for attempting to retrieve NO2 from OP-FTIR spectra, we used synthetic NO2 spectra to perform a sensitivity analysis of the impact of errors in assumed retrieval parameters (i.e., target and interfering trace gas initial concentrations, as well as certain instrumental parameters) on retrieved NO2 concentrations.

Session 1803080 - General Session - Atmosphere
Water Vapor Retrievals from the PARIS-IR Arctic Springtime Dataset
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Currently the Arctic is warming at a rate approximately twice that of the global mean. As climate is tied to atmospheric composition, studying changes in trace gas species can lead to a more thorough understanding of the changing Arctic conditions. One instrument that has been used to study atmospheric composition in the Arctic is the Portable Atmospheric Research Interferometric Spectrometer for the InfraRed (PARIS-IR). Between 2004 and 2017 PARIS-IR made measurements on a yearly basis out of the Polar Environment Atmospheric Research Laboratory (PEARL; 80.05° N, 86.42° W) located in Eureka, Nunavut, as part of the Canadian Arctic ACE/OSIRIS Validation Campaigns. These yearly springtime measurement campaigns commence in late February, shortly after polar sunrise, and continue for six weeks into early April. During these campaigns, PARIS-IR recorded one solar absorption spectrum within the range of 750 - 4400 cm-1 every seven minutes, weather permitting.

While prior studies have focused on retrievals of eight trace gas species (O3, HNO3, HCl, HF, CH4, C2H6, N2O and CO) from the PARIS-IR dataset, the focus of this work is the implementation of a ninth retrieval. This additional species is water vapor, chosen for study due to its importance as a greenhouse gas and the positive feedback relationship it exhibits with surface temperature. In this work the implementation of and first results from the PARIS-IR water vapor retrieval will be examined.

Session 1803080 - General Session - Atmosphere
Variation of Precipitation with Elevation on Vancouver Island
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Vancouver Island is essentially a large mountain range of approximately 450 km by 80 km, with elevations as high as 2200m. Precipitation over the interior river basins cannot be accurately quantified, however, as virtually all Environment and Climate Change Canada (ECCC) precipitation observing sites are located around the coastline. Most are at elevations below 100m, and none presently are sited at high elevations. Orographic lifting of approaching weather systems assures that precipitation is heaviest along the southwest flank of the island mountain range. Total annual precipitation at coastal sites vary from a low of 880 mm at Victoria Airport to more than 5000 mm at some locations along the west coast, with 80-90% of this occurring between October and March.

Despite the heavy winter precipitation, most communities along the northeast coastal plain from Victoria to Campbell River experience summer drought conditions due to orographic subsidence and the influence of the sub-tropical Pacific High pressure system that dominates island summers. With global warming exacerbating the frequency and intensity of these drought periods, some communities are contemplating increased water storage of winter/spring streamflow to ensure that summer water needs can be met. This study uses several non-ECCC high-elevation gauge sites to estimate the variation of precipitation with elevation, which might be useful in water storage planning where quantitative data are lacking.

Session 1803090 - ABL Composition, Processes and Surface-Atmosphere Exchange - Part 1
Processes Controlling Summertime Arctic Aerosol Size Distributions

Session 1803090 - ABL Composition, Processes and Surface-Atmosphere Exchange - Part 1
Structure of observable meteorological state variables during transitions in the stably stratified nocturnal boundary layer
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With the help of a hidden Markov model (HMM) the stably stratified nocturnal boundary boundary layer (SBL) can be classified into two regimes: one with moderate to strong winds, weak stratification and mechanically sustained turbulence (wSBL) and the other one with moderate to weak wind conditions, strong stratification and collapsed turbulence (vSBL). The HMM analysis calculates the most likely regime occupation sequence based on the input state variable set of stratification, mean wind speeds, and wind shear which describe the turbulence kinetic energy consumption and production, respectively. Having this state path time series allows for detailed analysis of the changes across state transitions of the state variables observed at tower sites. We present how transitions in the SBL are captured by the HMM analysis and how different meteorological state variables behave in times of turbulence collapse (wSBL to vSBL transition) and turbulence recovery (vSBL to wSBL transitions). The HMM analysis also reveals some results of possible precursors and external forces which might be responsible for transitions in the SBL. Results obtained can potentially be used to develop a new class of parameterisations for the SBL in models for weather and climate.

Session 1803090 - ABL Composition, Processes and Surface-Atmosphere Exchange - Part 1

Monitoring trace gases in downtown Toronto using open-path Fourier transform infrared spectroscopy

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Emissions of greenhouse gases (GHGs) in urban environments can be highly heterogeneous. For example, vehicles produce point source emissions which can result in heterogeneous GHG concentrations on scales <10 m. The highly localized scale of these emissions can make it difficult to measure mean GHG concentrations on scales of 100-1000 m. Open-Path Fourier Transform Infrared Spectroscopy (OP-FTIR) measurements offer spatial averaging and continuous measurements of several trace gases simultaneously in the same airmass. We have set up an open-path system in downtown Toronto to monitor trace gases in the urban boundary layer. Concentrations of CO2, CO, CH4, and N2O are derived from atmospheric absorption spectra recorded over a two-way atmospheric open path of 320 m using non-linear least squares fitting. Using retrieved boundary layer height from a co-located MiniMPL lidar and meteorological observations from a met-station, we investigate covariances between retrieved gas concentrations and meteorological conditions.

Session 1803090 - ABL Composition, Processes and Surface-Atmosphere Exchange - Part 1

Characterization of aerosol size distributions and optical properties in the Canadian High Arctic

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This study presents observations of aerosol size distributions for both coarse and fine modes as well as of aerosol light scattering and absorption that are ongoing at the Polar Environment Atmospheric Research Laboratory (PEARL) in the Canadian High Arctic (80N, 86W). A variety of field instruments for the characterization of aerosol properties are currently deployed to PEARL including a scanning mobility particle sizer, an optical particle counter, and two Photoacoustic Extinctiometers. With respect to aerosol optical properties, the scattering and absorption coefficients are measured at 405 nm and 870 nm, and from these measurements a number of derived optical parameters are calculated such as aerosol single scattering albedo (SSA), the scattering and absorption angstrom exponents as well as black carbon concentration. The measurements of the aerosol scattering and absorption coefficients are also compared against the coefficient values calculated using Mie theory and the measured aerosol size distributions in an optical closure study.

A second topic that will be discussed is the frequent aerosol growth events observed during summertime. The events begin in June and occur throughout the summer until September. The particle growth events are correlated between PEARL and Alert, Nunavut (82.5N, 62.3W), with similar particle number concentrations measured at both sites, despite a distance of approximately 500 km between PEARL and Alert. The growth rates are calculated and range between 0.1 and 1.0 nm/h, with an average of 0.5 nm/h (SD = 0.3 nm/h). These

growth rates are similar to previous measurements aerosol growth rates from research cruises in the Arctic Ocean. While the atmospheric and emission processes causing aerosol growth are not well understood, measurements suggest that oxidation of marine volatile organic compounds may be occurring on regional scales and is a source of condensing vapors that increases particle mass during summertime in the Arctic.

Session 1803090 - ABL Composition, Processes and Surface-Atmosphere Exchange - Part 1
Evaluating volatility basis set approach for modeling secondary organic aerosols in 3-D air quality models
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Organic aerosols (OA) are a major component of regional and global pollution. As an important component of particulate matter (PM), OA has a complex effect on climate and health, at all geographic scales. Global and regional air quality models underestimate the formation of OA, largely due to poorly constrained models for secondary OA (SOA), which is formed by oxidation of gaseous species in the atmosphere. In this work, a customized box model is developed to constrain commonly used SOA formation parameters using a volatility basis set (VBS). The box model has been tested against field measurements from California, Northeast United States, and the Athabasca Oil Sands, showing model-measurement agreement in each case.

This work describes the adaptation of the VBS into Environment and Climate Change Canada's 3-D air quality model, Global Environmental Multiscale – Modeling Air quality and CHemistry (GEM-MACH) in a 2.5km high-resolution domain centered on Alberta and Saskatchewan. This work compares the effects of two parameterizations for correcting biased low SOA yields used currently in GEM-MACH and many other chemical transport models. The first parameterization improves low yields with multi-generational oxidation reactions to add increased SOA mass. The second parameterization adjusts calculated SOA yields to correct for precursor losses to chamber walls in smog chamber experiments. Each parameterization is evaluated by comparing the model simulations of OA and oxygen-to-carbon ratios (O:C) against measurements taken during flights near the Oil Sands in 2013. Additionally, ground-based measurements from cities within the domain are used to test each parameterization's ability to predict organic aerosol concentrations.

Session 1803091 - ABL Composition, Processes and Surface-Atmosphere Exchange - Part 2
CO2/H2O Flux Measurements Using New Open-Path Low-Power Standardized Automated System
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Spatial and temporal flux data coverage have improved significantly in recent years, due to standardization, automation and management of data collection, and better handling of the generated data. With more stations and networks, larger data streams from each station, and smaller operating budgets, modern tools are required to effectively and efficiently handle the entire process.

These tools should produce standardized verifiable datasets, and provide a way to cross-share the standardized data with external collaborators to leverage available funding, and promote data analyses and publications.

In 2015, new open-path and enclosed flux measurement systems were developed, based on established gas analyzer models, with the goal of improving stability in the presence of contamination over older models, refining temperature control and compensation, providing more accurate gas concentration measurements, and synchronizing analyzer and anemometer data streams in a very careful manner.

In late 2017, the new open-path system was further refined to simplify hardware configuration, to significantly reduce power consumption and cost, and to prevent or considerably minimize flow distortion in the anemometer to increase data coverage.

Additionally, all new systems incorporate complete automated on-site flux calculations using EddyPro® Software run by a weatherized remotely-accessible microcomputer to provide standardized traceable data sets for fluxes and supporting variables.

This presentation will describe details and results from the latest field tests of the new flux systems, in comparison to older models and control reference instruments.

Session 1803091 - ABL Composition, Processes and Surface-Atmosphere Exchange - Part 2

Toward a 35-years North American Precipitation and Surface Reanalysis

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In support of the International Watersheds Initiative (IWI) of the International Joint Commission (IJC), a 35-years precipitation and surface reanalysis covering North America at a 3-hours and 15-km resolution is currently being developed at the Canadian Meteorological Centre (CMC).

A deterministic reforecast / dynamical downscaling approach is followed where a global reanalysis (ERA-Interim) is used as initial condition of the Global Environmental Multi-scale model (GEM). Moreover, the latter is coupled with precipitation and surface data assimilation systems, i.e. the Canadian Precipitation Analysis (CaPA) and the Canadian Land Data Assimilation System (CaLDAS). While optimized to be more computationally efficient in the context of a reforecast experiment, all systems used are closely related to model versions and configurations currently run operationally at CMC, meaning they have undergone a strict and thorough validation procedure.

As a proof of concept and in order to identify the optimal set-up before achieving the 35-years reanalysis, the approach is evaluated for the years 2010-2014 using observations and both standard CMC validation methodology as well as more dedicated scores such as comparison against the currently available products (Stage IV precipitation dataset, SMOS Surface moisture measurements and the

newly released ERA5 reanalysis). A special attention is dedicated to the evaluation of analysed variables, i.e. precipitation, surface/ground temperature and moisture and snow depth over the whole domain of interest.

Results from this preliminary 5 years sample are very encouraging and the optimal set-up is identified. The coupled approach, i.e. GEM+CaPA/CaLDAS, always shows clear improvements over classical reforecast and dynamical downscaling where surface observations are present. Furthermore, results are inline or better than currently available products and the reference CMC operational approach that was operated from 2012 to 2016 (GEM 3.3, 10-km resolution).

Such a reanalysis is of prime interest for the whole North American hydrometeorology and land surface community. Among other things, it will allow for bias correction of current estimates and forecasts, and help decision maker understand and communicate by how much the current forecasted state of the system differs from the recent past.

Session 1803091 - ABL Composition, Processes and Surface-Atmosphere Exchange - Part 2
Eddy covariance fluxes using a new low-cost relative humidity sensor
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Small unmanned aerial systems (sUAS) can be used to record eddy covariance fluxes and help bridge the gap between local and regional scales. Lightweight sensors capable of recording high-frequency wind velocity and temperature measurements are already available for such research. However, in order to better understand the energy balance of the Earth’s surface, water vapor flux measurements are also necessary. A new lightweight, low-cost relative humidity (RH) probe was evaluated for potential use on a UAS. The RH probe was installed on a small eddy covariance tower, and its measurements were compared to infrared gas analyzer (IRGA) measurements. After removing a significant bias from the RH probe measurements, eddy covariance fluxes and spectral analysis indicated that the response time of the probe was appropriate for eddy covariance measurements. The fast-response RH probe merits further development, evaluation, and perhaps eventual integration into a UAS.

Session 1803091 - ABL Composition, Processes and Surface-Atmosphere Exchange - Part 2
Examining the Role of Local Precursors and Long-Range Transport in Halifax Ground Level Ozone Formation
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Ground Level Ozone is a secondary atmospheric pollutant that is deleterious to the health of plants, animals and humans in the atmospheric boundary layer. The primary precursors to Ground Level Ozone are nitrogen oxides (NOx) and volatile organic compounds (VOCs), which in Nova Scotia are largely emitted by mobile sources and natural sources, respectively. As a small urban centre Halifax does not experience levels of air pollution that are characteristic of megacities, however elevated levels of ozone are observed on some days and the chemistry and meteorology behind these higher O3 values are not well characterized.

Moreover, the typical fraction of Halifax ozone that is transported from upstream sources has not been clearly established, as compared to, e.g., the possible influence of locally emitted biogenic VOCs given Halifax's Acadian forest setting, or locally emitted anthropogenic VOCs from marine activities. This study examines long-term (1995-2017) and multi-location NAPS data sets of O3 and precursor gases, as well as associated meteorological variables, in order to gain insight into the atmospheric conditions occurring on elevated ozone days, and the relative importance of local production vs. long-range transport of air pollution to Halifax. This research project has significance for policy-makers working to manage risks from air pollution in growing cities under a changing climate.

Session 1803091 - ABL Composition, Processes and Surface-Atmosphere Exchange - Part 2

Volatilization and uptake of ammonia by a urea-fertilized corn field: eddy covariance flux measurements over the growing season

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Ammonia (NH3) volatilization from urea application in cultivated fields impacts the nitrogen use efficiency of crops and is a major environmental concern. As NH3 is a main precursor of secondary aerosols in the atmosphere, it contributes to long range transport of reactive nitrogen and affects air quality, climate, and biodiversity. To better understand the processes and temporal dynamics of agricultural NH3 exchange, we measured direct eddy covariance (EC) NH3 fluxes above a corn field in Ottawa (ON). The flux tower was equipped with a 3-D sonic anemometer (CSAT3; Campbell Scientific, UT) and a fast time-response Quantum Cascade Tunable Infrared Differential Absorption Spectrometer (QC-TILDAS; Aerodyne Research, MA) for NH3 measurements. Here, we present NH3 fluxes from the fertilizer application in May to the start of the leaf senescence in October 2017. It is the first EC flux dataset for NH3 from field crops over an entire growing season. The emissions of NH3 reached up to 500 ng m 2 s-1 within a few days of the fertilizer application date, suggesting that the hydrolysis of the urea fertilizer occurred fast during this rainy period. When the corn canopy was fully developed, both NH3 emissions of up to 100 ng m-2 s-1 and NH3 deposition towards the end of the growing season of up to -250 ng m-2 s-1 were observed. This highlights the importance (1) of the stomatal compensation point and non-stomatal deposition for the net NH3 exchange and (2) of quantifying NH3 fluxes over longer periods of time to capture the bi-directional exchange, allowing to report more accurate budgets. Finally, we use a resistance model approach to improve our understanding of leaf and soil NH3 exchange processes, which is important for improving parameterizations used in NH3 emission models and inventories.

Session 1803091 - ABL Composition, Processes and Surface-Atmosphere Exchange - Part 2

Combining gradient and profile fit method for an advanced ceilometer-based boundary layer height detection algorithm

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For over a decade, scientists have been using backscatter information from eye-safe lidar ceilometers for observing boundary layer structures such as the daytime mixing layer. For users interested in the physical height of these

structures, detection algorithms have been developed that retrieve this information throughout the day. One of those algorithms is BL-VIEW 1.0 designed for the Vaisala ceilometers CL31 and CL51 was first introduced in 2010. It is based on the gradient method and features a cloud, fog and precipitation filter designed to avoid false hits, a noise and range dependent averaging scheme, and a variable detection threshold. While useful in many geographic locations, ceilometer based retrievals have been known to have difficulties in situations where multiple layers are detected within the lowest few kilometers of the backscatter profile and also in pristine atmospheres where the instruments receive little backscatter information. To address these difficulties, a new boundary layer detection algorithm has been developed. The algorithm provides a single value for boundary layer height at all times during the day, with a special focus on detection of the daytime mixed layer. It uses the result of the BL-VIEW 1.0 algorithm, combines it with a profile fit method that examines the entire profile, and finally uses the time of day for improved investigation of the mixing decays after sunset and the determination of the depth of stable nighttime layers. The Vaisala software product BL-VIEW 2.0 incorporates this new algorithm; it will also feature standardized data handling based on NetCDF for easy post-processing with other algorithms like STRAT+. The presentation will include measuring examples from geographically diverse locations with special focus on critical situations and algorithm performance validation with radiosondes.

Session 1804010 - High Latitude Systems and Climate Change
Radiative control of the interannual variability of Arctic sea ice

Session 1804010 - High Latitude Systems and Climate Change
Linking of the open water area of the North Open Water polynya to climatic parameters using a multiple linear regression prediction model.
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The North Open Water polynya is a recurring polynya which is a significant feature of northern Baffin Bay in the winter. Area of water remains as the sea ice grows around it in the fall, and in the spring the polynya gradually expands as the thinner ice surrounding ice melts away. It is an important wintering area for various bird and animal species. With climate change affecting the Arctic in particular, this polynya has seen significant transformation in terms of its area of open water. This study analyzes this transformation and attempts to understand it by linking it to climatic parameters using a multiple regression model. Using data from ice analysis from Environment and Climate Change Canada's Canadian Ice Service, a significant difference in the annual maximum polynya extent was observed before and after 1998. The main climate indices related to the extent of the polynya for the years prior to 1998 are the surface wind speed and the concentration of sea ice. For the years after 1998, the main indices are the surface wind speed, sea surface temperature and air surface temperature. This study could prove that the extent of open water of the polynya is a good indicator of a new climate regime after 1998.

Session 1804010 - High Latitude Systems and Climate Change
Impact of improved sea ice initialization on real-time Arctic sea ice forecasts from CanSIPS
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Deficiencies in the initialization of sea ice in the Canadian Seasonal to Interannual Prediction System (CanSIPS) have until now prevented real-time CanSIPS forecasts from representing Arctic sea ice evolution realistically. Here we describe three such deficiencies and measures that have been taken to correct them. The first is the use of a passive-microwave (PM) based sea ice concentration (SIC) product containing unrealistic trends to initialize SIC during the CanSIPS hindcast period 1981-2010. Bias corrections using these hindcasts result in anomalous Arctic sea ice extents (SIE) in the subsequent real-time forecast period that are too large, especially in the first forecast month in winter and spring. The second deficiency is an inconsistency between the analysis used to initialize SIC operationally, which combines synthetic aperture radar with PM estimates of SIC, and the PM-based SIC initialization used in hindcasts. This has the effect of exacerbating the positively-biased SIE anomalies caused by unrealistic trends, particularly in the melt season when PM observations tend to underestimate SIC. The third deficiency is the use of a model-based climatological sea ice thickness (SIT) initialization, which fails to capture both the recent thinning of the ice pack and interannual SIT anomalies. We treat the SIC initialization deficiencies by merging the recently-released HadISST2 product with SIC obtained from Canadian Ice Service digitized charts to initialize the hindcasts. We improve the SIT initialization by applying a simple but relatively skillful statistical model for SIT in both the hindcasts and real-time forecasts. The efficacy of this approach is illustrated by demonstrating how CanSIPS real time forecasts over 2012-2016 would have benefited from this improved sea ice initialization, as well as by verifying the 2017 Sea Ice Outlook in which this modified initialization has been applied in real time.

Session 1804010 - High Latitude Systems and Climate Change

Impacts of climate change in the Arctic Ocean

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Under climate change scenarios, the largest lower tropospheric warming is expected to occur in the Arctic. Here, we investigate how the Arctic Ocean might respond to the surface warming. We performed simulations from 1970 to 2099 with a coupled ice-ocean model (CIOM) implemented for the Arctic Ocean. The surface fields to drive CIOM were provided by the Canadian Regional Climate Model (CRCM), in turn driven by the third-generation Canadian global climate model (CGCM3) outputs following the A1B climate change scenario. Compared to observations, CIOM has a reasonable simulation of sea ice, ocean temperature and salinity in the Arctic Ocean. For example, the CIOM simulation exhibits a warm Atlantic water layer (AWL) in the central Arctic Ocean, captures the observed FWC maximum in the central Beaufort Sea, and the rapid decline of total ice concentration over the last thirty years. Under the A1B scenario, the CIOM simulations suggest an 11% decrease per decade in ice volume, with the Arctic Ocean becoming largely ice free in the summers by about ~ 2060s. Moreover, due to the increased ice melting and Ekman transport, there is an increasing trend in fresh water content (FWC) and sea surface height (SSH) in the Beaufort Sea. The increase is about 2 m for the FWC and 6 cm for the SSH from 1979 to 2069. In terms of the Atlantic water, there is a significant increase in water volume transport into the central Arctic Ocean through Fram Strait, due to the intensified atmospheric low pressure system over the Nordic Seas. However, the AWL temperature tends to decrease from 0.36oC in the 2010s to 0.26oC in the 2060s. In the vertical, the warm Atlantic water core slightly expands before

the 2030s, significantly shrinks after the 2050s, and essentially disappears by 2070-2099, in the southern Beaufort Sea. Finally, in the Barents Sea, the loss of sea ice significantly increases both the surface solar radiation and the ocean surface heat while the lateral heat transport tends to increase, and the net heat fluxes play an important role in the changes of the ocean temperature associated with the AWL.

Session 1804010 - High Latitude Systems and Climate Change
Collapse of the winter Beaufort High associated with the pan-Arctic intrusion of North Atlantic cyclones: A response to thinning sea ice?
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The Arctic has been undergoing an accelerated warming relative to the rest of the globe. This warming is cause for concern both within the Arctic, where it is causing environmental and ecosystem stresses, as well as in mid-latitudes, where there is evidence that the warming is leading to more extreme winter weather. Recent winters have also been remarkable for the occurrence of events where the surface air temperature at the North Pole rose above freezing. Here we show that the autumn of 2016 was the warmest in the Arctic since the start of the 20th century, and this resulted in reduced sea ice coverage and thickness that persisted into the winter of 2017. This allowed for intrusions of North Atlantic extra-tropical cyclones, associated with the Icelandic Low circulation pattern, into the western Arctic. These intrusions led to an unprecedented wintertime reversal of the surface winds and ice motion in the Beaufort Sea as well as the collapse of the Beaufort High. As Arctic sea ice continues to thin, such reversals may become more common resulting in impacts to ocean circulation, sea ice distribution, and biological productivity.

Session 1804010 - High Latitude Systems and Climate Change
Sea Ice Thickness and Snow Depth Retrieval with Data Synergy of Satellite Altimetry and Passive Radiometry
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Sea ice parameters, including sea ice thickness and snow depth, are key variables for both climate study and operational forecast. We propose a new data synergy framework that combine active satellite altimetry and L-band passive radiometry for the simultaneous retrieval of both parameters. Compared with traditional retrieval methods, the new method overcomes the limited accuracy of satellite altimetry as caused by snow loading, and attains the snow depth which is poorly constrained in current data products. Verification with airborne data and large-scale retrieval shows good retrievability of these parameters. The proposed method can be applied to the study of historical sea ice status, as well as retrieval with future satellite campaigns.

Session 1804020 - Advancements in the in situ measurement of solid precipitation
WMO-SPICE: overview, methods, and Canadian perspective
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In the World Meteorological Organization Solid Precipitation Intercomparison Experiment (WMO-SPICE), automated precipitation gauges with different principles of operation and configurations were tested at field sites in distinct climate regimes. Gauge performance was assessed relative to the Double-Fence Automated Reference (DFAR) at each site, which comprised an automated precipitation gauge and sensitive precipitation detector within an octagonal double-fence wind shield. To help ensure the comparability of results, a consistent approach for processing gauge data and identifying precipitating periods for assessment was applied to measurement data from all test configurations and sites. The assessment results are intended to guide gauge selection and configuration for potential users in different climate zones, with recommendations to be provided in the forthcoming final report. The results have already been applied to the derivation of transfer functions, which can be used in post-processing to compensate for wind speed and temperature effects on gauge collection efficiency. An overview of WMO-SPICE sites, gauge configurations, and methods is presented, along with results from Canadian test sites. The results are discussed within the context of Canada's operational networks, and demonstrate the value of applying both specialized data analysis and field experience to operational decision-making.

Session 1804020 - Advancements in the in situ measurement of solid precipitation

Snowy opportunities at the NEIGE site, Montmorency Forest, Québec, Canada.

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Although it is recognized that under-catch is a significant source of bias in the measurement of solid precipitation and snow water equivalent (SWE), this factor is still not standardized within monitoring networks in Canada. Multiple devices of snow measurement are, and have been, used across Canada. This makes it difficult to obtain spatially and temporally homogeneous information on a watershed scale. This situation is a source of considerable uncertainties, among others, when snow is an essential input for the simulation of river flows.

Few sites around the world can enable the inter-comparison of precipitation gauges and SWE protocols, but some of them are found in Canada. The country was an active participant of the World Meteorological Organizations (WMO-SPICE) international solid-weather precipitation program and had set up an autonomous parallel program (C-SPICE) with similar objectives. The NEIGE site, located in Montmorency Forest, Québec, Canada, is currently the most important multi-institutional experimental site for solid precipitation studies in Québec and among the most equipped in Canada.

Numerous partners are involved in the development, since 2014, of this experimental site dedicated to snow research. Located in a very snowy environment (mean annual snowfall of 619 mm), this easily accessible site enables the measurement of unshielded and shielded (Double Fence Intercomparison Reference [DFIR], Bush, Nipher, Alter, Double-Alter, Tretiakov) gages (mass and volume manual recipients, Pluvio² OTT, Geonor T200B). The continuous availability of competent bi-daily meteorological observers is also an irreplaceable benefit of this site. Measurement of SWE (4 manual protocols, gamma sensors [CS725/GMON], microwave radars, high resolution GPS), phase (Parsivels OTT), snow depth (manual scale and SR50) and many more meteorological parameters, are enabling the development and validation of

transfer functions and snow models. Research objectives, recent results and upcoming opportunities rising from this unique site will be presented.

Session 1804020 - Advancements in the in situ measurement of solid precipitation
The testing and development of transfer functions for tipping-bucket precipitation gauges in WMO-SPICE
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Although heated tipping-bucket precipitation gauges are used extensively in regions subject to winter weather and snowfall, heated tipping-bucket gauge measurements of solid precipitation have not been well characterized. Heated tipping-bucket gauges can suffer from significant errors, including a delayed response, as precipitation accumulated in the gauge funnel must be melted in sufficient quantity to trigger a full tip before being measured. Underestimates of measured precipitation due to wind and evaporation may also be larger in a tipping-bucket gauge than for other types of precipitation gauges. Several heated tipping-bucket gauges were evaluated in the World Meteorological Organization Solid Precipitation InterComparison Experiment (WMO-SPICE). The results of this intercomparison were used to develop and evaluate adjustments for the undercatch of solid precipitation exhibited by heated tipping-bucket gauges. Errors in the adjusted and unadjusted tipping bucket measurements were also evaluated.

Session 1804020 - Advancements in the in situ measurement of solid precipitation
Validation and adjustment of snowfall measurement biases for hydrological purposes in a snowy and cold boreal environment at Forêt Montmorency, Québec
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Uncertainty related to the quality of hydro-meteorological observations and modeling is mostly notable in the Eastern Canadian boreal biome where solid precipitation may reach up to 55% of the annual precipitation, and where the winter season may last up to 6 months. This work is part of a more general framework for studying the impact of changing input data on boreal forest hydrological balances. Indeed, solid precipitation undercatch can reach 20% to 70% depending on meteorological conditions and the type of instrument and windshield used. The establishment of hydrological balances for these forest ecosystems therefore requires an appropriate adjustment of the undercatch of solid precipitation.

The Montmorency Forest is a 412 km² public domain that has been dedicated to Université Laval's teaching and research activities since 1965. The main research facility is located 80 km north of Québec City in a balsam fir-dominated ecosystem representative of a cold and humid boreal biome. Hydro-meteorological data has been recorded since 1965 and shows a mean annual water budget where precipitation reaches 1400 mm, from which close to 600 mm is snow, evapotranspiration accounts for 500 mm and runoff for 900 mm. Since 2014, the forest includes the NEIGE site, which is a meteorological station

dedicated to solid precipitation observation and inter-comparison. It hosts two global reference precipitometers (DFIR and Bush-gage) and more than 30 other automatic and manual meteorological instruments.

The results will present a comparative analysis of the catch efficiency of all instruments and windshields couples from the NEIGE site, a validation of three transfer equations from the literature and a demonstration of a probabilistic approach for the estimation of solid precipitation adjustment. In future steps, these results are intended to be use in hydrological models to estimate the influence of solid precipitation measurement bias adjsutement on boreal water balance.

Session 1804020 - Advancements in the in situ measurement of solid precipitation
Post-SPICE transfer function validation
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In the World Meteorological Organization Solid Precipitation Intercomparison Experiment (WMO-SPICE), measurements from automated precipitation gauges in different shield configurations were compared against those from the field working reference configuration (the Double Fence Automated Reference, or DFAR) at 8 sites during the winters of 2013/2014 and 2014/2015. One outcome of SPICE was the development of transfer functions that can be used to adjust the systematic bias in solid precipitation measurements, largely due to the influence of wind, for different gauge and shield configurations. Following the end of the field program, many of the intercomparison sites continued to collect precipitation and ancillary data, providing an opportunity to perform a post-SPICE validation of the transfer functions in a “real-world” adjustment exercise. Two previously published transfer functions - a function that includes a temperature dependency and a simpler, phase-dependent function - were applied to the test gauge data using wind speeds measured at 10 meters, gauge height, or both, and the adjusted measurements were compared with the reference measurements. Preliminary results show that the SPICE transfer functions perform well, overall, but have varying degrees of success at individual sites, significantly over-adjusting solid precipitation at some sites and under-adjusting at others. It is clear, however, that the reconstructed time series of precipitation from the test gauge configurations compare more closely with the reference precipitation time series following the application of the WMO-SPICE transfer functions.

Session 1804030 - General Session - Cryosphere
Comparison of regionally-averaged Arctic snowfall rates from CloudSat and reanalysis products
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The presence of snow can affect the evolution of sea ice in a variety of ways. It can both promote and inhibit sea ice growth through a variety of mechanisms, due to its effect on ice albedo, mass balance, and thermal conductivity, for example. Characterizing the variability of snow on sea ice is necessary in order to quantify the relative strength of these effects. Furthermore, the presence of snow on sea ice can introduce significant uncertainty into remote measurements

of sea ice thickness, especially when the snow is saturated with water, as is often the case in warmer conditions.

Current knowledge of the variability of the snow cover on Arctic sea ice is limited, primarily due to the logistical challenges involved in taking measurements. In-situ snow depth measurements are very accurate, but tend to be limited in geographical and temporal extent.

Observations of snowfall rates retrieved from satellite radar data provide another possible means to quantify snow on sea ice. Useful insights may also be gained from reanalysis products. In this work, the surface snowfall rate product retrieved from CloudSat is compared to reanalysis surface snowfall rate products from ERA-Interim, MERRA-2, and ERA-5. The snowfall rate products are averaged over a region spanning latitudes 68° N to 82° N, excluding longitudes 60° W to 10° W. The effects of sampling inconsistencies are explored and discussed, and relative biases are identified.

Session 1804030 - General Session - Cryosphere
A Sea-Ice Forecast Model for Cambridge Bay, Nunavut
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Ocean Networks Canada maintains and operates a coastal cabled observatory in Cambridge Bay, Nunavut. The facility includes both in-water and shore-based sensors, including a cabled oceanographic station at 8m depth with a CTD, dissolved Oxygen, fluorometer, camera, hydrophone, and an acoustic shallow water ice profiler. The shore station has both an AIS receiver and a weather station. With both the above and in-water real-time data, ONC has developed a thermodynamic sea-ice model for predicting sea-ice growth/thickness, forced by the in situ observations of water and air properties. The model has allowed us to test various model configurations, layer formulations, and predictive skill against both the more broadly used CICE and LIM sea ice model formulations. In 2017, we added a forecast capability, driving the model with short and long-term weather forecasts. The observations, model formulations, and preliminary results will be presented.

Session 1804030 - General Session - Cryosphere
Propagation and attenuation of short waves in the marginal ice zone
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Observations of the wave propagation and attenuation obtained in the St. Lawrence Estuary, Canada, using bottom-moored pressure sensors and wave buoys deployed on sea ice in the marginal ice zone are presented for short period waves (3-8 s). The apparent attenuation coefficients are in the order O10^-2 m^-1, which is one or two orders of magnitude larger than observed in other experiments carried in the polar seas. This implies that short waves propagate far shorter distances and, consequently, can exert a stronger force near the edges of the marginal ice zone than previously thought. Since distances between instruments compared to previous experiments carried in the polar seas were significantly shorter and that ice thickness was better constrained, we propose a possible explanation for the so-called attenuation roll-over occurring at short periods based on non-linear transfer of energy towards higher harmonics.

Mechanisms underlying the generation of these harmonics are still unclear and will be discussed.

Session 1804030 - General Session - Cryosphere
A new source for Denmark Strait Overflow Water?
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Exchange flows between the sub-polar North Atlantic and the Arctic Ocean via the Nordic Seas are key components of the global climate system. The northward heat transport by Atlantic Water affects Arctic sea ice and land ice cover, ecosystems, European weather and global climate, while the southward deep overflows feed the abyssal limb of the Atlantic Meridional Overturning Circulation affecting global climate. Here we explore the transformation of the Atlantic Water (AW) that enters the NS through Denmark Strait. To do so, we use an eddy-permitting, 1/12° regional configuration of the Nucleus for European Modelling of the Ocean (NEMO) to examine the transformation of the AW, over the period 2002 to 2016. We used the well-tested off-line Lagrangian tool ARIANE which allow us to investigate the AW transformation as well as their pathways within the basin. Dense water (denser than 27.85 kg/m 3) is formed on the Icelandic shelf, west/north-west of Iceland. Once formed the dense water travels north/north-west around the shelf and then cascades off the shelf at different locations north of Iceland. Once it cascades the dense water contributes to the North Icelandic Jet and hence to the Denmark Strait Overflow Water within one year, or it travels around the Nordic Seas following the rim of the basin. The transformed water has properties initially consistent whit that of Atlantic Water.

Session 1804030 - General Session - Cryosphere
Parameterizing the radar-scale roughness of snow on sea ice: a wavelet-based approach
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Knowledge of the surface roughness of snow on Arctic sea ice is important to both understand the physical properties of the snowpack and to characterize its radar scattering behavior. Snow, like many natural surfaces, exhibits non-stationary roughness characteristics, and radar scattering is strongly frequency-dependent, so a multi-scale and multi-frequency approach is needed to adequately quantify roughness over the range of frequencies used in cryospheric remote sensing. Although snow roughness data has been collected in terrestrial settings such as on tundra and in alpine environments, there has been a lack of work in characterizing the roughness of snow on Arctic sea ice. We use state of the art two-dimensional wavelet techniques applied to high-resolution terrestrial lidar data collected in proximity to Eureka weather station, Nunavut during the 2016 Environment and Climate Change Canada campaign. We examine and parameterize the fractal properties of the snowpack from millimeter to decameter scales and its effect on the angular behavior of radar backscattering by analyzing the ten small-scale and six large-scale lidar sites collected across Slidre Fjord and Eureka sound. Quantification of the radar backscattering behavior from the snow surface will greatly aid the interpretation of radar data collected over Arctic sea ice, and the roughness parameterizations will help to better constrain the physical properties of the snow/sea ice system.

Session 1804030 - General Session - Cryosphere

Variation of summer oceanic partial pressure of carbon dioxide in the Prydz Bay using a self-organizing map analysis approach

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This study applies a neural network technique to produce maps of oceanic surface pCO2 in the Prydz Bay in the Southern Ocean on a 0.1 longitude 0.1 latitude grid for February 2015. The weekly oceanic pCO2 in February was estimated using a self-organizing map (SOM) by four proxy parameters (sea surface temperature, chlorophyll a concentration, mixed layer depth, and sea surface salinity). Four proxy parameters are used during the training phase to enable the network to resolve the nonlinear relationships between the pCO2 distribution and the complicated biogeochemical conditions in the bay. The observed pCO2 data were collected on the 31th CHINARE cruise in the bay during February 2015. The reconstructed oceanic pCO2 agreed well with the pCO2 measurements from SOCAT, with a root-mean-square error of 22.14 μatm. The study area was divided into three sections, Open Ocean region,, Seaice region and Shelf region. Prydz bay was mainly a strong CO2 sink in February 2015 with a monthly averaged uptake of 18.7 4.93 TgC. The CO2 sink is pronounced in in the Shelf region due to its lowest oceanic pCO2 with peak biological production. The Open Ocean region was barely affected by seasonal ice changes. While in the Seaice region, the distribution of oceanic pCO2 changes sharply due to the strong change of seasonal ice.

Session 1805010 - General Session - Hydrology

Twenty-First Century Hydrologic Change and Extreme Streamflow in the Fraser River Basin of British Columbia

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The Fraser River Basin (FRB) of British Columbia is a large, snow-dominated watershed of significant ecological and economic importance. Contemporary climate change has begun to have a detectable influence on regional hydrology in the FRB, with reduced snowpacks and earlier freshet flows recorded in recent decades.

In this study, we utilize a process-based hydrological model driven by an ensemble of CMIP5 global climate models to investigate future hydrologic change in the FRB. Our findings indicate a number of key changes in store for the basin for the remainder of the century, chief among these the following: 1) Increasing regional temperatures produce a notable increase in the rain-to-snow fraction by mid-century, especially in autumn. This is augmented by increases in atmospheric water vapor content over the Pacific Ocean driven by the same temperature increase, leading to more frequent atmospheric river events in autumn and spring over the Pacific West Coast. 2) The frequency of extreme (historical 99th percentile) daily rainfall events over the FRB more than doubles by the 2080s, with multi-day consecutive 99th percentile events becoming more common. 3) In concert with the continued decline of snowmelt-generated runoff in spring, these extreme rainfall events are increasingly associated with annual peak streamflows (APFs) in the future, accounting for about 25% of APFs by the 2080s. 4) A generalized extreme value analysis

applied to the future-simulated APFs suggests that return levels over all return periods will increase significantly by the late 21st century. For example, the largest recorded APF at Fraser-Hope, estimated as a 1-in-200 year event from historical data, is projected to become a 1-in-50 year event by the 2080s.

Session 1806010 - General Session - Weather - Part 1
A Simple Definition of Flow Regimes and its Relationship to High Impact Weather Events
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Historically, maxima in the variance of the mass field have been one of the metrics used to identify storm tracks. Consequently, a simple definition of flow regimes is developed here using the variance of the 500 hPa height field as well as the variability in precipitation over different time scales (7, 15, and 30 days) to identify active versus quiescent periods in the entrance and exit regions of the climatological storm tracks. Furthermore, a metric is developed to assess flow stagnation which here is defined as a 24 h period of sustained geostrophic easterlies at 500 hPa calculated over 10 degrees longitude bands. This flow stagnation is then combined with a measure of air mass quality through an assessment of the layer-averaged equivalent potential temperature anomalies to highlight regions that are susceptible to high impact precipitation events. This metric has proven useful in not only indicating regions of preferential mid-latitude cyclone activity, but also in tracking tropical disturbances. Preliminary results suggest that low variance (decreased storm track activity) regimes in the eastern North Pacific are associated with a combination of an equatorially displaced and westward retracted jet in the North Pacific basin as well a preference for the positive phase of the Pacific North American pattern. Flow stagnation in this regime occurs preferentially in the Gulf of Alaska and extends southwestward along the West Coast of North America with a separate maximum situated in the southwestern United States in association with anticyclonic wave breaking. These patterns are conducive to atmospheric river events in the Pacific Northwest and Alaska as well as a propensity for cut-off low formation in the Southwestern United States. In the western North Atlantic, low variance regimes are associated with an equatorially displaced and weakened jet (consistent with the negative phase of the North Atlantic Oscillation) with abnormally warm conditions over central Canada. Flow stagnation and increased precipitation in this regime occurs preferentially in Ontario and Quebec with a strong decrease in anticyclonic wave breaking and reduced wind shear suggested over the portions of the subtropical Atlantic. In the fall, this pattern can be associated with increased tropical cyclone threat in Atlantic Canada with the blocking high associated with extreme negative values of the NAO preventing recurvature of storms out to sea.

Session 1806010 - General Session - Weather - Part 1
An Overview of the Forecasting and Impacts of the January 2017 New Brunswick Freezing Rain Event
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On January 25, 2017, an intensifying low pressure system originating from the eastern seaboard of the United States tracked south of Nova Scotia. The system spread mixed precipitation across the Maritime Provinces including an extended period of freezing rain from northern Nova Scotia to northern New Brunswick.

Northeastern New Brunswick was particularly hard hit with an extreme icing event. The forecast associated with this system from the Atlantic Storm Prediction Centre will be outlined including a summary of the observations, with an emphasis on the substantial impacts incurred as a result of the winter storm. The timeline of the impacts spanned nearly two weeks, making history as being the most expensive restoration effort on record for New Brunswick Power. It also had cascading impacts, adding to the importance of the weather forecast even after the storm had passed.

Session 1806010 - General Session - Weather - Part 1
Recent work in the Analysis & Prognosis Section of the Canadian Centre for Meteorological and Environmental Prediction
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There is an increased demand for improved weather forecasts of high-impact weather in the short, medium, and long term. With extensive knowledge of weather models and a continuous examination of synoptic meteorology, meteorologists in the Analysis & Prognosis (A&P) section at the Canadian Centre for Meteorological and Environmental Prediction (CCMEP) have a unique perspective on national weather forecasts. In an effort to improve these forecasts, A&P has developed some interesting products based on the Canadian suite of weather models which have shown good promise in many cases. Overall, these products have proven to be very helpful in improving the skill and the lead-time of forecasting high-impact weather events across the country. This presentation will showcase some of the developmental products coming out of A&P and their performance based on subjective verification.

Session 1806010 - General Session - Weather - Part 1
The post-processing of gridded numeric weather forecast with Extreme Learning Machine in British Columbia, Canada
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The single layer feed-forward neural network with Extreme Learning Machine (ELM) method was applied to the post-processing of numeric weather forecast in British Columbia, Canada. The machine learning model was trained and validated with historic in situ weather station records, then applied to the gridded hourly and daily precipitation and 2-m temperature forecast. A significant improvement on the forecast verification scores can be found after the post-processing. The method in this presentation has a potential to be extended to other meteorological variables and applied online to provide realtime high resolution gridded forecasts.

Session 1806010 - General Session - Weather - Part 1
Regional modelling of weather conditions surrounding a tragic disaster in Mount Everest
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Mount Everest has always challenged the world’s finest climbers through its steep topography and unpredictable weather. During May 10-11, 1996 many climbers were trapped in a severe storm while descending from the summit of Mount Everest and several climbers lost their lives, with the incident remembered

as one of the worst disasters in the history of mountaineering. In this research we have produced high resolution simulations of the meteorological conditions of the event using the Weather Research and Forecasting (WRF) model, configured with three nested domains at 18, 6 and 2 Km horizontal resolutions. The WRF model is forced with ERA-Interim (0.750) reanalysis data to dynamically downscale the meteorological fields using two-way nested model run from 1-15 May 1996. The results of our simulations resolve the detailed weather conditions around Mount Everest during the incident. Relatively calm winds until 8th May strengthened by noon of May 9th with wind speed exceeding 20 m/s, but the wind speed weaken by midnight and the early morning of May 10th. The wind strengthens again by noon of May 10th with speeds up to ~30 m/s by the evening. The strong wind persists into the next day with temperatures falling below 300C on May 11th. Our model has simulated snowfall around the summit of Mount Everest and the South Col beginning around midnight of May 10th. An analysis of moisture flux convergence is performed and details the upstream origin of wind and snowfall anomalies. Due to the absence of meteorological stations around the high altitude Everest region, our results could not be directly tested against instrument observations; however, the results are consistent with observations by the survivors. The findings highlight the importance of high resolution modelling to understand the underlying atmospheric dynamics within extremely complex topography such as the Himalayas.

Session 1806010 - General Session - Weather - Part 1
Spaceborne Synthetic Aperture Radar Applications on Tropical Cyclone Studies
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We develop an approach to apply the C-band RADARSAT-2 Cross-polarization Synthetic Aperture Radar (SAR) to the tropical cyclone (TC) studies, based on a hurricane wind speed retrieval function denoted as C-3PO (C-band Cross-polarization Coupled-Parameters Ocean) and an idealized model denoted as SHEW (Symmetric Hurricane Estimates for Wind) model. With the advantages of high spatial resolution, relatively large spatial coverage and working under almost all weather conditions, SAR is suitable for the TC researches especially for the internal dynamic processes. We build the SHEW model to extract the TC intensity and structure and further to provide a frame for the TC internal dynamic analysis. Here we extract the asymmetric characteristics using our SHEW model and analyze the related hurricane evolution by comparisons with aircraft measurements. Compared to the classic eyewall replacement cycle theory, our investigation finds that the primary eyewall did not weaken and the secondary eyewall did not shrink over a period of more than 30 hr. We suggest that the reason for this persistence is that a boundary layer inflow pathway is provided by the relatively low winds in the asymmetric secondary eyewall area, as observed by synthetic aperture radar. Moreover, we investigate the vortex Rossby waves excited by the TC asymmetric structure by extracting vortex Rossby waves from SAR image over Hurricane Vance (2014) within the SHEW frame, and analyze the interaction between vortex Rossby waves and the TC main flow.

