

Atmosphere

11th ANNUAL CONGRESS

1-3 June 1977

Winnipeg

**Canadian Meteorological Society
Société Météorologique du Canada**

ATMOSPHERE

Volume 15 – 11th Annual Congress Issue – 1977

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ELEVENTH ANNUAL CONGRESS

CANADIAN METEOROLOGICAL SOCIETY

The Eleventh Congress of the Canadian Meteorological Society will be held on 1, 2, and 3 June 1977 at the Winnipeg Convention Centre.

For the third year the Society is fortunate in having the very active participation of its Oceanography Division at the Congress. Of the 90 papers scheduled to be presented, 30 have been grouped in six "Oceanography Sessions" (designated O.1 to O.6) and 60 in eleven Meteorology Sessions" (M.1 to M.11). For convenience the Oceanography and Meteorology papers have been assigned the numbers 02 to 30 and 102 to 160 respectively.

The Coordinating Committee for the Congress is composed of

K. A. Fluto, Chairman, Social Banquet

H. M. Hacksley, Winnipeg Centre Chairman, Facilities, Annual Meeting

H. M. Fraser, Scientific Program

J. F. McMorran, Treasurer

M. Shewel, Winnipeg Centre Vice-Chairman, Publicity

Doris Siemieniuk, Winnipeg Centre Secretary, Registration.

The Scientific Program Committee was composed of: E. Einarsson, C. D. Henry, W. C. Bell, J. Maybank, E. Lozowski, N. Boston, and B. R. Kerman.

SUMMARY OF SESSIONS

Wednesday 1 June

Time	Session	Room
0830 - 0850	Opening Welcome	1
0850 - 1030	Theme: The Meteorology of the Great Plains	1
1100 - 1300	O.1 Offshore Oceanography	16
1100 - 1200	M.1 Weather Forecasting	1
1330 - 1500	M.2 Weather Forecasting	1
1530 - 1700	M.3 Acoustic Sounding of the Atmosphere	1
1400 - 1710	O.2 Limnology	16
1930	Annual General Meeting CMS	1

Thursday 2 June

0900 - 1200	O.3 Estuaries	16
0900 - 1200	O.4 Coastal Processes	15
0830 - 1000	M.4 Numerical Modelling of the Atmosphere	13
1030 - 1200	M.5 Climatology	13
1200 - 1430	Banquet and Awards	3
	Speaker: Dr Paul Hiebert, Professor Emeritus, University of Manitoba	
1430 - 1630	Oceanography Division Business Meeting and Election of Officers	
1430 - 1700	M.6 Meteorological Applications	13
1430 - 1700	M.7 Boundary Layer; Mesometeorology	15

Friday 3 June

0900 - 1210	O.5 Canadian Arctic - Research	16
0830 - 1000	M.8 Solar and Wind Power	13
1030 - 1200	M.9 Air Quality	13
1400 - 1710	O.6 Canadian Arctic - Operation	16
1330 - 1500	M.10 Cloud Physics	13
1530 - 1700	M.11 Hail	13

PROGRAM

Wednesday, 1 June 1977

Opening Welcome:	Hon. Sidney Green Minister of Mines, Resources and Environmental Management Government of Manitoba	Wed 0830 – 0850 Room 1
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Dr J. E. Hay
Canadian Meteorological Society

Dr D. Farmer
CMS Subcommittee on Oceanography

THEME SESSION	<i>The Meteorology of the Great Plains</i>	Wed 0850 – 1030
Chairman	J. E. Hay	Room 1

THE INTERFACE BETWEEN THE ATMOSPHERE AND MAN'S ECONOMIC ACTIVITIES
Dr J. D. McQuigg, McQuigg Consultants, Columbia, Missouri

RECENT PROGRESS IN UNDERSTANDING OCEAN CURRENTS
Dr N. P. Fofonoff, Woods Hole Oceanographic Institution, Woods Hole, Massachusetts

SESSION O.1	<i>Offshore Oceanography</i>	Wed 1100 – 1300
Chairman	C. R. Mann	Room 16