Session 1806011 - General Session - Weather - Part 2
Addressing Marine Weather Challenges using the Next Generation of Weather Satellites

Session 1806011 - General Session - Weather - Part 2
Renewal of E-based training course - Atmospheric Monitoring

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We will summarize the process that the Technical Training Section within the MSC Monitoring and Data Services Directorate (MDSD) will use to renew its existing APTP e-based learning course. The aforementioned atmospheric Apprenticeship or Profession Training Program (APTP) requires that all new hires complete a ten module introductory training course. The course, built in 2003, was the first online training within the atmospheric monitoring community and is showing its age. It is designed to introduce new hires, largely community college technologists, to the theory and practice of meteorology, with a concentration on the how and why of meteorological measurement. It is not designed to be an advanced technical training course.

The temptation was to simply update the existing material and leave the format, quizzes, exams and methodology in place. Through consultation with training experts in Training & Career Development Division (TCDD) we came to understand that “Instructional Design” required the course development team develop a knowledge base and aptitude for developing training, a step beyond being subject matter experts. We will present how our evolving understanding of the potential and limitations of online learning guided our use of smart authoring tools (Adobe Captivate and Creative Cloud) to feed training material to Moodle, our Learning Management System (LMS).

Session 1806011 - General Session - Weather - Part 2
Towards a new Canadian weather radar network and the roll-out of modern operational radar products for end-users
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The Canadian Weather Radar Replacement Program (CWRRP) is a seven-year infrastructure project that will replace MSC’s existing network of aging and, in some cases, obsolete weather radars with modern S-Band Dual-Polarized radar systems. This project is entering a crucial phase as the first radar has recently been installed at Radisson, near Saskatoon, with products already available to the public and other users. The real-time delivery of data from these new radars, both internally and externally, is ensured by the Operational Radar Production team of the CMC Operations Division of MSC (ECCC).

In this presentation, we will provide an overview of the radar renewal project, including a discussion of preliminary plans for the generation and operational deployment of products to end-users. The tools used for this deployment, as well as various examples of new radar products that will soon become available will also be presented.

Session 1806011 - General Session - Weather - Part 2
Automated continuous water vapor profile measurements in Iqaluit, Nunavut, using a new ground-based DIAL lidar.
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There exists a demonstrated need for enhanced measurements of vertically-resolved meteorological parameters in order to evaluate and enhance the

performance of numerical weather prediction (NWP) systems, which is the focus of the World Meteorological Organization's Year of Polar Prediction project. Vertical profile observations of water vapour are of particular interest given their large impact on the radiative transfer in NWP models. As NWP model resolution increases, there is a growing need for high vertical- and temporal-resolution water vapour measurements, especially in the Arctic where meteorological observations are sparse. To address this need, Environment and Climate Change Canada (ECCC) is collaborating with Vaisala Inc. to test and deploy a new autonomous DIAL water vapour lidar system at ECCC's Iqaluit supersite (64oN, 69oW). The lidar is capable of 24/7 observations of vertically-resolved aerosol backscatter and water vapour within the planetary boundary layer. The benefit of integrated measurement systems at the Iqaluit supersite are being investigated to recommend the optimal cost-effective observing system for the Canadian Arctic that can complement existing radiosonde observations. This presentation will discuss the new water vapour lidar observations and research activities.

Session 1806011 - General Session - Weather - Part 2
Weather Research Forecast Data Ingestion for Renewable Energy Applications
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Green Power Labs (GPL) is currently investigating the effects of data ingestion on the skill of a Weather Research Forecast (WRF) weather model. By examining four data ingestion methods, the goal of the investigation is to determine if the data ingestion methods improve the forecast specifically for 24 to 48 hours ahead horizons as it relates to solar energy forecasting.

The following data ingestion methods have been investigated;

- Numeric Weather Prediction (NWP)

- Weather Research and Forecasting Data Assimilation (WRFDA) with 3DVAR

- WRFDA with 4DVAR

- Local Analysis and Prediction System (LAPS)

GPL reproduced the forecasts from January 1, 2017- March 15, 2017 initialized at 00 UTC over the South-Western United States. This region was selected due to the vast amount of available data both public and privately collected by GPL. Utilizing the GOES 15 satellite data GPL has re-created a cloud map and using a mutual information technique to relate the observed data and the forecast techniques, we have been able to determine what forecast best reproduces the observed clouds as it relates to irradiance forecasting.

Additionally, the use of meteorological data from the Meteorological Assimilation Data Ingest System (MADIS) has provided ground measurements that are compared against the forecasts for each forecast horizon with particular interest to the 24 to 48-hour ahead forecast horizons.

The resulting presentation aims to rank the data ingestion methods and which data sources produce the optimal forecast for solar and renewable energy application.

Session 1806011 - General Session - Weather - Part 2
Error characterization and data assimilation experiments using surface observations over North America
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Assimilation of meteorological variables from surface stations in a regional forecasting system poses a number of challenges, including differences between station height and model topography, potential impacts of spatial and temporal correlations, the numeric precision provided by the report format, as well as inherent biases in the measurements themselves. We characterize the error distribution, relative to independent model runs, of observations provided by the synoptic observation (SYNOP), Meteorological Aerodrome Report (METAR) and Meteorological Service of Canada (MSC) partner networks over North America. Of these, only SYNOP reports are currently utilized by the operational Canadian regional prediction system. Based on the errors observed, a blacklist has been introduced as part of the quality control procedure in an experimental version of the system. Several assimilation experiments were performed in order to gauge the sensitivity of resulting forecasts to the severity of temporal thinning applied. Although ingestion of reports from all three networks with a 6-hour thinning has a beneficial impact on surface verification scores up to 48 hours compared to a control, reducing the temporal thinning parameter to 1 hour or less introduces some degradation in scores in certain geographic regions. This suggests that observation temporal correlations may need to be accounted for in the analysis scheme, in order to assimilate the data at higher frequencies. In all cases, however, the signal from the surface dissipates rapidly and has very little impact on upper-air verification scores.

Session 1807010 - Climate Variability and Predictability - Part 1
Hydro-Climatic Variability and Extremes over the Athabasca River Basin: Historical Trends and Projected Future Occurrence
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Since humans and ecosystems require adequate, reliable water supplies, hydro-climatic variability and extremes pose serious threats to society and the environment. Western Canada, including the Athabasca River Basin (ARB), is prone to considerable hydro-climatic variability including periodic extreme droughts and excessive moisture conditions. The main causes of these extremes are persistent, mid-tropospheric circulation patterns that disrupt expected precipitation and temperature. However, no investigation has specifically focused on the occurrence and causes of both past and future hydro-climatologic variability within the ARB. Assessment of the Standardized Precipitation Evapotranspiration Index (SPEI) reveals substantial inter-annual and decadal-scale variability over the entire ARB and its individual reaches, with no discernible trends during the last ~100 years. Evaluation of the 500 hPa circulation patterns associated with identified hydro-climatic extremes shows that major droughts are related with higher frequencies of distinctive ridging patterns over the ARB and fewer incidences of troughing. Excessive moisture conditions

tend to have opposite patterns. Projections from several regional climate models reveal an average change toward more drought-like summer and slightly wetter annual conditions over the ARB, but there is a substantial range for individual models ranging from a considerable increase in drought with a higher degree of inter-annual variability, to relatively little change from current conditions. Simulated changes to key atmospheric circulations are consistent with these SPEI projections and indicate that those patterns associated with hydro-climatic extremes will continue in the future and in some cases, increase in frequency. Results from this analysis have quantified historical hydro-climatic variability in the ARB and have provided insight into potential future conditions as driven by changes to surface climate and synoptic-scale atmospheric circulation patterns.

Session 1807010 - Climate Variability and Predictability - Part 1
Identifying wave processes associated with predictability across time scales: An empirical normal mode approach
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The key to better prediction of S2S variability and weather regimes in a changing climate lies with improved understanding of the fundamental nature of S2S phase space structure and associated predictability and dynamical processes. The S2S variability can be partitioned with the Modified Lagrangian Mean (MLM) approach in terms of slow diabatic processes, such as radiative forcing, and adiabatic dynamical processes. The latter can be decomposed into a finite number of relatively large-scale discrete-like Rossby waves with coherent space-time characteristics using Empirical Normal Mode (ENM) analysis. ENM analysis is based on principal component analysis, conservation laws and normal mode theories. These modes evolve in a complex manner through nonlinear interactions with themselves and transient eddies and weak dissipative processes. The foundations and potential value of the ENM approach are presented but novel research is required to understand S2S predictability and dynamical processes like the nonlinear wave-wave and wave-mean flow interactions.

Session 1807010 - Climate Variability and Predictability - Part 1
Influence of Internal Variability on the Northern Extratropical Climate Response to External Forcing
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The Atlantic Multidecadal Variability (AMV) is an internal mode of climate variability in the North Atlantic Ocean that changes regional mean climate by, for example, its warm phase being linked to elevated summer temperatures in North America and Europe, and increased rainy season precipitation in the Sahel. An open research question is whether internally generated changes to the mean climate can influence the climate response to external forcing, for example from variations in solar irradiance or increases in carbon dioxide (CO_2) concentrations. In this study, we use a novel suite of simulations with a comprehensive ocean-atmosphere general circulation model (GCM) to assess how the warm and cold phases of the AMV influence the climate response to external forcing from CO_2. While the impact of AMV phase on the global mean response to CO_2 forcing is small, significant regional differences are found, in particular a dipole in the extratropical Northern Hemisphere with Eurasia warming more, and North America warming less, in the warm phase of the AMV. Using a

dynamical analogue technique, we find that the dipole is explained by a dynamical component related to the magnitude of the Arctic Oscillation response, and a thermodynamic response that remains poorly understood. The results from the comprehensive GCM are being examined using simulations with an atmospheric GCM using prescribed sea-surface temperatures and sea-ice. These additional simulations are designed to isolate specific physical mechanisms that explain the responses observed in the comprehensive coupled system.

Session 1807010 - Climate Variability and Predictability - Part 1
Beyond the annual mean: ENSO-driven interannual wintertime AMOC variability
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Recently established North Atlantic ocean observing arrays, such as RAPID, have revealed a large degree of high-frequency variability in the Atlantic Meridional Overturning Circulation (AMOC). Climate modeling studies of the AMOC, however, have traditionally focused on the low-frequency variability of the annual mean AMOC, with an emphasis on multi-decadal and longer time-scale variability. Thus, less is known about the origins of high-frequency AMOC variability. Using the Community Earth System Model, we here show that there is a distinctive leading mode of high-frequency variability in the wintertime AMOC that is not evident in the annual mean. We further show that this mode of variability is significantly linked to the El Nino-Southern Oscillation (ENSO) via the North Atlantic Oscillation (NAO). During El Nino (La Nina) events, the wind-stress over the extratropical North Atlantic is anomalously westward (eastward), leading to an Ekman-driven dipole about the wintertime AMOC maximum, with negative AMOC anomalies to the south (north) and positive AMOC anomalies to the north (south) of the wintertime maximum. Although this wintertime mode of variability in the AMOC is correlated with the NAO index itself, the correlation with the NINO3.4 index is stronger, likely due to the persistence of ENSO events throughout the winter season. Improving our understanding of seasonal AMOC variability will aide in our interpretation of the ocean observations, such as RAPID, and aide in our ability to detect and predict changes in the AMOC as the climate warms.

Session 1807010 - Climate Variability and Predictability - Part 1
Characteristics of Atmospheric Rivers and Their Association with Extreme Precipitation in a Changing Climate
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Atmospheric rivers (ARs) are narrow corridors or filaments of concentrated moisture in the atmosphere that have significant socioeconomic impacts induced by heavy rainfall, flooding, and strong winds. Future ARs will be affected by both the thermodynamic and dynamic responses of the climate system to continued anthropogenic forcing, with the former increasing atmospheric moisture content and the latter altering atmospheric circulation. Current methods for identifying ARs combine information about the thermodynamic and dynamic status of the atmosphere by relying on indices that compare vertically integrated vapor transport (IVT) against a fixed threshold (typically 250 kgm-1s-1). In this study, we use two definitions, one relying on a fixed IVT threshold and another accounting for increasing atmospheric moisture content, to distinguish between the effects of the thermodynamic and dynamics responses to anthropogenic

forcing on ARs. We study this question using reanalysis data and climate simulations data from phase 5 of the Coupled Model Intercomparision Project. Our presentation will summarize results and assess whether the separation of thermodynamic and dynamic influences is feasible through simple modifications of AR detection procedures.

Session 1807010 - Climate Variability and Predictability - Part 1
Selective Monsoon-ENSO Interaction: Active Role of the Southeast Asian Monsoon
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The interactive nature of the Asian monsoon and ENSO has been investigated extensively in the past decades; however, the annual cycles of the monsoon and ENSO have seldom been considered mutually and simultaneously in this interaction although the selective interaction between the two has been discussed Webster and Yang (1992). This presentation will first review some key features of Webster and Yang, focusing on monsoon variability, spring predictability barrier, selective monsoon-ENSO interaction, and precursory signals of monsoon in the subtropical westerlies. The importance of the Southeast Asian climate variations in monsoon-ENSO interaction will then be discussed. It is found that in the past decades the atmospheric heading and sea surface temperature in Southeast Asia and adjacent regions have increased apparently and these increases have caused changes in global climate and ENSO. For example, the convection over the Maritime Continent in spring time causes subsequent changes in the evolution of the Pacific trade wind and thus ENSO. The favorable role of the Maritime Continent (land) in ENSO decay will be demonstrated, along with the mechanisms for the influence of the Maritime Continent on ENSO evolution.

Session 1807011 - Climate Variability and Predictability - Part 2
Statistical Modelling of Annual Rainfall Pattern in Guanacaste, Costa Rica
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We analyze a body of rainfall data covering 38 years from five meteorological stations in the Nicoya Peninsula of the Guanacaste Province, Costa Rica. The purpose of the analysis is to uncover spatial and temporal variability of rainfall in order to support research into water and sustainability under the FuturAgua project. We use a variety of statistical analysis and modelling techniques. The analysis uncovers a relatively suppressed spatial pattern of rainfall. Rainfall totals for periods shorter than two weeks are dominated by strong stochastic variability, while longer totalizing periods reveal systematic variation. Monthly totals show the strong double peak, and an associated midsummer drought that has been previously reported. The annual cycle can be efficiently captured by a double Gaussian model. A simple application of this model to individual years shows large inter- annual variability, and a strong dependence of the rainfall peak amplitudes on the Oceanic Niñ o Index (ONI). A Bayesian analysis confirms the appropriateness of the double peak model, and quantifies the strength of the dependence on ONI. We discuss the implications of our statistical analyses for research under the FuturAgua project.

Session 1807011 - Climate Variability and Predictability - Part 2

Impact of Resolution on the Representation of Precipitation Variability Associated With the ITCZ

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The Intertropical Convergence Zone (ITCZ) is responsible for most of the weather and climate in equatorial regions along with many tropical-midlatitude interactions. It is therefore important to understand how models represent its structure and variability. Most ITCZ-associated precipitation is convective, making it unclear how horizontal resolution impacts its representation. To assess this, we introduce a novel technique that involves calculation of the precipitation fields decorrelation length scale (DCLS) using model data sets that share a common lineage with horizontal resolutions from 16 to 160 km. All resolutions captured the ITCZs mean structure; however, imprints of topography, such as Hawaii and sea surface temperature, including the variability associated with upwelling cold water off the coast of South America, are more clearly represented at higher resolutions. The DCLS analysis indicates that there are changes in the spatial variability of the ITCZs precipitation that are not reflected in its mean structure, thus confirming its utility as a diagnostic.

Session 1807011 - Climate Variability and Predictability - Part 2

Eastern Canada flooding 2017 and its subseasonal predictions

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Severe damages were made by the flooding event across Eastern Canada in the first week of May 2017, when thousands of residences were affected and many people were evacuated from their homes in Southern Quebec and Eastern Ontario. This event was mainly caused by the persistent heavy rainfall during that week. In this study, the ability of making a useful prediction of this heavy rainfall event about two weeks in advance is assessed for 11 Subseasonal-to-Seasonal (S2S) prediction models. It is found that the above normal precipitation in Eastern Canada during the week of May 1 to 7 was predicted by most of the models, although the forecast anomaly was in general too weak comparing to the observations. These models also predicted high probability of extreme precipitation. Analysis of atmospheric circulation pattern associated with the flooding event reveals a wave train of 500-hPa geopotential height anomaly along the middle latitudes from the North Pacific across North America to the North Atlantic, which sets up a favorable environment for strong water vapor transport from the Gulf of Mexico and the western Atlantic to Eastern Canada. Most models were able to predict this wave train. This flooding event is found to be likely connected to the tropical Madden-Julian Oscillation (MJO) through atmospheric teleconnections. It is observed that during the week of April 24-30 the MJO was in phase 7 with enhanced convection in the western-central Pacific. A numerical experiment is conducted using a linear model with a specified tropical diabatic heating similar to MJO phase 7. The resulting 500-hPa geopotential height response has many similarities to the observed wave train which was responsible for this flooding event.

Session 1807011 - Climate Variability and Predictability - Part 2

Tropical Forcing of the Circumglobal Teleconnection Pattern

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Recent studies have shown that variability within the South Asian Jet tends to comprise zonal wave-number 5 patterns. One phase in particular tends to be associated with variability farther downstream than the other phases. When the Jet is in this particular phase, there exists a circumglobal teleconnection (CGT) whereby disturbances originating near the Jet entrance, or within the Jet, remain trapped and circumscribe the globe. Observational evidence shows that the CGT pattern is associated with reduced convection in the vicinity of India. This study aims to find out if the CGT can be forced to occur given a convective anomaly in this location, or if this convective anomaly is just a response to the CGT.

Results from a linear model show that not only does a forcing near India produce this pattern, but convective anomalies elsewhere in the Tropics can induce local anomalies that resemble portions of the CGT, consistent with previous studies.

Session 1807011 - Climate Variability and Predictability - Part 2
Subseasonal Climate Predictability over the United States assessed from ECMWF and NCEP models
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The subseasonal predictability of surface temperature and precipitation is examined using two global ensemble prediction systems (ECMWF VarEPS and NCEP CFSv2), with an emphasis on the week 3–4 lead (i.e. 15–28 days ahead) fortnight-average anomaly correlation skill over the United States, in each calendar season. Although the ECMWF system exhibits slightly higher skill for both temperature and precipitation in general, these two systems show similar geographical variations in the week 3–4 skill in all seasons and encouraging skill in certain regions. The regions of skill are then interpreted in terms of large-scale teleconnection patterns. During winter, in particular, week 3–4 predictability is found to be higher during extreme phases of the El Niño–Southern Oscillation, Pacific-North American (PNA) / Tropical-Northern Hemisphere mode, and Arctic Oscillation (AO)/ North Atlantic Oscillation (NAO). Both forecast systems are found to predict these teleconnection indices quite skillfully, with the anomaly correlation of the wintertime NAO and PNA exceeding 0.5 for both models. In both models, the subseasonal contribution to the PNA skill is found to be larger than for the NAO, where the seasonal component is large. Over the southwest US in summer, the North American monsoon system leads to higher skill in precipitation and surface temperature, while high skill over northern California in spring is found to be associated with the seasonal variability of the AO.

Session 1807011 - Climate Variability and Predictability - Part 2
Effects of the Madden Julian Oscillation on 2 m Air Temperature Prediction over China during Winter in the S2S Database
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The data of 11 models in the sub-seasonal to seasonal (S2S) prediction project has been analyzed to investigate the influence of the Madden Julian Oscillation (MJO) on the predictive skill of winter 2 m air temperature over China. China is divided into four regions, including southern, western, central and northeastern China. Predictive skills are generally similar among those four regions in each of the 11 models. The ECMWF model can hold a well predictive skill (correlation skill ≥ 0.5) at about four pentads, and skills of the rest of models are generally

between 2-3 pentads. Compared ensemble spread with root mean square error, ECMWF and JMA models show more reliable ensemble predictions than the rest of models. The ensemble results of BoM, ECCC, CMA, and Meteo-France models are underconfident, and the results of HMCR, KMA, ISAC-CNR, UKMO, and NCEP are overconfident. Except for BoM and ISAC-CNR modes, the MJO has a significant effect on the skill of 2 m air temperature over central China at pentad three. When an active MJO event occurs at the initial time of a forecast, predictive skill at pentad three over central China is higher than that without an MJO event. This is because the active MJO event can excite a planetary scale teleconnection pattern over the Northern Hemisphere, and most of the models can holds this teleconnection pattern for about 3-4 pentads. Thus, the MJO affects the atmospheric circulation over central China in the models, and improves the predictive skill of 2 m air temperature. This finding suggests that the prediction of winter 2 m air temperature in the S2S models over central China can be more reliable at pentad three when an active MJO event occurs at the initial time of a S2S forecast.

Session 1807020 - Processes and Impacts of climate change in the Arctic realm: from past to future
CLIMATE SCENARIOS FOR CANADIAN ARCTIC BASED ON REANALYSIS PRODUCTS AND REGIONAL CLIMATE MODEL OUTPUTS
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The Canadian Arctic provides many challenges for documenting current rates of climate change and for developing scenarios of how the climate may evolve over the next 30-100 years. First, the regions' complex topography and waterways have major implications for local climate. Second, the surface observations network is relatively sparse making recent climate characterization and model validation difficult. This talk will present results of an objective methodology for evaluating and selecting the reference climate from a large number of reanalysis, observed and model-generated datasets. Then we will present the recent state as well as the evolution of key climate indicators based on daily temperature, precipitation, snow depth and wind, including their extremes. The climate scenarios are calculated on CORDEX climate model outputs, they are presented on a 0.25° grid for two future horizons (2040-2064 and 2076-2100) and for high- and medium-low radiative forcing scenarios (RCP 8.5 and RCP 4.5). The results will be presented for Nunavik and Nunatsiavut regions (ArcticNet IRIS-4 regional assessment), but are available for the entire Canadian Arctic.

Session 1807020 - Processes and Impacts of climate change in the Arctic realm: from past to future
Modelling High Frequency Variability in Hudson Strait Outflow
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Freshwater outflow from Hudson Strait, mostly from river discharge from Hudson and James Bays, is the third largest source of freshwater to the North Atlantic, with observational and modelling estimates ranging between 26-31 mSv (Sref = 33). Understanding the structure of freshwater and volume fluxes to the Labrador Current has implications not only for stratification in the Labrador Sea, but also nutrient and contaminant concentrations for the fishing industry along the shores of Eastern Canada. Earlier observations have shown that anticyclonic freshwater

eddies, generated by storms in Hudson Bay, carry a significant amount of freshwater in the Hudson Strait outflow. By combining both mooring observations and a high spatial (4.5 km) and temporal (6 hours) coupled sea ice-ocean model simulation, we investigate the presence of these freshwater eddies and variability in the freshwater outflow. We find that the model is able to simulate the anticyclonic freshwater eddies, however, they do not account for the large fluctuations seen in the volume and freshwater flux transports. Variability in the position and size of the freshwater jet is explored, in addition to generating processes.

Session 1807020 - Processes and Impacts of climate change in the Arctic realm: from past to future

seasonnally sea ice free eastern Arctic Ocean during the early-mid Holocene

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The Arctic sea-ice cover recorded important changes over the last decades. Whether or not the recent minimum of September sea-ice extent recorded in 2007 and 2012 are the single result of anthropogenic forcing or partly of natural variability, is still an open question. A way to answer this question is through examining time series documenting sea ice changes prior to its satellite monitoring, as illustrated here based on the analysis of six deep-sea

cores collected from west to east along the Lomonosov Ridge. These cores show contrasted sedimentary regimes. In the west, extremely low sedimentation rates, < 5 mm/kyr, and good preservation of calcareous microfauna characterize perennial sea ice environments. In the east, relatively high sedimentation rates ranging up to ~5 cm/kyr relate to high sea ice rafting rates and active Transpolar Drift dynamics. At sites near the easternmost edge of the Ridge, early-mid Holocene sediments are characterized by low to nil biogenic carbonates, but contain phototrophic organic-walled dinocysts. These features indicate phytoplankton productivity but poor $CaCO_3$ preservation that we link to intense brine production rates leading to vertical convection and CO_2 transfer from surface to bottom waters. Such conditions are likely related to first-year seasonal sea ice in the eastern Lomonosov Ridge area until ca. 4000 years ago. Whereas highly resilient perennial sea ice on long time scales characterizes the western Arctic Ocean, seasonal sea ice in the Russian Arctic seems to be a recurrent feature during warm episodes of the past. This suggests that the recent minimum in summer Arctic sea ice extent is part of the natural variability, but could well become a dominant mode in the future due to global warming and its Arctic amplification.

Session 1807030 - Earth System Models: Assessing Earth’s State and Fate from Regional to Planetary Scales - Part 1

An improved parameterization of leaf area index (LAI) seasonality in the Canadian Terrestrial Ecosystem Model (CTEM) v.2.1.1

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Leaf area index (LAI) and its seasonal dynamics are key determinants of vegetation productivity in nature and as represented in terrestrial biosphere models seeking to understand land-surface atmosphere flux dynamics and its response to climate change. Non-structural carbohydrates (NSCs) and their

seasonal variability are known to play a crucial role in seasonal variation of leaf phenology and growth and functioning of plants. The carbon stored in NSC pools provides a buffer during times when supply and demand of carbon are asynchronous. An example of this role is illustrated when NSC from previous years are used to initiate leaf onset at the arrival of favourable weather conditions. In this study, we incorporate NSC pools and associated parameterizations of new processes in the modelling framework of the Canadian Land Surface Scheme-Canadian Terrestrial Ecosystem Model (CLASS-CTEM) with an aim to improve the seasonality of simulated LAI. The performance of these new parameterizations is evaluated by comparing simulated LAI and atmosphere-land CO2 fluxes, to their observation-based estimates, at three sites characterized by broadleaf cold deciduous trees selected from the FLUXNET database. Results show an improvement in leaf onset and offset times with about 3-4 weeks shift towards earlier times during the year and in agreement with observations. These improvements in simulated LAI also help to improve the simulated seasonal cycle of gross primary production (GPP) and as a result simulated net biome production (NBP) as well.

Session 1807030 - Earth System Models: Assessing Earth’s State and Fate from Regional to Planetary Scales - Part 1
Quantifying the influence of snow parameterizations on climate in the Canadian LAnd Surface Scheme (CLASS)
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Snow processes exert important controls on the surface energy and water balance and are an important source of uncertainty in climate simulations with earth system models (ESMs). Yet, snow processes are typically subgrid-scale and must be parameterized in land surface models. Quantifying the importance of snow-related model parameters, and their uncertainties may, therefore, lead to better understanding and quantification of uncertainty within ESMs. This remains challenging due to the high-dimensional parameter space, poor observational constraints, and interactions between parameters. In this study, we investigate the sensitivity of the global surface climate to uncertainty in nine snow microphysical parameters in the Canadian LAnd Surface Scheme (CLASS). An efficient statistical emulator of CLASS is constructed using machine learning methods to sample the influence of all parameters across their full range of empirical uncertainty. A skill score metric (referenced to available observation-based climate data) is used to constrain the plausible range for each parameter, and to identify the parameters with the largest influence at global and regional scales. Sensitivity tests indicate that the most important parameters are a threshold parameter for snow albedo refreshment, and a parameter limiting the snow depth below which bare ground appears. The results suggest higher values (compared to the default) of these two parameters leads to reduced biases in simulated global surface albedo and snow water equivalent. The results also demonstrate a considerable reduction of the plausible ranges of many parameter values, and hence their uncertainty ranges, which could lead to a significant reduction in the overall uncertainty of global land surface simulations.

Session 1807030 - Earth System Models: Assessing Earth’s State and Fate from Regional to Planetary Scales - Part 1
Using a stochastic convective parametrization to improve the simulation of tropical modes of variability in a GCM
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Convection in the tropics is organized into a hierarchy of scales ranging from the individual cloud of 1 to 10 km to cloud clusters and super-clusters of 100's km and 1000's km, respectively, and their planetary scale envelopes. These cloud systems are strongly coupled to large scale dynamics in the from of wave disturbances going by the names of meso-scale systems, convectively coupled equatorial waves (CCEW), and intraseasonal oscillations, including the eastward propagating Madden Julian Oscillation (MJO) and poleward moving monsoon intraseasonal oscillation (MISO). Coarse resolution climate models (GCMs) have serious difficulties in representing these tropical modes of variability, which are known to impact weather and climate variability in both the tropics and elsewhere on the globe. Atmospheric rivers, for example, such the pineapple express that brings heavy rainfall to the Pacific North West, are believed to be directly connected to the MJO.

The deficiency in the GCMs is believed to be rooted from the inadequateness of the underlying cumulus parameterizations to represent the variability at the multiple spatial and temporal scales of organized convection and the associated two-way interactions between the wave flows and convection; these parameterizations are based on the quasi-equilibrium closure where convection is basically slaved to the large scale dynamics. To overcome this problem we employ a stochastic multi-cloud model (SMCM) convective parametrization, which mimics the interactions at sub-grid scales of multiple cloud types, as seen in observations. The new scheme is incorporated into the National Centers for Environmental Prediction (NCEP) Climate Forecast System version 2 (CFSv2) model (CFSsmcm) in lieu of the pre-existing simplified Arakawa-Schubert (SAS) cumulus scheme.

Significant improvements are seen in the simulation of MJO, CCEWs as well as the Indian MISO. These improvements appear in the form of improved variability, morphology and physical features of these wave flows. This particularly confirms the multicloud paradigm of organized tropical convection, on which the SMCM design was based, namely, congestus, deep and stratiform cloud decks that interact with each other form the building block for multiscale convective systems. An adequate account for the dynamical interactions of this cloud hierarchy thus constitutes an important requirement for cumulus parameterizations to succeed in representing atmospheric tropical variability. SAS fails to fulfill this requirement evident in the unrealistic physical structures of the major intra-seasonal modes simulated by the default CFSv2.

Session 1807030 - Earth System Models: Assessing Earth's State and Fate from Regional to Planetary Scales - Part 1
Unified Earth System Modelling at the Canadian Centre for Climate Modelling and Analysis
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Building on its expertise in coupled atmosphere-ocean modelling, over the past two decades CCCma has developed capacity to additionally model the Chemistry Climate of the middle-atmosphere and troposphere through the Canadian Middle Atmosphere Model (CMAM) and the land/ocean biogeochemistry of the earths carbon cycle through the CanESM. Both the CMAM and CanESM have made high-profile contributions to multiple phases of international Assessments such as

the WMO Scientific Assessment of Ozone Depletion and the Coupled Model Intercomparison Project in support of the Fifth Assessment Report of the IPCC. While currently independent of each other, the ultimate goal is to integrate these two capabilities into a single earthsystem modelling framework for operational applications. In this talk I will discuss the significant challenges that face such a unification effort which include, maintaining the existing quality of each component while facilitating their continued improvement and operational application against a background of evolving supercomputing and modelling infrastructures.

Session 1807030 - Earth System Models: Assessing Earth's State and Fate from Regional to Planetary Scales - Part 1

The ocean climate and carbon cycle in the Canadian Earth System Model 5

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The Canadian Earth System Model (CanESM) is a global Earth System Model used for climate studies on timescales from seasons to centuries. Developed at the Canadian Centre for Climate Modelling and Analysis (CCCma) with inputs from other government and university stakeholders, CanESM5 will take part in the Coupled Model Intercomparison Project phase 6 (CMIP6), and other upcoming coordinated international modelling exercises. The joint ocean, biogeochemistry and sea-ice components of CanESM5 are built off the NEMO modelling framework. Here I describe customizations to the base physical ocean model, and the two locally developed ocean biogeochemistry models : the Canadian Model of Ocean Carbon (CMOC) and the Canadian Ocean Ecosystem (CanOE). Using long control ocean simulations under specified surface forcing derived from earlier coupled models, I validate the ocean model distributions of temperature, salinity, sea-ice, inorganic carbon and nutrients, which are generally highly correlated with observed distributions, although biases do exist. Historical simulations under specified CO2 concentrations and evolving surface forcing, show patterns and rates of ocean warming, sea-ice loss and carbon uptake also largely in agreement with observed changes. Early results from fully coupled simulations with CanESM5 are discussed – in particular the extreme sensitivity of the Meridional Overturning Circulation to freshwater inputs from river runoff. In closing, I will describe emerging efforts to coordinate ocean and sea-ice modelling activities from weather to climate scales within Environment and Climate Change Canada and beyond.

Session 1807031 - Earth System Models: Assessing Earth's State and Fate from Regional to Planetary Scales - Part 2

Heat stress and labour productivity loss due to cumulative CO2 emissions

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Cumulative CO2 emissions have been shown to be a robust linear predictor of both global and regional temperature increases. However, many societal impacts are driven by climate extremes, rather than by mean changes, which has motivated recent attempts to link changes in extremes to cumulative CO2 emissions. Here, we thus show that cumulative CO2 emissions can be robustly linked to regional patterns of increasing heat stress, as well as the resulting societal and economic impacts associated with labour productivity loss. We estimate historical and future increases in heat stress using data from eight Earth

System Models. Both the global intensity and spatial pattern of heat stress increase linearly with cumulative CO2 emissions across all scenarios that we assessed. We also show that the pattern of heat stress intensity at a given level of global temperature increase is significantly affected by non-CO2 forcing; non-CO2 greenhouse gas emissions amplify heat stress increases, while high local emissions of aerosols tend to moderate them. Finally, we estimate a global mean loss of outdoor labour productivity of 14 to 25 days per year per trillion tonne of carbon emitted. This socioeconomic impact of cumulative CO2 emissions varies substantially across countries, however, with generally higher impact in low-income countries.

Session 1807031 - Earth System Models: Assessing Earth's State and Fate from Regional to Planetary Scales - Part 2
Role of Atmospheric and Oceanic Forcing in the Climate Response to Anthropogenic Aerosols
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The climate response to anthropogenic aerosols is known to have a spatial pattern that is distinct from the response to greenhouse gases. As a result, understanding regional responses to anthropogenic aerosols is important to understanding the total human impact on regional climates. In past studies, some of these regional responses have been linked to aerosol-induced sea surface temperature (SST) changes, while others are linked directly to aerosol forcing on the atmosphere. To further investigate the mechanisms underlying regional responses to aerosol forcing, we ran a set of simulations using the NCAR-DOE Community Atmosphere Model 5 (CAM5) with prescribed SST conditions. These simulations separately test the climate impact of aerosol and aerosol precursor emissions changes and the impact of aerosol-induced SST changes between 1950-1959 and 2000-2009. We find that the global mean land temperature and precipitation response to aerosol forcing is dominated by the response to oceanic forcing, while the response to aerosol atmospheric forcing dominates in regions with large emission changes such as South and East Asia. Furthermore, we see summertime circulation changes in the South Asian Monsoon and the polar jet that are largely driven by aerosol atmospheric forcing.

Session 1807031 - Earth System Models: Assessing Earth's State and Fate from Regional to Planetary Scales - Part 2
Should we abandon the 1% experiment for evaluating carbon cycle feedbacks to climate change?
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Idealized climate change experiments are used as benchmarks to facilitate the comparison of ensembles of climate models and to derive standard metrics of the Earth system such as: Climate Sensitivity, Transient Climate Response and Carbon Budgets. In the Fifth Assessment Report of the IPCC the 1% per year change in atmospheric CO2 concentration experiment was used to compare Earth System Models (ESMs). However this "1% experiment" was never intended for such a purpose and implies a rise in atmospheric CO2 concentration twice as fast as the instrumental record. Here I critically examine this choice by comparing the 1% experiment to an idealized CO2 pathway derived from a Gaussian function, that includes emission deceleration and a smooth transition to zero or negative emissions. The results suggest that during the emission rate

deceleration phase of the pathway the ocean sink strengthens and comes to dominate the global carbon cycle. An affect that cannot be studied with the 1% experiment. Additionally, the Gaussian pathway shows a continuum of carbon cycle behaviour between acceleration, deceleration, zero emissions, and negative emissions phases of the pathway. Using a Gaussian or similar pathway for intercomparing ESMs has extra computational cost but overall would allow for a more a comprehensive examination of the possible behaviour of the carbon cycle.

Session 1807031 - Earth System Models: Assessing Earth's State and Fate from Regional to Planetary Scales - Part 2
Northern Hemisphere climate response to anthropogenic aerosols in the CanESM2 large ensemble
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The role of anthropogenic aerosols on climate is still not clearly understood. Aerosol forcing is spatially heterogeneous and their emissions are controlled by regional economic and regulatory factors. However, it has been claimed that anthropogenic aerosols could be partly responsible for the global warming slowdown, mainly through a negative PDO response over the period 1998-2012.

We evaluate the regional impacts of anthropogenic aerosol emission changes over the recent past. We use the Canadian Earth System Model CanESM2 historical simulations that were contributed to CMIP5 as well as a large 50-member initial condition ensemble of the same model, forced by anthropogenic aerosols, natural forcing and all-forcing. The large ensemble provides a robust characterization of internal variability and a good estimate of the forced response.

In the large ensemble forced only with anthropogenic aerosols, global-mean surface temperature trend exhibits neither a global cooling or a negative PDO-like response over the slowdown period. Instead, anthropogenic aerosols cause a significant Arctic amplified warming over the North Pacific. This signal is also linked to a decrease in sea ice concentration. In addition, the differences between the large ensemble and the five realizations that were provided to CMIP5, provide a striking example of the caution needed in interpreting regional responses over short periods with relatively few realizations.

Session 1807031 - Earth System Models: Assessing Earth's State and Fate from Regional to Planetary Scales - Part 2
The Impact of Stratospheric Circulation Extremes on Minimum Arctic Sea Ice Extent
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Given the rapidly changing Arctic climate, there is an urgent need for improved seasonal predictions of Arctic sea ice. Yet, Arctic sea ice prediction is inherently complex. Among other factors, wintertime atmospheric circulation has been shown to be predictive of summertime Arctic sea ice extent. Specifically, many studies have shown that the interannual variability of summertime Arctic sea ice extent (SIE) is anti-correlated with the leading mode of extratropical atmospheric variability, the Arctic Oscillation (AO), in the preceding winter. Given this relationship, the potential predictive role of stratospheric circulation extremes and stratosphere-troposphere coupling in linking the AO and Arctic SIE variability is

examined. It is shown that extremes in the stratospheric circulation during the winter season, namely stratospheric sudden warming (SSW) and strong polar vortex (SPV) events, are associated with significant anomalies in sea ice concentration in the Barents Sea in spring and along the Eurasian coastline in summer in both observations and a fully-coupled, stratosphere-resolving general circulation model. Consistent with previous work on the AO, it is shown that SSWs, which are followed by the negative phase of the AO at the surface, result in positive sea ice anomalies, whereas SPVs, which are followed by the positive phase of the AO at the surface, result in negative sea ice anomalies, although the mechanisms in the Barents Sea and along the Eurasian coastline are different. The analysis suggests that the presence or absence of stratospheric circulation extremes in winter may play a non-trivial role in determining total September Arctic SIE when combined with other factors.

Session 1807031 - Earth System Models: Assessing Earth's State and Fate from Regional to Planetary Scales - Part 2

Large impacts, past and future, of ozone depleting substances on Brewer-Dobson circulation trends: A multi-model assessment

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While multidecadal increases in carbon dioxide concentrations have long been known to cause an acceleration of the Brewer-Dobson circulation (BDC) by the end of the 21st century, the impact of ozone depleting substances (ODS) on the BDC has received little attention. A few recent studies have suggested that ODS might be important drivers of BDC trends, but these studies were conducted with individual models. Here we take a multi-model approach, and analyze BDC trends for the past (1960-2000) and for the future (2000-2080) in the models participating in both the CCMVal2 and CCMI intercomparison projects. Examination of both age-of-air and vertical velocity, using 20 different stratosphere-resolving models, reveals that ODS are very important drivers of BDC trends. First: we find that in the last few decades of the 20th century ODS have contributed roughly half of the modeled trends. Second: owing to present and future ODS reductions as a consequence of the Montreal Protocol, BDC trends in the next several decades are projected to be much smaller (roughly by a factor two) than trends in the late 20th century. Our multi-model study, therefore, robustly establishes the major impact of ODS on BDC trends, and highlights how the Montreal Protocol will be altering the stratospheric circulation until the end of the 21st century.

Session 1807032 - Earth System Models: Assessing Earth's State and Fate from Regional to Planetary Scales - Part 3

Snow-precipitation coupling and related atmospheric feedbacks over North America

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Understanding snow-precipitation coupling mechanisms is of great importance both from theoretical and practical considerations. Here, carefully designed climate model experiments, with and without interactive snow, are conducted to study snow-precipitation coupling mechanisms over North America. Coupling hotspots are identified over southern Canada during December and over the central U.S. during January. The hot-spot over southern Canada involves a positive snow-atmosphere feedback mechanism, whereby snow modifies the

large-scale atmospheric features, which resembles the positive phase of North Atlantic Oscillation. This favors storm activity and enhanced snow over the region. The coupling over the central U.S. during January, on the other hand, is tied to the albedo effect of snow, which leads to cooling of the lower atmosphere, which in turn determines the precipitation phase, favoring snow formation over rain. The results from this study, in general, are informative for sub-seasonal to seasonal prediction of winter precipitation for the studied regions.

Session 1807032 - Earth System Models: Assessing Earth's State and Fate from Regional to Planetary Scales - Part 3
Bias-corrected regional climate projections with a stretched-grid AGCM
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We present simulations of the 20th and late 21st-century climate under the RCP8.5 scenario carried out with an empirically bias-corrected atmospheric general circulation model, forced with bias-corrected sea-surface temperatures and sea ice. The bias correction substantially improves the simulated late-20th-century climate. The simulated climate change is compared to climate change simulations made with the uncorrected version of the atmospheric model. The simulated climate change is broadly similar in the corrected and uncorrected simulations. Atmospheric circulation patterns are better represented in the corrected version of the model, and their changes are not geographically "pinned" by the applied bias correction. Finally the authors discuss different possible choices in terms of the place of bias corrections and other intermediate steps in the modeling chain leading from global coupled climate simulations to impact assessment.

Session 1807032 - Earth System Models: Assessing Earth's State and Fate from Regional to Planetary Scales - Part 3
Canadian Snow and Sea Ice: Assessment of Snow, Sea Ice, and Related Climate Processes in Canadas Earth-System Model and Climate-Prediction System
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The Canadian Sea Ice and Snow Evolution Network (CanSISE) is a climate research network focused on developing and applying state of the art observational data to advance dynamical prediction, projections, and understanding of seasonal snow cover and sea ice in Canada and the circumpolar Arctic. This study presents an assessment from the CanSISE Network of the ability of the Canadian Earth-System Model 2 (CanESM2) and the Canadian Seasonal to Interannual Prediction System (CanSIPS) to simulate and predict snow and sea ice from seasonal to multi-decadal timescales, with a focus on the Canadian sector. To account for observational uncertainty, model structural uncertainty, and internal climate variability, the analysis uses multi-source observations, multiple Earth-System Models (ESMs) in Phase 5 of the Coupled Model Intercomparison Project (CMIP5), and large initial-condition ensembles of CanESM2 and other models. It is found that the ability of the CanESM2 simulation to capture snow-related climate parameters, such as cold-region surface temperature and precipitation, lies within the range of currently available international models. Accounting for the considerable disagreement among satellite-era observational datasets on the distribution of snow water

equivalent, CanESM2 has too much springtime snow mass over the Canada, reflecting a broader Northern Hemisphere positive bias. Biases in seasonal snow cover extent are generally less pronounced. CanESM2 also exhibits retreat of springtime snow generally greater than observational estimates, after accounting for observational uncertainty and internal variability. Sea ice is biased low in the Canadian Arctic, which makes it difficult to assess the realism of long-term sea-ice trends there. The strengths and weaknesses of the modeling system need to be understood as a practical tradeoff: the Canadian models are relatively inexpensive computationally because of their moderate resolution, thus enabling their use in operational seasonal prediction and for generating large ensembles of multidecadal simulations. Improvements in climate-prediction systems like CanSIPS rely not just on simulation quality but also on using novel observational constraints and the ready transfer of research to an operational setting. Improvements in seasonal forecasting practice arising from recent research include accurate initialization of snow and frozen soil, accounting for observational uncertainty in forecast verification, and sea-ice thickness initialization using statistical predictors available in real time.

Session 1807032 - Earth System Models: Assessing Earth's State and Fate from Regional to Planetary Scales - Part 3
Vorticity Input and the partitioning of Ocean Heat between the Fram Strait and the Barents Sea Gate
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The transition from a perennial to a seasonal sea ice cover in the Arctic Ocean as simulated by many global climate models is not gradual. Instead it is occurring through periods of rapid sea ice decline related to pulses of ocean heat fluxes entering the Arctic Ocean that causes more open water. The open water in turn is amplified by the sea ice albedo feedback (Holland et al., 2006). Recent works show that it is the heat entering the Arctic over shallow shelves of the Arctic (Eurasian shelf and Barents Sea shelf) that has the largest impact on the temporal evolution of the sea ice extent (Auclair et al., CMOS, 2018) - because ocean heat can interact with the sea ice cover before sinking at depth where little interactions with the pack ice is present. To this end, we have analyzed output diagnostics from the Community Earth System Model - Large Ensemble and looked at the ocean heat flux partitioning between the Barents Sea Opening gate and the Fram Strait gate and their link with rapid sea ice decline. Results show that the partitioning of Heat flux is weakly associated with the Vorticity Input by surface air stress in the shelf break region. The total Volume and Heat fluxes passing through both gates are also well linked with the Vorticity Input throughout the ensemble. The flux values measured here are comparable to observational records but allow for the assessment of Arctic Heat input at longer timescales.

Session 1807032 - Earth System Models: Assessing Earth's State and Fate from Regional to Planetary Scales - Part 3
State-of-the-art and knowledge gaps in Arctic terrestrial modelling
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The Canadian Network for Regional Climate and Weather Processes, in collaboration with the Next-Generation Ecosystem Experiments-Arctic, held an international workshop to gain insight into the rapidly changing pan-Arctic land surface and boundary layer. Current representation of Arctic ecosystem, carbon,

water and energy balance processes in the land model component of Earth System Models, including land-atmosphere interactions, and the next steps to address knowledge gaps were reviewed at the workshop. This talk will provide a summary of the workshop findings, including a discussion on emerging modules/parameterizations and/or approaches and priority science questions and diagnostics related to Arctic terrestrial modelling.

Session 1807032 - Earth System Models: Assessing Earth's State and Fate from Regional to Planetary Scales - Part 3

Northern Hemisphere Terrestrial Cryosphere in 1.5, 2 °C warming scenarios

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The pan-Arctic land surface is warming rapidly, favouring near-surface permafrost degradation, earlier snowmelt, more frequent and intense extreme precipitation events and other changes to the hydrological cycle. This study is based on the analysis of an ensemble of 10 pan-Arctic simulations of the fifth generation Canadian Regional Climate Model (CRCM5) over the 1950-2100 period – five for the Representative Concentration Pathway 8.5 (RCP8.5) and the other five for RCP4.5, all driven by output from the Canadian Earth System Model. As hydrological routing is integrated within the CRCM5 framework, the impact of projected changes in the hydrological cycle and permafrost degradation on Arctic river flows is also explicitly modelled.

Analysis is presented in the context of 1.5 and 2 °C increases in global mean surface air temperature since pre-industrial times, as differences in impacts between these warming levels are highly relevant for the assessment of significant anthropogenic interference with the climate system, in addition to allowing for comparison across models and scenarios. Particular emphasis is given to the identification of regional tipping points for diverse variables, defined as levels of warming that mark the difference between the limits of present-day natural variability and a new climate regime.

Session 1807040 - Science for Canadian Climate Services

Future rainfall Intensity-Duration-Frequency curves in Canada from convection-permitting climate model simulations: a Generalized Extreme Value simple scaling approach

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There is growing evidence that climate models with parameterized convection are unsuited to project the response of sub-daily extreme rainfall to anthropogenic forcings. High-resolution convection-permitting models can more realistically simulate some storm-generating processes. However, convection-permitting integrations are typically short, which hinders robust estimation of societally-relevant products like Intensity-Duration-Frequency (IDF) curves. The use of convection-permitting models, in combination with statistical methods that make better use of short records, may be required to reliably project future changes in short-duration rainfall extremes. To this end, a parsimonious Generalized Extreme Value Simple Scaling (GEVSS) model is used to estimate IDF curves in Canada based on 4-km historical (CTL 2000-2013) and pseudo-global warming (PGW end-of-21st century) convection-permitting simulations from the NCAR HRCONUS WRF model. The GEVSS model leverages

information from multiple durations to characterize the relationships between extreme rainfall intensities, frequencies of occurrence, and durations. Pooling data from different durations provides more robust estimates of GEV distribution parameters.

First, historical WRF sub-daily rainfall extremes are evaluated against high-resolution gridded observations and tipping bucket rain gauge observations. Next, inferences about PGW-CTL changes in GEVSS parameters, estimated under a Bayesian framework, are made using a False Discovery Rate approach applied to posterior error probabilities from the posterior distributions. Significant increases in GEV location, scale, and scaling exponent parameters are projected over the domain, whereas almost no significant decreases in the GEVSS parameters are projected to occur. Projected increases in the GEVSS temporal scaling exponent provide direct evidence for greater intensification of shorter duration extremes relative to longer durations. In other words, IDF curves shift upward and steepen. This calls into question stationarity assumptions (i.e., that daily to sub-daily scaling remains the same) that underpin many existing IDF curve projections.

Session 1807040 - Science for Canadian Climate Services
EASE OF PRODUCTION AND USE VERSUS SCIENTIFIC NOVELTY IN A CLIMATE PRODUCT: OURANOS EXPERIENCE IN THE EVALUATION OF ADDED VALUE FROM AN END-USER PERSPECTIVE
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While climate analysts take pride in developing rich, new and scientifically rigorous products, a review of projects in Quebec that have led to actual adaptation actions reveals that the supporting climate information is often quite basic. For example, Quebec transportation authorities have added a constant 20% security factor to all culvert dimensions to account for more intense precipitations. A coastal risk assessment used simple mean global sea level changes from the IPCC 2013 report and a local isostatic correction to evaluate submersion risks. Based on a review of past projects, we posit that in many cases, the driving force behind adaptation is a well-funded, ambitious multi-stakeholder project that offers considerable scientific and technical improvement over current practices. The actual sophistication of the climate product and the methodology used to extract and process the climate information is often of secondary importance. This raises questions for the evaluation of climate services. A climate service that scores well on products improvement might fail on usability. The talk will summarize the experience acquired at Ouranos during the last 15 years to evaluate the need for novelty in tools and climate products to support diverse actors in their approach towards adaptation to climate change.

Session 1807040 - Science for Canadian Climate Services
PAVICS: A platform for the Analysis and Visualization of Climate Science - toward inter-operable multidisciplinary workflows
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Climate services are by nature interdisciplinary, and an important bottleneck in delivering relevant and timely climate services lies at the interface between disciplines; differences in jargon, conventions, data formats and programming

languages act as barriers to effective collaborations. Here we describe how a scientific model where researchers no not only publish papers and data, but also working algorithms in the form of online interoperable services, has the potential to reduce the friction across disciplines.

The PAVICS platform is built from modular components required to perform climate data analysis: netCDF data server, geospatial layer server, data catalog, netCDF layer renderer, and a number of climate-related operations offered through the Web Processing Service (WPS) standard. Individual operations can be combined into workflows and executed on a distributed network of heterogeneous computing resources. The presentation will describe the role such a platform can play in bringing research closer to science users, and in particular a project underway to map coastal vulnerabilities and compare adaptation options using cost-benefit analysis.

Session 1807050 - Regional Climate Analysis and Projections - Part 1
Future changes in wintertime occurrence and intensity of extratropical cyclones over the eastern coast of North America
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The coarse horizontal resolution of most global climate models (GCMs) providing century-long climate simulations limits the realistic simulations of extratropical cyclone (EC) occurrences and intensities, especially over the eastern coast of North America. Indeed, a large land-sea temperature contrast during wintertime, such as between the cold North American continent and the warm waters of the Gulf Stream, is not well reproduced by GCMs with large sea surface temperature (SST) biases. This has a strong effect on low level baroclinic features which strongly influence both cyclogenesis and EC intensity over this region. Regional climate models (RCMs), using higher resolution than GCMs, present potential added values in EC simulations, but RCMs might inherit some biases from their boundary conditions prescribed by GCMs (i.e. both atmospheric and oceanic features). To overcome this problem, unbiased SSTs can be used in oceanic boundary conditions of the RCM simulations. This study investigates the features of EC changes in terms of both occurrence and intensity as simulated by various configurations of RCMs, with original and unbiased SSTs, driven by two GCMs using two greenhouse gas emission scenarios. The changes of EC characteristics are analyzed over the wintertime months (from November to March) and over the eastern North America. The results show that corrected SSTs exert a key role in modifying the EC intensity under current climate conditions, especially in fall months. An impact is also revealed, to a lesser extent, on the EC occurrence. The future changes in EC intensity over the mid-21st century present a general increase from all simulations in early winter. This could induce higher risks of coastal flood and storm surge events over the maritime areas of Canada in the future, in links with a delayed and reduced sea-ice extent over the Gulf of St-Lawrence with respect to current climate conditions.

Session 1807050 - Regional Climate Analysis and Projections - Part 1
Towards a Canadian Coupled Atmosphere-Ocean Regional Climate Model
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The climate of coastal regions is greatly influenced by physical processes involving interactions between the landscape, the atmosphere and the surrounding ocean. Unfortunately ocean surface fields simulated by current coupled global climate models suffer biases that are particularly large in coastal regions. The Marine Environmental Observation Prediction and Response Network (MEOPAR) Network of Centres of Excellence, through its Prediction Core, has been supporting an effort to develop a relocatable, coupled atmosphere-ocean, regional climate model (CAORCM).

The initial focus region is Eastern Canada, for the purpose of studying Gulf of St. Lawrence and Scotian Shelf. The ocean component is NEMO 3.6 and the atmospheric component is the Canadian Regional Climate Model (CRCM) developed at ESCER/UQAM, largely based on GEM 4.8 that is used for numerical weather prediction at CMC/ECCC. The initial work has consisted in performing “loosely coupled iterative” simulations, as proof of concept towards the full coupling of CRCM-NEMO. The objective is two-fold: to gain experience in exchanging fields between CRCM and NEMO, and to identify (and eventually correct) systematic biases in individual components that would become detrimental when coupled for long climate time scales.

This work has greatly benefited from software developed by CMC/ECCC, collaboration with BIO/DFO, and financial support by MEOPAR and the DFO ACCASP program.

Session 1807050 - Regional Climate Analysis and Projections - Part 1

An Ontario Jet Stream Core Climatology

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Using the high resolution North American Regional Reanalysis (NARR), this study aims to create a jet stream core database for Ontario covering the period 1979 through 2016 inclusive. We use regional maxima in the smoothed horizontal wind field to locate both the latitudinal, and vertical (pressure) location of jet stream cores along specific meridians. Results show that the median pressure level of all jet cores in the region of interest is 250 hPa, and that two is the most likely number of distinct jet cores to occur along a given meridian at any given time.

The jet stream cores are also geographically categorized into three latitudinally based bins (south, middle, and north) in an attempt to capture the characteristics of different tropopause-level jet stream types (Sub-Tropical, Polar Front, Arctic). However, as vertical and horizontal extents of the jet streams were not analyzed, we cannot conclude for certain that each of the geographical bins corresponds to specific jet types. Nevertheless, from differences in the pressure and wind distributions between the three bins, it appears that each may encompass certain characteristics akin to a specific jet type.

Statistically significant negative (positive) trends in the seasonal and overall mean pressure (altitude) of the jet cores supports the findings of previous studies. Our analysis of NARR winds shows that jet core wind speeds increased in the region studied. This may be related to the increased height of jet cores through the thermal wind equation, as well as increased baroclinicity across sections of the region studied. Jet core latitude and Meridional Circulation Index

(MCI) trends were generally negligible and not statistically significant. An absence of significant changes in the |MCI| diverges from expectations and some theories of what to expect in a warming world with enhanced Arctic warming, or Arctic Amplification (AA).

Session 1807050 - Regional Climate Analysis and Projections - Part 1
Sensitivity study of available potential energy budget to optically thin ice clouds during the Arctic polar night
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In situ and satellite-based observations reveal the existence of two types of optically thin ice cloud (TICs) in the Arctic during the polar night. The first type, TIC-1, consists of small none precipitating ice crystals and invisible to the CloudSat radar. The second type, TIC-2, is detected by CloudSat radar and CALIPSO lidar and is characterized by a low concentration of large ice crystals of sufficient size to precipitate. Energy budget diagnostics appears to be one of the most efficient ways to improve functioning physical mechanisms in atmosphere. In this study, the energy cycle equations as formulated by Nikiéma and Laprise (2013) will be used to analyse the energy budget of the atmospheric circulation in the Arctic during the polar night. To address this question, satellite-based observations (CloudSat and CALIPSO) are used to characterize the ice clouds and analyze the atmospheric conditions conducive to their formation. A reanalysis driven application of the Canadian Regional Climate Model version 5 (CRCM5) is used to perform two simulations, one with the clear sky conditions and the other with overclouds conditions. A comparative analysis will be carried out to determine the role of the thin ice cloud according to their type in the response of the energy balance. Overall, this study contributes to evaluate the relative importance of polar clouds on the atmospheric energy balance.

Session 1807050 - Regional Climate Analysis and Projections - Part 1
The impact of climate change on the wave climate in the Gulf of St. Lawrence
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Our objective is to investigate possible changes in the wave climate for coastal waters off eastern Canada, particularly in the Gulf of St Lawrence (GSL) related to changes in marine winds, storm and sea ice, due to climate change. These analyses are based on application of a dynamical downscaling approach whereby a regional climate model is driven by climate change estimates from the Canadian Global Climate Model (CGCM3) to provide relatively high resolution winds to drive a wave model. The CGCM3 simulation follows the A1B climate change scenario from AR4 of IPCC (2007). The analyses of the wave climate are based on simulations of the waves from a third-generation wave model, WAVEWATCHIII, and downscaled winds from the Canadian Regional (atmospheric) Climate Model (CRCM). We show that the significant wave heights in the Gulf of St. Lawrence (hereafter GSL) and neighbouring coastal waters will slightly increase in the winter and decrease in the summer, in response to changes in storms and sea ice in the future climate (2040–2069) compared to the present wave climate, represented as 1970–1999. This time period is also denoted as the "historical" wave climate in this study. In summer, the changes in significant wave heights (Hs) are associated with estimated decreases in the

frequency of the occurrence of the cyclones. Projected changes in return values for summer extremes in the wave climate are consistent with the associated changes in the maximum Hs values. In winter, the projected increases in return values are mostly concentrated in the St. Lawrence Estuary, the northern and southwestern GSL, consistent with changes in the maximum waves in these regions. An important factor related to change in the winter wave climate is change in the sea ice.

Session 1807051 - Regional Climate Analysis and Projections - Part 2
Objective Analysis of Observational Network Sufficiency in BCs Complex Topography
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Weather and climate monitoring in British Columbia is made more challenging by the Province's complex topography and it remains an open question whether climate anomalies vary over short spatial scales in the lateral and vertical in such a region. Despite these challenges, the BC Agricultural sector, BC ministries and other user groups are interested in assessing the sufficiency of the observational network in the province and in determining where gaps or redundancies in station may exist. To address this question, objective analysis of temperature and precipitation has been performed following earlier work by Environment and Climate Change Canada in their network planning. The application described here differs given the dominance of topography on the observations and the relatively large set of available station data which may be used to assess the network. Our assessment is done over monthly and daily observations and shows instances of strong local variability, low inter-station correlations and the influence of observational reliability that all act to reduce the representativeness of stations in some areas. We are able to demonstrate numerous regions with insufficient observational density for the purpose of climate monitoring along with those that are overabundantly observed. However, these results are a strong function of an observation location's purpose for the operating agency and their operational demands.

Session 1807051 - Regional Climate Analysis and Projections - Part 2
Validation of the Ouranos Reconstructed Climate for the Province of Québec (CROQ)
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There is a lack of meteorological observations suitable for climate and impact studies over the province of Québec (PoQ). This lack is attributable to the limited number of observation stations, the limited length of their time series and the small number of variables that are observed. In order to address this problem, the CROQ project was developed at Ouranos to gain a better knowledge of Quebec's climate in the recent past.

The basic idea of the CROQ project consists of using the 5th generation Canadian Regional Climate Model (CRCM5) driven by reanalysis to produce historical fine-scale simulations (at 12-km resolution) of the recent climate over the PoQ. This methodology has been used in previous studies over other regions with results that are comparable to those from a regional reanalysis but at a fraction of the complexity and computational cost.

This presentation gives an overview of the analyses performed up to now to validate the different variables of the CROQ dataset. Results of these analyses provide a broad view of the spectrum of the available variables, the relative strength and weaknesses of the dataset, as well as its uncertainty.

Session 1807051 - Regional Climate Analysis and Projections - Part 2
Simulated air-ground temperature coupling and extreme events: the role of the Land Surface Model
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Previous studies have suggested a Land Surface Model (LSM) dependency in the simulation of the coupling between air and ground surface temperatures within climate models. We have performed three simulations, from 1980 to 2005 for North America using the WRF regional model coupled to three different LSMs (CLM4, Noah and Noah-MP) with output from the North American Regional Reanalysis as boundary conditions. We evaluated the representation of air-ground temperature coupling within these simulations, finding differences at annual and seasonal scales. Such discrepancies are associated with the LSMs treatment of land-cover and soil-moisture content, which results in different energy and water balance at the surface within each simulation. The LSM differences in the energy and water balance also affect the simulation of meteorological phenomena, such as the intensity and frequency of air temperature and precipitation extremes, showing larger LSM differences in temperature extreme events than those in precipitation extreme events.

Session 1807051 - Regional Climate Analysis and Projections - Part 2
High Resolution Regional Climate Modelling in Support of Adaptation In Ontario
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Due to the coarse resolution in the global climate models (GCMs), they are unable to resolve local geophysical features at regional/local scales, such as the Great Lakes and the Niagara Escarpment which have significant impacts on Ontario’s local climate. On the other hand, most adaptation practices are at local/community scales and need climate information at higher resolution. To address this climate information gap, Ontario Government has invested in the past decade to refine the climate information from the global scale (i.e. 100’s kilometers) down to local scales (i.e. 10’s kilometers) using state-of-the-science downscaling techniques. Terabytes of Ontario-specific high resolution regional climate projections have been developed and disseminated via climate data portals; these climate data portals provide both intuitive visualization to all users (general public and policy makers) and extensive data downloading for scientists/engineers for their risk/vulnerability assessments. This presentation will provide a fresh update to peers on Ontario-specific high resolution regional climate projections (both averages and extremes) and easy access to the most up-to-date data portals.

Session 1807051 - Regional Climate Analysis and Projections - Part 2
Detecting the Dynamics of Heavy Precipitation Weather Patterns under Climate Change using a Machine Learning Algorithm

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Several specific weather patterns and extra-tropical cyclones act as large-scale drivers of heavy precipitation that can trigger major flood events. Scientific knowledge on how the dynamics of such extreme events will be affected by climate change is still limited. An assessment of this complex task requires an improved understanding of the role of natural climate variability; this can be supported by the analysis of regional climate model simulations.

The ClimEx project (Climate Change and Extreme Events, www.climex-project.org) has developed an initial-conditions 50-member ensemble at 12-km resolution using the Canadian Regional Climate Model (CRCM5) driven by the CanESM2 global climate model. This dataset, covering two domains over north-eastern North America and Europe, allows to assess the impacts of climate change on meteorological and hydrological extreme events while considering natural climate variability as an important underlying uncertainty.

To address the major challenges involved in analyzing the big data of such an ensemble a machine learning approach was employed. It was built to specifically and efficiently detect weather patterns and extra-tropical cyclones related to heavy precipitation in the domains of interest.

We present the application of this machine learning procedure on two meteorological features: the weather pattern over Québec associated with the devastating Saguenay Flood in 1996 and the rare storm track type Vb over Central Europe, which has triggered several major flood events in Bavaria. Our results demonstrate the performance of the procedure and its capacity to detect historic events in a reanalysis-driven model run. Using the large ensemble, the particular relevance of considering natural variability in climate change impact assessment is highlighted. Finally, the long-term effects of climate change are illustrated in terms of higher frequencies, shifting seasonality and increasing precipitation rates related to the examined extreme weather situations.

Session 1807060 - General Session - Climate
Long-term Surface Temperature (LoST) Database as a Complement for GCM Preindustrial Simulations
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Control climate simulations aim to provide a stationary state to General Circulation Models (GCMs) under constant preindustrial conditions (piControl simulations). This stationary state is then used as initial conditions in GCM simulations to provide a stable and realistic climatology, reducing the potential bias in such simulations. However, it is difficult to provide a reference to assess the climatology of piControl simulations due to the lack of long-term preindustrial observations. We explore the use of long-term ground surface temperature estimates from borehole temperature profiles as an additional reference that may be useful for the initialization procedure of GCM simulations.

We compare five last millennium simulations and five preindustrial control simulations from the third phase of the Palaeoclimate Modelling Intercomparison Project (PMIP3) and the fifth phase of the Coupled Model Intercomparison Project (CMIP5) archives against estimates of long-term preindustrial ground surface temperatures from 514 borehole temperature profiles over North America. These long-term surface temperatures are retrieved from the quasi-equilibrium state of the subsurface thermal regime in each temperature profile, which is estimated from the deepest section of the profile. That is, the quasi-equilibrium state is recovered from the part of the temperature profile least affected by the recent changes in the surface energy balance. Temperatures vary linearly as a function of depth for the deepest part of the profile, and the extrapolation of this linear behavior to the surface is interpreted as the long-term surface temperature (T0 temperature) at each borehole site.

Our results suggest that integrated, long-term ground surface temperatures from borehole data could be employed as a reference within piControl simulations to enhance the quality of the initial conditions in GCM climate simulations.

Session 1807060 - General Session - Climate
The Not So Simple Tipping Bucket
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Hundreds of tipping buckets are used throughout Canada and with automation some are being used without the required correction to the standard manual gauge. The errors inherent to these gauges, both the basic tipping bucket and the siphoning version, are detailed. As the second oldest sensor used on automated stations, possible solutions to minimize these errors are also presented.

Session 1807060 - General Session - Climate
Observed and modelled above-canopy, subcanopy and ground energy budgets at a Quebec boreal forest site: a comparison between EVAP data and CLASS
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Recently, the EVAP Project (Modélisation hydrologique avec bilan énergétique) of Laval University was launched in 2015 with the main objective to improve upon existing hydrological models by focussing on their surface energy budget, in particular their evapotranspiration module. The observation site, part of the BEREV watershed research facility of Montmorency Forest, and located in a balsam fir-white birch stand about 70 km north of Quebec City, includes both a 15-m (“Juvenile”) and a 10-m (“Gaule”) tower, as well as a small instrument tripod at the foot of the Juvenile tower that is used to gather subcanopy data. Considering that subcanopy data are relatively rare, the site offers a chance to look into the complete energy and water balances of a boreal canopy-subcanopy-ground stand. This study presents the above-canopy and subcanopy-ground energy budgets of the stand at the Juvenile tower, and compare the measured fluxes and storage terms with those obtained from a simulation of the Canadian Land Surface Scheme (CLASS). Weaknesses of the scheme and possible fixes are hightlighted, such as an overestimation of the subcanopy incident solar radiation (due to an overestimated canopy transparency) and a significant cold bias of the canopy leaves at night (due to an underestimated longwave subcanopy incident radiation at night, leading to an exagerated diurnal cycle of

soil temperature. Other aspects of the stand's energy budgets are also evaluated.

Session 1808010 - Weather, shipping and subsistence activities in Arctic regions
Implementation of an Arctic Polar Regional Climate Centre
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We report on the first Arctic Polar Regional Climate Centre (ArPRCC) forum held in Ottawa Canada, May 15-17, 2018. This three day event brought together network representatives from Arctic national weather and ice services, and key end-users of climate information from the marine shipping sector and Indigenous organizations to discuss and co-develop priority summary and forecast products at the seasonal and sub-seasonal time-scales. A key outcome of the forum is a consensus statement, a user-relevant outlook for the spring/summer 2018 in the Arctic, and best practices for engaging with users in future annual forums.

The Polar Regional Climate Centers (PRCCs) are a legacy concept from the World Meteorological Organization's (WMO) involvement in International Polar Year (2007-2008). The sensitivity of the Polar Regions to climate variability and change is increasingly recognized as an issue of global significance. The WMO is moving into the demonstration phase of the implementation to apply the concept of Regional Climate Centres (RCCs) to the Polar Regions. RCCs are centres of excellence that operationally generate climate products in support of regional, national and international policy and decision-making for activities such as transportation, responsible resource development and infrastructure planning.

Session 1808020 - Integrated approaches of climate change impacts on marine fisheries - Part 1
Biophysical responses to ocean acidification and impacts on global fisheries
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Increased atmospheric carbon dioxide (CO2) concentrations alter ocean chemistry, causing ocean acidification and affecting marine species and the ecosystem goods and services provided to human society. Ongoing ocean acidification research provides modellers with valuable information and tools for constructing projection scenarios of elevated atmospheric CO2. By integrating the effects of ocean acidification as impacts on growth and mortality, we used spatially explicit species distribution models to project the impacts of ocean acidification in a multi-stressor framework on commercially exploited marine species. Temperature was the main driver of distributional shifts to higher latitudes, while ocean acidification had largely negative impacts on the biomass of invertebrate fisheries catch potential. Globally, invertebrate fisheries catch potential decreased 12.5% by the end of the century, of which ocean acidification effects accounted for about 3.5%—but impacts varied by region. For example, in Canada's Arctic region predicted to be highly vulnerable to ocean acidification, invertebrate fisheries catch was projected to increase 25% by the end of the century due to species invasion in response to ocean warming. However, this increase was reduced to only 10% due to ocean acidification impacts. We highlight the importance of testing various model assumptions to address uncertainty surrounding biological ocean acidification impacts at the parameter, structural and scenario levels. Our findings underscore the utility of models and scenarios to integrate ocean acidification with other CO2-related stressors to

more comprehensively assess climate change vulnerability and risk of impacts of marine species and fisheries.

Session 1808020 - Integrated approaches of climate change impacts on marine fisheries - Part 1

Socioeconomic risk from ocean acidification and climate change impacts on Atlantic Canadian fisheries

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Ocean acidification (OA) is an emerging consequence of anthropogenic carbon dioxide emissions. The extent of the biological impacts are currently not fully understood. However, it is expected that invertebrate species that rely on the mineral calcium carbonate will be among the first and most severely affected. Despite the limited understanding of the impacts, there is a need to identify potential pathways for human communities to be affected by OA and climate change. Research on the social implications of OA is a small but developing field of literature. To date, the majority of these studies have assessed the impacts of OA independent from other aspect of global climate change.

This research contributes to the literature by including OA effects alongside other climate change variables in an assessment of socioeconomic impacts in Atlantic Canada. The investigation follows a risk assessment framework, wherein the biophysical impact component (exposure) is informed by a Dynamic Bioclimate Envelope Model. The assessment framework subsequently addresses the socioeconomic vulnerability of the provinces in the region to identify where declines in fishery access are expected to co-occur with high reliance on fisheries and weak social adaptability. Results suggest New Brunswick and Nova Scotia will experience stronger declines in resource accessibility. While Newfoundland and Labrador along with PEI will be more socially vulnerable to losses in fisheries but are expected to experience relatively minor changes in overall resource access.

Session 1808030 - Risks and impacts relating to the insurance industry

Using machine learning to create a wildfire risk map

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Canada is a vast country, with close to 50% of its area being forested. Several communities are therefore exposed to a significant wildfire risk. With the Slave Lake and Fort McMurray wildfires happening within a short amount of time, there is a concern within the insurance industry that those events will happen more often due to climate change. Insurance practices including risk selection and pricing can be improved, however such changes require a better understanding of wildfire risk in Canada. The Intact Data Lab has decided to take a major step ahead and generate its own wildfire risk map, filling a dire need that can’t be filled by external products due to the current low offer. The team has taken advantage of machine learning and neural network to link wildfire observations with climate conditions. The presentation will cover the multiple steps of the modeling process, all the way from the data gathering to the map generation.

Session 1808050 - General Session - Risks and Impacts - Part 1

Modeling future scenarios of water temperature in the coastal environment and implications for potential infections with Vibrio Parahaemolyticus and Vibrio Vulnificus: application to shellfish beds in the Estuary and Gulf of St. Lawrence

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Vibrios are common bacterial inhabitant of marine environment especially the estuarine and coastal ecosystem. Vibrio parahaemolyticus and Vibrio vulnificus are considered as zoonotic agent associated with shellfish. Those vibrios are the leading cause of gastroenteritis but the outcome of infection by V.Vulnificus is the most dangerous and can lead to fatalities. Those pathogens are very sensitive to variations of sea temperature.

The growth of the vibrios proliferation is proportional to the temperature exceedance of a threshold, which increases the risk of infection by those pathogens. Face with this issue, the modelling of sea surface temperature in the Gulf of St Lawrence and its estuary is primordial to contribute in protecting human health.

In order to achieve this goal, we examines first the relationship between the target variable (sea surface temperature) in function of meteorological (air temperature, wind velocity), oceanographic (tides) and teleconnection patterns (climatic indices) variables through different measures of correlation to select the best input variables for our model. Then, we choose a non-parametric statistic approach, Artificial Neural Networks, which offer an effective and flexible tool to detect all types of interactions between dependant and independent variables as well as complex nonlinear relationships.

Interestingly, the first trial of this model, using the data gathered from the Montlouis buoy in the Gulf of St Lawrence, shows excellent performance. In fact, the root mean square error (RMSE) is of the order of 1.2°C, which represents 6% in relative terms. In addition, the R-squared is very high: i.e. 0.97.

Session 1808050 - General Session - Risks and Impacts - Part 1
The 2017 Northern Great Plains Drought

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The 2017 Northern Great Plains drought developed and intensified very quickly at the beginning of the 2017 growing season. Large portions of southern Saskatchewan, Alberta, Montana, North Dakota, and South Dakota faced their driest summer in 70 years. Many areas recorded less than half the normal rainfall during the growing season. For portions of southern Saskatchewan, it was the driest July in more than a century. Above normal temperatures and abnormally high consistent winds dried soils and exacerbated the drought situation.

The 2017 drought started during the winter season with below normal precipitation. Warmer than normal spring conditions and minimal snow accumulation, resulted in little to no runoff and poor soil moisture leading into the growing season. By May, livestock owners and ranchers in northern states began reducing their herds due to poor pasture conditions and feed shortages. Conditions intensified throughout the season resulting in significant concerns, in the agricultural and other sectors. Producers experienced feed and water shortages, poor soil moisture that reduced crop yields, and large fall grass fires

destroying rural infrastructure and resulting in livestock mortality. Parks and recreational areas were closed or had limited access due to dry conditions and the risk of fire. Urban and rural fire bans were in place throughout much of the region well into the fall. Building foundation settled and cracked resulting in significant damage and electrical fires.

This talk will present highlights of the 2017 Northern Great Plains Drought Assessment, conducted by the NOAA National Integrated Drought Information Service in partnership with Agriculture and Agri-Food Canada, and state climatologists in Montana, South Dakota and North Dakota. The presentation will focus primarily on the evolution of drought conditions and the recorded impacts in Canada.

Session 1808050 - General Session - Risks and Impacts - Part 1
Simulations of the ice storm in the Maritime Provinces on 24-26 January 2017
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The ice storm that affected the Maritime Provinces on 24-26 January 2017 led to major ice buildup on trees and power lines, resulting to a major power outage across the area. In New Brunswick, approximately 133 000 customers were affected over a period of 2 weeks in some area. Many types of precipitations such as freezing rain and snow were produced during the storm at temperatures near 0°C. During the event, up to 100 mm of snow liquid equivalent was measured. Freezing rain reached up to 50 mm in some area near the east coast and the Acadian Peninsula. The goal of this study is to investigate weather conditions and precipitation during the ice storm in January 2017. A complete atmospheric model coupled with a sophisticated microphysical scheme is used to simulate the storm. First, an analysis of the weather conditions and synoptic scale pattern leading to the ice storm was conducted. Second, the distribution of precipitation amounts and types at the surface were evaluated with respect to the atmospheric conditions and observations. Third, the combination of meteorological factors leading to the severity of the storm was investigated. Overall, the occurrence of this type of storms may increase with climate change and it is critical to improve our understanding of the mechanisms leading to the freezing rain versus other types of precipitation at the surface.

Session 1808051 - General Session - Risks and Impacts - Part 2
Quebec mining industry adapting to climate change
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The mining industry has a large part of economic development of the Abitibi-Témiscamingue region (western part of Quebec) since the early 20th century. The management and reclamation of the large amounts of mine wastes produced by the operations must take into account several environmental challenges. For example, geotechnical instabilities can potentially cause environmental damages and acid mine drainage (AMD) can be generated when reactive waste rocks and tailings contain sulfide minerals. Reclamation methods that aim at controlling AMD generation exist such as oxygen barrier covers that restrain oxygen diffusion from the atmosphere to the reactive tailings. Waste disposal and

reclamation infrastructures are specific to each mine site and are specifically adapted to local current climate conditions. Extreme precipitation (i.e. probable maximum precipitation) and dry periods (i.e. few months without precipitation) are taken into account to prevent dam failure and ineffectiveness of oxygen barrier covers, respectively, in designs for humid climates like Abitibi-Témiscamingue. Reclamation infrastructures need to be efficient for an indefinite period of time, which makes them vulnerable to climate changes.

As the climate in this region is projected to evolve through climate change (e.g. more intense extreme precipitation and longer dry periods), the current design characteristics may not be appropriate for the climate in 2100. The objective of this project is to assess: (1) the water management and infrastructure sustainability in tailings impoundments and, (2) the effectiveness of two types of oxygen barrier cover, both for long time scale.

Climate projections are bias corrected for three mine sites in Abitibi-Témiscamingue. Numerical models of gas diffusion and water infiltration are calibrated with current climate, and used with projected climate conditions. Evolution of extreme precipitation and drought periods by 2100 are also investigated and an adapted drought index was developed.

Session 1808051 - General Session - Risks and Impacts - Part 2
Continuous, ship-based sea ice thickness surveys in Hudson Strait
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Due to intensified natural resource extraction in the Arctic and easing sea ice conditions, winter shipping in ice-covered waters is becoming more feasible. To assure safe, economic, and environmentally responsible shipping activities, and for the implementation of marine shipping corridors, better ice information and a better understanding of ship passage through different ice conditions are required. Towards these goals we have carried out continuous ice thickness observations during voyages of the MV Arctic in Winters 2017 in the Labrador Sea and 2018 in Hudson Strait using a ship-based Sea Ice Measurement System (SIMS). The SIMS is composed of an electromagnetic induction sounder (EM) and a sonic ranger, which are mounted on a truss extending off the bow of the ship. Ice thickness measurements are reported to the bridge of the ship in real time via a wifi link. These data represent the first ship-borne EM-based ice thickness measurements acquired in Canadian waters. The ice thickness measurements will be used to: i) evaluate the impact of sea ice thickness on ship performance; ii) identify ice conditions conducive to ship besetment events; iii) assess the accuracy of ice conditions reported on ice charts; and iv) investigate the relationship between ice thickness and radar backscatter measured by synthetic aperture radar (SAR) satellites. Having demonstrated the feasibility of operating the SIMS in ice infested waters, we propose that the SIMS is well suited to provide ice thickness data for the initialization and validation of short-term and seasonal sea ice forecasts, and that it should be deployed in subsequent winters to compile a climate data record of sea ice thickness in regions of the Canadian Arctic where shipping occurs.

Session 1808051 - General Session - Risks and Impacts - Part 2
New concepts using Numerical Environmental Prediction to assist the Canadian Armed Forces.

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[FRANCAIS] Dans le cadre de son mandat, la cellule de développement appliqué du centre météorologique interarmées a défini les lignes directrices d'un projet destiné à répondre aux nécessités des Forces armées canadiennes (FAC) relatives à la prévision environnementale (météorologie et océanographie) et de ses impacts sur leurs opérations. Cette présentation décrit le franchissement d'une étape décisive, qui s'inscrit dans la philosophie du programme de transformation du Service météorologique du Canada et de l'approche centrée sur les données choisie par le Service météorologique et océanographique des Forces canadiennes. Les opérations menées par les FAC sont souvent multidisciplinaires et couvrent un large spectre spatio-temporel ce qui constitue un défi pour le développement d'un outil d'aide à la décision permettant de répondre aux différentes exigences associées aux nombreux types de missions. Cette étape de post-traitement utilise les sorties des modèles déterministes et ensemblistes dans leurs domaines d'excellence respectifs pour délivrer une information homogène, consistante et pertinente dans le temps et dans l'espace tout en restant ajustable aux spécificités des missions. Parallèlement au développement d'un prototype déterministe qui sera soumis pour évaluation aux FAC, les concepts de prévision d'impact britannique (Table MOGREPS) et européen (indice de prévision extrême) ont été utilisés pour développer le concept ensembliste du projet adaptée aux réalités des FAC. Alors que le prototype déterministe sera évalué sur ses qualités opérationnelles, le concept ensembliste fait l'objet d'évaluations sur la qualité et la pertinence du produit. Pour souligner la souplesse et le potentiel de ce type de post-traitement, des produits similaires ont été élaborés pour d'autres types de client. [ENGLISH] Within the frame of its mandate, the Applied Development Cell of the Joint Meteorological Centre has defined a project to meet the needs of the Canadian Armed Forces (CAF), for environmental forecasting (meteorological and oceanographic) and related impacts on their operations. This presentation marks a significant step of the project, inspired by the Meteorological Service of Canada transformation program and also aligned with the "data centric approach" promoted by the Canadian Force Weather and Oceanographic Service. Operations lead by CAF are often multidisciplinary and cover large geographical areas with variable duration. This constitutes a challenge for the development of a decision-support tool which meets the various requirements associated with many types of missions. A post-processing step uses both deterministic and probabilistic models outputs in their respective fields of excellence in order to provide homogenous, consistent and relevant information with respect to both time and space while remaining adjustable to operations specificities. In this second step, following a development phase, a deterministic prototype will be submitted to FAC for evaluation. In the meantime, both British (MOGREPS table) and European (Extreme Forecast Index) impact based forecast concepts are used for deriving a probabilistic concept of the project tailored to CAF realities. To emphasize the flexibility and potential of this type of post-processing, similar products have been developed for other types of customers.

Session 1808051 - General Session - Risks and Impacts - Part 2
Development of Fuzzy Rules Based Systems for Hazard Forecasting
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There is a growing interest in tools that allow for a risk within uncertainty based approach to decision making. This is especially true for meteorological and oceanographic related applications, where climate change suggests that the past is becoming an increasingly poor predictor of the future. Here we outline the development of a flexible yet rules based approach to parsing forecasts and other data with the intent of identifying hazardous conditions.

Observations, simulations, and other forecast products relate to information which is essential for planning and operations. However, they often take the form of frustratingly large data sets which only indirectly address the topics were most interested in. This data also contains many inherent uncertainties and limitations, requiring a lot of subtle and nuanced interpretation. We need both to extract signal from noise, and to assess how definitive we can consider our results to be. Even the notion of what information is directly relevant is often ambiguous; How confident am I that 80[km/hr] winds will cause damage, but 79.5[km/hr] is fine?, Simulations show rough sea conditions 20 kilometres south of my centre of operations, does that mean Im fine, or should be worried?

To address these questions we define thresholds using continuous logic curves rather than binary criteria, and employ flexible spatial and temporal search radii when parsing forecasts for a given location. This system allows for the consistent and transparent application of subjective criteria, while also opening the possibility for data driven calibration of physically meaningful parameters. That is, we can generate statistics on location and timing errors in simulations as they relate to distinct event types, rather than simply long term averages of parameter and site specific noise/biases. These results can be reported back to the scientific community for further development. As well, the fuzzy logic paradigm provides the ability to apply interpretation schemes to further tailor final outputs to an individual users levels of risk aversion, providing more flexibility than purely statistics driven forecast aggregates. A key consideration in the operational use of such analysis systems, is how to manage trade-offs between keeping enough consistent structure to be easy to interpret, but still allow the expression of nuanced information. Balancing these objectives in a way that gives the most benefit to different user bases will be a central topic of discussion.

Session 1809010 - Big Data and Artificial Intelligence in Meteorological, Oceanographic, and Environmental Applications - Part 1
Artificial Intelligence and Deep Learning: a mini workshop demystifying the current techniques in the field

Session 1809011 - Big Data and Artificial Intelligence in Meteorological, Oceanographic, and Environmental Applications - Part 2
Development of Vegetation Products With Multiple Spatial-temporal Resolutions From SNPP and JPSS VIIRS For Environmental Modeling and Monitoring
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Current numerical weather prediction models and land surface monitoring systems require real time and large scale land surface information for modeling initialization. The daily and global observational data provided by Suite National Polar-orbiting Partnership (SNPP) and Joint Polar Satellite System (JPSS) with the Visible Infrared Imaging Radiometer Suite (VIIRS) are the available source to obtain the initialization information. The NOAA JPSS Land Team develops an

operational NOAA Vegetation Products System (NVPS) to map VIIRS granule data into gridded data and then aggregate the gridded data at spatial resolution from 0.003o(~0.3km) to 0.009o (1km) and 0.036o(4km) and composite at temporal resolution from daily to weekly and biweekly. The NVPS can currently generate the VIIRS Green Vegetation Fraction (GVF) and Vegetation Index (VI) data. The VI data include the Top Of the Atmosphere (TOA) Normalized Difference Vegetation Index (NDVI), Top Of the Canopy (TOC) NDVI as well as the TOC Enhanced Vegetation Index (TOC EVI). Meanwhile, quality assurances of VI data are generated to consider impact of various environmental factors (e.g., cloudy, sun glint, aerosol). The VIIRS vegetation products will be generated operationally within NOAA's Suomi NPP Data Exploitation (NDE) system.

Session 1809011 - Big Data and Artificial Intelligence in Meteorological, Oceanographic, and Environmental Applications - Part 2
A novel approach for improving accessibility, understanding and performance of Ocean Prediction Systems
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Significant ocean prediction research and development since 2010 has resulted in the implementation of large high resolution Global and regional Ocean and Ice Reanalysis and forecast systems. These systems as they further develop will continue to produce increasingly vast volumes of numerical output. This large output data volume can provide a daunting analysis challenge in extracting insight and understanding. This is true particularly when trying to understand the impacts of upgrading numerical parameterization in the ocean model and assessing the impact on the overall prediction system. Furthermore, a challenge is making the ocean prediction output useful for other science and engineering sectors. Herein we present an oceanographic viewer web server entitled Ocean Navigator that has 3 components: a THREDDS server with a data archive of NETCDF and GRIB files, a python based analysis/plotting system and a JavaScript based web interface server. The facilitation to fully explore 3D ocean, ice and atmospheric output from various prediction systems, enables clear understanding of the marine environment in real time for various operations such as Search and Rescue, Shipping, Navy operations, Fishery Management, Oil Industry operations as well as fishing activity. Additionally the web interface enables easier access to reanalysis systems for extracting quickly oceanographic information for biological research, engineering research or other strategic analysis. This talk presents the strategic approach and choices taken for data visualization covering hardware, analysis code and implementation methodology. We will also present the system capabilities for analysis and visualization as well as present some end uses enabled by this visualization system.

Session 1809011 - Big Data and Artificial Intelligence in Meteorological, Oceanographic, and Environmental Applications - Part 2
MERIDIAN is Listening to the Sounds of the Ocean with Deep Learning
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Ocean noise from shipping and offshore industrial activities is becoming a significant issue due to its potential impact on protected marine

species that use sound to communicate, sense their environment, navigate, and feed. Therefore, ocean development must be done sustain-ably, which includes controlling and/or mitigating the impact of noise. To enable the ocean community to fully exploit acoustic ocean data to monitor trends and to allow for a more timely, effective and efficient protection of valued marine species and areas, the Canada Foundation of Innovation funded MERIDIAN (Marine Environmental Research Infrastructure for Data Integration and Application Network), a multi-institutional and multi-disciplinary consortium that is developing a data infrastructure to consolidate and support ocean acoustic data management and analytics. Currently, large amounts of acoustic and ancillary environmental data are unmanaged, not interoperable, difficult to find and access. The MERIDIAN infrastructure will provide a single, comprehensive point of access to ocean acoustic and AIS (Automatic Identification System) data and make them FAIR (Findable, Accessible, Interoperable and Reuse-able; www.FORCE11.org). MERIDIAN is also going to offer data analysis and visualization tools based on advanced data science methods and algorithms [1], and best practice guides and policies for Big data management. We are currently working on data analytics strategies and methods based on Machine Learning and Deep Learning to detect, classify and localize (DCL) whales. This tool will automatically extract and classify specific vocalization and dialects from large acoustic data sets or streams of data produced by survey equipment. Also under development is a system to model noise intensity and propagation from ship-tracking data [2] using the global satellite AIS (Automatic Information System) data streams. Overall, we expect the infrastructure and its tools to be a widely used resource for the academic community, governmental institutions and industries.

Session 1809011 - Big Data and Artificial Intelligence in Meteorological, Oceanographic, and Environmental Applications - Part 2

FHSS-BFSK JANUS-Based protocol for Underwater Hybrid Cellular-Ad hoc Network

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The JANUS protocol is the first global standard for digital underwater communications promulgated by NATO to break the interoperability barrier for collaborative underwater communications. Standardized protocols enable sharing information among heterogeneous network nodes for a wide range of applications such as sending and receiving information or distress signals among nodes, including submarines, AUVs, and surface vessels that operate acoustic modems and run the JANUS protocol.

In this presentation, the protocol stack for JANUS-based services will be discussed. To increase the robustness of the proposed underwater network against an acoustic link failure or against an unreachable gateway, a hybrid cellular-ad hoc topology will be investigated which employs alternative paths through the network. To avoid eavesdropping and tampering of critical information, lightweight Advanced Encryption Standard (AES) and Elliptic Curve Cryptography (ECC) schemes that are compatible with JANUS will be investigated.

In the network layer, a topology deployment, as well as network architecture and routing design will be reviewed with respect to the network tolerable delay and overhead. In the MAC layer, channel access control mechanisms for multiple users in a cellular topology will be reviewed. Alternatively, collision avoidance

and handshaking in distributed ad hoc mode will be discussed. A self-organized ad hoc mode will be presented as a backup when the local gateway becomes unreachable. The ad hoc mode controls the congestion in cells and enables the network to remain responsive through collaborative packet relaying between neighbor nodes. The performance of the scheme will be evaluated using the number of network covered nodes, particularly when the network is dense.