02 ON THE STABILITY OF EASTERN BOUNDARY CURRENTS
Lawrence A. Mysak, Department of Mathematics, University of British Columbia,
Vancouver

03 AIR-SEA INTERACTION – MEASUREMENTS AT A STABLE TOWER OFF
HALIFAX HARBOUR, NOVA SCOTIA
R. J. Anderson and S. D. Smith, Bedford Institute, Dartmouth

04 CURRENT MEASUREMENTS BENEATH THE GULF STREAM
Ross Hendry, Bedford Institute, Dartmouth

05 DIRECT AIR-SEA CO₂ GAS FLUX MEASUREMENTS USING THE EDDY
CORRELATION TECHNIQUE
E. P. Jones and S. D. Smith, Bedford Institute, Dartmouth

06 BAROCLINIC INSTABILITY IN SHALLOW SEAS

C. L. Tang, Bedford Institute, Dartmouth

07 ABYSSAL OCEAN CIRCULATION EFFECTS IN AN ENERGY BALANCE MODEL

Anne O'Toole and George J. Boer, Atmospheric Environment Service, Downsview

Lunch 1300 - 1400

SESSION M.1

Weather Forecasting

Wed 1100 - 1200

Chairman

M. W. Balshaw

Room 1

102 ON THE USE OF GRAVITY WAVES IN OPERATIONAL
CONVECTIVE FORECASTING

Richard P. McNulty, National Severe Storms Forecast Center, Kansas City, Missouri

103 NUMERICAL PREDICTIONS OF SURFACE AIR TEMPERATURE AND MOISTURE

A. Maarouf, Atmospheric Environment Service, Downsview

104 STATISTICAL AIDES IN OPERATIONAL METEOROLOGY

A. W. Cott, R. L. Raddatz, and K. Fluto, Atmospheric Environment Service, Winnipeg

Lunch 1200 - 1330

SESSION M.2

Weather Forecasting

Wed 1330 - 1500

Chairman

M. W. Balshaw

Room 1

105 VERIFICATION OF FORECASTS IN A MAJOR FORECAST OFFICE

N. Yacowar, J. Blouin, Y. Bernier, P. Dubreuil, J. Irwin, H. Woronko, and Staff of the Québec Weather Office

106 AN OPERATIONAL TECHNIQUE FOR THE VERIFICATION OF SUBJECTIVE
FORECASTS

H. T. Beal, Prairie Weather Centre, Winnipeg

107 VERIFICATION OF WORDED PUBLIC FORECASTS

J. Gariépy, L. Garand, N. Yacowar, and the Staff of the Québec Forecast Office

108 MEASUREMENT OF THE CONCENTRATION OF FALLING SNOW

J. R. Stallabrass, NRC, Ottawa

109 RELATING ALBERTA THUNDERSTORMS TO SYNOPTIC SHORT WAVES

G. S. Strong, Alberta Hail Project, Mynarski Park

Coffee 1500 - 1530

Chairman

B. R. Kerman

Room 1

- 110 TYPICAL FEATURES OF ATMOSPHERIC TURBULENCE PROFILES ASSOCIATED WITH CHINOOKS
T. Mathews and R. B. Hicks
- 111 THE LAKE BREEZE AT TORONTO
Richard C. Bennet, Ministry of the Environment, Victoria
- 112 OBSERVATIONS OF NOCTURNAL INVERSION LAYERS BY REMOTE ACOUSTIC AND TETHERED BALLOON SOUNDING
R. B. Hicks and T. Mathews
- 113 QUANTITATIVE MEASUREMENTS WITHIN THE TROPICAL MARINE BOUNDARY LAYER DURING GATE USING A SHIP-MOUNTED ECHO SOUNDER
John E. Gaynor, NOAA, Boulder, Colorado
- 114 THE RELATIONSHIP OF SFERICS AND CONVECTIVE ACTIVITY OVER NORTH AMERICA
R. D. Grimes, Canadian Forces Weather Office, Westwin, Manitoba
Dr Bhartendu, Atmospheric Environment Service, Downsview