In addition to JANUS's 8-bit cyclic redundancy check mechanism, an FHSS communication system with BFSK modulation is evaluated in a noisy multipath channel with fading and possible jamming. The physical layer reliability is boosted by a turbo code to decrease the BER. Conducted experimental trials 10-km off the Nova Scotia coast, supported by computer simulations confirm the performance of the communication link in these conditions.

Session 1809011 - Big Data and Artificial Intelligence in Meteorological, Oceanographic, and Environmental Applications - Part 2
PROGNOS: A renewed statistical post-processing infrastructure and opportunity for AI applications for the Meteorological Service of Canada (MSC)
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PROGNOS, a recent MSC initiative, aims to provide a more versatile, modular and innovative weather and air quality post-processing system to replace the current operational system (UMOS). The proposed design intends to reduce system maintenance cost, facilitate the adaptation to frequent numerical model updates, improve the ability to apply new post-processing strategies and better serve research and development projects. PROGNOS has extensible statistical modeling and machine learning capabilities. It currently issues real-time experimental air quality and temperature forecasts for cities across Canada and will eventually be applied to additional meteorological fields and numerical models; such preliminary PROGNOS forecasts will be showcased. The system is developed following an iterative and incremental approach. In its current development phase, batch updates of MLR models occur weekly using parallel processing in a cluster computing environment. Less flexible, but more computationally efficient, online updating methods are also considered as alternative post-processing options for future development. In addition, several statistical modeling and machine learning approaches have been explored, including Kalman filter and random forest prototypes for air quality forecasts. The evaluation of such techniques is facilitated by the systems modular design. Logging, parameterisation, diagnostic and visualization features are also being developed and tested for improved system traceability, user-friendliness, transparency and portability. The next major milestone consists on designing and building a standalone database and an adapted data ingest procedure in order for PROGNOS to be a fully independent system. Medium to long term objectives include integrating seasonal and other transitional schemes as well as gridded post-processing.

Session 1809011 - Big Data and Artificial Intelligence in Meteorological, Oceanographic, and Environmental Applications - Part 2
SWE data fusion by machine learning: an examination of performance by physiographic region
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In hydrologic regimes dominated by spring snowmelt-driven freshets, good regional-scale estimates of peak snow water equivalent (SWE) are critical to water resources management. While individual data sources are subject to varying degrees of bias, data fusion of multiple sources may hold promise in areas of complex topography, such as that seen in British Columbia (BC), Canada. An artificial neural network (ANN) comprised of three best performing gridded SWE products (ERA-Interim/Land, GLDAS-2, and MERRA), a snow model driven by bias-corrected temperature and precipitation fields, and survey site covariates has been constructed for BC. This ANN was evaluated against in situ surveys and compared to its constituents and the calibrated Variable Infiltration Capacity (VIC) model over BCs five major physiographic regions, in order of decreasing average SWE: the Coast Mountains and Islands (CMI), Columbia and Southern Rocky Mountains (CR), Northern and Central Plateaus and Mountains (NPM), Interior Plateau (IP), and BC Plains (BP). Average survey station mean absolute errors (MAEs) were highest for all products and models in CMI and CR, the regions of highest accumulation, and lowest in BP. Average station biases followed this regional pattern in magnitude but with negative sign, indicating most errors came from SWE underestimates. Across BC and within all physiographic regions, the ANN had the highest average station peak SWE correlation (0.77). The ANN average station MAE (127 mm) and MAE normalized by mean peak SWE (0.4) were lowest across BC and within all regions except BP. While the ANN average station bias was the least negative for other regions, bias was positive in BP. This finding points to a possible overcompensation due to higher accumulations elsewhere and suggests that additional performance improvements may be realized by further dividing the model domain.

Session 1809020 - Integrated Predictions for Best Responses
A prediction challenge: making our cities resilient

Session 1809020 - Integrated Predictions for Best Responses
Future Seamless Data-Processing and Forecasting System : Improving Nations Readiness through Continuous Global Science and Technology Advancements
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The World Meteorological Organization (WMO) coordinates a world-wide network/system of operational centers operated by WMO Members. This system, called the Global Data-Processing and Forecasting System (GDPFS), comprises many NWP centers all around the world and provide defined products and services for applications related to weather, climate, water and the environment. The WMO emerging ‘seamless’ framework is about accelerating the science of weather, climate and environmental forecasting to deliver a step change in the accuracy, relevance and consistency of impact-based and risk-based warnings, forecasting and advice to the partner agencies, responders and government.

This approach is designed on a seamless, science to service methodology; seamless across timescales (weather and climate), seamless across disciplines (weather and water (hydrology and oceanography in particular)), seamless across the value chain of impact based services (weather, climate, water and impact modelling), seamless across providers of the information and a seamless cycle of user needs determination from research to operations (R2O) to customer satisfaction and vice versa.

All Members including developing countries are expected to benefits from the advanced science and technology through the future seamless GDPFS. This presentation frames the discussion based on the multi hazard, impact based information flow diagram that describes the weather and climate and how this is translated to hazards and improved readiness. The presentation will explore further the rationale for embracing a paradigm shift towards ‘seamless’ and provides real-case examples where such an approach is working for WMO members and what are the implications for Canada.

Session 1809020 - Integrated Predictions for Best Responses
Communicating hurricane risk in Eastern Canada: Enhancing the communication lines between the Canadian Hurricane Centre, municipalities and insurers
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In 2016-2017, the Institute for Catastrophic Loss Reduction conducted a research project funded by the MEOPAR Network looking at hurricane risk communication in Eastern Canada. Hurricanes represent a critical challenge for Emergency Management Organizations (EMOs) in Atlantic Canada. These storms, while possessing similar baseline characteristics and identifying features, invariably possess a degree of distinctiveness and novelty, which translate into unique challenges for emergency managers and their organizations. Effective response to such events requires highly developed institutions that provide the structural basis and support for emergency managers, while having the flexibility and adaptability to ensure personnel are capable of executing optimal decisions in less than optimal situations.

The dynamic nature of systems within their jurisdiction requires EMOs to continually assess and refine their approaches, methods and strategies. The report published following the completion of the study sets out to strengthen these institutions and heighten their ability to respond to the impacts and consequences of climate change by reviewing the communication strategies employed by EMOs. Although the existing communication systems and strategies are comprehensive, refining them will increasingly allow for EMOs to mitigate impacts and loss associated with severe hurricanes.

The report’s six recommendations for communication reform are derived from a series of interviews with emergency management professionals in Nova Scotia and New Brunswick and a survey of the Canadian insurance industry. The interviews inform the report’s characterization of emergency management communication frameworks in these provinces, and along with the insurance industry survey, reveal potential options for communication refinement in EMOs.

Session 1809020 - Integrated Predictions for Best Responses
Informing Canadians to Best Address Global Agenda 2030
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Canada and most other countries have endorsed the Global Agenda 2030: Paris Agreement, Sustainable Development Goals and Sendai Framework for Action on Disaster Risk Reduction and in December 2016, Canada’s First Ministers agreed on the Pan-Canadian Framework on Clean Growth and Climate Change which includes actions to adapt to current and future climate impacts to help

protect Canadians from climate change risks, build resilience, reduce costs, and ensure that society thrives in a changing climate. Governments across Canada, at all levels, and all Canadians need to be informed about changing scientific information, including socio-economic cultural information, changing total environmental conditions and guided in decision making so there is positive, productive and long-lasting responses to the Agenda including the intersecting and sometimes possibly conflicting responses to the full Global Agenda 2030. This paper will discuss these issues and make recommendations on paths forward.

Session 1809020 - Integrated Predictions for Best Responses
FloodSmart Canada: Communication that Motivates and Drives Flood Risk Management in Canada
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Canadian homeowners are not typically aware of their flood risk, or what options are available to reduce their risk. Communities may offer guidance, or even incentive programs for home upgrades to reduce basement flooding, but uptake of these programs is generally low. As rainfall increases, communities continue to grow, and infrastructure continues to age, our exposure will only increase, resulting in hundreds of millions of dollars in losses to homeowners, governments, and insurers annually. Integrating climate science and communicating effectively and memorably with homeowners is critical to driving behavioural change and reducing personal and community-level flood risk.

Partners for Action is an applied research network advancing flood resiliency in Canada in the face of a changing climate and extreme weather. We collaborate with a diverse set of stakeholders from academia, business, government and non-governmental organizations to protect Canadians from the risks of flooding in the face of climate change and extreme weather. P4A is based in the Faculty of Environment, University of Waterloo, with founding funding from the Co-operators Group Ltd. and Farm Mutual Re.

Our current research looks at international flood and climate risk communication best practices, and results of a survey of the experiences of flood survivors in Windsor, Ontario, to help shape personal preparedness messaging towards resilient communities. Our national communication initiative, FloodSmart Canada brings together partners from government, academia, the non-governmental sector, business, and practitioners to combine best practices in risk communication with climate science to overcome barriers to preparedness and create messages that personalize risk, empower action, and drive support of flood risk management policy in our communities.

Session 1809020 - Integrated Predictions for Best Responses
Safe and Sustainable Development of the Ocean Frontier
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The Ocean Frontier Institute (OFI) is a collaborative research initiative to harness the vast potential of the world’s ocean. An international hub for ocean science, OFI brings together researchers and institutes from both sides of the North Atlantic to understand our changing ocean and create safe, sustainable solutions for development.

This presentation will describe some of the key scientific research priorities, including key aspects of atmosphere-ocean interaction, the resulting ocean dynamics, and shifting ecosystems.

OFI research benefits include the improved prediction and mitigation of major storms to strengthen marine safety. It will also enable effective approaches to resource development that are sustainable, globally competitive, societally acceptable and resilient to change

Session 1809040 - Coupled Environmental Prediction
SalishSeaCast: Coupled bio-chem-physical Ocean Model with downstream Waves, Near-shore Circulation and Oil Spill Model
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SalishSeaCast is an integrated coastal forecasting system for the Salish Sea on the West Coast of Canada. Examples of forecast and nowcast products available or under development include storm surge and wave height, near-surface extreme currents, aragonite saturation state, and oil spill tracking. The ocean physics model is a NEMO regional configuration with a coupled lower trophic level biological model (SMELT) and a coupled carbon cycle model. The model is run daily in real-time. It is forced with real-time Environment Canada HRDPS winds, Fraser River flow and turbidity measurements, boundary conditions from a larger configuation model and sea surface height from a storm surge forecast model. After completion of the NEMO run, its current fields are used for a WAVEWATCH III ® model and to construct boundary conditions for an FVCOM model. The FVCOM model resolves near-shore areas including the lower Fraser River and Vancouver Harbour. Under MEOPAR cycle two, we are adding an oil spill model. In this talk we will briefly introduce the configuration of each component and focus on the methods of coupling and automation. We will discuss methods of distribution of results to different types of stakeholders. We will highlight the benefits and future benefits of this coastal forecasting system including storm surge forecasting for ports, near-surface extreme currents for pilots, aragonite saturation horizon depth for shellfish farmers and oil spill risk for community planners.

Session 1809040 - Coupled Environmental Prediction
Dynamical modeling of the marginal ice zone: a process study in one dimension
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Historically, waves were neglected in sea ice because of their rapid attenuation. With the increasing resolution of operational forecasting models, the marginal ice zone, the area where waves and ice interact, can now be better represented. Wave energy loss increases with frequency. This energy is transferred to the ice, breaking it into smaller floes and mobilizing it, as well as exerting a stress on the ice similar to winds and currents. This double effect can lead to rapid movements of sea ice in the presence of waves which are not captured by current forecast models. A one-dimensional, fully integrated wave and ice model has been implemented to assess the importance of waves in the dynamics of sea ice under a variety of conditions. The model is used to simulate coastal ice at a variety of

scales. Results are then compared to in-situ and satellite observations from the Saint-Lawrence estuary and gulf as well as Greenland Sea.

Session 1809040 - Coupled Environmental Prediction
Overview of CONCEPTS Coupled Environmental Prediction Systems
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As numerical weather prediction (NWP) systems become further refined, the interactions across the Air-Ice-Ocean (AIO) interface are becoming increasingly important. This is giving rise to the development of a new generation of fully-integrated environmental prediction systems composed of atmosphere, ice, ocean, and wave modeling and analysis systems.

Within the Canadian Operational Network of Coupled Environmental PredicTion Systems (CONCEPTS), AIO forecasting systems are progressing through research and development, technology transfer and operational implementation at the Canadian Centre for Meteorological and Environmental Prediction (CCMEP). A fully-coupled AIO forecasting system for the Gulf of St. Lawrence (GSL) has been running operationally at CCMEP since June 2011. The GSL system is also being run at higher resolution over the Laurentian Great Lakes. A Global Ice-Ocean Prediction System (GIOPS) has been running in real-time at CCMEP since January 2013, upgraded to operational status in August 2015, and coupled with the operational atmospheric Global Environmental Multi-scale (GEM) model in November 2017 to become the first fully coupled AIO model used for operational medium-range weather forecasting. A higher resolution Regional Ice-Ocean Prediction System (RIOPS) is running over the Northwest Atlantic Ocean and Arctic Ocean. The Canadian Arctic Prediction System (CAPS) is providing atmospheric forecasts at a 3 km horizontal resolution and is being coupled with RIOPS in support of the Year of Polar Prediction. High resolution coastal prediction systems are being developed for the northeast Pacific and Canadian East Coast regions. Ensemble prediction systems are also being developed and implemented, particularly with a lower resolution version of GEM-GIOPS being used for coupled seasonal prediction.

Here we present an overview of recent developments and plans for these systems including their use within the Ocean Protection Plan.

This presentation will be made on behalf of our colleagues in CONCEPTS, many of whom will be giving further details in companion presentations.

Session 1809040 - Coupled Environmental Prediction
Subseasonal Forecast of Arctic Sea Ice Concentration via Statistical Approaches
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Subseasonal Forecast of Arctic Sea Ice Concentration via Statistical Approaches

Subseasonal forecast of Arctic sea ice has received less attention than the seasonal counterpart, as prediction skill of dynamical models generally exhibits a significant drop in the extended range (>two weeks). The predictability of pan-Arctic sea ice concentration is evaluated by statistical models using weekly time series for the first time. Two statistical models, the vector auto-regressive model and the vector Markov model, are evaluated for predicting the 1979-2014 weekly

Arctic sea ice concentration (SIC) anomalies at the subseasonal time scale, using combined information from the sea ice, atmosphere and ocean. The vector auto-regressive model is slightly inferior to the vector Markov model for the subseasonal forecast of Arctic SIC, as the latter captures more effectively the subseasonal transition of the underlying dynamics. The cross-validated forecast skill of the vector Markov model is found to be superior to both the anomaly persistence and damped anomaly persistence at lead times > 3 weeks. Surface air and ocean temperatures can be included to further improve the forecast skill for lead times > 4 weeks. The long-term trends in SIC due to global warming and its polar amplification contribute significantly to the subseasonal sea ice predictability in summer and fall. The vector Markov model shows much higher skill than the NCEP CFSv2 model for lead times of 3~6 weeks, as evaluated for the period of 1999-2010.

Session 1809040 - Coupled Environmental Prediction
Air-sea-ice interactions during the Great Arctic Cyclone of August 2012
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The great Arctic cyclone of August 2012 formed on 2 August over Siberia, moved into the Beaufort Sea thereafter, and decayed in the Canadian Arctic Archipelago on 14 August. Its minimal central pressure was 966hPa, and it made substantial contributions to the record minimum of sea ice extent in September 2012. During this event air-sea-ice interactions were strong. To understand these interactions during the storm, we conducted two experiments using NEMO 3.6 ocean model and WRF 3.6 atmospheric model, with and without two-way atmosphere-ocean coupling. The coupling is done through OASIS-MCT3. The horizontal resolutions are ¼ degree for NEMO and 25 km for WRF. Compared to reanalyses data, our coupled system has a reasonable simulation of sea ice and the Arctic storm intensity and propagation characteristics. We first compare the two simulations to understand the role of the significant loss of sea ice in the Western Arctic Ocean on the intensity and storm track of the Great Arctic cyclone. Thereafter, we investigate the thermodynamic and dynamic impacts of this strong cyclone on the melting of sea ice from the perspective of anomalous cloudiness, ocean surface heat budget and winds. Finally, we diagnosed the melting processes in terms of the surface, bottom and lateral melting caused by the cyclone. Thus, in this study, we focus on the roles of air-sea interactions on the life cycle of the cyclone as well as on the record minimum of September sea ice extent.

Session 1809050 - Changing Arctic: Science and Policy Studies
Spatial Variability of the Ice Drift Response to Wind Forcing in the Canadian Beaufort Sea as Revealed from a Dense Array of Moored Upward Looking Sonar Instruments
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From 2009-2011, a dense array of 9-10 upward looking sonar (ULS) instruments was operated from subsurface moorings providing accurate (± 0.015 m/s) and continuous measurements of ice velocity using Acoustic Doppler Current Profiler instruments. The moorings were operated in water depths ranging from 50 to 1010 m depth on the shelf and continental slope of the Canadian Beaufort Sea. The horizontal separation of individual moorings ranged from 4 to more than 100 km. Surface winds used in the analysis are derived from the Meteorological

Service of Canada (MSC) gridded winds calculated from hourly reanalysis data of historical surface winds.

The ice velocities exhibit seasonal variations with reduced ice velocities in winter and early spring resulting from the increased ice concentration and thickness which inhibits sea ice motion due to internal ice stress. The synoptic wind events of the region are dominated by two reasonably distinct wind types: winds blowing from the east which are the most common and winds blowing from the west through north. The response of ice drift to these two synoptic wind categories are characterized by divergent ice movement (easterly winds) and convergent ice movement (northwesterly winds) reflecting the offshore- and onshore-directed drift components, respectively, associated with the effects of the rotating earth (Coriolis force). The ice velocity response to wind forcing is generally larger for convergent wind events and smaller for divergent wind events. For the 2009-2011 period of ice cover, there were 80 divergent events and 67 convergent events with mean durations of 80 hours and 67 hours, respectively. A representative subset of these events were selected for more analysis by subcategories of early ice formation, winter to early spring ice cover and the break-up period. In particular, the analysis focussed on the ice drift to wind speed response factor and its spatial variability among the mooring sites for each selected wind episode.

Session 1809050 - Changing Arctic: Science and Policy Studies

Circulation patterns in and origins of the lower Arctic Ocean shown in geochemical data

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Climatological water mass structures were identified in the Arctic Ocean using the geochemical dataset in the Hydrochemical Atlas of the Arctic Ocean (HAAC), and also a geochemically conserved parameter PO4* based on phosphate and dissolved oxygen. In the upper ocean above 500-m depth, the HAAC has proved its reliability by showing the circulation patterns of the Pacific-origin Water (P-Water) and Atlantic-origin Water (A-Water), which have the boundary along 135°E-45°W near the surface, rotating counter-clockwise with depth. Thus, P-Water with higher silicate and A-Water with lower silicate exchange between the Arctic and Atlantic oceans. In the lower ocean below 1500-m depth with the basins separated by the Lomonosov Ridge, the PO4* field was statistically analyzed to derive the following results: the Eurasian Basin receives penetration of the Nordic Seas Deep Water with low PO4* flowing from the Greenland Sea along the bottom. The routes from the upper ocean to the lower ocean were identified: high PO4* is limited to the southern portion of the Canada Basin, receiving the source water from the Chukchi and Beaufort Seas, while the other portion of the Amerasian Basin (or Canadian Basin) receives low PO4* water from the Laptev Sea and/or the Barents Sea. The Eurasian Basin has a main origin from the intermediate layer (500-m to 1500-m depth) and also receives medium PO4* from the upper ocean in the Fram Strait. The intermediate layer water is gradually originated upward from the lower ocean and returns toward the Atlantic, entraining the subsurface portion (200-m to 500-m depth). It is likely that high PO4* water occasionally flows down from the upper ocean along Greenland, making the heterogeneous Eurasian Basin.

Session 1809050 - Changing Arctic: Science and Policy Studies

A COMPARISON OF THE STATISTICAL AND DETERMINISTIC APPROACHES TO FORECASTING SHORT TERM ICEBERG DRIFT ON THE GRAND BANKS

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Forecasting the drift of icebergs for tactical ice management is a topic of special interest for the Canadian offshore oil and gas industry. As icebergs approach offshore platforms, they must be continuously reassessed so that progressive preparations can be initiated in time to reduce risk to workers, the environment, and commercial infrastructure.

Since the early 1980s, two schools of thought have existed on how to model iceberg drift. The deterministic approach uses forecasts of relevant environmental drivers and assumes the resultant forces determine acting on the iceberg can be predicted and used to model the iceberg motion as a point mass in a two-dimensional plane. The statistical approach holds that small-scale current eddies are inherently chaotic, and that the best source of information on the influence of such ocean currents is derived from the analysis of recently-observed trajectory of individual icebergs.

The statistical approach has been largely neglected until recently, in spite of its ability to assimilate observed iceberg trajectories in real-time. Operational iceberg drift forecasts are still done exclusively using deterministic models, which must be parameterized using coarse assumptions about iceberg shape and drag.

We compare the skill of reference deterministic and statistical iceberg drift models to predict 20 short-term (48 hour) iceberg tracks in the vicinity of the Hibernia Gravity Based Structure platform in 2012. These models were implemented in an experimental software framework called OpenBerg. This new program, based on the open-source Python library OpenDrift, forces models using primarily either ocean/atmosphere forecasts (deterministic approach) or recent iceberg position time series observations (statistical approach). This framework also calculates positional error as a function of elapsed time which can then be analyzed and interpreted to compare model skill.

Session 1809060 - Satellite Remote Sensing: Vital Information on the Health of the Planet - Part 1
EUMETSAT Meteorological and Environmental Satellite Services

Session 1809060 - Satellite Remote Sensing: Vital Information on the Health of the Planet - Part 1

The SAGE II/OSIRIS/OMPS-LP USask 2D Ozone Data Record and its use Within the LOTUS Initiative

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The SAGE II, OSIRIS and OMPS-LP instruments have been measuring vertically resolved ozone number density profiles for well over three decades. The current versions of OSIRIS and OMPS-LP are still operational, and OMPS-LP is manifested on future JPSS missions that will last for more than two decades. Ozone data records from these three instruments were merged as part of the SPARC LOTUS Initiative and this time series was used within a custom multivariable linear regression model to determine long term ozone change,

independent of the influence of the QBO and the solar cycle. The results from LOTUS have been fed directly into the upcoming WMO Ozone Assessment. This talk will detail the merging process, the trend results and some difficulties that were encountered during the merging process. The results indicate that while upper stratospheric ozone is increasing due to the policies implemented within the Montreal Protocol, the overall change in global ozone is not easily understood.

Session 1809060 - Satellite Remote Sensing: Vital Information on the Health of the Planet - Part 1
Carbon Monoxide as Seen from the MOPITT instrument
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On 18th December 1999 the Terra platform was launched from the Vandenberg Air Force base carrying the Measurements Of Pollution In The Troposphere (MOPITT) instrument. Although manifested for a 5-year mission, the Terra satellite and MOPITT have now completed more than 18 years of operation. A recent NASA review stated that: Several subcommittee members convincingly argued that Terra is perhaps the single most important NASA Earth Science Mission ever.

The 18-year continuous data series that MOPITT has provided (so far) affords a great opportunity to look at longer-term changes over the planet if sufficient care is taken to eliminate instrumental effects. Fortunately, the instrument has been more stable than originally predicted and care has been taken throughout the mission to ensure that the data are properly validated. The result is a well-characterised time record that can now be “mined” for a variety of phenomena charting decadal changes (or stability) in carbon monoxide and looking at the frequency of events that often drive anomalies in the carbon monoxide distribution.

A global trend of decreasing carbon monoxide has been observed (which is a good thing), but other phenomena have also been observed, both regular and sporadic. These are caused by a mix of changes in sources, transport and sinks, particularly with the increasing trend for the concentration of people in (mega)cities. This paper will consider some of these phenomena by way of case studies and statistics.

MOPITT was built in Canada by COMDEV of Cambridge, ON, data processing is performed at the National Center for Atmospheric Research in Boulder, CO, the Terra instrument is funded and operated by NASA and the MOPITT instrument and operations are funded by the Canadian Space Agency.

Session 1809060 - Satellite Remote Sensing: Vital Information on the Health of the Planet - Part 1
Using Atmospheric Trace Gases like CCl_4 to derive key Parameters of the Brewer-Dobson Circulation
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The Brewer-Dobson circulation is a global transport phenomenon and a potential indicator for climate change. While model predictions coherently show an increase in the speed of the Brewer-Dobson circulation, this could not be comprehensively shown through measurements. However, by inverting the continuity equation and using the distribution of long-lived atmospheric trace gases month-to-month changes in 2D velocities and mixing coefficients can be inferred. A tool to solve this problem was developed at Karlsruhe Institute of Technology, Institute of Meteorology and Climate research, to provide a closer insight into the Brewer- Dobson circulation using measurements of the Michelson Interferometer for Passive Atmospheric Sounding (MIPAS). This work shows one of the first applications of this inversion tool and the benefits that come with the inclusion of additional trace gases. One of the additional trace gases used in this study is CCl_4 that was newly derived from MIPAS measurements and carefully validated against other instruments, e.g., the Atmospheric Chemistry Experiment Fourier Transform Spectrometer (ACE-FTS). The MIPAS CCl_4 agrees very well with other instruments and due to its long lifetime of 44 years is an excellent candidate for studies on the Brewer-Dobson circulation. It could be shown that including two additional gases in the inverse tool notably reduced the uncertainty in the estimate of the 2D velocity.

Session 1809060 - Satellite Remote Sensing: Vital Information on the Health of the Planet - Part 1
Estimations of natural variability between satellite measurements of trace species concentrations
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In order to validate satellite measurements of atmospheric states, it is necessary to understand the range of random and systematic errors inherent in the measurements. On occasions where the measurements do not agree within those errors, a common “go-to” explanation is that the unexplained difference can be chalked up to “natural variability”. However, the expected natural variability is often left ambiguous and rarely quantified. This study will look to quantify the expected natural variability of both O₃ and NO₂ between two satellite instruments: ACE-FTS (Atmospheric Chemistry Experiment – Fourier Transform Spectrometer) and OSIRIS (Optical Spectrograph and Infrared Imaging System). By sampling the CMAM30 (30-year specified dynamics simulation of the Canadian Middle Atmosphere Model) and WACCM-SD (Whole Atmosphere Community Climate Model – Specified Dynamics) climate chemistry models throughout the upper troposphere and stratosphere at times and geolocations of coincident ACE-FTS and OSIRIS measurements at varying coincidence criteria, height-dependent expected values of O₃ and NO₂ variability will be estimated and reported on. The results can also be used to better optimize the coincidence criteria used in satellite measurement validation studies.

Session 1809060 - Satellite Remote Sensing: Vital Information on the Health of the Planet - Part 1
Validation and Scientific Results from the Canadian Atmospheric Chemistry Experiment (ACE) Satellite Mission
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The Canadian-led Atmospheric Chemistry Experiment (ACE) mission on board the SCISAT satellite has been making routine measurements of the Earth's atmosphere since February 2004. SCISAT/ACE uses infrared and UV-visible spectroscopy to investigate the chemistry and dynamics of the Earth's atmosphere. The long lifetime of ACE has provided a valuable time series of composition measurements that contribute to our understanding of ozone recovery, climate change and pollutant transport.

The primary instrument on board, the ACE Fourier Transform Spectrometer (ACE-FTS) is a high-resolution (0.02 cm-1) infrared FTS operating between 750 and 4400 cm-1. It also contains two filtered imagers (0.525 and 1.02 microns) to measure atmospheric extinction by clouds and aerosols. The second instrument is a dual UV-visible-NIR spectrophotometer called ACE-MAESTRO (Measurements of Aerosol Extinction in the Stratosphere and Troposphere Retrieved by Occultation) which was designed to extend the ACE wavelength coverage to the 280-1030 nm spectral region. From these solar occultation measurements, altitude profiles of atmospheric trace gas species, temperature and pressure are obtained. A review of validation and science results from the ACE mission will be presented.

Acknowledgement: The Atmospheric Chemistry Experiment (ACE), also known as SCISAT, is a Canadian-led mission mainly supported by the CSA and NSERC.

Session 1809061 - Satellite Remote Sensing: Vital Information on the Health of the Planet - Part 2

Evaluation des Méthodes dInterpolation Spatiale et des Techniques de Télédétection dans la Caractérisation Bathymétrique du Plateau Continental de l'État Rio Grande do Norte, Brésil.

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L'imagerie par satellite a beaucoup évolué et on sait que la cartographie du plateau continental est une activité réalisée à plusieurs fins, par exemple servant de données dentrée pour les modèles de prédiction dondes. Cela aide dans l'étude de lérosion côtière, limpact de paysage, écologique et etc.

L'imagerie satellitaire en utilisant certaines méthodes de calculs spécifiques peut révéler la morphologie du plateau continental. Les méthodologies de Mcfeeters (1996) et Philpot (1989) sont des exemples de telles méthodes. La littérature montre quon ne sait pas encore quelle méthode de calcul est la plus appropriée.

L'image satellite peut également être utilisée dans lanalyse da extraction de bathymétrique sonar. Le coût et la durée de cette extraction sont proportionnels au nombre de points capturé par le sonar.

Les objectifs de ce travail sont de déterminer ce qui est le plus approprié entre les méthodes Mcfeeters (1996) et Philpot (1989), et de vérifier le minimum de points requis pour une extraction de bathymétrie sonar.

L'analyse a été réalisée sur le plateau continental nord de lÉtat Rio Grande do Norte, au nord-est du Brésil. Lextraction de la bathymétrie par image de satellite a été réalisée avec les logiciels Arcgis, Envi et Matlab. Quatre modèles

numériques de terrain ont été générés en utilisant le Surfer avec 100%, 75%, 50% et 25% du total des points. Les résultats ont été des profils altimétriques et des analyses statistiques du coefficient de corrélation (R^2), de lindice de concordance (d), du MAPE, du RMSE et de la validation croisée.

En termes de résultats dextraction de bathymétrie, Mcfeeters (1996) a été la méthode qui a apporté une meilleure représentation de la région. En ce qui concerne le nombre de points requis dans le levé sonar, il a été possible de réduire ce nombre jusquà 50 percent.

Session 1809061 - Satellite Remote Sensing: Vital Information on the Health of the Planet - Part 2
Assessing snow extent data sets over North America to inform trace gas retrievals from solar backscatter observations
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Satellite observations of solar backscatter provide valuable information on pollutants relevant to air quality and climate. Trace gas retrievals from solar backscatter rely on an accurate representation of surface reflectivity. Surface snow cover presents a significant challenge due to its variability, and a lack in confidence in snow identification leads existing algorithms to often omit potentially snow-covered scenes. However, the high reflectance of snow is advantageous for trace gas retrievals; Using a radiative transfer model, we find that the average sensitivity to the tropospheric nitrogen dioxide (NO2) column substantially increases (doubles) when the surface is snow covered. Therefore, the ability to confidently identify snow covered scenes could greatly improve spatial and temporal sampling in UV-Vis remote sensing of trace gases and allow for the inclusion of high-quality information on the lower troposphere that is often dismissed.

We evaluate seven existing satellite-derived or reanalysis snow extent products against ground station observations over North America to assess their capability of informing surface conditions for retrievals from the upcoming TEMPO geostationary instrument. We use the F score, which balances precision and recall, to determine overall product performance. The Interactive Multisensor Snow and Ice Mapping System (IMS) had the best agreement with ground observations (F=85%). Multiangle Implementation of Atmospheric Correction (MAIAC) retrievals of MODIS observed radiances (F=82% for Aqua and Terra) had high precision, but underestimated the presence of snow. MAIAC generally outperforms the standard MODIS products (F= 46(54)% for Aqua(Terra)). The Near-real-time Ice and Snow Extent (NISE) product had good precision but missed a significant number of snow covered pixels (F=58%). The Canadian Meteorological Centre (CMC) Daily Snow Depth Analysis Data set also had robust performance metrics (F=81%). A retrieval algorithm that combines daily snow detection from IMS with a climatology of snow reflectance has the potential to significantly improve upon current methodologies.

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Using CloudSat snowfall estimates to evaluate gridded snow products
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Improving our capacity to understand and model snow is an ongoing challenge which benefits from new perspectives and tools for data collection. Using a combination of ground and space based observations, we present an investigation into the validation of satellite retrieval estimates of terrestrial snow in the Canadian Arctic and its application towards improved Earth System Modelling. Space based data is collected from the NASA cloud profiling satellite CloudSat, which is equipped with a cloud profiling radar instrument that generates reflectivity cross-sections describing the inner structures of clouds. Comparing the results of the reflectivity profiles with recorded observational data at a set of Canadian weather stations, allows us to characterize the general uncertainty of snowfall estimates from the CloudSat retrieval process and identify areas of systematic error. This characterization is performed by averaging together CloudSat estimates of snowfall at temporal scales of over a week in length and then comparing the results with nearby Arctic weather station records of snow accumulation for the same time periods. We then map the individual CloudSat retrievals to a gridded data structure and compare it with a blended ensemble of other gridded snow products to identify areas of inconsistency.

Session 1809061 - Satellite Remote Sensing: Vital Information on the Health of the Planet - Part 2
Fire Detection and Monitoring with GOES-16
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Fire detection and characterization has been operationally available from geostationary satellites since 2002 when the Wildfire Automated Biomass Burning Algorithm (WFABBA) went into service at NOAA/NESDIS. The Fire Detection and Characterization Algorithm (FDCA), aka the WFABBA for Advanced Baseline Imager (ABI) class sensors, was a day 1 product for GOES-16. It provides six categories of detection and for the highest confidence categories it supplies fire radiative power (FRP), fire size, and fire temperature for the CONUS and full disk ABI scans. This presentation will provide a short tutorial on how satellite fire detection works and examine examples from GOES-16 of different types of fires to demonstrate the use of the product: grassland fires of the Great Plains, forest fires in the Rocky Mountains and Canada, agricultural burning, and other cases. In those examples use of the quantitative FDCA products will be compared to the use of qualitative tools like raw imagery and composites like the “fire temperature RGB” to demonstrate the strengths and weaknesses of those offerings as they apply to the work of operational forecasters, broadcasters, and smoke modelers. The utility of geostationary fires for early detection of events at high latitudes will be discussed. Trends in high temporal resolution fire radiative power for different fires will also be presented and discussed.

Session 1809061 - Satellite Remote Sensing: Vital Information on the Health of the Planet - Part 2
Remote Sensing of Waves Propagating in the Marginal Ice Zone by SAR
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In fall of 2015, a joint field experiment on ‘Sea State and Boundary Layer Physics of the Emerging Arctic Ocean’ was carried out in Beaufort Sea, where sea state conditions have been extensively measured under various ice conditions by

multi-platform observation instruments. One of the main objectives of this project is to investigate wave-ice interactions under the emerging ice free Arctic Ocean. In this presentation, we highlight our contribution in this project on remote sensing of wave-ice interactions by synthetic aperture radar (SAR).

Wave-ice interactions are important in high sea state conditions, when waves propagate from the open ocean into the marginal ice zone (MIZ) and the pack ice. In situ observations of waves and wave-ice interactions can be obtained at a small number of MIZ locations in costly and challenging experiments, whereas remote sensing using satellite RADARSAT-2 SAR (synthetic aperture radar) images can observe waves throughout the MIZ, in all weather conditions. We present a methodology to retrieve MIZ wave parameters from SAR data. As waves penetrate the MIZ, SAR remote sensing observations suggest increased wavelengths at the spectral peak, attenuated wave energy and shifted mean wave directions. The SAR observations and estimates for retrieved wave attenuation in the MIZ are shown to be consistent with wave attenuation theory and in situ field observations. Thus, valuable estimates of MIZ waves over large spatial scales at high- resolution are provided by the SAR measurements. The innovative measurements from SAR can provide vital wave observations in the harsh polar climate and thus contribute to improved understanding of dynamical mechanisms of ocean-ice-atmospheric systems.

Session 1809061 - Satellite Remote Sensing: Vital Information on the Health of the Planet - Part 2

Does all the snow melt in the Canadian Arctic Archipelago during summer?

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Snow cover extent is identified by GCOS and WMO as an Essential Climate Variable (ECV). The related land cover type termed “permanent (perennial) snow/ice” is included in all global land cover data, which is also considered an ECV. One can expect that the annual minimum snow/ice extent is representative of the corresponding land cover type. The snow cover spatial extent over the Canadian Arctic Archipelago landmass reaches its annual minimum at the end of summer melt season. If all the snow outside of the glaciated areas melts during the summer then the “permanent snow/ice” map should correspond to the glacier and ice cap covered area. To verify this hypothesis we compared several land cover datasets with data from the Randolph Glacier Inventory (RGI) and Moderate Resolution Imaging Spectroradiometer (MODIS) dataset produced at the Canada Centre for Remote Sensing (CCRS) since 2000 (https://open.canada.ca/data/en/dataset/808b84a1-6356-4103-a8e9-db46d5c20fcf). Our comparison revealed large inconsistencies in the Canadian Arctic between various land cover datasets that in some cases can exceed 300,000 sq. km (biases close to 200%). At the same time, the CCRS MODIS time series demonstrated a high degree of temporal consistency and agreement with the RGI baseline. Analysis of CCRS MODIS data showed that the semi-permanent snowpack in the Canadian Arctic, which persists through the entire melting season, is a significant component relative to the ice caps and glacier-covered areas (up to 36% or 5.58×10**4 km**2). Inter-annual variations agree very well with the local climate dynamics, such as warm season average temperature, energy fluxes, solid precipitations and modelled snow cover extent from ERA and NARR re-analyses. The correlation coefficients (absolute value) can be as high as 0.77. The smallest snow cover extent (1.53×10**5 km**2), that

is nearly identical to the RGI value, was observed in 2012, which was the warmest year in the Canadian Arctic since 2000.

References:

A.P.Trishchenko and S. Wang, 2018: Variations of climate, surface energy budget and minimum snow/ice extent over Canadian Arctic landmass for 2000-2016. Journal of Climate, vol. 31, no. 3, pp.1155-1172. doi: https://doi.org/10.1175/JCLI-D-17-0198.1.

Trishchenko, A.P., S. Leblanc, S. Wang, J. Li, C. Ungureanu, Y. Lu, K.V. Khlopenkov, and F. Fontana, 2016: Variations of annual minimum snow and ice extent over Canada and neighboring landmass derived from MODIS 250 m imagery for 2000-2014 period, Canadian Journal of Remote Sensing, 42(3), pp. 214-242. doi:10.1080/07038992.2016.1166043.

Session 1809062 - Satellite Remote Sensing: Vital Information on the Health of the Planet - Part 3

Validation of ACE and OSIRIS ozone and NO2 measurements using ground-based instruments in Eureka

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Consistent measurements of ozone and NO2 are essential to assess the state of the Arctic stratosphere. Long-term satellite datasets are useful for characterizing ozone loss and recovery, but satellite validation is challenging at high latitudes. We present long-term intercomparisons (2003-2017) between ozone and NO2 measured by the Optical Spectrograph and Infra-Red Imager System (OSIRIS) and the Atmospheric Chemistry Experiment (ACE) satellite instruments and by ground-based instruments at the Polar Environment Atmospheric Research Laboratory (PEARL), near Eureka, Nunavut (80° N, 86° W). The ground-based instruments include three Differential Optical Absorption Spectroscopy (DOAS) instruments, one Bruker 125HR Fourier Transform Infrared Spectrometer (FTIR) and one Brewer spectrophotometer. Satellite 14–52 km ozone and 14–40 km NO2 partial columns within 500 km of PEARL were calculated for ACE-FTS v3.6, ACE-MAESTRO v3.12.1 and OSIRIS v5.10 ozone and v6.0 NO2 data products. Ozone partial columns were combined with 0-14 km ozonesonde data, and these combined columns agree with the ground-based measurements with mean relative differences of 1.7-8.2 %. NO2 partial columns agree with the ground-based partial columns with mean relative differences of 0.3-9.3 %. Mean absolute and relative differences are similar or smaller when compared to previous validation efforts, with large improvements seen in the NO2 intercomparisons. To account for ozone variability in the spring, selection criteria were implemented based on the location of the polar vortex. To improve year-round comparison results, a new cloud filtering algorithm was applied to the DOAS ozone datasets with promising results. To explain the remaining differences, three instrument collocation analysis was applied, and the reported uncertainties were taken into account. The results indicate that a large portion of the differences between the satellite and ground-based datasets might be the result of collocation mismatch, differences in spatiotemporal sampling and smoothing of the observed variable.

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Spatial Heterodyne Observations of Atmospheric Water Vapour from the NASA ER-2 airplane

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The Spatial Heterodyne Observations of Water (SHOW) instrument is a prototype Canadian satellite instrument specifically designed to make high spatial resolution measurements of water vapor in the upper troposphere and lower stratosphere through vertical imaging of the limb scattered sunlight in a near infrared vibrational absorption band. The spatial heterodyne approach provides for the ability to rapidly image the limb with sufficient spectral resolution and signal-to-noise performance so as to reconstruct the two dimensional water vapour distribution, i.e. in altitude along the satellite track, with unprecedented vertical and horizontal resolution. This presentation will highlight the instrument concept, prototype design, and performance, as well as first results from measurements taken during a suborbital demonstration flight on the NASA ER-2 airplane in 2017.

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Using high-resolution NWP model and satellite data to understand the injection of water vapor into the mid-latitude lower stratosphere by convective clouds

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Water vapor is one of the major sources modifying the planetary energy budget and thus is crucial for understanding future climate. Water vapor in the lower stratosphere has been found to play an important role and injection of water vapor into this region by strong mid-latitude convection is thought to be an important but poorly characterized process. Satellite data shows that high water vapor contents are observed in the lower stratosphere over mid-latitudes but the source is not clear (Sun and Huang, 2015). This study uses the Environment and Climate Change Canada's high resolution Global Environmental Multiscale (GEM) model to improve understanding of how water vapor is injected by convection. Simulations were performed over a 250 km x 250 km domain located over Southern Ontario with a horizontal grid-spacing of 250 m. Transport of water vapor and ice particles into lower stratosphere by deep convection and then by turbulence of gravity wave breaking will be characterized. The sublimation of ice into water vapor at lower stratosphere will also be described. To supplement these model simulations, we will use satellite data from the Fourier Transform Spectrometer (ACE-FTS) on board the Atmospheric Chemistry Experiment (ACE) as well as the Microwave Limb Sounder (MLS) on board Aura satellite. Since current climate models can not explicitly resolve convective clouds due to their low horizontal resolution we will use results from the high resolution model to guide development of a parameterization for water vapor and ice injection by convection in global climate models.

Sun, Y., and Y. Huang (2015), An examination of convective moistening of the lower stratosphere using satellite data, Earth and Space Science, 2, doi:10.1002/2015EA000115.

Session 1809062 - Satellite Remote Sensing: Vital Information on the Health of the Planet - Part 3

A new era in monitoring the earth's atmosphere, land and ocean surface from geostationary satellite with GOES-R

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A new series of geostationary satellites became operational in early January 2018. The satellite brings capabilities to monitor clouds, lightning, and properties of the earth and ocean surface with enhanced temporal and spatial resolution. This presentation will highlight some of these capabilities with animations of 1-minute intervals. The high resolution imagery is being used to explore if an optical flow technique can routinely estimate winds from cloud and water vapour motion. The patterns of divergence and vorticity inferred from these winds may be useful in augmenting observations from Doppler radar, rawinsondes, and aircraft. Additional applications of the new satellite observations will be discussed, including lighting distribution in recent hurricanes, tracking smoke plumes. monitoring changes in vegetation cover, and the total solar eclipse of August 2017.

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The proposed Chemical and Aerosol Sounding Satellite (CASS) Mission

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The Chemical and Aerosol Sounding Satellite (CASS) is a science mission concept developed and studied by the Canadian Space Agency to provide climate quality atmospheric composition measurements from a low Earth orbit satellite platform. Climate quality satellite observations have become vital to climate research and climate services. CASS is designed to meet user needs on data for atmospheric and climate sciences and services, and to support monitoring of the efficacy of regulatory protocols and polices. Building on the strong Canadian heritage of state-of-the-art optical and infrared space instrumentation, the CASS payload is composed of the next generation Atmospheric Chemistry Experiment Fourier Transform Spectrometer (ACE-FTS), currently on SCISAT, and the next generation of the Optical Spectrograph and InfraRed Imaging System (OSIRIS) instrument, on the Odin satellite. CASS utilizes demonstrated Canadian technologies and strong scientific expertise to address an international need in climate and atmospheric sciences as part of the global effort to provide critical climate-quality measurements.

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An Ozone-Dynamics mission for the middle atmosphere

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Understanding the nature of the middle atmosphere, beyond the view provided by balance conditions, requires observation of the transport and dynamics over a range of scales and heights. In this presentation, a mission concept consisting of six instruments is described which addresses this requirement by providing high

vertical resolution observations of wind, temperature and constituents. The instruments include a wind/temperature/ozone instrument, a stellar occultation Instrument, a Doppler wind and temperature sounder, an infrared imaging spectrometer, a gravity wave imager and mapper and a GPS atmospheric profiler. These are at various levels of maturity Together this instrument suite provides observations of constituents, wind and temperature from the tropopause to the lower thermosphere. The vertical and horizontal resolution is sufficient for the observation of gravity waves and their propagation throughout the atmosphere. It provides information on the coupling processes linking various regions in the middle atmosphere and the variability of the dynamics and constituents needed to diagnose the energetics especially where non-linear processes come into play.

Session 1809070 - Research and operational activities supporting the Year of Polar Prediction - Part 1
Model process-based evaluation using high-frequency multi-variate observations at the Arctic supersites during the Year of Polar Prediction
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The Polar Prediction Project Steering Group has identified a number of key Arctic and Antarctic observatories with multiple systems deployed for long-term monitoring. The Arctic supersites include the International Arctic Systems for Observing the Atmosphere (IASOA) observatories as well as the Environment and Climate Change Canada (ECCC) sites Iqaluit and Whitehorse. These supersites have suites of instruments, using both in-situ and remote sensing techniques (such as lidars, radars, ceilometers), that provide detailed measurements characterizing the vertical column of the atmosphere as well as the surface conditions and energy fluxes. These observations extend far beyond the traditional synoptic surface and upper-air observations.

The Year of Polar Prediction (YOPP) supersites were selected to span the diversity in climatology and topography found in the polar areas and thus represent a variety of challenges for Numerical Weather Prediction (NWP) systems. Some model centres (such as the European Centre of Medium-Range Weather Forecasts and Environment and Climate Change Canada) are providing NWP model output at high frequency (on the order of model time-step) on model levels to enable comparison with the multitude of available measurements at the supersites.

This unique dataset of paired model output and multi-variate high-frequency observations enables detailed process-based analysis investigating: the representation of cloud micro- and macro-physics; the representation of aerosols and hydrometeors microphysics; the closure of the radiation, turbulence and energy budgets; the representation of the energy and momentum fluxes. This contribution will illustrate the set up and some preliminary results of the model process-based evaluation at the YOPP supersites.

Session 1809070 - Research and operational activities supporting the Year of Polar Prediction - Part 1
Evaluation of an Argo equivalent float deployment on the Labrador Shelf: for better understanding of ocean circulation and prediction systems on the shelf.
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In Summer 2017, an ARGO equivalent profiling float was deployed mid Labrador shelf of seal island bank The profiling float was set to profile from surface to 200m depth on a daily basis with observations provided to the WMO GTS on a daily basis. A similar deployment was done in 2016 in the Gulf of St. Lawrence by Gilbert et al. The current deployment lasted 6 months and ended with the arrival of pack ice on the Labrador shelf in January 2018. Herein we present results from the daily profiles including a look at the onset of seasonal cooling over the fall of 2017, the higher frequency changes in stratification on the Labrador shelf, and the verification with the CONCEPTS RIOPS and GIOPS ocean prediction systems. We evaluate the potential impact a profiling float provides to monitoring of shelf conditions, and to verification of ocean prediction system performance on the Labrador Shelf. For a harsh remote oceanographic on shelf location with sparse in-situ oceanographic observations (from an operational oceanography perspective), a profiling ARGO float that's quasi-stationary may provide useful in-situ information.

Session 1809070 - Research and operational activities supporting the Year of Polar Prediction - Part 1
Pre-Year of Polar Prediction Evaluation of Numerical Weather Prediction Models for the Canadian Arctic
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The Global Environmental Multiscale Model (GEM-2.5 km, GEM-10 km, and GEM-Global) was evaluated between January 2016 and December 2017 to provide a pre-Year of Polar Prediction evaluation of Environment and Climate Change Canada's (ECCC) operational numerical weather prediction (NWP) models.

The Canadian Arctic is divided in three regions - Eastern Arctic, Western Arctic, and Canadian Arctic Archipelago - to investigate the spatial and seasonal variability of numerical weather prediction forecasts between the different regions. Results show that the NWP skill scores typically decrease with increasing latitude and lead time, and vary with longitude and seasons. The GEM-2.5 km exhibits a warm surface temperature bias in winter in the Eastern Arctic, while the GEM-10 km and GEM-Global models typically exhibit a cold surface temperature bias all year in the Western Arctic. Surface wind speed is typically underestimated by all models for all months and all regions, with the largest underestimation over the Canadian Arctic Archipelago. Six-hourly precipitation > 10 mm is typically under forecast in the Eastern Arctic, but over forecast in the Western Arctic, while all models over forecast 24-hourly precipitation.

Further model evaluation at ECCC's Iqaluit supersite (64°N, 69°W) showed that observed stratified wind layer events are not accurately represented by ECCC NWP models. Analysis showed that NWP surface temperature and wind speed forecast bias is amplified or reversed during wind layer events. This change in forecast skill suggests that stratified wind layer events influence surface conditions at Iqaluit by affecting vertical mixing of the atmosphere and influencing the radiation balance.

Session 1809070 - Research and operational activities supporting the Year of Polar Prediction - Part 1
The Year of Polar Prediction: International and Canadian perspectives
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The Year of Polar Prediction: International and Canadian perspectives.

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The Year of Polar Prediction (YOPP) is running from mid-2017 to mid-2019 as the core phase of the ten year (2013-2022) Polar Prediction Project (PPP), an initiative of the WMO‘s World Weather Research Programme (WWRP), to enable a significant improvement in environmental prediction capabilities for the Polar Regions and beyond. Special Observing Periods (SOPs) have been scheduled at both Poles during YOPP when the international monitoring and environmental modeling communities will concentrate their efforts to evaluate the impact of enhanced observations on environmental forecasts at the poles as well as globally, and to engage users to explore how this information can be of greater value.

The first part of the presentation will focus on the international collaboration YOPP is either enabling or accelerating in research and development for numerical weather and environmental prediction in polar regions. The activities covered will include the YOPP Portal, SOP1 field campaigns, Supersites and planned OSE experiments. The second part of the presentation will focus on Canadian interests and contributions to YOPP, in particular on ECCC’s increased monitoring activities and efforts to date and planned for verification and subjective evaluations of environmental modelling in high-latitudes.

Following the presentation, time will be allowed for a discussion on further research that could lead to a greater understanding of polar environmental processes as well as how we can better identify, address and close performance gaps in environmental prediction capacities and services in the North.

Session 1809070 - Research and operational activities supporting the Year of Polar Prediction - Part 1
Impact of small-scale coupled atmosphere-ice-ocean interactions: Results from the Canadian high-resolution forecasting system for YOPP
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In the context of the Year of Polar Prediction (YOPP, 2017-19), a pan-Arctic coupled atmosphere-ice-ocean model has been developed to investigate the impact of coupled interactions in daily 48h forecasts produced in real-time during YOPP. The atmospheric component, the Canadian Arctic Prediction System (CAPS), runs over a regional domain with a 3 km grid spacing and has the latest innovations from the Global Environmental Multiscale (GEM) model, including a new Prediction Particle Properties (P3) microphysics scheme (clouds, precipitation). During the forecast, the atmospheric model is coupled at each time step to an ice-ocean model running over a regional 3-8 km resolution domain, covering the Arctic and North Atlantic regions, namely the Regional Ice-Ocean Prediction System (RIOPS). RIOPS uses the NEMO-CICE ice-ocean model and includes explicit tides, a landfast ice parametrization based on the effect of grounded ice ridges (for improved representation over shallow waters), and an increased resistance to tension and shear in the ice rheology (for improved representation in land-locked areas). Each time step CAPS sends its surface state variables to RIOPS that computes in exchange detailed surface fluxes (momentum, heat and moisture) over the open ocean and the ice pack, aggregating them over the multi-thickness ice distribution. Results are presented from coupled and uncoupled forecasts showing the impact of coupled interactions at regional and basin scales. In particular the effect of lead fractions and wind channeling in the Canadian Arctic Archipelago are discussed. Additionally, it is shown that details of sea ice model physics can affect small-scale sea ice features (coastal polynyas, ridging) which in turn result in a tangible impact on atmosphere-ice-ocean fluxes of heat and moisture.

Session 1809071 - Research and operational activities supporting the Year of Polar Prediction - Part 2

Winter coastal divergence as a predictor for the minimum sea ice extent in the Laptev Sea

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We present the latest results of our regional seasonal forecasting method for the minimum sea ice extent (SIE) based on observations of sea ice during the winter (Brunette et al. [2018], submitted). In addition to its downward trend, the minimum SIE displays important interannual variability that represents a challenge in terms of sea ice predictability. Williams et al. [2016] propose winter dynamic preconditioning as a seasonal predictor for the pan-Arctic minimum SIE. We study this mechanism at a regional scale. Following Nikolaeva & Sesterikov [1970], we take the Laptev Sea as a first case of study. We follow motion of sea ice in the winter using the Lagrangian Ice Tracking System (LITS), forced with sea ice drifts from the Polar Pathfinder V3 (Tschudi et al. [2016]). We identify areas of coastal divergence that lead to the formation of coastal polynyas. New ice forms in the coastal polynyas during the winter. However, new ice that forms late in the winter does not grow to a sufficient thickness to survive the summer melt. Between February 1st and May 1st, new sea ice can freeze up to a thickness of 1 to 1.5m on average, which is equivalent to climatological summer melt (Nikolaeva & Sesterikov [1970]). Consequently, anomalies of late winter coastal divergence are associated to anomalies of the following September minimum SIE, i.e. the more late winter coastal divergence, the less sea ice in September. In the Laptev Sea, the strongest negative correlation is obtained when considering coastal divergence occurring between February and May ($r=-0.63$). Also, a slope of $m=-1.6$ is present between anomalies of coastal

divergence and minimum SIE, indicating that sea ice states anomalies at the end of the winter are amplified through the melt season.

Session 1809071 - Research and operational activities supporting the Year of Polar Prediction - Part 2
Improving visibility forecasting in summer time polar fog
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Low visibility is a serious issue in the Canadian Arctic because it affects so many activities, especially transportation. Some communities obtain supplies exclusively by ship or air, and delays due to visibility can have devastating effects on the supply of goods and fuel, personal safety, access to health care and food security. In the Canadian Arctic, foggy air masses are significantly influenced by the sea surface, which can directly affect the profiles of wind, temperature and humidity through turbulence fluxes and local circulations through horizontal heterogeneities, or indirectly modify the radiative properties of the atmosphere by microphysical processes and varying aerosol emissions. Depending on the conditions, turbulence and radiative processes together can lead to either fog formation or dissipation. Therefore, if we want to correctly simulate fog in polar regions, it is vital that coupled atmosphere-ocean-wave models are used to accurately estimate air-sea fluxes. The overall goal of this project is to improve fog and visibility forecast processes in a way that is useful to local communities. In order to achieve this, intensive field observations are first needed to validate the modelled boundary layer before improvements in the operational forecast can be attempted. Intensive observations of aerosol and fog microphysics, visibility, meteorology and air quality will be conducted in Tuktoyaktuk, Nunavut from July to September 2018 to coincide with the YOPP special observation period. These measurements will contribute to the analysis of synoptic conditions that are most conducive to reduced visibility; ocean surface factors and air-sea interaction processes that contribute to fog formation; and parameterizations of fog properties including visibility in single column and operational forecasting models. This project is funded by MEOPAR and Polar Knowledge Canada.

Session 1809071 - Research and operational activities supporting the Year of Polar Prediction - Part 2
Forecasting Regional Arctic Sea Ice from a Month to Seasons (FRAMS)
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The presentation will provide an overview of the FRAMS project which has for its objective to develop improved operational products and services relating to forecasting of Arctic sea ice on time scales from a month to seasons. This is being achieved by building on existing capabilities of Environment and Climate Change Canada’s Meteorological Service of Canada (MSC) and Canadian Ice Service (CIS), within the framework of Canada’s role in support of the World Meteorological Organization’s (WMO’s) new Arctic Regional Climate Centre (ArcRCC). More specifically, the project is involving the development of Long-Range Sea Ice Forecasts using a multi-model ensemble approach based on climate prediction systems operated by designated operational WMO Global Producing Centres including MSC, NCEP, Meteo-France, ECMWF and the UK Met Office. In support to these developments, the project is identifying physical

processes and aspects of initial states that enable sea ice to be skillfully predicted, and examining their representation in the forecast models. Important innovations resulting from this project will include new and user-relevant sea-ice-related prediction products. A special effort is being put on the visual representation and GIS integrability. Finally, to guaranty the usefulness of the forecast products and related services, a component of the project includes interaction with end users in the Arctic shipping sector to ascertain sector needs for seasonal sea ice forecast information. In addition to collaborations between the Government of Canada Operational and R&D centres, three Canadian universities closely collaborate under the FRAMS initiative: McGill University, Université du Québec à Montreal (UQAM) and University of Victoria (UVic). This project, endorsed by the Year of Polar Prediction (YOPP) is enabled by funding from MEOPAR.

Session 1809071 - Research and operational activities supporting the Year of Polar Prediction - Part 2
Multi-model Probabilistic Seasonal Forecasts of Regional Arctic Sea Ice Coverage
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This presentation will describe developments in multi-model probabilistic forecasts of Arctic sea ice through the YOPP-endorsed project “Forecasting Regional Arctic Sea Ice from a Month to Seasons” (FRAMS). Such probabilistic forecasts that represent uncertainty can be essential for end-users who want to quantify risk and make decisions taking forecast uncertainty into account. In particular, we extend a probabilistic forecasting procedure, intended for seasonal forecasts of local sea ice coverage, to a multi-model forecasting framework. This procedure consists of fitting single-model ensemble forecasts of local sea ice concentration (SIC) to a well-suited probability distribution, and calibrating these distributions using trend-adjusted quantile mapping (TAQM). Such a procedure can be used to make calibrated forecasts of the spatial SIP quantity -- describing the probability of local sea ice coverage based on a minimum 15% SIC threshold -- used for the annual Sea Ice Outlook. Here, we present on the utility of this approach by combining calibrated outputs from different models from WMO Global Producing Centres, including MSC, NCEP, Meteo-France, ECMWF and the UK Met Office. As individual models contain their own errors from a variety of sources, multi-model ensembles tend to produce more skillful forecasts. To place our approach of calibrating individual model forecasts and combining their calibrated output into context, probabilistic forecast skill is compared against simpler approaches such as the direct averaging of raw model output.

Session 1809071 - Research and operational activities supporting the Year of Polar Prediction - Part 2
Fram Strait winter sea-ice areal export as a preconditionner the summer sea ice minimum extent: Global Climate Models vs observations
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Coastal divergence from the Eurasian coastline and Fram Strait sea ice areal export derived from observed sea ice drift in late winter (Nov-May) explain a significant fraction of the variance in the minimum sea ice extent anomaly from the long term trend (Williams et al., 2016). Late winter divergence along the Eurasian coastline leads to the formation of new ice that does not have time to

reach sufficient thickness to survive the following summer melt. As such the predictability relies entirely on the presence of a mean divergence sea ice drift field along the Eurasian coast together with inter-annual variability in this coastal divergence associated with the state of the Arctic Oscillation. In this paper, we examine whether similar predictability exist in Global Climate Models or if biases in their simulated mean Arctic atmospheric circulation lead to an absence of predictability in the GCM world compared with the real world. To this end we analyzed two GCMs for which large ensembles exist: the National Center for Atmospheric Research's Community Earth System Model Large Ensemble (CESM-LE), and the Geophysical Fluid Dynamics Laboratory's Forecast-Oriented Low Ocean Resolution Climate Model (FLOR). Preliminary results show that the Fram Strait ice export in both models (a proxy for coastal and within pack ice divergence in the real wold and a good predictor of the minimum sea ice extent anomaly) is not correlated as well as in the observations suggesting that the potential predictability of the minimum sea ice extent in the real system is larger than that of the two GCMs. We hypothesize (work in progress) that a bias in the location of the Arctic High and the associated anomalies in the sea ice drift pattern can be responsible for the lower predictability.

Session 1809071 - Research and operational activities supporting the Year of Polar Prediction - Part 2
Ice verification across the CCMEP forecast systems
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Forecasting systems operated by Canadian Centre for Meteorological and Environmental Prediction (CCMEP), such as the Regional Ice-Ocean Prediction System (RIOPS) and the Global Ice-Ocean Prediction System (GIOPS), generate hourly to seasonal products with regional to global cover. All these systems need to be verified against available observational data before and after implementation in operations. In some cases, this evaluation has even included forecasting systems from outside CCMEP. The Interactive Multisensor Snow and Ice Mapping System (IMS) and GODAE Oceanview class4 are used to evaluate the performance of the sea-ice component in each forecasting system. Traditional point to point statistical evaluation as well as spatial verification scores (ice-edge distance) are presented to demonstrate capabilities of each forecasting system.

Session 1809080 - Numerical Methods and Model Development
Higher-order finite volume with selective upwinding on the sphere

Session 1809080 - Numerical Methods and Model Development
Leveraging public cloud infrastructure to produce affordable and reliable numerical weather forecasts
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Cloud computing resources are being increasingly used for atmospheric research and real-time weather forecasting, despite the high costs associated with resource use, data storage and egress. However, the use of preemptible compute resources on the Google Cloud Platform (GCP) may be a viable option to reduce compute costs by 80%, and file compression of the gridded output files can reduce storage and egress costs by 50%. Preemptible resources are heavily

discounted virtual compute cores that can be reclaimed by the GCP without prior warning when demands are high. By taking advantage of the Weather Research and Forecasting (WRF) Models restart feature, real-time numerical weather prediction (NWP) runs can be made on these heavily discounted resources without sacrificing forecast-completion reliability. Test runs with these preemptible resources were conducted using a nested domain over the Arctic, and the runs were profiled to determine the relative impacts of virtual machine size, restart frequency, time step size, and network demands on simulation times. A careful selection of virtual machine size and file output frequency, and the use of preemptible resources and file compression, can reduce annual NWP costs on the public cloud by a factor of 4. When compared with the purchase cost of a new high-performance compute cluster, a twice daily ensemble of similarly sized runs on the cloud would cost less than 65% of the annual amortization cost of the cluster over a five-year period. Public cloud infrastructure can therefore be a cost-efficient alternative to dedicated cluster ownership for weather prediction and scientific computation in general, allowing smaller research groups and institutions to produce their own forecasts without investing in expensive compute infrastructure.

Session 1809080 - Numerical Methods and Model Development
Spectral refining and coarsening of a numerical simulation
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Time dependent numerical simulations may require various grid resolutions at distinct times as a result of changing dynamical features. Sometimes these resolution requirements are restricted to a percentage of the domain and Adaptive Mesh Refinement techniques are used. In the case of a global method (such as a spectral method), or globally varying resolution requirements, a different approach is necessary. We present a method for spectrally refining or coarsening a global grid. We also present criteria to indicate when such refinement is necessary, or when coarsening is applicable.

Session 1809080 - Numerical Methods and Model Development
Guideline for high-resolution ocean models, using a model with probability distribution functions (PDF) of a thermohaline circulation
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Huge computational resources are necessary for high resolution thermohaline circulation models with plumes (~1 km). For evaluation of this model, new modeling is proposed with a PDF on the temperature–salinity (T–S) plane, which can represent horizontal heterogeneity within each grid of low resolution models (Ikeda, 1997, JPO). The T–S distribution retains only the probabilities of water types, while their locations are discarded. Time progressions of the PDF are calculated with mechanisms of mean variability, heterogeneity generation, horizontal mixing and convection with the lower layer.

First, a box model is chosen as the basic model, with one active box for the surface layer of the Arctic Ocean (200m thick), which receives saltier water from the Atlantic Ocean and could mix with the Arctic subsurface layer. This box model possesses a salinity-driven state receiving the saltier water, also a convected state with the subsurface layer.

As global warming proceeds, the Atlantic Water, which flows into the Arctic Ocean modified under ice formation in the Barents Sea, reduces the density of the Arctic Ocean subsurface layer. The surface layer may become sensitive to convection, developing plumes. As the subsurface layer is freshened by 0.1, the salinity-driven solution shifts toward the convected state.

As the more realistic PDF model, the Atlantic Water is distributed over the saltier portion, and the fresher Pacific Water is supplied to a certain T–S point. The shift to the convected state becomes slightly weaker than the basic PDF model. The low salinity core is retained near the Pacific Water (T, S), even with convection in the saltier portion.

The PDF models have shown requirement of a plume-resolving model. As the next step, the PDF will be implemented in a low-resolution model without mesescale eddies, and then, in an eddy-resolving model without a plume.

Session 1809080 - Numerical Methods and Model Development
Semi-Lagrangian Advection in the NEMO Ocean Model
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Global and regional eddy permitting ocean simulations are presented focusing on the impact of using a semi-Lagrangian (SL) advection scheme in the Nucleus for European Modelling of the Ocean (NEMO) model. The SL method permits the use of higher-order interpolation for the advection of both tracer and momentum quantities, improving the models ability to capture rapidly-varying features. The SL scheme is relatively more stable than other schemes commonly used in ocean modelling, allowing a potential increase of the model time step under certain considerations. The implementation of the SL scheme in NEMO is summarized and results from multi-year simulations are presented. We focus on how the SL scheme impacts the energetics and the tracer conservation. The impact of controlling the creation of local new maxima and minima with reduced-order interpolation is also examined. We discuss the application of the SL scheme in an environmental prediction context (e.g. ice-ocean and coupled weather forecast), considering issues like computational cost and model time-step.

Session 1809090 - Atmosphere, Ocean, and Climate Dynamics
Characterizing gravity waves using PASI and SATI at PEARL in Eureka, Nunavut
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Developing a climatology of middle atmospheric dynamics is important for understanding the global distribution of energy and energy transport. To say anything about climatological trends it is necessary to first characterize and parameterize dynamical events in this region of the atmosphere. In this study I will focus on the detection of gravity wave events as detected in the airglow layers above the Canadian high arctic by two instruments; the PEARL All-Sky Imager (PASI) and the Spectral Airglow Temperature Imager (SATI). By correlating data from these two sources, using PASI to contextualize the sky and SATI to provide temperature information, a better understanding of various wave parameters and wave energetics is determined. This paper presents an analysis

of observations taken during the new moon period in December 2014 and the extent to which the diagnosed parameters conform to linear gravity wave theory.

Session 1809090 - Atmosphere, Ocean, and Climate Dynamics
Northward Propagation, Initiation, and Termination of Boreal Summer Intraseasonal Oscillations in a Zonally Symmetric Model
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A simple multilayer-zonally symmetric model, using a multicloud convective parameterization and coupled to a dynamical bulk atmospheric boundary layer, is used here to simulate boreal summer intra-seasonal oscillations (BSISO) in the summer monsoon trough and elucidate the underlying main physical mechanisms responsible for their initiation, propagation, and termination. Northward-moving precipitating events initiated near the equator propagate northward at roughly 1\textdegree~day^{-1} and terminate near 20\textdegree~N. Unlike earlier findings, the northward propagation of precipitation anomalies, in this model, is due to the propagation of positive moisture anomalies in the northward direction, resulting from an asymmetry in the meridional velocity induced by the beta effect. From a moisture budget perspective, advection constitutes a biased intrusion of dry air into the convection center, forcing new convection events to form north of the wave disturbance, while moisture convergence supplies the precipitation sink. The BSISO events are initiated near the equator when the competing effects between first-baroclinic divergence and second-baroclinic convergence, induced by the descending branch of the Hadley cell and in situ congestus heating, respectively, become favorable to convective intensification. The termination often near 20\textdegree~N and halfway stalling of these precipitating events occur when the asymmetry in the first-baroclinic meridional winds weakens and when the negative moisture gradient to the north of the convection center becomes too strong as the anomaly exits the imposed warm pool domain.

Session 1809090 - Atmosphere, Ocean, and Climate Dynamics
Longer and more frequent marine heatwaves over the past century
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Marine heatwaves are important climatic extremes that can have devastating and long-term impacts on marine ecosystems, fisheries and aquaculture – with subsequent socioeconomic consequences. Recent and prominent marine heatwaves have attracted considerable scientific and public interest, notably in the Mediterranean in 2003, off Western Australia in 2011, the northwest Atlantic in 2012 and in the northeast Pacific in 2014-2016. Nonetheless, a comprehensive assessment of how these ocean temperature extremes have been changing globally is missing. Using a range of ocean temperature data including global records of daily satellite observations, daily in situ measurements, and gridded monthly in situ-based datasets we identify significant increases in marine heatwaves over the past century. We find that from 1925 to 2016, global average marine heatwave frequency and duration increased by 34% and 17%, respectively, resulting in a 54% increase in annual marine heatwave days globally. Modes of climate variability (i.e. ENSO, AMO, PDO) were found to significantly modulate marine heatwave activity globally, but do not negate the significant long term change. Importantly, these trends can largely be explained by increases in mean ocean temperatures, suggesting that we can expect further

increases in marine heatwave days under continued global warming. The implications of this long term increase in marine heatwaves on marine ecosystems can be expected to be widespread, significant and persistent.

Session 1809090 - Atmosphere, Ocean, and Climate Dynamics
Stimulated Loss of Balance and the Wave-Vortex Decomposition
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Recent models by Xie and Vanneste (2015) and Wagner and Young (2016) use reduced dynamics to model loss of balance in situations where near-inertial kinetic energy is large. In their formulation, potential vorticity includes quadratic wave components and the advecting velocity includes a Stokes drift associated with the waves. Energy removed from vortical modes involves interactions that are quartic and higher. Here, we relate these transfers to the wave-vortex decomposition, in which vortical to wave transfers occur only in association with off-resonant traids. Here, we relate these two points of view and speculate that a certain class of the quartic interactions assumed by XV/WY will dominate in the more realistic regime where the near-inertial energy is not large compared to geostrophic kinetic energy. Simulations using a two layer shallow water model are then used to test this hypothesis.

Session 1809090 - Atmosphere, Ocean, and Climate Dynamics
Performance assessment of a new high-resolution global reanalysis (FIO-COM) on temperature-derived simulations in tropical oceans
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The accuracy of a new high-resolution global reanalysis product from a surface wave-tide-circulation Coupled Ocean Model developed by First Institute of Oceanography (FIO-COM) is assessed based on the comparisons with two other high-resolution global analysis products (CMEMS and HYCOM) and buoy observations in the tropical oceans, including Sea Surface Temperature (SST), temperature at 5m depth, the 20oC Isothermal Depth and the monthly mean Mixed Layer Depth (MLD). The validation shows that seasonal variations of MLDs calculated from FIO-COM agree well with observations. Compared to the observations, the averaged root-mean-square (RMS) errors of seasonal MLDs calculated from FIO-COM, CMEMS and HYCOM in the tropical oceans are 9.2m, 9.5m and 12.9m, respectively. Quantitative assessment of the 20oC Isothermal Depth and temperature at 5m depth between the simulations and buoy observations is conducted. Furthermore, the capability of FIO-COM to simulate the SST variability during the 2015 El Niño episode was investigated by comparing with the observations from the 19 TAO buoys located in Niño 3.4 region; the average resulting root-mean-square error is 0.37oC, and the correlation coefficient is 93%.

Session 1809090 - Atmosphere, Ocean, and Climate Dynamics
The interplay of model resolution, eddy geometry and eddy-mean flow feedbacks
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A geometric decomposition of eddy-mean flow feedbacks (see Waterman and Lilly 2015) is a description of eddy-mean flow interactions in terms of the patterns

of eddy variance ellipse geometry. It has the potential to offer new insights into eddy-mean flow interactions by identifying the ingredients of the eddy motion that have a mean flow forcing effect, describing the eddy forcing in terms of a lower order (less-differentiated) description of the flow, and linking eddy feedbacks to spatial patterns of variance ellipse geometry that can suggest physical mechanisms underpinning these effects.

In this study we employ the geometric decomposition framework to gain insight into the breakdown of eddy-mean flow feedbacks with the degradation of model resolution. To do so, we perform a series of experiments with an idealized model and examine the impact of spatial resolution on eddy shape, propagation and feedback characteristics. We find a rapid breakdown in the eddy feedback as the spatial resolution is degraded, despite the fact that eddy energy remains well-resolved. Investigation into eddy geometry reveals that although the average eddy size is unchanged as the model resolution is degraded, eddy shape is not. This is significant, as eddy anisotropy plays a critical role in allowing eddies to propagate against the mean flow and feedback onto mean dynamics. These results thus suggest that the failure to adequately resolve eddy shape properties, in particular the small length scales in one direction to resolve eddies with large anisotropy, can result in a critically reduced eddy effect at a model spatial resolution that nevertheless well resolves the eddy size.

Session 1809100 - Societal Applications: Transforming Weather, Marine and Climate Communication through Policy, Research and Practice

Combining remote sensing and community sea ice information to inform safe travel in the Kitikmeot region of Nunavut, Western Canadian Arctic

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Consultations with residents in Cambridge Bay and Kugluktuk in the western Canadian Arctic have revealed that locals are interested in having access to remotely sensed image data, enhanced image products, and ancillary information to help plan travel and subsistence activities on sea ice. We are investigating the use of new and archived image datasets to optimize the identification of sea ice features of community interest in Cambridge Bay and Kugluktuk and to support safe sea ice use. We began by conducting interviews with community members in Cambridge Bay and Kugluktuk from May - June 2017 and November 2017 in order to determine what types of information the communities were interested in obtaining and to document relevant information about sea ice features and conditions. The first theme that emerged from the interview process was the need for sea ice roughness information, as roughness is a key feature impacting trafficability in this landfast-ice dominated region. Synthetic Aperture Radar (SAR) is an active microwave remote sensing technology that provides high-resolution (metre-scale) images independently of sunlight and cloud cover, and it is invaluable for monitoring Arctic sea ice conditions. Consequently, we are working to use data from the Sentinel-1 C-band SAR sensors to understand roughness conditions relevant to community sea ice use. A second theme from the interview data was a concern about changes in sea ice phenology. Consequently, we are also using an archive of MODIS images to track the timing of freeze-up, melt onset, melt pond flooding, and break-up near Cambridge Bay and Kugluktuk by analysing surface reflectances. Ultimately, we are working to make image-based outcomes from this research available to sea ice users via the Google Earth Engine platform, and hard copy maps and products via

northern partnerships (e.g., the local Hunters and Trappers Office, the Wildlife Office, the Library).

Session 1809110 - General Session - Interdisciplinary
CMC Operations: Implementing Operational Weather and Environment Prediction Systems and the Advent of a New HPC Infrastructure
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The Canadian Meteorological Centre (CMC) maintains a fully operational 24/7 production environment that includes data assimilation systems feeding various weather and environment forecast models, several of which are now coupled. At the same time, the CMC must also implement a steady stream of improvements for the numerous prediction systems. Following a rapid increase in the number of operational prediction systems in recent years, there are now upwards of 20 weather and environmental systems to maintain and upgrade. These upgrades require careful coordination with research and development groups throughout the implementation process. In the first part of this presentation, we will describe the complex technological transfer process, as a newly developed or modified system moves from research to development to operations.

During part of 2017, there was a rare, temporary freeze of technological transfers as efforts focused primarily on migrating existing systems to a new High Performance Computing (HPC) infrastructure. Hence, we will also briefly describe important features of the new HPC solution, as well as review implementation highlights of the past year while looking forward to important system upgrades scheduled for 2018 and beyond.

Session 1809110 - General Session - Interdisciplinary
Les services de données du SMC: vers une forum de données ouvertes en 2019
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Le Service météorologique du Canada (SMC) met à la disposition des usagers spécialisés une multitude de données météorologiques et prévisionnelles sur son serveur de données ouvertes HTTP, appelé Datamart du SMC. Créé en 2014, ce dépôt de produits et données météorologiques du Canada ne fait que prendre de l’ampleur année après année avec de nouveaux jeux de données sans cesse ajoutés suite à l’innovation en Recherche et Développement. Il compte actuellement plus de 2.5 Tb de données, soit près de 4 fois plus qu’à sa création, et plus de 22 millions de visiteurs par mois.

De plus, une proportion grandissante des données du Datamart du SMC sont aussi accessible via le serveur de données géospatiales du SMC, appelé GeoMet.

Les usagers à travers le monde sont issus de différents secteurs d’application, soit les secteurs météorologiques privés, les secteurs de l’énergie, de l’agriculture, de l’aéronautique et des transports, mais aussi de la finance, du droit, des media, etc. On compte aussi un bon nombre de développeurs d’applications mobiles ce qui donne au SMC une visibilité grandissante dans un monde où la météorologie devient un élément clé dans des activités émergentes comme l’intelligence artificielle.

Dans ce contexte bouillonnant, le SMC souhaite élargir ses échanges avec les usagers de ses données ouvertes afin de mieux cerner les besoins et ainsi permettre d'améliorer l'offre de service actuelle.

Le SMC souhaite profiter du cadre de la SCMO pour organiser un forum de données ouvertes en 2019 au cours duquel des présentations et des ateliers seront offerts au sujet des outils que sont le Datamart et GeoMet, ainsi qu'au sujet des données et des services associés. Un large volet sera aussi dédié à nos usagers afin de leur permettre de présenter leurs applications et leurs différents domaines d'activité.

Cette présentation donnera un portrait général des services de données du Datamart du SMC et de GeoMet, et lancera le projet de forum de données ouvertes prévu pour la SCMO 2019 à Montréal, ville intelligente par excellence et pôle mondial en intelligence artificielle.

Session 1809110 - General Session - Interdisciplinary
Variable Energy Resources: Operational Energy Forecasting Approaches
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As renewable assets are deployed, the requirement for highly accurate operational energy forecasts are increasingly becoming more important for the utility grid operators. Integrating variable energy resource (VER) forecasts into operations processes enables the grid to adequately add more renewables without major upgrades and changes to existing practices of grid management. An accurate forecast allows grid operators to maximize the amount of renewable energy reaching the grid while minimizing unnecessary loses due to unexpected ramping events along with minimizing the impact to consumers.

Green Power Labs' SolarSataDataTM operational forecast application for renewable energy utilizes a combination of deterministic and artificial intelligence models to provide highly accurate energy production forecast models for grid applications. The forecasts are currently utilized in the utility energy sector for Integrated Resource Planning; Electrical Market Operations: Day-Ahead and Real Time System Scheduling; Transmission System Operations; Electrical Distribution Operations and Demand Response Operations.

GPL utilizes the following weather forecasts;

- Publicly available numerical weather predictions (NWP)

- In-house mesoscale high-resolution NWP seeded with current weather conditions

- Smart persistence model for real-time forecasts up to 3 hours ahead

- Cloud motion model that integrates meteorological weather sources and satellite data to construct a 3D image of current clouds, updating every 15 minutes

The high-resolution weather forecasts are ingested into our SolarSataDataTM system; through a machine learning approach using our ensemble model, a best

forecast is constructed from the different forecast models to deliver the most accurate energy forecast for the target region and climate.

The resulting presentation provides insight into Green Power Labs' cutting-edge forecast approaches which have been utilized by clients across most major global markets.

Session 1810010 - POSTER SESSION - PART 1
Enhancement of Sea Surface Wind Skewness by Filtering

Session 1810010 - POSTER SESSION - PART 1
Investigations into the link between surface and columnar aerosol properties at the PEARL high-Arctic site
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Co-located measurements of surface-based and columnar aerosol properties are compared in order to investigate the information content both from the standpoint of redundancy and significant differences. The surface measurements consist of microphysical particle size distribution (PSD) measurements from a scanning mobility particle sizer and an optical particle counter as well as absorption, scattering (and thus extinction) coefficient measurements from two Photoacoustic Extinctiometers (two wavelengths). The columnar measurements consist of AEROCAN / AERONET sunphotometers / sky radiometer measurements whose optical inversion yields a suite of parameters that are analogous to the vertical integration of the surface measurements. The CANDAC Raman Lidar provides aerosol vertical profiles that are critical to understanding the link between the columnar and surface parameters. The comparative study will include an analysis of the correlation (and lack thereof) between extensive (quantity dependent) parameters such as fine and coarse mode extinction coefficients and aerosol optical depths as well as intensive (per particle) parameters such as the fine and coarse mode geometric mean radius and geometric mean standard deviation of the PSD. We also investigate how cases of redundancy (or lack thereof) between the surface and columnar measurements can lead to information regarding the refractive index of the prevailing aerosols (and thus aerosol type).

Session 1810010 - POSTER SESSION - PART 1
Information obtained from observable meteorological state variables about regime occupation in the stably stratified nocturnal boundary layer
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The stably stratified nocturnal boundary layer (SBL) can be classified into two distinct regimes: one with moderate to strong winds, weak stratification and mechanically sustained turbulence and the other one with moderate to weak wind conditions, strong stratification and collapsed turbulence. We will show that with a hidden Markov model (HMM) analysis of the three dimensional state variable space of stratification, mean wind speeds, and wind shear we are able to classify these regimes accurately in both the Reynolds-averaged as well as turbulence state variables. The features of the two-regime SBL are a generic structure at different tower sites around the world independent of their underlying surface types, the meteorological setting, or the complexity of the surrounding. Sensitivity

analysis indicate that essential information about regime occupation and regime transitions are present in both the shear and the stratification variables as these properties describe turbulent kinetic energy production and consumption, respectively. However, results are presented demonstrating that surface winds are already a good proxy in order to obtain some information on regime occupation in the SBL and therefore a global analysis of the regimes and their transitions is potentially possible.

Session 1810010 - POSTER SESSION - PART 1
Community Observations and Impacts of Storm Surges in the Canadian Beaufort Sea
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Declining Arctic sea ice extent and commensurate increases in fetch are increasing the risk of damaging storm surges along the Canadian Arctic coastline. Storm-driven changes in water levels can result in coastal flooding, increased wave erosion, and low-water levels (negative surge). Extensive storm-induced flooding occurs mostly during the fall before sea ice has formed. Delayed freeze-up attributed to climate change maintains fetch in October when strong storms and winds can occur, and will likely increase the likelihood of storm flooding and the frequency of overbank flooding. Although coastal ecosystems are dependent on frequent sedimentation and salinization from small floods, larger storm inundations can cause salinization of freshwater ponds and non-saline meadows, damage vegetation along the margins of permafrost plateaus, and melt subterranean permafrost causing underground hollows subject to collapse (thermokarst). This may introduce subsequent hazards and challenges to community infrastructure, transportation, and socioeconomic activities.

Results are presented from a community-based survey of storm surge events during recent years of rapidly declining sea ice cover (2007 – 2017), and delayed autumn sea ice formation. Community surveys were conducted in April 2018 in the northern coastal communities of Sachs Harbour, Uluhaktok, and Tuktoyaktuk to quantify and qualify exceptional storm surge events, trends in sea ice formation, and wave climatology. Historical information on past storm events is also assessed where available. Community-based accounts of notable storm events are matched to the synoptic climatology of the region. This work will be followed by numerical modeling exercises of water levels for the Western Canadian Arctic, and identify meteorological parameters associated with “worst case” surge events.

Session 1810010 - POSTER SESSION - PART 1
Re-engineering of weather elements production system: towards the transformation of the forecasting system
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With the coming of science & technology innovations and an increasing amount of data and information generated by our center, the current forecasting system must adapt and respond to evolving client needs. Information from high resolution numerical prediction systems, ensemble prediction systems and environmental prediction systems are currently poorly integrated into the forecast production system. Furthermore, in certain cases information is diluted in the production chain due to aging technologies and specifications historically defined

by Services. This leads to the fact that, for example, details from high resolution models, uncertainty estimated from ensemble systems and information from environmental prediction systems are all underused and difficult to access by external users.

In this presentation we will present the transformation of the weather elements production system. Weather elements needed for forecast production (public, marine and aviation) will soon be available on a grid instead of only being available at points (the “SCRIBE” points) aiming to represent specific regions. Among other benefits, this will allow forecast to be produced anywhere on a grid and will also provide a production system to which new information will be more easily integrated and available in the forecast products distributed to users.

In addition, as part of the warning production re-engineering project, it was decided that the MetObject approach will be used to generate and transmit weather and environmental warnings in the coming years. This has led us to innovate by implementing a system that generates diagnostics of high impact weather derived from NWP models at all time scales. These products will be transformed into a HIMO: High Impact Met Objects. We will describe this innovative system and explain how these diagnostic Met Objects will be used within the future warning production system that is currently being developed.

Session 1810010 - POSTER SESSION - PART 1
The role of topographically induced standing meanders on the pathways of the Global Overturning Circulation.
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The traditional zonally averaged perspective of the Meridional Overturning Circulation (MOC) shows two separate overturning cells, stacked on top of each other in a latitude-depth plane. However, this zonally averaged perspective can be misleading since it does not represent the important overlapping (or coupling) that exists between the two overturning cells. For example, observations show that an important fraction of the upper cell waters is upwelling under surface buoyancy loss in the Southern Ocean, thus increasing its density, it sinks to the abyss as part of the lower cell. A zonal asymmetry is necessary to describe this important pathway of the MOC. This study aims to understand the role of the circumpolar current’s standing meanders on creating this zonal asymmetry and allowing the coupling between the two overturning cells. Numerical experiments are performed in an idealized configuration of a basin coupled with a channel to the south. A standing meander is generated by the addition of a Scotia-Ridge like topography in the model’s Drake Passage. Surface boundary forcing ranges from surface buoyancy relaxation to fixed buoyancy flux. Increasing the zonal extent of the domain amplifies the strength of the standing meander, thus enabling to investigate the role of an increasing stationary wave on the MOC. Changes in watermass transformation are estimated from surface buoyancy fluxes and passive tracer release, allowing to map the tridimensional pathways of the circulation and the coupling between the two overturning cells.

Session 1810010 - POSTER SESSION - PART 1
Updates to NO2 Dry Deposition in a Global Chemical Transport Model: implications of sub-grid vertical transport with hydrolysis on the ground surface
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Atmospheric reactive nitrogen has significant biosphere and health implications, such that an accurate simulation of its burden is of great interest. Current global chemical transport models (CTMs) employ a dry deposition parameterization that allows removal of NO2 by vegetation in daytime, with negligible deposition occurring at night. This despite evidence of significant nocturnal NO2 removal via hydrolysis reactions on humidified ground surfaces. We implement published, field measured, NO2 uptake coefficients—describing heterogeneous NO2 hydrolysis on the ground surface yielding adsorbed HNO3 and evolved HONO—into the dry deposition parameterization of the GEOS-Chem CTM. This update reduces biases between simulated and measured (eddy covariance) nocturnal NO2 and NOy dry deposition velocities over Harvard Forest (June-Nov. 2000). We further improve the representation of dry deposition of near-surface emitted NOx by considering dry deposition alongside sub-grid vertical transport in the first level of the GEOS-Chem CTM (ca. 120m agl). This is achieved through construction of a simple 1D high-resolution, first-order turbulent transport model of passive scalers which are permitted to dry deposit. A look-up-table of the underestimate of dry depositional loss resulting from instantaneous dilution to ca. 120m is constructed as a function of friction velocity, atmospheric stability, surface roughness, and resistance to surface uptake. An updated high-resolution GEOS-Chem simulation over North America (NA) for the year 2013 indicates an effective reduction in surface NOx emissions of ca. 7% over eastern NA and an increase in NOy deposition of ca. 25% (larger increases occurring in proximity to NOx sources). Large increases in surface nocturnal HONO concentrations (ca. 130%) result in improved comparison to limited field campaign data.

Session 1810010 - POSTER SESSION - PART 1

Labrador Sea oxygen ventilation: the role of lateral oxygen fluxes and the NAO (a part of project VITALS)

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Winter deep ocean ventilation in the Labrador Sea maintains the high oxygen levels at depth throughout the North Atlantic. This favours aerobic respiration and nitrification, essential processes in a healthy ocean. The Labrador Sea ventilation, however, is vulnerable to changing atmospheric conditions such as the North Atlantic Oscillation (NAO). During NAO+, the cold and windy conditions, which are positively correlated to stronger air-sea oxygen fluxes, has been linked to higher oxygen content in the Labrador Sea, while the opposite is true during NAO-.

While air-sea oxygen fluxes are thought to be the principal source of oxygen into the Labrador Sea, little research has been conducted to quantify lateral sources from neighbouring regions, such as the Irminger sea or Arctic Ocean. In this study we question the relative role of air-sea and lateral advective oxygen fluxes to the Labrador Sea oxygen inventory and export using an ocean - sea ice - biogeochemical model hindcast (1958 – 2016). We also carry out NAO sensitivity experiments. We find that while deeper convection, favoured during NAO+ years, is critical to the ventilation of Labrador Sea it is not the air-sea fluxes that dominates the ventilation process. Our simulations suggest that lateral fluxes play a significant role in oxygenating the surface waters of the Labrador Sea and that during deep convection this oxygen is transferred from the surface to greater depth. This shallow to mid-depth (above 1556m) lateral advection contribute 75%

of the deep Labrador Sea oxygen export, while air-sea fluxes contribute only 25%. These results highlight the importance of colder Arctic waters export to the North Atlantic and convection in the Irminger Sea as potential sources of oxygen to the Labrador Sea.

Session 1810010 - POSTER SESSION - PART 1
Temporal variability of internal wave-driven mixing from multi-year mooring time series in the Canadian Arctic Archipelago
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While ocean mixing is known to be inherently patchy in time, data scarcity in the Arctic Ocean poses significant challenges in our ability to accurately quantify the temporal variability of turbulent mixing in this region. To address this need for temporal analyses, we investigate multi-year time series of ocean temperature, salinity, and velocity from mooring records in Barrow Strait in the Canadian Arctic Archipelago. Here, two moorings equipped with upward-looking 300 kHz ADCPs that sampled the upper ~160 m of the stratified water column, as well as CTDs located at 40, 80, and 160 m depths, operated continuously for seven years from 1998-2005. In this study, we apply a shear-based finescale parameterization of turbulent dissipation to these records to characterize the time series of wave-driven turbulent dissipation rates, diffusivity rates, and associated turbulent heat fluxes. We assess the variability of these signals on daily, seasonal, and yearly cycles. We further quantify the frequency of significant mixing events and the extent to which they mediate climatological heat fluxes. Finally, we consider the environmental conditions that allow for these high-energy episodic or periodic mixing events to disrupt the typically quiescent nature of the Arctic Ocean interior.