SESSION O.2

Limnology

Wed 1400 - 1710

Chairman

F. M. Boyce

Room 16

- 08 THE EVOLUTION OF A NUMERICAL MODEL FOR ESTIMATING PHYTOPLANKTON PRIMARY PRODUCTION IN LAKES (Invited paper)
Everett J. Fee, Freshwater Institute, Winnipeg
- 09 SOME FEATURES OF THE THERMAL STRUCTURE OF LAKE ONTARIO
F. M. Boyce, Canada Centre for Inland Waters, Burlington
- 010 MIGRATING TEMPERATURE STRUCTURE IN STRATIFIED FRESH WATER LAKES
J. R. Lazier and H. Sandstrom, Bedford Institute, Dartmouth
- 011 NUMERICAL STUDIES OF AIRFLOW OVER SHORT, STEEP WIND WAVES
P. A. Taylor, Department of Oceanography, University of Southampton, England
- 012 TRENDS IN SEDIMENTATION RATES IN THE SAGUENAY RIVER AS DETERMINED BY THE Pb-210 METHOD
J. N. Smith and A. Walton, Bedford Institute, Dartmouth
- 013 WHITECAPS AND MOMENTUM TRANSFER
M. A. Donelan, Canada Centre for Inland Waters, Burlington

Coffee 1500 - 1530

Thursday, 2 June

- | | | |
|-------------|------------------|------------------|
| SESSION 0.3 | <i>Estuaries</i> | Thur 0900 - 1200 |
| Chairman | G. L. Pickard | Room 16 |
- 014 A REVIEW OF STUDIES IN ESTUARIES (Invited paper - Tentative Title)
D. M. Farmer, Institute of Ocean Sciences, Victoria
- 015 A STUDY OF PHYSICAL PROCESSES IN THE RUPERT BAY ESTUARY
R. G. Ingram, C. d'Anglejan and J. -C. Deguise, Marine Sciences Centre, McGill University, Montreal
- 016 GEOCHEMISTRY OF SULPHUR IN SEDIMENTS FROM THE ST LAWRENCE ESTUARY AND SAGUENAY FJORD
André Ouellet and Bjørn Sundby, Laboratoire d'océanographie Université du Québec à Rimouski
- 017 OBSERVATIONS IN THE SUSPENDED MATTER MAXIMUM OF THE ST LAWRENCE ESTUARY
Bjørn Sundby and Norman Silverberg, Laboratoire d'océanographie, Université du Québec à Rimouski
- 018 SUSPENDED AND BOTTOM SEDIMENT INTERACTION IN THE MIRAMICHI ESTUARY, N.B.
Kate Kranck, Bedford Institute, Dartmouth
- 019 THE CAUSE OF THE MID-DEPTH TEMPERATURE MINIMUM IN SOME B.C. INLETS
M. R. MacNeill and G. L. Pickard, Institute of Oceanography, University of British Columbia, Vancouver
-

- | | | |
|-------------|--------------------------|------------------|
| SESSION 0.4 | <i>Coastal Processes</i> | Thur 0900 - 1200 |
| Chairman | N. E. J. Boston | Room 15 |
- SOME PERSPECTIVES ON COASTAL OCEANOGRAPHY (Invited paper)
D. M. Farmer, Institute of Ocean Sciences, Victoria
- 020 FACTORS INFLUENCING TRACE METAL CONCENTRATIONS IN COASTAL WATERS
P. A. Yeats, J. M. Bewers, and A. Walton, Bedford Institute, Dartmouth
- 021 WATER EXCHANGE AT THE EDGE OF THE CONTINENTAL SHELF
H. Sandstrom, Bedford Institute, Dartmouth
- 022 A NOTE ON FREE OSCILLATIONS OF CHEDABUCTO BAY
F. G. Barber and J. D. Taylor, Marine Sciences Directorate, Ottawa
- 023 PHYSICAL OCEANOGRAPHY OF JAMES BAY
S. J. Prinsberg, Ocean and Aquatic Sciences, Burlington