Session 1810010 - POSTER SESSION - PART 1
Vertical Motions Leading the Intensification of Simulated Typhoon Hagupit (2008)
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Signals prior to the intensification of tropical cyclones (TCs) are important for improving the TC intensity forecast. The existence of such signals has been noted by previous studies of satellite-borne observations and lightning. Vertical motions can enhance TCs via the transportation of heat to warm core, thus we hypothesize that they may be considered as the signals preceding TC intensification. In this study, we separately examine the processes of updrafts and downdrafts, which are both concentrated within the eyewall that surrounds the warm core. The analysis focuses on the intensification of Typhoon Hagupit (2008). Numerical experiments are conducted using the Weather Research and Forecasting model to show the changing structures of vertical motions and their impacts on the timing of TC intensification. Control simulation (CTL) reproduced the storm structures well, while Half-Bogus (Half-Moisture) experiment generated the relatively less-organized TC core structures (weakened moisture convection). Upward motions are found to induce storm intensification by a lead of 1.75–3.75 h in all experiments. Downward motions also have a lead of TC intensification by 0.25–4.42 h in Half-Bogus and Half-Moisture experiments. However, the lead-lag relationship of downward motions and TC intensification is unclear in CTL, which is related to the greater quantity of water vapor held up by the enhanced eyewall. Thermodynamic analysis show the quantity of latent heat consumed in downdrafts in CTL is much larger than that in the other two experiments, resulting

to the smallest heating contribution in downdrafts then their weak relationship with TC intensification.

Session 1810010 - POSTER SESSION - PART 1
Composition and hygroscopicity of aerosols artificially generated from sea water samples
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Oceans cover 70% of the earth's surface, yet their emissions into the atmosphere are still poorly constrained which impacts Earth's radiation budget through the scattering of solar radiation and acting as cloud condensation nuclei. Sea spray aerosols are generated from breaking waves in the ocean and consist of inorganic and organic fractions. Their interaction with radiation is governed by parameters like chemical composition, size, and hygroscopicity. It was found previously that the hygroscopicity decreased after the removal of inorganics. This contradicted predictions based on the high volume fraction of inorganics which should of resulted in a hygroscopicity value similar to the original sample. In this project an atomizer was used to generate particles which were collected on a filter to determine if the composition of atomized aerosols is different from the solution in the atomizer. Control experiments in the laboratory using sodium chloride were conducted in order to confirm that the composition of the atomized solution was the same composition of the particles collected on the filter. A comparison between the composition of the solution and particles collected on the filter will be shown and their implication will be discussed.

Session 1810010 - POSTER SESSION - PART 1
Impact of model resolution on the representation of the wind power statistics: an example from the UK
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Wind power is becoming a popular choice for a renewable energy source; however, the efficiency of wind farms relies on the long-term reliability of wind statistics. Reanalysis datasets are starting to be used to characterize these statistics so as to improve our knowledge of the spatial variability of the surface wind allowing for more optimal placement of future wind farm development. However most global reanalysis datasets have a spatial resolution of greater than 100 km and require downscaling to provide information on spatial scales appropriate to decision making regarding wind farm placement. One known, and common, factor that affects wind speed variability is topography and it is unclear how horizontal resolution of climate models and the downscaling process impacts the representation of the surface wind field.

Here we use a set of reanalysis and analysis datasets all based on the ECMWF's Integrated Forecast System with horizontal resolutions ranging from ~75km to ~9km to investigate the impact of model resolution on the representation of the wind power statistics from the UK region. We find that apart from an increase in magnitude with increasing resolution, the spatial patterns of the mean wind field agreed fairly well across all resolutions. However, agreement with respect to the mean does not imply that the spatial variability is being accurately represented. Using a novel technique called the decorrelation length scale analysis, we show that there are changes in the spatial variability of the wind speed that are not reflected in its mean structure. Furthermore, our analysis suggests that model

resolutions as high as 31km do not accurately represent the spatial variability of the surface wind field over the United Kingdom, especially in coastal regions as well as in regions with complex topography.

Session 1810010 - POSTER SESSION - PART 1
Effect of wind forcing on the oceanographic conditions of Fortune Bay (NL) a large, mid-latitude, fjord
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Fortune Bay is a long (~130 km), wide (~20 km) and deep (~600 m at its deepest point and ~430 m within its main basin) fjord located on the southern shore of Newfoundland. Due to its sheer size, volume and to the general lack of tidal amplification around Newfoundland, tidal ranges are small (~2m) and tidal currents are weak (generally <10-20% of the total variance of observed currents). Wind, as opposed to the tide, appears to be a major force affecting the oceanographic conditions observed. Oceanographic response from this forcing is mainly expressed as spatial and temporal variations of the thermocline, i.e., as upwelling and downwelling events associated with surface and sub-surface currents. Driven by the need to understand and reproduce (model) the ocean dynamics to respond to aquaculture related issues, Fisheries and Oceans has initiated a project based on comprehensive observations and numerical modeling. Latest results of this program will be presented and discussed with focus on the observations component.

Session 1810010 - POSTER SESSION - PART 1
Influence of the QBO on the MJO-NAO connection
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Previous studies have provided observational evidence that certain phases of the Madden-Julian Oscillation (MJO) are statistically associated with changes of the North Atlantic Oscillation (NAO) about 10 days later. Such a lagged association implies that the tropical convection of the MJO may provide sources of skill for subseasonal predictions in the extratropical regions.

In this study it is found that the MJO-NAO connection is influenced by the phase of the quasi-biennial oscillation (QBO). During the westerly phase of QBO (WQBO), stronger and longer lasting MJO-NAO teleconnection is observed. Such connection is consistent with previous studies, i.e., about two pentads after MJO phase 3 (7), which corresponds to enhanced (suppressed) diabatic heating anomaly in the tropical Indian Ocean and reduced (enhanced) convection in the western Pacific, a positive (negative) NAO tends to occur. On the other hand, under easterly of QBO (EQBO), the MJO-NAO teleconnection is also observed but much less significant.

The QBO influences the MJO related teleconnection by modulating the extratropical basic state. During WQBO years, there is subtropical anomalous westerly wind in the North Pacific, which agrees with the previous studies of QBO. The enhanced subtropical westerly jet provides a favorable environment for the MJO induced extratropical Rossby wave to propagate into the extratropical North Atlantic. The opposite is true for the years of EQBO.

Session 1810010 - POSTER SESSION - PART 1

Labrador Sea Water formation rate and its impact on the Meridional Overturning Circulation in the North Atlantic Ocean

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The Atlantic Meridional Overturning Circulation (AMOC) is a key component of the Earths climate system as it contributes to the redistribution of heat, salt and anthropogenic carbon in the world ocean. The lower limb of the AMOC is associated with dense water formation driven by buoyancy forcing and is carried by a vigorous deep western boundary current (DWBC). The main water mass in the subpolar North Atlantic is the North Atlantic Deep Water (NADW) and its lightest contribution is the Labrador Sea Water (LSW). The LSW is formed in the Labrador Sea through deep wintertime ocean convection. Many numerical studies have shown a link between the LSW formation rate and the strength of the AMOC. However, the impact of the formation of the LSW on the AMOC remains unclear and is still under debate. In this study, we will analyze the change in the fate of the LSW formation through calculation of its subduction rate, as well as change in its properties through a density layer analysis. The formation rate of the LSW is computed using an instantaneous kinematic subduction approach by analyzing the vertical transport of a water mass through the base of the instantaneous mixed layer. Change in the transport of the DWBC associated with change in the LSW formation rate will be then investigated. Pathways of LSW after its formation will be analyzed by using an oceanic Lagrangian analysis (Ariane) in order to understand how the LSW can impact the transport in the DWBC and the AMOC throughout North Atlantic Ocean, from the RAPID array at 26N to the OSNAP array (subpolar gyre). We will address the impact of the Labrador Sea Water on the AMOC over the time period from 2002 to 2016 using simulations from the DRAKKAR project, especially an eddy-permitting 1⁄12 degree Arctic and Northern Hemisphere Atlantic (ANHA) configuration.

Session 1810010 - POSTER SESSION - PART 1

Communities and Cables: An Integrated Approach to Monitoring in the Arctic and Beyond

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Ocean Networks Canada maintains and operates a network of permanent, ocean sensing systems in the Canadian Arctic (Cambridge Bay and Devon Island, Nunavut) and along the coast of BC. Complementary to these cabled, seafloor and shore-based instrument platforms, is a growing network of mobile oceanographic instruments that enable trained community members to collect data over a wide geographic area and at a higher temporal resolution than typically possible with dedicated research vessels. Additionally, mobile devices (tablets) loaded with purpose-built app software allow for time-stamped and geo-referenced observations, measurements, and annotations to be easily captured and stored in a searchable database. Community-driven data collection not only builds wide-spread capacity with respect to the scientific method and technical skills, but also creates opportunities for the integration of local/traditional knowledge during program development and throughout the data collection process. Ocean Networks Canada’s “Oceans 2.0” data management system serves data from fixed position and mobile systems by archiving, combining, and disseminating data using a wide range of tools and data-products; such products

range from near-instantaneous emergency alerts (e.g. for earthquakes and oil spills) to co-designed community-orientated products that address local priorities (e.g. visualization of snow and ice data with respect to safe travel conditions). Combining these capabilities with the ability to manage third-party data sets, Ocean Networks Canada is working on supporting a long-term fully-integrated near real-time monitoring program that spans the Arctic.

Session 1810010 - POSTER SESSION - PART 1
Observation and analysis of mesospheric bores over Eureka
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Several optical instruments located at the PEARL Observatory in Eureka, Nunavut (80.05N, 86.42W) have probed the polar mesosphere for a decade. A dynamically active region, the mesosphere is host to a broad spectrum of interacting waves. One rare type of wave, known as a bore, is studied here. These are sharp wavefronts that have trailing oscillations. They are observed through modulation in the brightness of nightglow, a natural emission caused by temperature- and density-dependent photochemical reactions. The properties and structures of several bores observed in the data collected at the PEARL Observatory are studied in order to gain insight into the unique trailing oscillations. Three emission layers are examined: hydroxyl (87 km), sodium (90 km), and atomic oxygen (96 km). Scans from the PEARL All-Sky Imager, a CCD imager, allow intensity variations in the airglow at these altitudes as waves pass through to be detected. ERWIN II, a Michelson interferometer, gives information on winds from Doppler shifts in these airglow emissions. Satellite data acquired during SABER-TIMED observations at these latitudes allows temperature profiles to be obtained near and over Eureka. Several analysis techniques are implemented to study the bores. Horizontal wavelengths are obtained by averaging slices of All-Sky Imager intensity data parallel to the wavefronts and plotting brightness versus geographic coordinates. Wave speeds are computed from time series' of bores. Preliminary comparisons with bore theory are made. A temperature inversion accompanied by a duct, which permits propagation of the bore at altitudes just beneath the inversion, is often observed. A duct can be seen in profiles of the Brunt-Väisälä frequency, calculated directly from SABER temperature profiles. The airglow emission layers are perturbed differently as a function of height, resulting in the complimentary variations of airglow brightness and wind between various heights often seen in the images.

Session 1810010 - POSTER SESSION - PART 1
Meso-scale SST fluctuations and wind speed statistics
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The atmospheric (ABL) and ocean (OBL) boundary layers are intimately linked via mechanical and thermal coupling processes. In many regions over the world oceans this results in a strong co-variability between anomalies in wind speed and SST. At oceanic mesoscale this coupling can be driven either from the atmosphere or the ocean.

Gridded SST and wind speed data show that over the western North Atlantic the ABL mainly responds to the OBL, whereas in the eastern North Pacific and in the Southern Ocean the OBL largely responds to wind speed anomalies. This general behaviour is also verified by in situ buoy observations. A stochastic non-

dimensional 1-d coupled air-sea boundary layer model is utilized to assess the relative importance of the coupling processes. For regions of little intrinsic SST fluctuations, i.e. most regions of the world ocean away from strong temperature fronts, the inclusion of entrainment at the thermocline is crucial. In regions with strong frontal activities, e.g. the western boundary regions, the coupling is dominated by the SST fluctuations and the frontal variability needs to be included in models. Generally, atmospheric and ocean-driven coupling lead to an opposite relationship between SST and wind speed fluctuations. This effect can be especially important for higher wind speed quantiles.

Session 1810010 - POSTER SESSION - PART 1
Moored Temperature, Salinity and Current Measurements from the Scotian Slope and Rise, 2008-2016
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Time series of near-bottom temperature, salinity and currents obtained from moored measurements between October 2008 and April 2016 at six sites across the Scotian Slope and Rise, in water depths ranging from 1100m to 3900m, are presented and described. The measurements were obtained as part of a collaboration between the United Kingdom RAPID-WATCH climate programme and Fisheries and Oceans Canada. Moorings with at least an upward-looking ADCP at 50 m above bottom (mab), a MicroCAT (MC) temperature salinity recorder in the 100-150 mab interval, and a Seabird Bottom Pressure Recorder were deployed for five successive 9-18 month periods at the six sites up to September 2014, and for an additional 19 months at four of the sites. The moored MC measurements were calibrated to deep-ocean standards using MC-CTD calibration casts. Temperature and salinity had weak positive trends of up 0.2oC and 0.03, respectively, per decade at the shallowest mooring site, but also had fluctuations of comparable magnitude on time scales ranging from hours to years. Record-mean currents were approximately westsouthwestward (equatorward along the slope) in all cases with average magnitudes in the 2-3 cm/s range at the four shallowest sites (water depths of 1100 to 2800m) and in the 5-6 cm/s at the two deepest sites (3400 and 3900m) in the Deep Western Boundary Current. Peak current speeds at all sites were typically in the 20-30 cm/s range. Unexpected influences of local topography on the mean current directions at the two deepest sites were identified. The various time series will be used to provide estimates of AMOC variability during the mooring period, following the method of Hughes et al. (JAOT 2013).

Session 1810010 - POSTER SESSION - PART 1
Forced change and internal variability in Canadian Arctic renewable energy resources
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There are two main contributions to changes in climate: Forced Change (FC) and Internal Variability (IV). FC is caused by anthropogenic activities, such as production of fossil fuels, carbon and aerosol emissions and land use change, while IV refers to natural variations resulting from atmospheric, oceanic, land and cryosphere processes and their interactions. Quantifying these two contributions is important in order to better understand the possibilities of the climate’s future, and also for the development and exploitation of renewable energy resources

such as wind and solar power, which may offset much of today's fossil fuel consumption and related emissions.

Past studies have demonstrated that the Arctic is expected to show larger forced changes in climate compared to elsewhere on the globe. Warming of the Arctic ocean and increases of air temperature in the region are already in progress. As a result, the sea-ice extent has decreased considerably. Changes in the wind field and surface irradiance, both with respect to FC and IV, directly affect renewable energy production. In the Canadian Arctic, small-scale wind power is perhaps the most promising energy supply for the region, because of its availability during the whole year.

In order to better understand climate variability and change in the context of renewable energy production, we will use the CanRCM4 ensemble driven by the CanESM2 large ensemble to estimate FC and IV in Canadian Arctic surface wind and irradiance and their interactions.

Session 1810010 - POSTER SESSION - PART 1
The effects of resolution and inter-tidal areas on the solution of a FVCOM model of Saint John Harbour
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Located in the Bay of Fundy, Saint John Harbour is not only subject to large tides but also has the largest freshwater input into the bay from the Saint John River. These opposing forces result in a complex flow regime as well as bathymetry with significant inter-tidal areas. Saint John Harbour has a high level of tanker traffic and is one of six ports for which hydrodynamics models are being developed as part of the Ocean Protection Plan (OPP) Marine Safety initiative.

A FVCOM implementation of Saint John Harbour has been developed as part of OPP. The model has tidal and non-tidal forcing, river runoff and atmospheric forcing. Starting with a grid with 100m resolution in the harbour, a finer resolution grid was developed to assess the effect on grid resolution on the model results. Additionally, the model was run in two modes: a wet-dry solution and a wet only solution. Solutions to these model runs are used to assess the effects of inter-tidal areas on model results. Model assessments are carried out by comparing results with field data collected for model verification and validation and include water levels, currents, temperature and salinity.

Session 1810010 - POSTER SESSION - PART 1
Climate change off Newfoundland and Labrador over 2011-2069: results from a regional downscaled ocean and sea ice model under a median emission scenario
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In this study a three-dimensional ice-ocean model is developed to examine likely changes of ocean and ice conditions over the Newfoundland and Labrador Shelves in response to climate change. The model has a horizontal grid of ~7 km and a vertical grid of 46 levels. The hindcast period is from 1979 to 2010. The projection period is from 2011 to 2069 under a median emission scenario A1B of the Intergovernmental Panel on Climate Change (IPCC). For the projection period, the surface atmospheric forcing fields are from the Canadian Regional Climate Model over the North Atlantic. The open boundary conditions are from

the Canadian Global Climate Model Version 3 (CGCM3), adjusted for the 1981-2010 mean of the Simple Ocean Data Assimilation (SODA) model output. The simulated fields over 1981-2010 are consistent with those in observations. Over the projection period, the model shows general trends of warming, freshening, and decreasing ice over the Newfoundland and Labrador Shelves. From 2011 to 2069, the model projects that under A1B the sea surface temperature will increase by 1.4 degree C, the bottom temperature will increase by 1.6 degree C, the sea surface salinity will decrease by 0.7, the bottom salinity will decrease by 0.3, and the sea ice extent will decrease by 70%; The freshwater transport of the Labrador Current will double due to freshening. The regional ice-ocean model reproduces more realistic present climate conditions and projects considerably different future climate conditions than the CGCM3.

Session 1810010 - POSTER SESSION - PART 1
Ocean Wind and Current Retrievals from Satellite SAR measurements
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A total of 168 fully polarimetric synthetic aperture radar (SAR) images are selected together with the buoy measurements of ocean surface wind fields and high-frequency radar measurements of ocean surface currents. Our objective is to investigate the effect of the ocean currents on the retrieved SAR ocean surface wind fields. The results show that, compared to SAR wind fields that are retrieved without taking into account the ocean currents, the accuracy of the winds obtained when ocean currents are taken into account, is increased by 0.2–0.3 m/s; the accuracy of the wind direction is improved by 3–4° . Based on these results, a semi-empirical formula for the errors in the winds and the ocean currents is derived. Verification is achieved by analysis of 52 SAR images, buoy measurements of the corresponding ocean surface winds, and high-frequency radar measurements of ocean currents. Results of the comparisons between data obtained by the semi-empirical formula and data measured by the high-frequency radar show that the root-mean-square error in the ocean current speed is 12.32 cm/s and the error in the current direction is 6.32°. See also ‘Ocean Wind and Current Retrievals Based on Satellite SAR measurements in conjunction with buoy and HF Radar Data’ by He Fang, Tao Xie, Will Perrie, Li Zhao, Jingsong Yang, Yijun He. In Remote Sensing.

Session 1810010 - POSTER SESSION - PART 1
Surface Wave Effects on the Wind-Power Input to Mixed Layer Near-Inertial Motions
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Ocean surface waves play an essential role in a number of processes that modulate the momentum fluxes through the air–sea interface. In this study, the effects of evolving surface waves on the wind-power input (WPI) to near-inertial motions (NIMs) are examined by using momentum fluxes from a spectral wave model and a simple slab ocean mixed layer model. Single-point numerical experiments show that, without waves, the WPI and the near-inertial kinetic energy (NI-KE) are overestimated by about 20% and 40%, respectively. Globally, the overestimate in WPI is about 10% during 2005–08. The largest surface wave effects occur in the winter storm-track regions in the midlatitude northwestern Atlantic, Pacific, and in the Southern Ocean, corresponding to large inverse wave

age and rapidly varying strong winds. A relatively low frequency of occurrence of wind sea is found in the midlatitudes, which implies that the influence of evolving surface waves on WPI is intermittent, occurring less than 10% of the total time but making up the dominant contributions to reductions in WPI. Given the vital role of NIMs in diapycnal mixing at the base of the mixed layer and the deep ocean, the present study suggests that it is necessary to include the effects of surface waves on the momentum flux, for example, in studies of coupled ocean–atmosphere dynamics or climate models. Also see the manuscript: Liu, G., Perrie W. and C. Hughes (2017): Impacts of Ocean Surface Waves on Wind Power Input to the Mixed-Layer Near-Inertial Motions. J. Phys. Ocean. DOI: 10.1175/JPO-D-16-0198.1.

Session 1810010 - POSTER SESSION - PART 1
Collective assessment of a set of improvements to surface process parameterizations in CRCM5 over Western Canada
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Western Canada, with glaciers and complex topography presents significant challenges for regional climate models. Many surface-related parameterizations were improved or newly implemented in the Canadian Regional Climate Model to improve the representation of the surface climate and hydrology. These include dynamic vegetation, dynamic glaciers, lake-river system and frozen soil hydraulic conductivity parameterizations. The objective of this study is to evaluate the impact of these improvements on the simulated climate of western Canada. The collective evaluation on the model behaviour is assessed through three current climate (1980-2010) simulations. Two of these simulations are performed at 0.44° resolution, with and without improvements, while the third one is performed at 0.11°, with all improvements. All the simulations are driven by ERA-Interim reanalysis at the boundaries.

Simulations with the modified version of the model demonstrate improvements in the simulated climate, particularly at 0.11° resolution for 2-m air temperature and at 0.44° for mean spring total precipitation, when the temperature and precipitation biases get reduced by up to 4 °C and 1 mm/day respectively in some regions. Analysis of temperature and precipitation extremes suggests improvements, particularly over regions with important orography. Comparison of simulations at 0.44° and 0.11° resolutions suggest improvements in precipitation extremes for elevated regions by 0.5-1 mm/day.

Session 1810010 - POSTER SESSION - PART 1
Thermal evidence of submarine groundwater flow beneath the Scotian Slope
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Submarine groundwater fluxes facilitate important hydrological and biogeochemical exchanges between marine and submarine environments, yet few studies have investigated spatially-distributed groundwater fluxes in deep-ocean environments such as continental slopes. Heat has been previously used as a submarine groundwater tracer via a solution that assumes steady-state conditions and homogeneous thermal conductivity. These assumptions are often

violated in marine sediment due to ocean bottom temperature changes or sediment thermal property variations. Here, heat tracing analysis techniques recently developed for terrestrial settings are applied in concert to examine the influences of groundwater flow, ocean temperature changes, and subsurface thermal conductivity variations on deep-ocean sediment temperature profiles. Temperature observations from the sediment and overlying ocean on the continental Scotian Slope off eastern Canada are used to demonstrate how simple thermal methods for tracing groundwater can be employed if more comprehensive techniques indicate where the simplifying assumptions are valid. The spatial distribution of the inferred groundwater fluxes on the Slope suggests a downward groundwater flow system with recharge occurring over the upper-mid slope and discharge on the lower slope. Groundwater flow in continental slopes is often thought to be upward due to density gradients from geothermal convection; however, we speculate that the downward groundwater flow system inferred on the Scotian Slope is due to density-driven processes arising from underlying salt domes. Improvements in the design of future submarine hydrogeological studies are proposed for both thermal data collection and groundwater flow analysis.

Session 1810010 - POSTER SESSION - PART 1
Sensitivity of landfast ice to tides, ice rheology and ocean mixing in a sea-ice ocean numerical model
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Landfast ice modeling has been a weak point for most sea ice models due to lack of a proper parameterization. In recent studies, a modified sea ice rheology and grounding scheme has shown promising ability to improve the simulated landfast ice cover. With those, we have conducted a series of pan-Arctic simulations using NEMO-CICE to study various factors impacting landfast ice. Model results show for instance that tides play a very important role on the distribution of landfast ice in active tidal regions such as the Gulf of Boothia, Prince Regent Inlet and Lancaster Sound. The ice strength decreases while the ocean stress on the ice increases when tides are present, resulting in a significant loss of landfast ice coverage in these area. Our results also show that the landfast ice cover is not sensitive to the choice of the ocean vertical mixing scheme.

Session 1810010 - POSTER SESSION - PART 1
Characterization of ambient PM1 at Kejimkujik National Park: trends, composition, and processes
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From June 2015 to August 2016, measurements of PM1 mass and number distribution, chemical speciation, VOCs, and meteorology, along with PM2.5 mass, were made at 30-minute resolution at 10m height in a small clearing in the forest of Kejimkujik National Park. The purpose of this study is to increase our understanding of the nature of the PM1 aerosol in a rural Atlantic Canadian environment, focussing on quantifying the fraction of PM2.5 that is PM1, identifying the relevant sources and processes determining this fraction, and quantifying its chemical composition. Preliminary results show that PM1

comprises about 70% of the PM2.5, with monthly averages ranging from 55% to 85%. Highest fractions are seen in summer (July, August); lowest fractions are seen in autumn (October, November). On average, the PM1 fraction increases throughout the day until sunset and falls to a minimum overnight, suggesting photochemistry and boundary layer dynamics play a role. Case studies are investigated using positive matrix factorization and back trajectories to gain understanding of the processes contributing to both high and low PM1:PM2.5 ratios in this natural environment.

This work stems from the body of evidence supporting the hypothesis that particles in the PM1 size range may play the biggest role in determining health outcomes, and the recommendation of the 2008 Smog Science Assessment to address knowledge gaps regarding the processes affecting PM chemistry and the role of sub-micron particles in air quality in Canada's Atlantic Region.

Session 1810010 - POSTER SESSION - PART 1
Local egg production and larval losses to advection contribute to explain interannual and long-term variability of American lobster Homarus americanus settlement intensity
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American lobster (Homarus americanus) egg production and settlement intensity were examined over a 19-yr period in the Gulf of St. Lawrence, at the Magdalen Islands (MI) where the population is spatially isolated during the benthic phase. Settlement and hatch dates by year were retro-calculated from observed young-of-the-year size structure and juvenile and larval growth models. Drift of locally-released larvae, from stage I to end of stage III, was simulated using an ocean circulation model. Settlement intensity was related positively to egg production and negatively to drift distance. There was a positive trend in settlement intensity explained largely by increasing egg production, and declining larval duration and drift distance. In the last years of the study, settlement intensity may have been limited by nursery saturation. The results point to limitations of larval drift modeling studies – including this one – and suggest that connectivity through larval drift is highly dynamic in time and it may have declined in recent decades. The demographic dependence of the MI lobster population on other populations in the Gulf of St. Lawrence is probably low.

Session 1810010 - POSTER SESSION - PART 1
On the origin and cycling of nutrients in Baffin Bay: Evidence from nitrate and nitrous oxide isotope ratios
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The Canadian Arctic plays a key role in the marine nitrogen cycle by connecting the North Pacific, an area of active denitrification, with the North Atlantic, a region of high N2 fixation. Yet, more knowledge is needed on the spatial variation of nutrient supply and N transformation processes in these highly understudied ocean basins.

We present here nutrient concentrations as well as natural abundance nitrogen (N) and oxygen (O) isotope ratios of nitrate (NO3-) and nitrous oxide (N2O) of five water column profiles sampled during the Canadian GEOTRACES expedition

in 2015, which divulge dominant N cycling processes in the central and eastern Canadian Arctic. Exceptionally low δ18O-NO3- values in the deep Baffin Bay at the eastern end of the GEOTRACES transect suggest that the NO3- in the deep basin originates predominantly from remineralization in situ. Correspondingly elevated δ15N-NO3- values indicate the remineralization of 15N-enriched organic matter, consistent with surface productivity fuelled by Pacific-derived nutrients. A pronounced N-deficit along with reduced O2 concentrations (~ 100 µmol/L-1) in the deep Baffin Bay is associated with an increase in N2O concentrations and saturation, as well as isotopic enrichment in both δ15N and δ18O of N2O, implying a sedimentary denitrification source. Coherently, the process-dependent, intramolecular site preference (SP) increases above values expected for N2O production pathways, suggesting the consumption of N2O via benthic denitrification processes. In all, the N biogeochemistry of Baffin Bay suggests that the deeper basin is poorly ventilated, and that nutrients therein are produced and modified predominantly within the basin.

Session 1810010 - POSTER SESSION - PART 1
Possible effect of the Tibetan Plateau on the “upstream” climate over West Asia, North Africa, South Europe and the North Atlantic
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Through a set of sensitivity experiments using the CESM1.2.2, this study investigates the role of surface heating over the Tibetan Plateau (TP) in the variations of the global climate. It is found that the change in the surface thermal condition of the TP significantly influences the patterns of the atmospheric circulation in its “upstream” regions over central-western Asia, Africa, southern Europe, and the North Atlantic. The atmospheric response to the TP heating is characterized by a vertical circulation, with a strong rising branch over the TP and broad subsidence further to the west. This analysis indicates a climate link between Asia and Africa and the important role played by the TP in this link. The relative contribution of the TP to the heat sources over the entire Asian Continent in influencing the African-European-Atlantic climate is also discussed.

Session 1810010 - POSTER SESSION - PART 1
Arctic sea ice monitoring using L-band Synthetic Aperture Radar
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Selection of C-band SAR (synthetic aperture radar) as the preferred microwave frequency for sea ice monitoring was made in the 1980s when the Arctic sea ice regime was different (i.e. predominantly multi-year ice [MYI]) from what it is today (i.e. predominantly first-year ice [FYI]). Moreover, during the melt season, it has been demonstrated that C-band SAR fails to exhibit necessary backscatter contrast among various ice-types that make classification difficult, compared to L-band. Thus, L-band SAR is considered as an optimal choice for sea ice monitoring in the new Arctic sea ice regime. Considering limited L-band sea ice application, this study aims to investigate the thermodynamic evolution of l-band microwave signature from snow-covered Arctic sea ice over the Canadian Arctic Archipelago using L-band ScanSAR imagery from ALOS PALSAR. Time-series microwave backscatter signatures for both FYI and MYI are explored using L-band SAR imagery in 2010.

Seasonal evolution of L-band microwave backscatter over FYI shows similarity with C-band, with lower intensity. However, this study reveals that seasonal evolution of L-band MYI signature during winter to melt transition is opposite to C-band, which certainly exhibit different scattering mechanism. L-band also demonstrates better separability among new ice types during the freeze-up period and identify ice floes more accurately during the melt season, compared to C-band. As result, L-band SAR imagery provides an opportunity to classify sea ice types in the Arctic in an efficient manner compared to the popular microwave frequencies. This will allow extracting more reliable sea ice information in Canadian water for safe navigation. The unique characteristic of L-band SAR during the thermodynamic evolution of Arctic sea ice that will be invaluable with the imminent launch of future L-band missions (e.g. SAOCOM, NISAR). This study recommends further investigation of L-band SAR interactions with sea ice compared to higher frequencies.

Session 1810010 - POSTER SESSION - PART 1
Multilevel Estuarine Circulation in the Kitimat Fjord System.
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The Kitimat Fjord system located on the west coast of Canada is a complex arrangement of waterways linking the port town of Kitimat to the deep-sea. Moored observations of water properties and dynamics collected over a three year period are used to unravel a seasonally varying multilevel circulation. The freshwater inputs from rivers at the heads of Douglas Channel and Gardner Canal as well as significant local rainfall drive the outflow on the surface. The deep sill and multiple connections to the coastal sea of Hecate Strait allow for the return estuarine flow to be variable in depth. The variability of this return flow is controlled by conditions in Hecate Strait which are subject to seasonal upwelling and downwelling regimes. When sufficiently dense water is generated in Hecate Strait in summer, the two layer estuarine circulation can move this water landward over the deep sills (~150m) into the deeper basins (~350m). As it renews the bottom water, this landward gravity current drives a middepth seaward compensatory current resulting in four layers of alternating seaward and landward flows. These circulation dynamics and the changes in water properties they induce have profound implications for the transport of contaminants. This is further complicated by the large range in ocean water density existing at this location and the unpredictability of the relative buoyancy of the contaminants, whether they will sink out of the system or find a level of neutral buoyancy in one of the layers of circulation.

Session 1810010 - POSTER SESSION - PART 1
Shallow water ray-tracing and measured channel estimation comparison
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Underwater acoustic communication is a key enabler for civilian and military applications such as ocean sampling networks, offshore exploration, pollution monitoring and underwater surveillance. Being able to understand and model the impact of time-varying environmental properties on the communication link would improve ray-tracing simulation fidelity which is currently one of the few tools available to test, analyze, and compare underwater communication schemes and performances. DalComms1 sea trials took place in the summer of 2017 in an effort to better understand the impact of the environment on the underwater

acoustic link performance, to test spread spectrum modulation techniques and to validate signal processing algorithms. The experiment was conducted on the Scotian shelf and included transmissions of channel sounding sequences, such as low frequency modulated and pseudo-random noise sequences, at ranges between one and ten kilometres. Other instruments such as an acoustic data current profiler, a conductivity-temperature-depth profiler, and a surface roughness measuring instrument complemented environmental data such as surface wind velocity, significant wave height and dominant wave period obtained from a nearby weather buoy and visual observations. The processing of the received signals allowed the extraction of important performance metrics such as estimated channel impulse responses, Doppler and delay spreads, as well as coherence times. Ray-tracing simulations through BELLHOP revealed an acceptable degree of agreement between the simulated deterministic result and the measurements. The behaviour of the underwater acoustic channel was then statistically modelled using a series of simulations with varying sound speed profiles, surface roughness, and relative motion between the source and receiver. This statistical model can be used to augment the deterministic ray-tracing simulation to provide a more realistic output. The series of simulations also allowed for the determination of the underwater acoustic channels sensitivity to a variety of environmental perturbations. The result is an increasing agreement between the models and measurements and a better understanding of the channels variability.

Session 1810010 - POSTER SESSION - PART 1
A reconstruction of Madden–Julian Oscillation variability and global connections from 1905 to 2014
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The most widely accepted characterization of the Madden–Julian oscillation (MJO) is the bivariate index developed by Wheeler and Hendon (Monthly Weather Review, 2004). This index relies in part on satellite-based observations of outgoing longwave radiation and thus is not defined for the pre-satellite era. The MJO is known to have a strong signature in surface pressure, and daily measurements of this variable are available as far back as the late nineteenth century. We present a statistical reconstruction of the Wheeler and Hendon MJO index from 1905 to 2014 based on tropical surface pressures estimated by the twentieth-century reanalysis project, with errors quantified using an ensemble of indices. The temporal and spectral properties of the reconstructed index are shown to be consistent with the Wheeler and Hendon index over the common period (the satellite era), as are known links with a number of atmospheric and oceanic variables. The long reconstructed index has been used to examine historical links between the MJO and a broad set of climate variables, as well as their joint-modulation by lower-frequency modes (ENSO, AMO, PDO): surface winds and cloud cover over the ocean (1952-2008), extreme precipitation in Australia (1905-2011), Pacific sea levels (1905-2008), global and North Atlantic tropical cyclone activity (1905-2011), wintertime air temperature in Alaska (1906-2010), snowfall and storm tracks over New England (1936-2011), and the mid-summer drought in Costa Rica (1956-2014).

Session 1810010 - POSTER SESSION - PART 1
The Fraser River plume
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The West Coast of Vancouver Island (WCVI) is an important marine ecosystem in which concentrations of dissolved oxygen can reach hypoxic levels at certain times of the year. However, although the general features of its oceanography are well understood, little is known in particular about the seasonal cycle of oxygen in shelf areas and its interannual variability. Here a 10 year time series of monthly hydrographic stations in Barkley Sound, British Columbia, is used to identify the seasonal cycle of temperature, salinity, density, dissolved oxygen, and chlorophyll fluorescence in a WCVI fjord. Analysis suggests that there is a standard estuarine circulation in surface and near-surface waters of the Sound, and a deep renewal cycle in intermediate and deep waters, and that the two are largely independent. The deep basin in the Sound undergoes annual summer renewals in response to wind-driven upwelling on the shelf, separated by stagnation and hypoxia during fall/winter/spring downwelling periods. Other than for the stagnant deep waters in winter, residence times in different parts of the Sound are only a few weeks. Barkley Sound characteristics thus adjust rapidly to shelf conditions, and inshore measurements can with care be used as a proxy for some shelf properties. However, phytoplankton biomass does not appear to be affected by the onset of deep renewal and the associated reversal of along-shore winds, and instead responds to local factors. Finally, once the seasonal cycle is accounted for, interannual variations in temperature, density, and dissolved oxygen are uncoupled, possibly in response to longer-term changes in the characteristics of source waters offshore and/or to changes in shelf processes.

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Recent Changes in Sea Ice Thickness and Mixed-Layer Depth in Baffin Bay and the Labrador Sea

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The interannual variability of sea ice thickness in Baffin Bay is examined using CryoSat-2 data collected in 2011-2017. For validation of the Cryosat data, they were compared with ice draft measurements collected with Upward-Looking Sonar (ULS) moorings in western Davis Strait in 2012-2013. Ice thicknesses from both Cryosat and ULS moorings were higher in 2012 than in 2013. However, larger magnitudes were obtained from the ULS moorings than from Cryosat, probably due in large part to the close proximity of the mooring to the coast. Sea ice drifts south through Davis Strait and melts over the continental shelf and in the Labrador Sea, so that it can affect surface salinity and mixed-layer depth in the area, where deep convection is important. The interannual variability of late-winter mixed-layer depth in the Labrador Sea is examined using a dataset derived from Argo profiling floats, and the spatial variability is compared with sea ice distribution provided on Canadian and Danish ice charts. Baffin Bay sea ice thickness, Labrador Sea ice area, and mixed-layer depth variability are all strongly associated with the North Atlantic Oscillation.

Session 1810010 - POSTER SESSION - PART 1

The role of wind-driven gyres on mitigating North Atlantic heat uptake in response to a global warming perturbation

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By absorbing more heat than the other components of the climate system, the ocean plays an important role in delaying global warming. This ocean heat uptake is not uniform in space, as it is influenced by the meridional overturning circulation (MOC). For example, most GCMs show a delayed warming (and even cooling) of the North Atlantic sea surface temperature in response to a warming perturbation. Since this is not observed in the North Pacific, the delayed warming of the North Atlantic has been attributed to the rapid shoaling and weakening of the Atlantic MOC (upper cell). Here, a series of idealized OGCM experiments is used to show that this delayed warming may be linked to rearrangements of the subpolar gyre, rather than the weakening of the MOC. Experiments are first performed in a single basin configuration, covering both hemispheres. The strength of the upper cell of the MOC is controlled by opening and closing a circumpolar channel to the south. Comparison between the two configurations show that the pattern of northern delayed warming is robust to large variations of the MOCs upper cell strength, but varies widely in response to the northern hemisphere winds, suggesting a subpolar gyre control on the anomaly. To test this hypothesis, experiments are also performed in a global ocean configuration with realistic geometry. Starting from a control experiment where delayed warming occurs in the North Atlantic only, simulations are performed with modified geometry in the North Pacific and North Atlantic basins. Results show that the delayed warming can be observed in both basins, and scales with the strength of the subpolar gyre rather than the strength of the MOC.

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Quantifying source and sink processes for a passive tracer model of Mn, Ga, and Pb in the Canadian Arctic Archipelago

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Changing freshwater and tracer fluxes in the Canadian Arctic Archipelago are a result of permafrost thawing, glacial melt, reduction in sea-ice, and cryogenic weathering processes, among others. These changes may have cascading effects on the biogeochemistry and circulation patterns of the Archipelago and through that the Atlantic Ocean. The Canadian GEOTRACES program provided measurements of tracers across the Archipelago. This study aims to parameterise the processes involved in the biogeochemical cycling of manganese, gallium, and lead in the region, with a focus on the impacts of terrestrial, cryosphere, and oceanographic processes using the observations as a guide. Although tracer distributions likely vary with seasonal processes such as sea-ice melt and formation, the effects of these factors are unknown and a single transect cannot resolve them. We are developing an offline tracer model driven by a three-dimensional 1/12 degree model of the Archipelago. This model of water mass tracers will provide a new way to study changes in river runoff, sea-ice melt, scavenging, and atmospheric processes, as well as the potential implications these changes may have for the circulation patterns and biogeochemical cycling in the Archipelago. We present parameterisations of tracer concentrations in Archipelago rivers that incorporate seasonality, reversible scavenging, and a one-dimensional model of the release and incorporation of tracers from sea and land-fast ice into the ocean.

Session 1810010 - POSTER SESSION - PART 1
Post-processing techniques for automated precipitation gauge time series
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Data retrieved from current automated accumulating precipitation gauges are inherently noisy. These instruments are susceptible to mechanical and electrical interference related to the measurement principle, signal transmission, and the measurement environment. For example, noise in the bucket weight measurements of many accumulating precipitation gauge types can be caused by wind vibration of the infrastructure, diurnal heating of the sensor, and electrical transients due to improper grounding. This noise, combined with data features associated with evaporation from the bucket and gauge servicing, complicates the automated derivation of sub-daily precipitation estimates. This study presents and tests three automated or semi-automated processing techniques for the derivation of ‘clean’ precipitation time series from high frequency gauge bucket weight measurements. The techniques include the current MSC operational algorithm, the previously published “Brute Force” filter, and the “Brute Force Supervised” filter. The behaviour of each filter is discussed in the context of case studies, which indicate the merits and drawbacks of each processing technique.

Session 1810010 - POSTER SESSION - PART 1
Winter Far InfraRed Measurements in the High Arctic
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During the polar night, the majority of earth emission to space occurs in the Far InfraRed (FIR) (λ>15μm). Below 10 mm of column integrated water vapour (WV) the atmosphere becomes partially transparent in this spectral range, extending the atmospheric window to longer wavelength. Small variations of WV content can thus lead to strong variations of the transmittance of the atmosphere, impacting its cooling rate and the water vapour greenhouse effect. This is especially true in the Arctic since more than 50% of atmospheric cooling occurs in the FIR. Furthermore, remote sensing observations from CALIPSO and CloudSat satellites over the Arctic have enlighten the ubiquity of optically thin ice clouds (TIC). Those clouds act as effective radiators through the whole troposphere and their formation process is still poorly understood.

Theoretical work has shown the added value of FIR measurements for WV and TIC optical properties retrieval. Even so there is currently no spaceborne instrument performing spectrally resolved measurements in the FIR. The TICFIRE (Thin ice cloud in the far infrared experiment) satellite project aims to fill this gap.

Here we present the results of the first ground experiments using a breadboard of the satellite, the Far InfraRed Radiometer (FIRR). It measured downwelling radiance at Eureka, NU. The FIRR uses an array of uncooled microbolometers to measure radiance in 9 spectral channels spanning from 8 - 50 μm. The emission of the atmosphere in this spectral region is extremely sensitive to its WV content and the effective diameter of TIC ice crystals. By comparing these measurements with the E-AERI, a FTIR, and a radiative transfers model, we assess the radiative accuracy of this new technology as well as its sensitivity to the state of the

atmosphere. Preliminary results show that the FIRR is able to distinguish between the two types of TIC and to retrieve the total WV column.

Session 1810010 - POSTER SESSION - PART 1
Mixing rates and heat fluxes in the southeastern Beaufort Sea from oceanic turbulence observations
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We use new coincident measurements of shear and temperature variance from the southeastern Beaufort Sea to study oceanic dissipation rates, mixing, and heat fluxes. We focus on the warm halocline sequestering warm Atlantic-sourced water from shallower, colder Pacific-sourced water. Direct measurements of turbulence in the Arctic Ocean are rare but critically important because they are needed to constrain and validate parameterizations for vertical mixing rates in ocean and climate models. Our measurements are from 348 ocean glider profiles in the Amundsen Gulf and comprise one of the densest microstructure data sets in the Arctic to date, allowing us to create true statistical measures of the microstructure fields. We observe that turbulent mixing rates vary over more than four orders of magnitude in the study region, and we examine dynamic features that contribute to this variability. However, we find that the stabilizing effects of stratification dominate the vertical mixing and that averaged vertical heat fluxes are always small despite the presence of energetic dynamic features.

Session 1810010 - POSTER SESSION - PART 1
A new extrema-diminishing, density-preserving neutral diffusion scheme
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The turbulent mixing of tracers by the mesoscale eddy field along neutral directions is commonly parameterised as a form of lateral diffusion in general circulation models. With the notable exception of isopycnal-coordinate models, neutrally buoyant directions and the models native surfaces are not parallel and so epineutral diffusive fluxes are calculated by rotating the diffusion operator. However, this approach has some drawbacks in that it cannot be made positive definite (thus leading to the development of new extrema) nd slopes must be limited in regions of weak vertical gradients for numerical stability. Here we present a new non-local, neutral diffusion scheme that is positive definite and appropriate to use in a variety of vertical coordinates. In brief, polynomial reconstructions of temperature and salinity are used to construct sublayers bounded by neutral surfaces. Then, diffusive fluxes are calculated along these sublayers using a simple down-gradient diffusion operator. Finally, a small number of flux limiters are applied to prevent changes in buoyancy and vertical diffusion. The numerical aspects of this scheme are demonstrated using a series of idealized test cases using linear and nonlinear equations of state in GFDLs MOM6. A version of NEMO 3.4 is used to compare the effects on global ocean state and computational cost between our scheme and the traditional rotated tensor approach.

Session 1810010 - POSTER SESSION - PART 1
Monitoring biogeochemical properties of a mesoscale anticyclonic eddy off the Scotian Shelf using glider data
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Dalhousie Universitys glider group, with support from the Ocean Tracking Network and the Marine Environmental Observation Prediction and Response Network, flew a series of missions beginning in 2011 with Teledyne Webb Slocum gliders along the Halifax Line, a series of stations stretching off the Halifax Harbour, to past the edge of the Scotian Shelf. These gliders, designed to dive to 200m, were equipped to measure temperature, conductivity, oxygen concentration, downwelling irradiance, fluorescence from chlorophyll and coloured dissolved organic matter, and optical particle backscattering. During one mission a glider encountered a warm-core ring at the edge of the shelf break that had spun off from the Gulf Stream during the summer of 2012. The ring was characterized by warmer temperatures, higher sea-surface height, and lower chlorophyll fluorescence. The glider detected decreased chlorophyll layer thickness, lower vertical attenuation coefficients (412, 443, and 555 nm), and a deeper mixed layer depth when comparing 3-day averages before, during, and after the glider entered the mesoscale eddy. Estimates of phytoplankton growth rates and biomass accumulation rates as determined by diel changes in particle backscatter show a difference between the cooler shelf waters and the warmer eddy waters. This study shows that gliders are a reliable and cost-effective instrument that can be used for determining coastal mesoscale dynamics.

Session 1810010 - POSTER SESSION - PART 1
Simulation of wave-current interactions under hurricane conditions using an unstructured grid model: Impacts on ocean waves
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The effect of wave-current interactions on ocean waves under hurricane conditions is investigated through application of the unstructured-grid finite-volume community ocean model (FVCOM) coupled to the unstructured-grid surface wave model (SWAVE) in the North Atlantic Ocean. We study wave-current interactions during the life cycles of extratropical hurricanes Juan (2003) and Bill (2009) as they propagate from subtropical waters to mid-latitudes in the Northwest Atlantic. Simulations of ocean wave parameters in each hurricane are shown to compare well with buoy and satellite altimeter observations, in terms of winds, significant wave heights, wave energy spectra and wave directions. This is partially achieved by restricting the drag coefficient. It is well known that the maximum intensity of tropical cyclones depends on the ratio of the enthalpy coefficient to the drag coefficient. The latter increases with wind speed, levels off with category one hurricanes and may drop for even higher winds. In our study we find that setting a limiting value on drag coefficient improves the simulations ocean waves at peak storm intensities. Simulation of wave-current interactions is also shown to improve the simulation of the wave heights and wave energy spectra. This is notable at the peak of the storms, in comparisons with the observations from buoys in areas of both deep and relatively shallow water. The effect of currents on significant wave heights is shown to reach 0.4 m for hurricane Juan and 1.0 m for hurricane Bill, or as much as about 10% for wave heights distributed along the storm track.

Session 1810010 - POSTER SESSION - PART 1
Improving ocean surface drift models
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Surface drift forecasts constitute critically important information for a large number of marine operations. The error associated with these forecasts comes from many sources, a significant part of it coming from the poor representation of the ocean's surface dynamics, where the mean eulerian current interact non-linearly with surface gravity waves generated by the wind. Here we present simulations of trajectories from several drift models compared with O10^5 data points obtained from drifting buoys deployed in 2014-2015 in the Gulf of St. Lawrence (GSL) in order to better constrain the error and hopefully improve drift models. Drift models use mean eulerian currents provided by ISMER's GSL-5km and STLE-400m models forced by RDPS winds, which are also used to account for windage. Wave forcing is obtained from the WAVEWATCHIII model ran on a 5-km resolution grid over the GSL and forced by the same winds. We explore how i) including explicitly the Stokes drift and ii) extrapolating the vertically sheared horizontal current leads to error reduction and find that both effects, when taken into account, significantly improve the performance of the traditionally used leeway eulerian drift model.

Session 1810010 - POSTER SESSION - PART 1
The Impact of Internal Tide Mixing Parameterizations in an Eddy-Permitting Model of the Arctic Ocean
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In this study we consider the impact of enhanced mixing due to the breaking of internal tides on the vertial diffusivity strength and distribution, and resulting changes to the model state in the Arctic Ocean. Specifically, we quantify the impact of including an additional parameterization of mixing due to the breaking of internal tides in a regional Arctic and Northern Hemisphere Atlantic (ANHA) configuration of the NEMO model at ¼ degree resolution. Two model runs including enhanced tidal mixing parameterizations, each with different vertical dissipation profiles based on Polzin (2009) and St Laurent et al. (2001) respectively, as well as a control run without the additional parameterization, are compared quantitatively. The unique, low energy, and highly stratified environment of the Arctic Ocean requires special consideration when including tidal mixing in a courser resolution numerical model. We find that many important processes in the Arctic are impacted by the type of tidal mixing parameterization used in this region. Atlantic and Pacific water masses, surface circulation patterns, sea ice concentration, heat and freshwater content, and volume, heat and freshwater fluxes through the Canadian Arctic Archipelago, are all impacted by the choice of internal tide mixing parameterization used in the Arctic region.

Session 1810010 - POSTER SESSION - PART 1
The climatology of seiche-inducing winds in a large intermontaine lake: Quesnel Lake, British Columbia, Canada
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Episodic winds throughout the multiple intersecting valleys surrounding Quesnel Lake, British Columbia, have been shown to excite both barotropic and baroclinic wave modes within this morphometrically complex lake. However, the seasonal nature of such episodes, and the synoptic forcing for winds observed at the lakes surface, are poorly understood. We present research investigating winds on, and surrounding, Quesnel Lake. This deep, glacial formed, fjord-type lake nestles into the eastern flank of the Cariboo Mountains and the resulting complex geometry

of both topography and basin contributes to a complicated seiche response to wind forcing.

Primarily, synoptic climatology methods are utilized to produce a wind climatology for Quesnel Lake, improving the current understanding of the basins wind seasons, regional winds, and the synoptic connections to the near-surface wind field. Secondly, we begin an examination of the spatial variability of the near-surface wind field, with an outlook to future modelling of the wind forcing required to induce basin-scale processes within the lake.

The Northern Hydrometeorology Groups Cariboo Alpine Mesonet (CAMnet) array of weather stations provides the bulk of the near-surface meteorological data from locations at Lake level (728 m a.s.l), and in the nearby Cariboo Mountains (up to 2105 m a.s.l). Synoptic-scale gridded datasets are obtained from the National Oceanic and Atmospheric Administrations North American Regional Reanalysis (NARR).

Preliminary results include the resolving of prevailing wind conditions recorded along the southern shore of Quesnel Lakes main basin, and a positive correlation between wind data from multiple locations within the region. Research continues towards a complete synoptic-to-microscale analysis of the wind field along all three arms of this pristine sub-alpine lake.

Session 1810010 - POSTER SESSION - PART 1

A new rooftop atmospheric observatory at Saint Mary's University, Halifax, Canada

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A mobile open-path Fourier Transform InfraRed (OP-FTIR) remote sensing system has been deployed in numerous field campaigns in the Halifax area since 2015, e.g., sampling shipping, vehicle, biogenic and indoor environment emissions. Equipped with an active IR source and a retroreflector that is typically placed ~200-500 meters away in the monostatic configuration, the system is sensitive to the path average atmospheric column oriented horizontally in the planetary boundary layer. The atmospheric path is well defined spatially and bridges the spatial scales of in situ point measurements on one hand and space-based satellite measurements on the other. Another major advantage of an active source system is that measurements are possible during both sunny and cloudy – as well as moderately foggy and rainy – atmospheric conditions, during both day and night. With detector sensitivity between 700 cm-1 and 5000 cm-1, the system detects absorptions of a number of atmospheric trace gases and greenhouse gases (GHGs) relevant to air quality (AQ) and climate change, e.g., O3, NO2, CO, CH4, CO2, N2O, NH3, HCHO, CH3OH and other VOCs. Spectra can be recorded at up to 5 Hz, but are typically obtained from first co-averaging 240 interferograms over ~1 minute at 0.5 cm-1 resolution.

The mobile system is being prepared for continuous deployment (apart from targeted field campaigns) at Saint Mary's University (SMU) within a rooftop atmospheric observatory currently under construction on campus. The observatory will become central to the Tropospheric Remote Sensing Laboratory at SMU, and it will serve as a host site for complementary "guest" trace gas and aerosol measurements, both campaign-based and longer term, as appropriate.

The observatory design will be presented, along with sample OP-FTIR capabilities and long-term facility research goals.

Session 1810010 - POSTER SESSION - PART 1
WSOK – a weather station on a kite or tethered balloon
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Profiling of temperature, humidity and winds through the atmospheric boundary layer up to heights of order 1 km can be done in many ways but a simple, inexpensive, light weight package for rapid deployment has enormous potential for field projects. Lidar wind profilers and radiometers for temperature and humidity profiles are costly, as are ground stations for radiosonde packages, so the development of a simple, easy to deploy WSOK, based on an Arduino or Raspberry Pi device seemed worthwhile.

Our initial system is based on the Sparkfun variant of the Arduino Fio system with the MEMS sensor package, based on a Bosch Sensortec BME 280 Integrated Environmental Unit measuring Temperature, Humidity and Pressure. In a small enclosure (2cm x 4cm x 5 cm) we can add data storage, radio communication, batteries etc. and keep weight to a minimal level to be easily lifted by a small helium filled tethered pilot balloon, a suitable, stable sled or box kite or possibly an Allsopp Helikite (http://www.allsopp.co.uk/). The latter could be the most appealing for launch and recovery in high winds (15 ms-1) at sea and for profiling to heights of order 500m.

A basic package has been developed and is currently being tested. Initial profiles will be presented.

Session 1810010 - POSTER SESSION - PART 1
Variability of Anthropogenic Carbon Dioxide in the Labrador Sea between 1986 and 2016

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The past five to six years have seen rapid advances in the field of artificial intelligence coupled with big data. Improved algorithms developed largely in Canada in the late nineties and in the 2000s have been leveraged by fast graphical computer chips and huge amounts of data from companies like Google and Facebook; to the point where they now perform better at visual facial recognition than humans themselves. The same deep learning / neural network techniques are now being applied to a wide range of fields and significantly reducing human intervention. The fields of meteorology and oceanography are good candidates to apply these techniques towards realizing improvements and new developments, thanks to the vast amounts of data observed and generated.

In part I of our AI and Big Data sessions, Prof. Trappenberg from the Faculty of Computer Science of Dalhousie University will give a little overview of machine learning techniques, including Deep Learning, with an emphasis on demystifying those techniques and explaining when they are good or bad. Since most people attending the conference will mostly have heard about some of those AI techniques, without necessarily having an in-depth knowledge in them, this mini workshop aims to give enough intuitive, graphic understanding of AI and Deep

Learning so that researchers can better see what technique(s) might be most appropriate to apply to their work or to think about potential projects.

The first 60 minutes of the workshop will explain AI and Deep Learning techniques and the next 30 minutes will be interactive, with attendees having the opportunity to ask a renowned expert in the field very detailed questions with regards to on their own AI project or on how to start one. Every attendee will benefit from the experiences and questions of others.

Session 1810010 - POSTER SESSION - PART 1
Multi-year warm season ice probability maps in the Canadian Arctic coastal zone from MODIS and VIIRS
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Coastal zone ice is a very important phenomenon that affects coastline dynamics by changing the effective rate of the wave and wind erosion. It alters the shallow seabed disturbance and sediment transport regime. It is also an important factor that affects sea transportation and accessibility in remote regions. Quantitative information about the distribution of coastal zone ice is required to better understand the changes in the dynamics of land and ocean ice conditions associated with climatic changes.

In this study, we utilized the 18-year record (2000-2017) of warm season (April-September) snow/ice probability maps derived at the Canada Centre for Remote Sensing (CCRS) from Moderate Resolution Imaging Spectroradiometer (MODIS) and Visible Infrared Imaging Radiometer Suite (VIIRS) at 250m spatial resolution (https://open.canada.ca/data/en/dataset/808b84a1-6356-4103-a8e9-db46d5c20fcf). The fraction of coastal zone area with permanent presence of ice (i.e. probability ~ 100%) and ice–free conditions (probability <20%) has been evaluated as a function of distance from the shoreline for the entire Canadian Arctic Archipelago ocean waters. We found that the fraction of ice–covered coastal zone during the warm season could vary from 3-5% to 35-40% depending on climate conditions during specific years and the distance from the shoreline. Despite substantial year-to-year variations, our analysis showed the presence of systematic negative (positive) trends in the ice (ice-free) multi-year time series and their correlation with regional mean surface temperatures taken from ERA and NARR reanalysis data.

References:

A.P.Trishchenko and S. Wang, 2018: Variations of climate, surface energy budget and minimum snow/ice extent over Canadian Arctic landmass for 2000-2016. Journal of Climate, vol. 31, no. 3, pp.1155-1172. doi: https://doi.org/10.1175/JCLI-D-17-0198.1.

Trishchenko, A.P., S. Leblanc, S. Wang, J. Li, C. Ungureanu, Y. Lu, K.V. Khlopenkov, and F. Fontana, 2016: Variations of annual minimum snow and ice extent over Canada and neighboring landmass derived from MODIS 250 m imagery for 2000-2014 period, Canadian Journal of Remote Sensing, 42(3), pp. 214-242. doi:10.1080/07038992.2016.1166043.

Session 1810010 - POSTER SESSION - PART 1

Characterization of the Anisotropy of Coherent Mesoscale Eddies

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Coherent mesoscale eddies play an important role in ocean circulation through their transport and mixing of both dynamical and passive tracers. Since the early 1990s, eddy detection and characterization on a global scale based on sea level anomaly (SLA) data has been feasible, but until recently eddy detection algorithms (e.g. Chelton et al. 2011) have identified coherent mesoscale features using isotropic assumptions. In 2015 Faghmous et al. published the OpenEddy database, which characterizes coherent mesoscale eddies larger than 1 deg2 between 1993 and 2014 on a daily timescale. This dataset provides a unique opportunity to quantify the anisotropy of the coherent eddies identified.

In this work, we characterize the statistical distribution of anisotropy of the ~45 million mesoscale features identified in the Open Eddy database. Further we look for unique patterns of this distribution as a function of geographical region, time, and dynamical regime. By characterizing the nature and distribution of eddy anisotropy in both space and time, a more complete understanding of the global and local effects of eddy anisotropy can be formed. Understanding patterns in the anisotropy of coherent mesoscale eddies is an important step in the development of strategy for the parameterization of these features.

REFERENCES:

Chelton, D., M/ Schlax & R. Samelson (2011). Global observations of nonlinear mesoscale eddies. Prog. Oceanogr. 334, 328–332.

Faghmous, J. H. et al. (2015). A daily global mesoscale ocean eddy dataset from satellite altimetry. Sci. Data 2:150028.

Session 1810010 - POSTER SESSION - PART 1

A numerical study on dispersion properties in Saint John Harbour

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The horizontal dispersion, referred to the local spreading of a patch of fluid to adjacent areas, is a key transport process in physical and biological oceanography because of the wide range of related phenomena, such as the transport of water, dispersal of fish larvae, the spreading of suspended sediment and nutrients, and pollutants and oil spills. The mechanism of the dispersion is usually complicated because the flows are usually featured with strong spatial and temporal variations, caused by various forces, such as wind stress, freshwater input, density gradient and tides, and in estuary waters, the flows are further complicated by the abrupt changes in local geometry and bathymetry. In the present study, the dispersion properties in the Saint John harbor have been investigated using a hydrodynamic model with a high horizontal resolution (~ 10m) based on the Finite Volume Community Ocean Model (FVCOM). The model was evaluated against the surface drifter data and good agreement was obtained. Using the model, the specific contribution of the dispersion due to tides and river discharge are analyzed.

Session 1810010 - POSTER SESSION - PART 1

Monitoring Deep Ocean Hydrographic Variability off Atlantic Canada

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Subannual oceanographic variability in the in the Labrador Sea and over the Scotian Slope and Rise is described and interpreted based on the annual ship surveys of DFO's Atlantic Zone Off-Shelf Monitoring Program (AZOMP), Argo float, moored and remote sensing data, complementary atmospheric datasets and ocean model simulations.

The Labrador Sea is the primary location for the ventilation of the Atlantic Oceans intermediate-depth waters that occurs through winter cooling, densification, convection and associated sinking of surface water to depths of 500-2500 m (depending on winter severity). Through above-average cumulative atmospheric cooling during 2012-2017, winter convection depths progressively increased to 2100 m in 2016 and 2017. As a result, the volume of recently-ventilated Labrador Sea Water (LSW) is the largest since the record volume observed in the early 1990s, and potentially the second largest since 1938. This recent increase in LSW production, during a positive phase of the winter North Atlantic Oscillation (NAO), resembles that observed during the 1987-1994 formation of the record depth (2500 m) LSW, with sustained positive NAO forcing providing critical preconditioning in both cases. As a result of this intermittent recurrence of intensified LSW formation, the annual average temperature and density in the regions upper 2000 m have predominantly varied on a bi-decadal time scale, rather than having a long-term trend as expected from anthropogenic climate change.

These results have potential implications for broader-scale changes in heat content and other oceanographic variables in the North Atlantic, and for the Atlantic Meridional Overturning Circulation and its regulation of global climate variability.

We also discuss recent variability in the Slope Water off Nova Scotia, and the competing influences of the advection of subpolar water from upstream and of the warming Gulf Stream. Finally, we use numerical model simulations to study the processes associated with LSW variability and its broader-scale influences.

Session 1810010 - POSTER SESSION - PART 1

Linking the wintertime surface temperatures over North Asia and North America by the Asian-Bering-North American pattern

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The surface temperature variance and its potential change with global warming are most prominent in winter over Northern Hemisphere mid-high latitudes. Consistent wintertime surface temperature variability has been observed over large areas in Eurasia and North America on a broad range of time scales. However, it remains a challenge to quantify where and how the coherent change of temperature anomalies occurs over the two continents. Here we demonstrate the coherent change of wintertime surface temperature anomalies over North Asia and the central-eastern parts of North America. This is supported by the results from the empirical orthogonal function analysis of surface temperature and temperature trend anomalies over the Northern Hemisphere extratropical lands and the timeseries analysis of the regional averaged temperature

anomalies over North Asia and the Great Plains and Great Lakes. The Asian-Bering-North American (ABNA) teleconnection provides a pathway to connect the regional temperature anomalies over the two continents. The ABNA is also responsible for the decadal variation of the temperature relationship between North Asia and North America.

Session 1810010 - POSTER SESSION - PART 1
Spatiotemporal Distribution of Infragravity Waves and Its Influence on Wide-swath Altimeter Signal
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Infragravity waves are surface gravity waves with lower frequency (0.005-0.05 Hz) than wind-sea and swell and longer wavelengths (about 10km). Most of them are generated in the coastal areas and then radiate into the open ocean. The future high-resolution wide-swath altimeter SWOT (Surface Water and Ocean Topography) mission will capture the signal of infragravity waves with horizontal scales down to 10km. Thus, the Infragravity waves will often be an important error source in the surface currents obtained by SWOT. Here, we used simulations from a numerical model for global infragravity waves, combined with bottom pressure records from DART stations (Deep ocean Assessment and Reporting of Tsunami), to investigate the detailed spatial and temporal evolution of the global infragravity waves. Two locations with strong infragravity wave energy are the Northeast Pacific and the Northwest European Shelf. These areas are studied, where the sea surface elevation contributions by infragravity waves are on the order of 1cm and therefore cannot be ignored in SWOT surface current measurements. By comparisons with the total orbital error estimated by the SWOT Simulator (±5cm), it is found that the contributions of the winter infragravity waves to sea surface elevation can reach 25% of the initial requirement for the noise level for SWOT in Northwest European Shelf. For the narrow continental shelf off the US West coast, infragravity waves are generated along shorelines and quickly spread into the Deep Ocean, causing significant noise effects over a broader area, accounting for about 15% of the initial error level of SWOT. Key words: Infragravity waves, wide-swath altimeter, submeso-scale ocean circulation.

Session 1810010 - POSTER SESSION - PART 1
Sensitivity of Idealized Squall Line Simulation to Resolution and Subgrid Turbulence Mixing
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In this project, the sensitivity of idealized squall line simulation to horizontal grid spacing and turbulent mixing parameterization will be discussed. Inconsistent results from numerical simulations of convective system have suggested that there are issues with the behavior of the subgrid turbulent mixing parameterizations with increasing resolution that still need to be resolved. The Weather Research and Forecasting Model (WRF) will be used to perform large eddy simulations of idealized squall line with horizontal grid spacing of 4 km, 1 km, 500 m and 250 m. A common background sounding profile is used so that simulations from this project can also be used to compare with some studies in the community. The dependence of various squall line characteristics on resolution, including cloud top height and mass flux, turbulence kinetic energy and energy spectra will be discussed. In particular, 4 km grid spacing is not

recommended as it contains an unreasonable amount of subgrid turbulence kinetic energy and it is not enough to resolve some of the large energy containing eddies in a idealized squall line simulation.

Session 1810011 - POSTER SESSION - PART 2
Evaluation and Collaboration: SalishSeaCast and the SMELT Ecosystem Model

Session 1810011 - POSTER SESSION - PART 2
A rugged, flow-through, underway, biogeochemical measurement system which can be certified for installation on Volunteering Observing Ships.
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Volunteer Observing Ships (VOS) can support widespread, regular measurement of biological, chemical and physical properties in the oceanic surface layer and overlying atmosphere. They have become the main platform for measurement of the air-sea CO2 partial pressure difference (ΔpCO2) to constrain global assessments of CO2 sources and sinks. VOS are underutilized, however, relative to their potential in part because of the complexity of existin biogeochemical measurement systems. These can involve large-volume, gas equilibrators, analyzers, complex plumbing and multiple gas cylinders used for calibration. Such systems can be difficult to install in vessels with limited space and where certification of installations by marine classification societies is required. Here, we present a rugged, simplified approach to multiparameter, underway measurement based around compact, easy-to-maintain, flow-through chambers housing multiple sensors for physical (temperature, salinity), chemical (pCO2 and pO2) and bio-optical parameters. Expansion to additional measurement systems (e.g. for plankton identification) is possible. Key features include use of copper-containing piping to reduce biofouling and use of dissolved gas sensors in place of analyzers. The chamber-based system was recently installed, and certified by DNV GL, for use on a commercial, offshore support vessel (Atlantic Condor) operating off Nova Scotia. Introduction of new measurement systems requires rigorous demonstration that data quality is not compromised. We will present results from two trans-Atlantic crossings aboard the Irish research vessel Celtic Explorer which allowed detailed performance evaluation relative to two, gas-analyzer-based systems. We will also present a performance assessment based on multiple repeat transects across the Scotian Shelf, conducted on Atlantic Condor since summer, 2017.

Session 1810011 - POSTER SESSION - PART 2
The role of ocean heat fluxes on rapid sea ice declines in the Community Earth System Model Large Ensemble
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A significant decrease in the minimum sea ice extent (SIE) has been observed since the beginning of the satellite era in the late seventies. It has been shown in the Community Climate System Model version 3 (CCSM3) that rapid sea ice declines leading to a seasonally ice free Arctic were linked to pulses of ocean heat transport (Holland et al, 2006). In this study, we use output diagnostics from the RCP8.5 runs of the Community Earth System Model Large Ensemble (CESM-LE) to verify if the ocean heat fluxes pathway (whether they enter the

Arctic through the Fram Strait, the Bering Strait or the Barents Sea Gate) has an impact on the presence of rapid sea ice declines. All the rapid declines of the Arctic minimum SIE in the CESM-LE are thermodynamically driven. Around 70% of the rapid declines in the model are linked to anomalous ocean heat flux. It is primarily over the shelves seas that the advective ocean heat fluxes interact with the sea ice cover and can trigger rapid declines. The Bering Strait ocean heat flux is responsible for more rapid sea ice declines than the Barents Sea Gate ocean heat flux even if it is smaller, presumably because the Eurasian shelf area where these interactions take place is larger. No clear link is found between the rapid sea ice declines and the Fram Strait ocean heat flux. Rapid declines that happens earlier in the simulations when the SIE is larger are more likely to be linked with ocean heat flux. As the ice cap gets smaller, rapid declines are more linked to the ice-atmosphere heat flux and the ice-albedo feedback.

Session 1810011 - POSTER SESSION - PART 2
Time Series of Ocean Acidification in the Canadian Arctic Ocean
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Ocean acidification is an important yet often disregarded outcome of anthropogenic carbon dioxide (CO_2) emissions and the consequent rise in atmospheric CO_2 levels. Roughly a third of the CO_2 released to the atmosphere since the industrial revolution has been absorbed by the world's oceans, resulting in a decrease in seawater pH, carbonate ion concentration and saturation state of seawater with respect to the calcium carbonate minerals aragonite and calcite (ΩA, ΩC). These changes in seawater chemistry constitute a possible threat for the health of marine ecosystems, particularly to calcifying organisms whose ability to secrete calcium carbonate skeletons and tests might be hindered by a decrease in pH and Ω. The Arctic Ocean is particularly vulnerable to acidification due to the weak buffer capacity of its cold waters and its steadily melting sea-ice cover, exposing a gradually larger area of surface waters to freshening and gas exchange with the atmosphere.

An oceanographic dataset covering the Canadian Arctic Archipelago and its adjacent basins (Beaufort Sea and Baffin Bay) is used to construct time series of key acidification parameters spanning the last 15 years. These time series exhibit a large spatial and seasonal variability, exacerbating the difficulty in isolating an anthropogenic acidification signal. Nonetheless, significant surface and sub-surface undersaturation of seawater with respect to aragonite is observed throughout the studied time period. These results, combined with a water mass analysis, are used to constrain the extent of acidification in the Canadian Arctic Ocean as well as factors that modulate it.

Session 1810011 - POSTER SESSION - PART 2
Improved sea ice drift estimates in Lagrangian methods for sea ice forecasting
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We have recently developed a Lagrangian Ice Tracking System (LITS) for the Arctic Ocean. The LITS tracks motion of sea ice in a Lagrangian framework using sea ice drifts. It has been used to develop a seasonal forecasting model of the minimum sea ice extent (Williams et al. 2016) based on observational drifts. In continuity, we are working on the seasonal predictability of the sea ice system on a regional scale (Brunette et al. 2018 - in preparation). The current version of the

LITS uses the Polar Pathfinder sea ice motion vectors (V3, Tschudi et al. 2016). However, the raw drift vectors used to construct Polar Pathfinder contain biases. The satellite-derived velocities (from SMMR, SSM/I, AMSRE, AVHRR) and free drift estimates present a low bias when compared to the buoy drift observations, taken to be essentially true. Biases are larger in the summer, when fewer satellite-derived drifts are available and the composite sea ice drift relies more heavily on the free drift estimates. While being useful for climatic studies and model validation (Sumata, 2015), the issues found in Polar Pathfinder become more apparent when building a regional forecasting model. We propose to recompile a new optimally interpolated sea ice drift dataset, using bias-corrected and error-weighted raw drift vectors from Polar Pathfinder, buoy data, free drift estimates derived from reanalyses, and other available satellite-derived drifts. Preliminary results and analysis of the spatial and temporal distribution of errors in the observational sea ice drift products will be presented.

Session 1810011 - POSTER SESSION - PART 2
New Time- and Space-Synchronized Flux, Weather, Soil and Optical Sensor Network
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Many hundreds of flux stations are presently operational as standalone projects and as parts of regional networks. Many have weather and soil data to help clean, analyze and interpret the flux data. However, the vast majority do not have optical proximal sensor measurements, do not allow straightforward coupling with remote sensing (drone, aircraft, satellite, etc.) data, and cannot be easily used for validation of remotely sensed products, ecosystem modeling, or upscaling from the field to regional and global levels.

In 2016-2018, new tools to collect, process, analyze and share time-synchronized flux data from multiple flux stations were developed and deployed globally. Originally designed to automate site and data management and streamline flux data analysis, these tools allow relatively easy matching of tower data with remote sensing data:

1. GPS-driven PTP protocol synchronizes instrumentation within the station, different stations with each other, and all of these to remote sensing data to precisely align remote sensing and flux data in time

2. Footprint size and coordinates computed and stored with flux data help correctly align tower flux footprints and drone, aircraft or satellite motion to precisely align optical and flux data in space

3. Sophisticated interactive data analysis software allows to clean, gap fill and analyze the flux and all the supporting data in a fast and efficient manner

4. Full snapshot of the remote sensing pixel can then be constructed, including leaf-level, ground-based optical sensor, and flux tower measurements from the same footprint area, closely coupled with the remote sensing measurements to help interpret remote sensing data, validate models, and improve upscaling

Additionally, current flux stations can be augmented with advanced ground-based optical sensors and can use standard routines to deliver continuous products (e.g. SIF, PRI, NDVI, etc.) based on automated field spectrometers and other optical systems.

Session 1810011 - POSTER SESSION - PART 2
Verification of sea-ice prediction by using distance measures
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Sea-ice is characterized by a coherent spatial structure, with sharp discontinuities and linear features (e.g. leads and ridges), the presence of spatial features, and a multi-scale spatial structure (e.g. agglomerates of floes of different sizes). Traditional point-by-point verification approaches do not account for this complex spatial structure and the intrinsic spatial correlation existing between nearby grid-points. This leads to issues (such as double penalties), and an overall limited diagnostic power (e.g. traditional scores are insensitive to distance errors).

This work explores the use of binary image distance measures of the Hausdorff and Baddeley family for the verification of sea-ice extent and sea-ice edge. The metrics are illustrated for the Canadian Regional Ice Ocean Prediction System evaluated against the Ice Mapping System analysis. The distance measures account for the sea-ice coherent spatial structure, are sensitive to the overlapping and similarities in shape of observed and predicted sea-ice extent: they reveal to be a robust and suitable set of verification measures, complementary to the traditional categorical scores. Moreover, these measures can provide distance errors, e.g. of observed versus predicted sea-ice edge, in physical terms (i.e. km), thereby being informative and meaningful for user-relevant applications.

Session 1810011 - POSTER SESSION - PART 2
Summertime Characteristics of Fog and Visibility over Halifax using In-situ Instrumentation
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Microphysics of fog and associated visibilities have attracted substantial scientific attention, primarily due to its direct and indirect effects on human life. Fog microphysics particularly involves droplet size, chemistry of particles involved in its formation, radiation perturbations, and local dynamics of the atmosphere. Different types of fog occur due to the various physical, chemical, dynamical, and radiative processes active at various temporal and spatial scales. Amongst different types of fog, marine/coastal fog occurs due to the transport of warm air masses over cold surfaces or vice versa. This happens quite frequently in spring and summer although local metrological conditions, topography and particles in the boundary layer, and sea surface conditions are also important. Fog formation and extent are not easily predicted and sometimes the onset of fog in coastal regions is so sudden that it reduces visibility to a high-risk level. In this regard, a fog droplet monitor (FDM) and a horizontal visibility sensor (measuring visibility up to 2km), were operated simultaneously from a height of ~70 m amsl, in Halifax (45ºN, 64ºW), on the coast of Nova-scotia in Atlantic Canada, during the summer (June to October) of 2017. Fog droplet size distributions are classified into

meteorological regimes of haze, mist and fog based on the horizontal visibility. A diurnal and monthly statistical analysis of fog occurrence will be presented as well as chemical speciation of fog water collected during one of the intense fog event. Our in-situ observations are complemented by space-based IR imagery data for the study period, enabling us to distinguish between low level cloud and fog. Details of the analysis, its implications and future plans for continuing this study will be presented.

Session 1810011 - POSTER SESSION - PART 2
Evaluation of boundary layer parameterizations for a mesoscale atmospheric model for a long-lasting fog case over Grand Banks
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Dense fog occurs frequently and lasts for days over the Grand Banks, which significantly affects marine transport, offshore oil and gas activates and other marine operations. However, accurate numeral simulations and forecasts of marine fog are a big challenge. We present numerical simulations of a heavy fog event, over the Grand Banks during 26-31 July 2016, using the Weather Forecast and Research (WRF) atmospheric model at 10 km resolution with four local planetary boundary layer (PBL) parameterizations. Our results show that the formulation of the PBL parameterization plays an important role in fog simulation. This fog event is also analyzed using ERA5 reanalysis data for validation, representing reality.

Results show that this was an advection fog controlled by the Azores High, bringing warm moist air over cooler ocean surface, driven by a southwesterly wind; the cooling of the air leads to fog formation. Fog dissipation is caused by a cold vortex from northeastern Canada. The experiments with the four different PBL fog parameterizations are shown to generally simulate this fog event reasonably well. However, compared to ERA5 reanalysis data, these simulations show poor agreement with respect to: (i) the spatial pattern and magnitude of liquid water content (LWC) except for the Mellor-Yamada Nakanishi and Niino Level 3 PBL, and (ii) simulation of higher temperatures and lower wind speeds in the foggy area except, for the Mellor-Yamada Nakanishi and Niino Level 2.5 PBL. The results from the four schemes also show that the thermal inversion layer base is lower and the inversion intensity is stronger, compared to ERA5 data, which indicate that the WRF experiments overestimate the warm air advection at lower levels of the PBL. In addition, the four schemes exhibit large bias after 72 hours. However, the fog dissipation time is close to the reality.

Session 1810011 - POSTER SESSION - PART 2
Preliminary Assessment of the Earth’s Energy Budget within the CMIP5 Historical Simulations
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The energetic imbalance at top-of-atmosphere over the last century has caused an accumulation of energy within the ocean, the continental subsurface, the atmosphere and the cryosphere. Although 93% of the energy gained by the climate system has been stored in the ocean, other components of the Earth’s

energy budget cannot be neglected because of associated climate feedback processes dependent on heat, such as soil carbon and permafrost stability.

Here, we explore the ability of thirty General Circulation Models from the Fifth phase of the Coupled Model Intercomparison Project (CMIP5) for simulating the change in heat content within the energy reservoirs during their Historical simulations. CMIP5 GCM simulations show net gains of heat in all subsystems during the second half of the 20th century in agreement with observations, although with large variability among model results. The temporal evolution of the Earth's heat content and the net top-of-atmosphere radiative imbalance are in agreement for these GCM simulations, but the simulated energy distribution changes with time, increasing for the ocean and the cryosphere, decreasing for the ground and the atmosphere. The land surface model depth appears to influence the distribution of energy among the different climate subsystems.

Session 1810011 - POSTER SESSION - PART 2
Shared true variance as a metric of synergy among in situ, satellite, and gridded ocean products
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The calibration and validation of geophysical data often employs, for practical purposes, a reference dataset that is familiar, with error bounds defined by ordinary and reverse least squares regression. For a unique solution between these bounds, Stoffelen (1998) proposed the use of a third dataset. Triple collocation has thus provided a sophisticated approach to geophysical cal/val for the past twenty years. We introduce a new statistical model, called INFERS, that has evolved out of recent studies of the triple collocation model. INFERS may be one of the first regression models to diagnose error correlations, but once such contributions are accommodated, it is shared true variance (i.e., truth rather than error) that appears to be the most interesting parameter. Model properties are revealed in practical applications to the calibration and validation of ocean surface heat flux, ocean surface current, and marine fog experimental products.

Session 1810011 - POSTER SESSION - PART 2
The biogeochemistry of the Saguenay Fjord water column
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The Saguenay Fjord is a major tributary of the St Lawrence Estuary and is strongly stratified. A 6-8 m wedge of brackish water typically overlies up to 270 m of seawater. Despite all the research carried out to date, the mode, magnitude and frequency of water and carbon exchange between the estuary and the fjord remain unquantified. Relative to the St Lawrence River, the surface waters of the Saguenay Fjord are more acidic and host lower dissolved inorganic carbon (DIC) and higher dissolved organic carbon (DOC) concentrations. The surface waters of the Fjord are projected to be a net source of CO2 to the atmosphere. Nonetheless, the intrusion, at the surface, of brackish water from the upper estuary with the rising tide, as well as mixing of seawater, overflowing the sill from the lower estuary, below the pycnocline modulate the CO2 dynamics in the Saguenay Fjord.

Using geochemical and isotopic tracers as well as an optimisation multiparameter algorithm (OMP), we determined the relative contribution of

known source-waters to the water column in the Saguenay Fjord, including waters that originate from the Lower St. Lawrence Estuary and replenish the fjord's deep-basins. These results, when combined to a conservative (S, T, TA, DIC) mixing model and compared to field measurements, serve to identify the dominant factors, other than physical mixing, such as biological activity (photosynthesis, respiration) and gas exchange at the air-water interface, that impact the water properties (e.g., pH, pCO2, nutrient concentration) of the fjord. Preliminary results indicate that the fjord's surface waters are a net source of CO2 to the atmosphere during periods of high freshwater input (e.g., spring freshet) whereas the surface waters serve as a net sink of atmospheric CO2 when their salinity exceed ~ 5-10.

Session 1810011 - POSTER SESSION - PART 2
A Marine Radar Network on the West Coast of Canada: Currents, Waves, and Tsunamis
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Ocean Networks Canada maintains and operates a network of permanent ocean sensing systems along the coast of BC, including a series of marine radar installations to monitor ocean surface conditions. The HF radar systems include both CODAR and WERA type surface current arrays, as well as x-band WaMOS wave systems. There are presently six 25MHz CODAR arrays operating in the Salish Sea and near Prince Rupert, with two more arrays to be added in Juan de Fuca Strait in 2018. DFO has also installed two long-range CODAR arrays across Hecate Strait, to complete the present CODAR network. Surface current maps are generated every hour. We ar developing extensive data QA/QC checks to verify data quality. ONC also operates a single 13.5MHz WERA array near Tofino, on the west coast of Vancouver Island, in an effort to detect, monitor, and model approaching tsunamis. The two WaMOS wave radar systems are located near Campbell River and Prince Rupert, respectively, aiding in the monitoring of extreme wave events. The presentation will high-light the diverse sites, data quality issues related to system performance and various complex coastal flows, the influence of major river input, and review potential applications of the marine radar systems.

Session 1810011 - POSTER SESSION - PART 2
MyOceanSQL: a free Structured Query Language (SQL) application to store, access and share ocean observations data
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While ocean observations are inherently costly and challenging to obtain, their proper archiving, access and distribution are far from being ideal. Inherent complexity, underfunding, duplications and lack of resources, time, commitment and leadership are only a few examples plaguing the development of national, regional and private archives easy to access. While this problem is common to most countries, it appears particularly acute in Canada. After years of varied observations (from CTD profiles to atmospheric parameters) Newfoundland's aquaculture section of Fisheries and Oceans Canada needed a tool to archive and easily access its oceanographic data. This tool was designed to address the

challenges of complexity arising from a diverse set of data and interactive (i.e., ‘user friendly’) access. The tool features an application to upload data, a relational database (based on MySQL) and a web-interface designed to retrieve user desired data effectively. The tool was developed on limited budget and resources and therefore focuses on simplicity and efficiency rather than on sophistication. Rationale, criteria, structure, main capabilities and results will be presented and discussed.

Session 1810011 - POSTER SESSION - PART 2
Improving the representation of grounded ridges in sea-ice numerical models and other considerations concerning the statistical representation of drag on ice
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Lemieux et al. (2015) introduced a simple and efficient way of representing landfast ice in numerical models of sea-ice. It is now used operationally in Canadian ice-ocean short-term forecasting models. We propose herein extensions of this representation that duly takes into account the ice thickness distribution of present-day models. Moreover, the sub-scale variation of the true bathymetry inside each grid cell of the model can be represented via a normal distribution that can be used to form a cross-probability function of intercepting bathymetry and ice thickness. This leads as well to considerations about the representation of form drag using a statistical approach. Moreover, it appears as well that the drag between ridges and the ocean should include the explicit treatment of the penetration of ridges into the oceanic vertical coordinate system.

Session 1810011 - POSTER SESSION - PART 2
Performance Analysis of an Adaptive Filter Using a Characterized Space-time Noise Model of a Realistic Ambient Environment
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The performance of an underwater acoustic receiver is not accurate when the noise at the receiver is assumed to follow a Gaussian distribution. In this work, the performance of an array of acoustic sensors is analyzed in the presence of ocean ambient noise. To achieve this, first, an analytical autoregressive (AR) model to generate space-time noise data over a receiver array is presented. Spatial and temporal variations is observed for noise sources due to surface crashing waves and distant shipping noise. Varying angles of arrival due to multi-path behavior of acoustic noise is analyzed empirically for data set obtained from a measurement campaign. The performance of a space-time adaptive equalizer is analyzed for this space-time correlated noise. The optimal weights which minimizes distortion due to multiple arrival of correlated noise is obtained by using an adaptive minimum mean square error (MMSE) space-time equalizer. The performance gain of the system is obtained for optimum signal directionality.

Session 1810011 - POSTER SESSION - PART 2
Changes in North America Snowpacks for 1979-2007 Detected from the Snow Water Equivalent data of SMMR and SSM/I Passive Microwave & related Climatic Factors
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Changes to the North American (NA) snowpacks for 1979-2007 based on the snow water equivalent (SWE) retrieved from SMMR and SSM/I passive microwave data were analysed using the non-parametric Kendall's test. About 30 % of detected decreasing trends of SWE for 1979-2004 are statistically significant, which is about x3 more than increasing trends of SWE detected in NA. Significant decreasing trends in SWE are more extensive in Canada than in the US, where such decreasing trends are mainly found along the American Rockies. The overall mean trend magnitudes are about -0.4 to -0.5 mm/year which means an overall reduction of snow depth of about 10 to 13 cm in 26 years (assuming an average snowpack density of 0.1) which can significantly impact regions relying on spring snowmelt for water supply. From detected significantly increasing (decreasing) trends of gridded temperature (precipitation) data of North American Regional Reanalysis (NARR) and the University of Delaware for North America, and their respective correlations with SWE data, it seems the extensive decreasing trends in SWE detected mainly in Canada are more caused by increased temperatures than by decreasing precipitation, though climate anomalies such as PDO could also contribute to part of the detected changes. For example, the PC1 of NA's SWE is found to be correlated to the Pacific Decadal Oscillation (PDO) index, marginally correlated to the Pacific North American (PNA) pattern, but not much related to El Nino Southern Oscillation (ENSO) measured in terms of Nino3 and SOI.

Session 1810011 - POSTER SESSION - PART 2
Characterization of Air and Ground Temperature Relationships within the CMIP5 Historical and Future Climate Simulations
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The relationships between air and ground surface temperatures across North America are examined in the historical and future projection simulations from 32 General Circulation Models (GCMs) included in the fifth phase of the Coupled Model Intercomparison Project (CMIP5). The difference between surface air (2 m) and ground surface temperatures (10 cm) is affected by simulated snow cover, vegetation cover and precipitation through changes in soil moisture and soil properties. In winter, the differences between air and ground surface temperatures, for all CMIP5 simulations, are related to the insulating effect of snow cover and soil freezing phenomena. In summer, the differences between the two temperatures, for the majority of simulations, are inversely proportional to leaf area index and precipitation, likely due to induced-changes in latent and sensible heat fluxes at the ground surface. Our results show that the transport of energy across the air-ground interface differs from observations and among GCM simulations, by amounts that depend on the components of the land-surface models that they include. The large variability among GCMs and the marked dependency of the results on the choice of the land-surface model, illustrate the need for improving the representation of processes controlling the coupling of the lower atmosphere and the land surface in GCMs as a means of reducing the variability in their representation of weather and climate phenomena, with potentially important implications for positive climate feedbacks such as permafrost and soil carbon stability.

Session 1810011 - POSTER SESSION - PART 2
In-cloud oxidative processing of tree-pollen for a large range of cloud relevant temperatures

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Biological particles such as bacteria and pollen are known to facilitate ice nucleation at temperatures just below the freezing point of water (Möhler et al. 2007), relevant for ice-forming processes in clouds. Once formed, ice has a significant impact on the radiative properties and precipitation formation in clouds, yet our knowledge about ice-forming processes is very limited (McFarquhar et al. 2017). Uncertainties in cloud ice formation and evolution expands into current cloud parametrizations in global climate models (Boucher et al., 2013).

In a previous study, the effect of chemical oxidation of silver birch and grey alder pollen by the atmospherically-important hydroxyl radical was studied for in-cloud conditions at -39°C using the University of Toronto Continuous Flow Diffusion Chamber (UT-CFDC) (Gute & Abbatt, 2018). Both, pollen types were found to have significantly decreased ice nucleation ability after aqueous OH oxidation.

This study will expand on the previous finding, by studying the effect of OH oxidation on pollen for a wide range of temperatures relevant for warm, mixed-phase and cold cloud conditions. Similar to the previous study, pollen are exposed to OH in water and changes in ice activity is monitored for 4 hours. A new drop-freezing setup, the DRoplet Ice Nucleation Counter Zurich (DRINCZ) based on principles described elsewhere (Bigg, 1953) – built by David and Kanji at ETH Zurich – is used to detect freezing onset temperatures from 0ºC to -30ºC. The aqueous pollen samples are transferred to 96 50µL wells of a PCR-tray which is placed in an ethanol bath, allowing samples to be gradually cooled at a rate of 1ºC per minute. Freezing of each 50µL aliquot is detected by a camera. New experimental results and atmospheric implications from this study will be presented.

Session 1810011 - POSTER SESSION - PART 2
Time Series Ocean Observations in the Bedford Basin
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Bedford Basin, Nova Scotia, has been host to frequent monitoring by the Department of Fisheries and Oceans (DFO) at the Bedford Institute of Oceanography (BIO) since the 1960s until the program was formalized into the Bedford Basin Monitoring Program (BBMP), a weekly time series established in 1999. Bedford Basin began as a convenient location for monitoring, but is now known to be representative of conditions on the Scotian Shelf. A time series of this scale and frequency provides valuable environmental data, giving insight into how various parameters are changing over time. In 2008, Dalhousie University joined the BBMP to begin a bio-optical time series, beginning the close relationship between the academic and government researchers. Both sides of the program have grown significantly with support by the Marine Environmental Observation Prediction and Response (MEOPAR) Network Centre of Excellence. Dalhousie's sampling has expanded beyond bio-optics to include dissolved oxygen, nitrogen isotopes, halogen compounds, microbial composition, and genomics. In addition to these samples, new technology is appearing in the basin; DFO's Viking Buoy, deployed in February 2018, is providing 24/7 environmental data for one year before being moved offshore, and Dalhousie will

be installing a benthic pod with regular data offloads via an acoustic modem. The benthic pod will be deployed in April 2018 for six months sampling nitrate, carbon dioxide, dissolved oxygen, conductivity, temperature, and fluorescence. Utilizing the latest oceanographic technology will create a more detailed picture of environmental conditions, but larger volumes of data requires proper data management. Using a database management system for complex datasets like the Bedford Basin is not reliable; Dalhousie has moved to NetCDF, creating faster data retrieval. This move is one large step in the process to improve the quality and accessibility of Dalhousie's Bedford Basin data.