024 LOW-FREQUENCY FLUXES OF MOMENTUM, HEAT, SALT AND NUTRIENTS AT THE EDGE OF THE SCOTIAN SHELF

Peter C. Smith, Bedford Institute, Dartmouth

Coffee 1000 - 1030

Banquet and Awards 1200 - 1430

SESSION M.4 *Numerical Modelling of the Atmosphere* Thur 0830 - 1000

Chairman P. Merilees Room 13

115 A CANADIAN GCM
G. J. Boer, N. McFarlane, L. Steinberg, Atmospheric Environment Service, Downsview

116 SIMULATION OF THE ZONALLY AVERAGED ATMOSPHERIC CIRCULATION
N. McFarlane, Atmospheric Environment Service, Downsview

117 THE IMPORTANCE OF VERTICAL RESOLUTION IN PLANETARY WAVE MODELLING
J. Derome, E. Kirkwood, and J. G. Desmarais, McGill University, Montreal

118 A THREE-DIMENSIONAL STUDY OF ATMOSPHERIC FRONTOGENESIS
G. V. Price, Lehigh University, Bethlehem, Pa

119 EVALUATION OF NUMERICAL APPROXIMATIONS FOR ESTIMATING THE GROUND HEAT FLUX IN MESOSCALE NUMERICAL MODELLING
John D. Reid, Atmospheric Environment Service, Downsview

Coffee 1000 - 1030

SESSION M.5 *Climatology* Thur 1030 - 1200

Chairman K. Hage Room 13

120 NATIONAL ARCHIVAL DATA FOR CLIMATOLOGICAL AND METEOROLOGICAL APPLICATIONS
Jack Edward Donegani, Atmospheric Environment Service, Downsview

121 NEW QUALITY CONTROL PROCEDURES FOR CLIMATOLOGICAL DATA
D. W. Buss, Atmospheric Environment Service, Downsview

122 A CLIMATIC CLASSIFICATION OF THE NORTHWEST TERRITORIES FOR RECREATION AND TOURISM
R. B. Crowe, Atmospheric Environment Service, Downsview

123 CLIMATIC CLASSIFICATIONS OF THE PRAIRIE PROVINCES
J. M. Powell, Canadian Forestry Service, Edmonton

124 LAPSE RATES IN THE LOWER 250 METRES NEAR WINNIPEG
W. C. Bell, University of Winnipeg, Winnipeg

Oceanography Division Business Meeting and Election of Officers

1430 – 1630
Room 16

Coffee 1530 – 1600

SESSION M.6 *Meteorological Applications* **Thur 1430 – 1700**

Chairman S. V. A. Gordon **Room 13**

- 125 **PHYSICAL VS MATHEMATICAL MODELS IN AGROMETEOROLOGY**
P. H. Schuepp, Macdonald College, Ste Anne de Bellevue
- 126 **RELATIONSHIP BETWEEN THE SMALL NEGATIVE AIR IONS AND THE RESPIRATION OF MOUSE LIVER CELLS IN VITRO**
Dr Bhartendu, Atmospheric Environment Service, Downsview, and I. A. Menon, University of Toronto
- 127 **IMPACT OF AIR IONS ON BIOLOGICAL ACTIVITIES OF PLANTS**
N. Barthakur, T. M. Elkiey, R. L. Pelletier, and Dr Bhartendu, Macdonald College, Ste Anne de Bellevue
- 128 **METEOROLOGICAL INFLUENCES ON THE DISPERSION OF GRAIN DUST INTO COMMUNITIES ON THE CANADIAN GREAT PLAINS**
S. R. Shewchuk, Saskatchewan Research Council, Saskatoon
- 129 **AGRICULTURAL WEATHER IN THE RED RIVER BASIN OF SOUTHERN MANITOBA OVER THE PERIOD 1800 TO 1975**
T. R. Allsopp, Atmospheric Environment Service, Downsview
- 130 **DROUGHTS ON THE CANADIAN PRAIRIES**
Henry Stanski, Dale Henry, and H. M. Fraser, Atmospheric Environment Service, Winnipeg
- 131 **PRECIPITATION NETWORK REQUIREMENTS FOR HYDROLOGICAL FORECASTING – AN APPLICATION OF OBJECTIVE TECHNIQUES**
W. I. Pugsley and L. O. Mapanao, Atmospheric Environment Service, Downsview
- 132 **A REGRESSION MODEL FOR THE PREDICTION OF WIND INDUCED SET-UP ON LAKE WINNIPEG**
E. Einarsson, K. A. Fluto, G. B. Atkinson, and H. T. Beal, Atmospheric Environment Service, Winnipeg