Session 1810011 - POSTER SESSION - PART 2
Impact of bias correction of CGCM-generated sea-surface temperature for dynamical downscaling over the CORDEX North American domain using the Canadian Regional Climate Model (CRCM5)
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Dynamical downscaling (DD) uses the output of Coupled Global Climate Models (CGCM) as atmospheric lateral and sea-surface boundary conditions (BC) to drive Regional Climate Model (RCM) simulations. Biases in the CGCM-generated BC, however, can have detrimental impacts in nested RCM simulations. A way to reduce the negative impact of driving BC is to follow a 3-step approach for DD: the CGCM-simulated sea-surface temperature (SST) fields are empirically corrected to remove their systematic biases and used as ocean-surface lower BC for an Atmosphere-only GCM (AGCM) simulation, which in turn provides the BC to drive an RCM simulation. We show the impact of this strategy on present and future climates (RCP8.5) using the fifth-generation Canadian Regional Climate Model (CRCM5) over the North American CORDEX domain driven by two CMIP5 CGCMs: CanESM2 and MPI-ESM-MR.

Session 1810011 - POSTER SESSION - PART 2
Climate Feedbacks in the Sub-Arctic Boreal Forest
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Over the high latitude Northern Hemisphere, snow albedo feedback (SAF) has a strong control on climate, second only to lapse rate in the annual mean. During the spring melt season, SAF is the dominant control on temperature change over much of the Arctic. In the Boreal Forest, however, modelled SAF strength shows a large range of uncertainty, owing to differences in the albedos of snow covered surfaces. Additionally, the relative importance of other feedbacks (such as cloud, water vapour and lapse rate feedbacks) in the Sub-Arctic Boreal Forest have not been extensively explored. Radiative kernels are applied to the output from 28 CMIP5 models to determine the contributions to surface warming from SAF, water vapour (WV), lapse rate (LR), and cloud feedbacks (CLD), in response to climate warming in the North American and Eurasian Boreal Forests (ENF) and Shrub Tundra Zones (SHR). The strongest feedbacks are WV, LR, and SAF, with considerable spread around the multi-model mean. Mean feedback values (± 2 standard deviations) in the ENF region are 0.23 ± 0.40 Wm-2 K-1 for SAF, 0.21 ± 0.24 Wm-2 K-1 for LR, and 0.41 ± 0.11 Wm-2 K-1 for WV. Over shrub tundra, feedback values are 0.31 ± 0.56 Wm-2 K-1 for SAF, 0.32 ± 0.34 Wm-2 K-1 for LR, and 0.28 ± 0.12 Wm-2 K-1 for WV. The results are somewhat sensitive to the reference dataset of vegetation types: for SAF the feedback values are slightly

weaker (0.20 ± 0.40 Wm-2 K-1) over the ENF region, and slightly stronger (0.43 ± 0.78 Wm-2 K-1) over shrub tundra, when using the Simple Diagnostic Photosynthesis and Respiration Model (SDPRM) vegetation dataset. Our results suggest that previous studies may have overestimated SAF strength in the boreal forest, and highlight the importance of investigating feedbacks at the scale of plant functional types.

Session 1810011 - POSTER SESSION - PART 2
Heavy lake-effect snowfall events for the Laurentian Great Lakes region for current and future climates
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Lakes are important components of the climate system and can affect regional climate by modulating surface albedo, surface energy, and moisture budgets. Therefore, they should be realistically represented in climate models. Many climate models are currently representing lakes interactively using 1D models. However, for large lakes such as the Laurentian Great Lakes, 3D models are required, as it is important to simulate the circulation patterns which can impact lake temperature as well as ice onset melt dates and fractional coverage, and therefore heavy lake-effect snow (HLES) as suggested by recent studies. The aim of this study is to compare HLES simulated by a regional climate model (CRCM5: Canadian Regional Climate Model) with 1D and 3D models for the Great Lakes, and to assess projected changes to HLES in a future warmer climate.

For comparing the impact of 3D lakes, two CRCM5 simulations, using 1D (Hostetler model) and 3D (NEMO) lake models, driven by ERA-Interim reanalysis are performed and analysed over the Great Lakes region for the 1979-2012 period at 10 km resolution. Lake ice cover is overestimated in the simulation with 1D lake model leading to reduced HLES due to the reduced source of moisture for HLES events. Simulated HLES events are greatly improved with the 3D model. Projected changes to HLES are assessed by comparing CRCM5 simulations for the 2079-2100 future and 1989-2010 current periods, driven by CanESM2. Analysis of projected changes to heavy lake effect snowfall suggests mostly decreases both in the amounts and frequencies which could be explained by the increased temperature, leading to rain rather than snow, and reduced frequency of the cold air outbreaks triggering these extreme events.

Session 1810011 - POSTER SESSION - PART 2
Rogue coccolithophore bloom in the Strait of Georgia in 2016: investigating cause and biogeochemical consequences
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The Strait of Georgia is generally fresh, relative to the southern Salish Sea, leading to large regions of surface waters with low aragonite and calcite saturation states, even during the summer. In a typical summer season, the Strait of Georgia hosts diatom-dominated blooms, interspersed with periods characterized by numerous nanoplankton and low nutrient concentrations. In the

summer of 2016, calcifying phytoplankton, which would not be expected to flourish in corrosive waters, were observed. From June until August of that year, strong blooms of the coccoliphore Emiliania huxleyi were visible from space around the whole of Vancouver Island at various times. It is known that such blooms reduce surface alkalinity and may export alkalinity to depth.

We investigate the biogeochemistry and phytoplankton species composition in the Strait of Georgia and on the outer coast of Vancouver island, before, during and after this anomalous bloom. In addition, we explore the potential for seeding of this bloom from outer waters using the SalishSeaCast model and a time-series of satellite reflectance data throughout the region. Finally, we combine these investigations to explore the cause of this rogue bloom, its impact on the local carbon cycle, and the likelihood of such blooms in the future.

Session 1810011 - POSTER SESSION - PART 2
Modelling carbon uptake and transport in the Canadian Arctic using NEMO-BLING
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The oceans are an important component of the global carbon cycle, and are estimated to have taken up 54% of the anthropogenic carbon released to the atmosphere since pre-industrial times. Polar regions are disproportionately affected by climate change, yet are major regions of carbon uptake. In the North Atlantic, carbon is transferred from the ocean surface (a short-term reservoir) to deep water (a long-term reservoir). This carbon sequestration at depth occurs along two main pathways: (1) a density-driven physical pump moves cold, CO2-rich water to abyssal depths (e.g. convection) and (2) a biological carbon pump (BCP) converts atmospheric carbon into organic material via photosynthesis which eventually sinks to deep water. Carbon can enter and leave regions of deep convection either by air-sea flux or by lateral exchanges with nearby water basins. We estimated carbon fluxes into the Canadian Arctic from 2002-2017 using the BLINGv0-DIC model (Biogeochemistry with Light Iron Nutrients and Gasses) coupled to the NEMO-LIM ocean-sea ice framework on the ANHA4 configuration (¼ degree Arctic and Northern Hemisphere Atlantic). Model evaluation of inorganic carbon, organic carbon, and alkalinity showed good agreement with GLODAPv2 observations in the North Atlantic. We quantified contemporary carbon flux to deep water in years of strong and weak convection, determined which regions are sources and which are sinks, and estimated the relative amount of carbon export and sequestration that occurs by the two different pathways (solubility-driven flow and the BCP).

Session 1810011 - POSTER SESSION - PART 2
On the Rainfall Changes over Xinjiang during the Summer of 2006-2035 through the Dynamical Downscaling of CMIP5 Model Results
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The simulation of summer rainfall over Xinjiang in 9 CMIP5 models had been evaluated. Five of the 9 models, which can well present the summer rainfall over Xinjiang were chosen for dynamical downscaling by using RegCM4. Those five models are CanCM4、CMCC-CM、CNRM-CM5、HadCM3、MIROC4h. It is

found that dynamical downscaling can well simulate the precipitation caused by topography over Xinjiang. Through analyzing the ensemble mean of dynamical downscaling results, it is shown that the summer total rainfall over Xinjiang during 2006-2035 decreases and has a decreasing trend, compared with the rainfall climatology during 1976-2006. For the differences of the spatial distribution of the rainfall between 2006-2035 and 1976-2005, rainfall significantly decreases over the Tianshan Mountain and to the south of Tianshan Mountain during 2006-2035, but significantly increases over the north slope of Kunlun Mountain. This is caused by the anomalous geopotential height and anticyclonic circulation at 500 hPa, which induce the significant moisture flux divergence over Tianshan Mountain and convergence over the north slope of Kunlun Mountain.

Session 1810011 - POSTER SESSION - PART 2
Canadian Weather Radar Replacement Program – An Update
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On February 28th, 2017 – Canada's Minister of the Environment and Climate change announced investments to modernize Canada's weather-forecasting infrastructure. As part of this initiative, an $83-million contract was awarded to Selex ES GmbH for 20 new weather radars that are to be built across the country by 2023, the first installation having been completed in the fall 2017 at Radisson.

This paper will provide information and updates on the Weather Radar Replacement Program in general, with a focus on the design of new radar system and infrastructure, benefits and limitations of the new radars, project implementation plans and construction timelines. Preliminary installation orders for the next couple of years will be discussed. Approach used to perform radar siting analysis and considerations for the selection of new radar sites will be highlighted.

Session 1810011 - POSTER SESSION - PART 2
Remote sensing of Phytoplankton Size Class in Northwest Atlantic from 1998 to 2016: bio-optical algorithms comparison and application
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Abstract: Phytoplankton community structure and phytoplankton size class (PSC) are linked to ecological and biogeochemical changes in the oceanic environment. Many models developed to obtain PSC from satellites remote sensing, have been evaluated only in open oceans, and no effort has been carried out to report on the performance of these PSC models in coastal productive waters. In this study, we evaluated the performance of nine PSC models in the coastal Northwest Atlantic (NWA) using phytoplankton pigment measurements and coincidental satellite data from the Sea-Viewing Wide Field-of-View Sensor (SeaWiFS), Moderate-resolution Imaging Spectroradiometer (MODIS), and Visible Infrared Imaging Radiometer Suite (VIIRS). Our results show that no PSC model can retrieve all three phytoplankton size classes (pico-, nano-, and micro-phytoplankton) with reliable accuracy in the region of interest. In particular, these PSC models show poor performance for retrieval of the picophytoplankton fraction of total phytoplankton in our study region. For the accuracy of retrieved

micro-phytoplankton and combined nano-pico phytoplankton, Devred et al. (2011) model yielded the best result, which is not surprising given that this model was developed using a regional. This model was applied to the Ocean Color Climate Change Initiative (OC-CCI) archive in the NWA, from 1998 to 2016. We report solely on the micro-phytoplankton given the inverse relationship that exists with the nano-pico class. The multi-decadal trend along with the deseasonalized trend of micro-phytoplankton fraction was computed and analyzed for six ecological provinces located in the NWA. Over the 19-year time series, the linear trend exhibited a significant and positive for four of the six provinces, with a slope of 0.36 %·yr-1 in the Northwest Continental Shelf (NWCS), 0.25 %·yr-1 in the Arctic Waters (ARCT), 0.12 %·yr-1 in the Slope Waters (SW) and 0.06 %·yr-1 in the Gulf Stream (GFST). Strong positive anomalies of micro-phytoplankton fraction were found in winter months in NWCS between 2009 and 2014, which could be associated with changes in environmental factors.

Session 1810011 - POSTER SESSION - PART 2
Observations of wave dispersion under sea ice in Antarctica
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When ocean surface waves encounter sea ice, interactions between the waves and ice occur. These interactions are two way, where ice may cause waves to refract, shoal or attenuate, while waves may cause the ice to break-up or compress. Understanding the interactions between waves and sea ice is necessary to create accurate wave prediction models, which aid the safety of marine operations. Additionally, feedback mechanisms between waves and ice may have an important influence on the future extent of sea ice.

We investigate the effects of sea ice on propagating ocean waves in the Ross Sea in Antarctica using Synthetic Aperture Radar (SAR) imagery from the TerraSAR-X satellite, in addition to in-situ buoy data from the same time and location. We compare our observations of changes in wavelength and wave direction to wave dispersion models which include ice effects to determine the applicability of different wave-ice models to certain ice conditions.

Session 1810011 - POSTER SESSION - PART 2
Verification method used at the Canadian Meteorological Aviation Centre (CMAC-West office) to measure the performance of terminal aerodrome forecasts (TAF)
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Well known to the aviation industry, poor visibilities and low ceilings at airports have major impacts on the flight operations. Therefore, the ability to accurately forecast these unfavourable conditions and verify the forecasts against reality is very important. As one of the two operational weather offices providing aviation weather forecast services to NAV Canada, the CMAC-West in Edmonton uses Heidke skill score to measure the forecast performances with emphasis on hub airports such as Vancouver and Calgary internationals due to their special significance to the air navigation system. The poster will describe how the Heidke skill score is calculated for each TAF site, define what is considered statistically significant, and show how the statistics are used to help improve future forecasts. The limitations of the current verification method and areas for possible improvements will also be discussed.

Session 1810011 - POSTER SESSION - PART 2
Evaluating the ecosystem and carbon cycling in the Arctic Ocean using a fine-resolution ocean/sea-ice/biogeochemical model
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A decade-long hindcast using an ocean/sea-ice/biogeochemical model covering the Arctic and the adjoining North Atlantic and North Pacific Oceans is analyzed. The ocean/sea-ice model is based on NEMO3.6 and LIM3, with a nominal horizontal resolution of ¼-deg in longitude/latitude, achieving ~12 km at high latitudes. The biogeochemical model is a modified version of PISCES, which includes 19 prognostic variables and simulates biogeochemical cycles of carbon, oxygen and the main nutrients (nitrate, ammonium, phosphate and silicic acid) controlling phytoplankton growth. Here we present the evaluation of the seasonal and inter-annual variations of sea-ice, hydrography; nutrients, chlorophyll-a and inorganic dissolved carbon concentrations in the Arctic Ocean, through comparison with available observational data and results published in literature. The evaluation suggests that the model possesses reasonable skills in reproducing the main features of ecosystem and carbon cycling for further studying their mechanisms in the Arctic.

Session 1810011 - POSTER SESSION - PART 2
Estimating the effect of the permafrost carbon feedback on carbon budgets using a perturbed parameter ensemble modelling approach.
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The permafrost carbon pool holds a mass of carbon over double that which was present in the pre-industrial atmosphere. As climate warms and permafrost thaws a fraction of this carbon is expected to be released to the atmosphere, producing a positive feedback to climate change. The Paris Agreement to limit climate warming is framed in terms of temperature targets that should avoided, the 1.5o and 2.0oC targets. These targets can be translated into a cumulative total of fossil fuels that can be burned over all time compatible with the target – a ‘carbon budget’. The theoretical underpinning of carbon budgets relies on a compensation mechanism of oceanic origin. Thus the permafrost carbon feedback could have a non-linear effect on to final carbon budget. Here we use a perturbed parameter ensemble of an intermediate complexity climate model, representing the uncertainty in the permafrost carbon system, to assess the likely effects of the permafrost carbon feedback on final carbon budgets. For threshold peak carbon budget the permafrost carbon feedback reduces the budget by 9% [1 to 24%] by 2100 for both the 1.5o and 2.0oC targets. After global temperature stabilizes permafrost carbon continues to decay and by year 2300 the carbon budget has been reduced by 18% [2 to 55%] for the 1.5o C target and 13% [3 to 36%] for the 2.0oC target, implying the need for net negative emissions. Overall the permafrost carbon feedback has a significant effect on the estimated carbon budget for the Paris targets and must be accounted for in allocation of the remaining allowable emissions.

Session 1810011 - POSTER SESSION - PART 2
Assessing the oyster microbiome in Atlantic and Pacific oyster farms
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Ocean acidification is one of several factors, together with increasing temperature, and nutrient loading that may lead to environmental conditions unfavorable to the production of oysters. As part of Meopar's ICAP project, we sampled several oyster farms located on the Atlantic and Pacific coasts between December 2016 and August 2017. The purpose of our study was to characterize 1) the microbial community of the waters in bays supporting oyster and 2) the oyster-associated microbiome. The routine sampling involved the collection of planktonic microorganism by filtration, followed by DNA extraction and high throughput sequencing. We have routinely obtained a microbiome signature for each sample from the 16S rRNA amplicons sequencing. Our initial results clearly indicate that the oyster's microbiome is highly distinct from the microbial community of the surrounding waters. All of the DNA samples were also screened for the presence of nifH gene, a gene marker for the nitrogenase enzyme essential for dinitrogen fixation. The nifH screening of oyster tissue samples led to the realization that bacteria from oyster gills often contained the nifH genes, indicating their ability to fix dinitrogen gas into ammonia. Recent studies have discovered chemolithotrophic sulfur oxidizing symbionts in bivalves that were also capable fixing dinitrogen gas. We are currently exploring whether the nitrogen fixing bacteria associated with the gills of oysters are symbiotic or simply concentrated through the filter feeding activity of the oysters. Our results indicate that the oysters retain certain bacteria within their tissue, although further studies are needed to demonstrate whether the bacteria are simply ingested as food source or are actual symbionts. If the symbionts are within the oyster, it could have implications for aquaculture in that oysters with these bacteria may be better suited for growth in high densities.

Session 1810011 - POSTER SESSION - PART 2
Canadian Arctic Weather Science: Iqaluit and Whitehorse Supersites
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The Canadian Arctic Weather Science Project was established by Environment and Climate Change Canada (ECCC) to advance the knowledge necessary to understand weather, climate, and cryosphereic systems, to trial observation technology appropriate to the Canadian Arctic, to validate space-based observations, and to enhance the performance of the Canadian weather prediction system over the Canadian Arctic region. The first phase of the Project focusses on characterization of atmospheric processes within the boundary layer. Two supersites will conclude commissioning this year and include Doppler weather radars and lidars, water vapour and aerosol lidars, radiation flux sensors, and different fog and precipitation measurement devices. The supersites are located in Iqaluit (64oN, 69oW) and at Whitehorse (61oN, 135oW). Initial observations demonstrate the instruments' ability to detect and measure the extent of blowing snow and trace precipitation, which traditional precipitation gauges cannot detect, during severe weather when radiosondes cannot be launched. The instruments have demonstrated excellent survivability and data quality during extreme Arctic conditions with no operator support required. The benefit of integrated measurement systems and coordinated scan strategies are being investigated to recommend the optimal cost-effective observing system for the Canadian Arctic. The observations conducted at the supersites will also provide significant contribution to the World Meteorological Organization's Year

of Polar Prediction (YOPP), with a focus on numerical weather prediction verification.

Session 1810011 - POSTER SESSION - PART 2
Biogenic carbonate production and preservation in the Labrador Sea since the Last Glacial Maximum (LGM)
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In the present study, we evaluated the role of biological productivity and carbonate preservation on temporal variations of coccolith and foraminifer concentrations and fluxes in Labrador Sea sediments since the Last Glacial Maximum (LGM). We report the first high-resolution record of calcite dissolution indices for one core collected in the northwestern Labrador Sea. A multi-proxy approach, including micropaleontological counts (coccoliths, foraminifers, and palynomorphs) and biogeochemical analyses (alkenones), was used to interpret the sediment record. Sediments deposited in the northwestern Labrador Sea during the LGM and the subsequent deglaciation contain significantly lower biogenic carbonate microfossils than Holocene sediments, reflecting either calcite dissolution and/or low productivity of foraminifers and coccolithophores. Calcite dissolution indices suggest that there has been little-or-no microfossil dissolution since the LGM, and, thus, variations in biogenic carbonate content of the sediments most likely reflect changes in surface water productivity and fluxes. According to the sediment record, planktonic foraminifers exhibited an increase in productivity at the end of the deglaciation (~ 12 ka), reaching Holocene levels before coccolithophores followed suit (~ 10 ka). We interpret that production of planktonic foraminifers in the early Holocene was likely tied to a decline in sea-ice cover and thickness. Alkenone and coccolith abundances are uncorrelated to each other in our sediment record. This may be due to either non-production with allochthonous alkenone additions, and/or production of non-calcifying coccolithophores until the early Holocene. Given a detectable and consistent alkenone record since the LGM, non-calcifying alkenone-producing haptophyte algae likely produced alkenones during the LGM and deglaciation. Finally, any allochthonous alkenones and coccoliths observed in the Labrador Sea cannot originate from the erosion of Cretaceous, Paleocene, and Eocene rocks of the southeast Baffin Shelf as these rocks contain no detectable alkenones and coccoliths but they may originate from elsewhere in the North Atlantic.

Session 1810011 - POSTER SESSION - PART 2
Iceberg modelling: Improving pathways and sources of freshwater to the North Atlantic
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From the moment they calve from Greenland, icebergs become a threat to ships and offshore structures along the east coast of Canada. The ones that reach the interior Labrador Sea may also affect deep convection since icebergs are a source of freshwater. Up to now, those icebergs have been studied using a model that takes only surface ocean fields to move and melt icebergs. Here, we use a new version that integrates the ocean fields from surface to iceberg keel before using them in the iceberg equations. By coupling this new iceberg model to the Nucleus for European Modelling of the Ocean (NEMO), we show how velocity changes with depth affect the main pathways of Greenland icebergs and

how these results compare to observations. Additionally, we evaluate the impacts of iceberg melt on Labrador Sea subduction. In particular, we assess changes in subduction when dividing Greenland discharge into liquid and solid components – as opposed to introducing all discharge in liquid form – and highlight the importance of including icebergs in freshwater numerical studies.

Session 1810011 - POSTER SESSION - PART 2
Using 226Ra and 228Ra isotopes to distinguish water mass distribution in the Canadian Arctic Archipelago
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226Ra and 228Ra are the two long-lived isotope species (226Ra, t½=1600y and 228Ra, t½=5.8y) derived from the Radium Quartet. Each isotope in the Quartet is radioactive, mostly water soluble, and unperturbed by biological activity. Compared to the short-lived radium species (223Ra and 224Ra) the slow decay rate of 226Ra and 228Ra allows for these isotopes to be traced over great distances, thus providing insight towards the water mass composition, mixing processes and distribution patterns and timescales throughout the Canadian Arctic Archipelago (CAA). For this study, samples for radium isotope measurements were collected at 17 stations during the 2015 Canadian GEOTRACES cruise through the CAA. Both long-lived Ra isotopes were found in a large range of activities, which may be attributed to the diverse coast, shelf and ocean environments present within the study area. Plotting the 226Ra, and 228Ra data, as well as their ratio 228Ra/226Ra over salinity allowed for trends to be estimated from Pacific, Atlantic and polar mixed layer distinctive end members. From these trends an attempt will be made to assess the flow rate as the Pacific water works through the CAA from west to east. Alternatively, although the Atlantic water was observed on either side of the Archipelago, it’s is suspected that the shallow depth and underwater shelf found within the CAA prohibit the dense Atlantic waters from flowing through in eastward direction. Finally, under consideration of biogeochemical data such as dissolved inorganic carbon or alkalinity, an attempt will be made to forecast the effects of changes in the ocean trajectory through the CAA might have on biological life. This study aims to provide a stepping stone for future research initiatives within the Canadian Arctic Archipelago, indicating how quantifying disparities in radioactive isotopes can provide insight toward climate change within vulnerable areas.

Session 1810011 - POSTER SESSION - PART 2
Overview of the Canadian Seasonal to Interannual Prediction System (CanSIPS) products on the Canadian Climate Data and Scenario (CCDS) web portal
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This talk will give an overview of the Seasonal Forecasts section of the Canadian Climate Data and Scenario (CCDS). The CCDS is a web interface for distributing typical climate change information, such as historical data records, climate extreme indices, global and downscaled climate scenarios, but also climate predictions from the Canadian Seasonal to Interannual Prediction System (CanSIPS). The current version of CanSIPS has been developed by the Canadian Centre for Climate Modelling and Analysis (CCCma) and is operated at the Canadian Centre for Meteorological and Environmental Prediction (CCMEP). CanSIPS seasonal forecasts are issued on a monthly basis and provide up to

nine months of lead time. After a brief introduction giving more details about CanSIPS, we will navigate the CCDS' Seasonal Forecasts section and present some useful capabilities such as downloading the data used to make the images. A mouse-driven user interface allowing an interactive presentation of the forecast and expected skill information from the maps will also be presented. This CCDS' seasonal forecasts section is a complement to the Meteorological Service of Canada Seasonal Forecast web pages (https://weather.gc.ca/saisons). For instance, it provides forecast information for more variables as well as a global coverage in addition to the Canadian regions.

Session 1810011 - POSTER SESSION - PART 2
Dynamic Inundation Modelling in Climate Models
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This study introduces a simplified approach to model inundation areas, depths and velocities dynamically in climate models, which in addition to modifying surface characteristics and therefore energy and water partitioning at the surface are also important from emergency evacuation and response planning view points. The approach is tested with GEM4.8 for the 2009 Red-River spring flood, which is the second largest flood in Manitoba since the start of official records in 1912. Considering that this spring flood was likely related to the weather conditions of fall 2008, GEM4.8 simulations driven by ERA-Interim were performed for the 19 months from Nov 2007 to May 2009 (including spin-up period) and we analyzed the period from fall 2008 to spring 2009. Generally, GEM4.8 reasonably reproduced the spatial and temporal variation of surface variables for the analysis period, compared to observations. However, it overestimated precipitation and underestimated temperature, which resulted in the overestimation of snow water equivalent during winter, leading to a larger maximum streamflow in the Red-River basin during spring than observed. The flood inundation area during April 2009 is reasonably well captured by the model, albeit slight overestimation primarily due to the overestimation of the streamflow, when compared to available inundation maps. Some ideas to further improve the inundation model are currently being explored and related preliminary results will also be presented.

Session 1810011 - POSTER SESSION - PART 2
The attribution of marine heatwaves to anthropogenic climate change
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In 2015-2016 a quarter of the ocean surface experienced either the longest or most intense marine heatwave since satellite records began in 1982. The role of climate change in these events is inevitable given anthropogenically-driven ocean warming. Here we present a framework for quantifying the degree to which anthropogenic climate change has modified the likelihoods of particular historic events. The framework is based on the Fraction of Attributable Risk metric commonly used to attribute atmospheric heatwaves and other extreme events. We use IPCC AR5-class global climate model simulations under natural-only, historical (natural and anthropogenic), and future projected forcing scenarios to calculate the likelihood of events under different conditions. By comparing the

event likelihoods in the historical or future projected world against those in a natural world we can quantify the role of climate change in these event occurrences. We investigate three regions – southeastern Australia, Northern Australia and the Bering Sea/Gulf of Alaska – each of which, in 2015/16, experienced their most intense marine heatwaves in the 35-year satellite record. We demonstrate that the duration and intensity of these events were many times more likely due to human influences on the climate than they would be in a world with only natural variability.

Session 1810011 - POSTER SESSION - PART 2
Sub-mesoscale modelling of the Labrador Sea
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The Labrador Sea is a very dynamic region, with physical processes occurring at a variety of scales, from large scale gyre circulation to small scale convection processes. These small scale features are difficult to represent with numerical simulations due to high computational costs. We use an ocean model, NEMO, with nesting software, Adaptive Grid Refinement in FORTRAN (AGRIF), to simulate the Labrador Sea at nearly 1 kilometer (1/60°) of horizontal resolution. We use two nests inside our simulation, with a 1/4° parent over the Arctic and Northern Hemisphere Atlantic, a 1/12° nest inside the North Atlantic sub-polar gyre, and a further 1/60° nest over the Labrador Sea.

We apply high spatial and temporal resolution atmospheric forcing from the Global Deterministic Prediction System by the Canadian Meteorological Centre. Preliminary analysis on the first few years of our planned 2002-2017 simulation showcases fine scale features within the Labrador Sea, from Irminger Rings shedding from the west coast of Greenland, to eddy features appearing during the convective wintertime. We identify multiple tracer pathways, including Irminger Water flowing west past Cape Farewell, Labrador Sea Water produced during convection, meltwater from Greenland, and fresh Arctic outflow water. We also investigate shelf-basin exchange around the Labrador Sea. Finally, We compare the high resolution simulation against simulations at a lower resolution with identical forcing to illustrate the increase in resolving power.

Session 1810011 - POSTER SESSION - PART 2
Introducing the DFO Operational Oceanography Service Desk
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Over the last 10 years, Fisheries and Oceans Canada (DFO) and Environment and Climate Change Canada (ECCC) have been developing ocean forecasting capability under the interdepartmental CONCEPTS (Canadian Operational Network of Coupled Environmental Prediction Systems) initiative. As this effort in operational oceanography has matured, a DFO Operational Oceanography Service Desk was recently established at the ECCC Canadian Centre for Meteorological and Environmental Prediction (Dorval, QC) to be the DFO hub for the application of operational ocean models. The Service Desk supports DFO internal operational oceanography in three areas: 1. data monitoring and quality control of observations that support ocean modelling; 2. real-time operational ocean analysis and forecast monitoring and quality assurance to ensure that operational ocean models function efficiently; and 3. operational ocean product dissemination and service delivery. Its mission is also to facilitate the application

of hydrodynamic models to drift prediction by ECCC and hydrographic electronic navigation by the Canadian Hydrographic Service.

Session 1810011 - POSTER SESSION - PART 2
Utilizing Agrometeorological Indices to Inform the Agriculture Industry of Risks from Extreme Weather
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Agriculture is an important primary production sector in Canada. Agricultural production, profitability, sustainability and food security depend on many agrometeorological factors. Extreme weather events in Canada, such as drought, floods, heat waves, frosts and high intensity storms, have the ability to significantly impact field crop production.

Agriculture and Agri-Food Canada (AAFC) and Environment and Climate Change Canada (ECCC) have together developed extreme agrometeorological indicators for four types of critical weather factors: temperature, precipitation, heat, and wind. Using ECCC's medium and long range forecasts, these indices will be generated at daily, weekly, monthly, and seasonal timeframes.

Through collaborative work, these agrometeorological indicators will be made available on AAFC's Drought Watch website www.agr.gc.ca/drought to inform the agriculture industry about weather related risks over the growing season at time frames relevant to agricultural activities.

Session 1810011 - POSTER SESSION - PART 2
Subseasonal Variations of Wintertime North Pacific Evaporation, Cold Air Surge and Water Vapor Transport
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Strong subseasonal variations of oceanic evaporation are observed in the western North Pacific, especially around the Kuroshio current and its extension (KOE) region during winter. This study addresses this variations, and the connection with the cold air surge (CAS) and related atmospheric water vapor transport on subseasonal time scale by using the OAFlux and ERA-Interim daily data. Two dominant modes of oceanic evaporation anomaly are revealed by performing an EOF analysis on subseasonal evaporation anomaly ( ) in the region (120°E–120°W, 0°–55°N) for 30 winters. The qualitative description of the connection is obtained by lead-lag regressing the atmospheric variable and water vapor transport and its divergent fields in winter against the two principal components of the EOFs, respectively. Furthermore, three individual physical processes of atmospheric water vapor transport involving multi-scale interactions of wind field and specific humidity are addressed based on the scale decomposition method. Hydroclimate effects on Atmospheric River (AR), storm track and precipitation over the pan-North Pacific region are also discussed.

Session 1810011 - POSTER SESSION - PART 2
UCYN-A within the Bedford Basin (Nova Scotia): tracking a globally significant diazotroph within a temperate coastal basin using a weekly time-series.
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Candidatus Atelocyanobacterium thalassa, otherwise known as “UCYN-A”, is a currently unculturable type of unicellular cyanobacteria found in the marine environment. As a diazotroph, UCYN-A is capable of fixing atmospheric nitrogen (N2) into biologically available inorganic nitrogen (in the form of NH3). Unlike other unicellular cyanobacteria, UCYN-A is more widely distributed into the temperate zone and is also an episymbiont of haptophyte algae (e.g., Braarudosphaera bigelowii). Its symbiotic relationship involves the exchange of fixed nitrogen for fixed carbon from its haptophyte host. As a consequence of not needing to rely on its own oxygenic photosynthesis for carbon acquisition, UCYN-A has lost its genes for a functional photosystem II. Recent work on this microbe has involved the classification of multiple ecotypes using oligotyping analyses — a technique that uses nucleotide sites with higher variability rather than full length MiSeq data. Upwards of six different ecotypes have been proposed for UCYN-A using this method, and such ecotypes are already being found to differ in their environmental preferences, as well as their likely host specificities. To provide a more comprehensive understanding of growth patterns for ecotypes (for e.g., time, depth, temperature, etc.) we present an oligotyping and phylogenetic analysis of UCYN-A found in a multi-year weekly time-series from the Bedford Basin (NS) – a temperate coastal marine basin. This is paired with weekly chloroplast 16S sequence data to help elucidate haptophyte & UCYN-A ecotype co-occurrences throughout the 2016-sampling year. Our data will help contribute to the definition of UCYN-A subtypes, as well as the future acquisition of novel ecotype genomes, and culturing attempts. A comprehensive understanding of UCYN-A ecotypes will be of vital importance for predicting how this microbe’s growth and distribution can change in response to the alteration of its environment.

Session 1810011 - POSTER SESSION - PART 2

SPIRITed seas; inferring sea surface roughness with a custom built sensor.

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Over larger scales, (1-10 km), sea surface roughness and wave height can be measured effectively by plane or orbital radar. On small to medium (0.1-100 m) scales, sensors including floats, pressure transducers, Baylor wave staffs, and lasers rangefinders have met relative success. However they have limitations in range resolution of the sea surface and in deployment method; requiring tuning to a particular region of the spectrum, facing false measurements due to spray, and generally not being mobile once installed. The objective of this project is to design, build, and test the Single Point Interface Roughness Inferring Transducer (SPIRIT), a wide spectrum surface roughness sensor for mobile platform use. The instrument is composed of a downward pointing ultra-sonic range finder, a co-located nine degrees of freedom inertial motion sensor and global positioning system, along with a data acquisition system. It is mounted topside, on an adjustable boom extending perpendicular to the centerline, at a sufficient distance to place the sensor outside the wake of the ship. The instrument package records the range from sensor to the sea surface, as well as the pitch, roll, yaw and three-axis linear acceleration of the sensor head. A recursive particle motion filter is used to isolate ship and sensor movement from sea surface measurements prior to the spectral analysis of the surface range time series, which is then compared to a Pierson-Moskowitz surface gravity wave spectrum. Applications of this new sensor platform with respect to under-sea acoustic communications are discussed. Sea trials of SPIRIT were completed off the coast of Nova Scotia and aboard the RV Neil Armstrong on the Blake Plateau

in 2017. The reported ocean surface spectra will be used to investigate the effect of surface roughness on under sea acoustic communications and transmission loss.

Session 1810011 - POSTER SESSION - PART 2
Evaluation a limited-area energy budget cycle of an extratropical storm under a Lagrangian framework with the CRCM5.
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Uncertainties regarding the future state of extra-tropical cyclones is of major concern for the eastern coast where these phenomena are most common. The rapid changing of intensity, duration, size and trajectory of these storms under a changing climate can negatively impact the livelihood of individuals and wildlife alike as well as increasing the costs of repair and maintenance of numerous infrastructures. To conceptualize these uncertainties, a study of their energy cycle is useful as it provides key information of their fundamental structure. Following the work by Clement (2016) who evaluated the energy budget of a mid-latitude cyclone using a fixed domain, this study seeks to use the same set of equations but instead have the framework follow, to a degree at which this is most possible, the storm from its cyclogenesis to its cyclolysis. Consequently, the results will not risk being hindered by exterior phenomena, such as a second storm, and will also capture its entire lifespan. The variables used to evaluate the storm are received by the Canadian Regional Climate Model v.5 (CRCM5) within a three-hour interval. The storm in question was arbitrary chosen and resides in the period of the 10-18th December 2004. The components of the energy cycle are all divided into monthly time mean and deviation. Only the latter is of study as it is where the storm’s energy is mainly located.

Session 1810011 - POSTER SESSION - PART 2
Elucidating carbon transport mechanisms that drive air-sea CO₂ fluxes on continental shelves: A numerical modeling study for the Scotian Shelf
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Previous studies of the Scotian Shelf have yielded conflicting results, some identifying it as a source, others as a sink, of atmospheric CO₂. In order to resolve these inconsistent estimates of air-sea CO₂ flux, a quantitative understanding of the underlying carbon transport mechanisms is needed. Two main mechanisms have been proposed to explain the behaviour of continental shelves as either sinks or sources of CO₂. The continental shelf pump, which is thought to apply to continental shelves in general, posits that effective transport of carbon from the shelves to the subsurface open ocean creates a sustained sink of CO₂. In contrast, the Scotian Shelf has been described as an upwelling system, where carbon-rich water is brought from the deep ocean onto the shelf sustaining a source of CO₂ to the atmosphere. To investigate these mechanisms for the Scotian Shelf, we employ a biogeochemical model that reproduces inorganic carbon observations well. Implementation of passive dye and age tracers in the model allows us to elucidate transport pathways. Model results show that the shelf is, overall, neutral with regard to air-sea CO₂ flux, while the near-shore site of a carbon time series acts as a source of CO₂. Mean residence times on the shelf are relatively long.

Analysis of transport pathways shows that water moves along the shelf, but does not cross the shelf break efficiently. The presence of a shelf break current, separating the broad Scotian Shelf from the adjacent deep ocean, effectively prevents both previously reported mechanisms, i.e. outgassing of upwelled inorganic carbon from the deep ocean and export of carbon via the continental shelf pump. This finding likely applies to other coastal regions with broad continental shelves that are bounded by shelf break currents.

Session 1810011 - POSTER SESSION - PART 2
Algal bloom transport modelling in Lake Erie
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We present an algal bloom transport model for Lake Erie using a combination of remote sensing and hydrodynamic modelling. Chlorophyll-a data from the Sentinel-3 OLCI satellite sensor is used to initialize a passive tracer field in the hydrodynamic model. The hydrodynamic model is based on the Water Cycle Prediction System for the Great Lakes and Gulf of St. Lawrence (WCPS-GLS), operated out of Environment and Climate Change Canada. We perform several sensitivity tests during the 2017 bloom season in Lake Erie. We find that the model prediction of surface chlorophyll-a concentration is sensitive to the initial vertical distribution of the chlorophyll-a and the buoyancy velocity of the algal species represented by the bloom.

Session 1810011 - POSTER SESSION - PART 2
Low Sea Ice Concentration in Central Arctic and its Impact Factors
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Central Arctic experiences low sea ice concentration in recent years. To study on the occurrence of this unusual phenomenon and its impact factors, the Low sea ice Concentration in Central Arctic (LCCA) index is defined by using several sea ice concentration data. Although results from each dataset give different index value, the LCCA process is obvious exist. According to ERA-Interim reanalysis data, there are 7 cases recognized as the peaks of LCCA index within the period of June to September from 2009 to 2016. Based on NSIDC NT2 data, there are 5 cases recognized as the peaks of LCCA index from 2003 to 2011. Relatively, LCCA index from AMSR-E/AMSR2 ASI data which ranged from 2003-2017 have few peaks than the others. The analysis results show that the leading factor of low sea ice concentration is not the local air temperature. Dynamically, the drifting pattern of sea ice and the location where the low sea ice concentration occurred response consistently to the atmospheric circulation. Particularly, cyclones used to be found north of 70°N before LCCA index reached peak value. These cyclones moved towards north with warm air from lower latitudes causing sea ice divergence and rapid melting of sea ice. Frequently, cyclones were accompanied with Dipole Anomaly (DA) atmospheric circulation pattern. LCCA index correlates positively with northward heat advection across the circle of 84°N as well as the divergence of Central Arctic sea ice.

Session 1810011 - POSTER SESSION - PART 2
Evaluation of a three level, one-way nested grid model of the Bay of Fundy for the Oceans Protection Plan

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As part of the Oceans Protection Plan initiative, a three-level one-way nested grid model covering the Bay of Fundy has been developed using NEMO. This model is constructed with the finest resolution grid (~100 m) centred on the Saint John harbour and river system, with a 500 m grid covering the entire bay and a 1/36° grid covering the surrounding region of the Scotian Shelf. The model effectively reproduces both tidal and non-tidal flow, and the behaviour of the river plume is consistent with observations. Comparing the model with CTD profiles taken throughout the year shows that the density structure of the Bay is also well-reproduced by the model. Results are shown quantifying the behaviour of the model, including tidal analysis, currents in the Saint John harbour, and comparison with available observations.

Session 1810011 - POSTER SESSION - PART 2
Towards a flexible, multi-platform observing system in the Northwest Atlantic including a Profiling Reference Ocean Site and a fleet of autonomous platforms.
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Within the Northwest Atlantic the atmosphere, surface and deep ocean interact, driving massive exchanges of heat and dissolved gases, and sequestering large amounts of anthropogenic CO2. The region is also highly productive and supports major fisheries. Increasingly, changes in the Arctic and changing southward transport of freshwater and nutrients can reduce deep mixing in the region (with impacts on dissolved gas and heat uptake) and alter productivity. Process understanding and identification of these climate change impacts will require design and deployment of a suite of autonomous measurement systems.

Here we present a concept for multidisciplinary, time-series observation in the Northwest Atlantic, which combines autonomous vehicles with flexible, fixed-location, moored platforms, including a PROS (Profiling Reference OceanSite). We will illustrate the approach with results collected from a deployment, within NSERC's VITALS program, of multidisciplinary moorings and a glider equipped with CO2 and O2 sensors. The deployment included SeaCycler - a profiling surface piercing mooring with two-way near real-time telemetry which carries a rich suite of autonomous sensors. Using SeaCycler data, we estimated the annual cycle of the air-sea oxygen and CO2 flux and downward carbon export. Concurrent, bio-optical data allowed estimation of biomass change and seasonal succession of phytoplankton groups. In situ carbon, nitrogen and oxygen-based estimates of productivity can be compared with each other and remotely-sensed estimates. A concurrent glider deployment used "fly-by's" of the mooring for data quality assessment, and estimation of the representativeness of the fixed-location measurements. We will outline a new, CFI-supported infrastructure program, Development of Autonomous Marine Observation Systems (DAMOS), which will allow extension of this concept to focus on: 1) characterizing shifting ecosystems and the consequent impacts on aquatic species, 2) quantifying ocean carbon uptake and the implications for managing climate change, and 3) understanding climate change impacts on the ocean. The infrastructure program has close ties to related efforts of DFO and the Ocean Frontier Institute.

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A data-assimilative physical-biogeochemical model for the Gulf of Mexico

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The Gulf of Mexico is a site of significant oil and gas exploration and extraction activities with potentially harmful effects on the surrounding ecosystem, as seen, for example, during the 2010 Deepwater Horizon oil spill. In addition to such catastrophic events, ocean ecosystems, including those in the Gulf, are under increasing pressure from ocean warming, acidification and deoxygenation. Numerical models are useful tools for short-term prediction, and to improve our understanding of long-term changes, but thus far a lack of high-resolution ocean observations has made it difficult to validate and improve physical-biogeochemical models. We are developing a data-assimilative physical-biogeochemical model for the Gulf of Mexico with the goal of improving predictive power of how natural variability, anthropogenic effects, and climate change affect marine ecosystems now and in the future. The model will assimilate physical and biogeochemical observations from satellites and autonomous floats including sea surface height, seas surface temperature, sea surface chlorophyll, and profiles of temperature, salinity, chlorophyll, particulate organic carbon, and oxygen. Initial model results will be discussed in the context of our long-term objectives.

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Estimation of phytoplankton taxonomic groups in the Arctic Ocean using phytoplankton absorption properties: implication for ocean-colour remote sensing

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Knowledge on the phenology and distribution of phytoplankton taxonomic groups (PTG) represent valuable information when studying marine ecosystem, especially in the Arctic Ocean where rapid warming has drastic effects. Taxonomic groups of phytoplankton can be discriminated based-on their pigment signature, which, in turn, impact their absorption spectra, given that different pigments have different absorption properties. Using 126 measurements of phytoplankton diagnostic pigments and associated absorption spectra (aph) in the Bering and Chukchi Seas, a novel method is designed to estimate the concentration and contribution to total biomass of PTGs from aph using a linear mixed model. First, the chemotaxonomic tool CHEMTAX applied to twelve diagnostic pigments measured by high-performance liquid chromatography (HPLC) revealed that the phytoplankton community composition was made of eight groups, from which four dominant were identified: Diatoms, Dinoflagelates, haptophytes and Prasinophytes . Twenty pairs of Total chlorophyll-a concentration (Chla) and aph were randomly selected and used in a linear inverse calculation to extract the specific absorption spectra (absorption spectra normalized to Chla) endmember of each PTG. This step was repeated 1000 times to provide the mean specific absorption and standard deviation of the four PTGs. In turn, these four specific absorption spectra endmembers were used to reconstruct total aph , which was consistent with the measured aph with high correlation (R2 from 0.8 to 0.95) and a slope of linear regressions close to one (slopes from 0.9 to 1.2) at all visible wavelengths (400-700 nm). Our approach was further applied to aph(λ) for the ten MODIS wavelengths to retrieve the Chla

of the four PTGs. A comparison between the estimated and measured Chla of the four phytoplankton groups showed good correlations ($R2 > 0.5$) and low mean absolute percentage error ($MAPE< 40\%$). The method developed in this study showed similar performance than MODIS when using SeaWIFS wavelengths.