Coffee 1530 – 1600

Chairman

D. Leahey

Room 15

- 133 MODEL OF THE ATMOSPHERIC BOUNDARY LAYER OVER AN EXTENSIVE SNOWFIELD AND ITS RELATION TO AIR MASS TRANSFORMATION OVER THE CANADIAN AND AMERICAN PLAINS
I. M. Halberstam, Jet Propulsion Laboratory, Pasadena, California
- 134 A MESOSCALE BOUNDARY LAYER MODEL FOR THE STUDY OF UPSLOPE WEATHER OVER THE CANADIAN WESTERN PLAINS
R. L. Raddatz and M. L. Khandekar, Atmospheric Environment Service
- 135 ON THE PREDICTION OF MESOSCALE WINDS AT YORKTON, SASKATCHEWAN AND VICINITY
S. Venkatesh, Atmospheric Environment Service, Downsview
- 136 DETERMINATION OF SURFACE WINDS IN THE ALBERTA OIL SANDS AREA FROM A MESOSCALE MODEL
John L. Walmsley and John D. Reid, Atmospheric Environment Service, Downsview
- 137 GATE CLOUD CLUSTERS
Catherine Gautier, Université du Québec à Rimouski
- 138 A CRITICAL REVIEW ON THE SIGNIFICANCE OF THE DIABATIC INFLUENCE FUNCTIONS AND THE VON KARMAN CONSTANT
A. K. Lo and G. A. McBean, Atmospheric Environment Service, Downsview
- 139 EFFECTS OF AEROSOL INDUCED HEATING ON THE CONVECTIVE BOUNDARY LAYER
A. Venkatram, Atmospheric Environment Service, Downsview
- 140 FIELD MEASUREMENTS OF DRY REMOVAL RATES OF AIR POLLUTANTS OVER VEGETATION SURFACES
J. G. Droppo, Battelle, Pacific Northwest Laboratory, Richland, Washington

Coffee 1530 - 1600

Friday, 3 June

SESSION O.5

Canadian Arctic - Research

Fri 0900 - 1210

Chairman

A. E. Milne

Room 16

- 025 RECENT ADVANCES IN ARCTIC OCEANOGRAPHY (Invited paper)
E. L. Lewis, Frozen Sea Research Group, Victoria
- 026 OCEANOGRAPHIC OBSERVATIONS IN PENNY STRAIT, NWT
G. S. Peck, Ocean and Aquatic Sciences, Burlington
- 027 OCEANOGRAPHIC OBSERVATIONS IN BARROW STRAIT, NWT
R. H. Herlinveaux and D. B. Fissel, Institute of Ocean Sciences, Victoria

- 028 WATER STRUCTURE IN THE GREELY FIORD SYSTEM
R. A. Lake and E. R. Walder, Frozen Sea Research Group, Victoria
- 029 RECTILINEAR LEADS AND INTERNAL MOTIONS IN THE ICE PACK OF THE WESTERN ARCTIC OCEAN
J. R. Marko and R. E. Thomson, Institute of Ocean Sciences, Victoria
- 030 THE WINTER ENERGY REQUIREMENT OF AN OPEN WATER CHANNEL IN THE GULF OF ST LAWRENCE
Fabiola Renaud, Department of Meteorology, McGill University, Montreal

Coffee 1000 - 1030

Lunch 1210 - 1400

SESSION M.8 Solar and Wind Power Fri 0830 - 1000

Chairman J. E. Hay Room 13

- 141 WIND POWER AND SOLAR ENERGY RELATED TO A SUBURBAN OR FARM HOME
A. H. Lamont, Atmospheric Environment Service, Winnipeg
- 142 SOLAR POWER - IS IT THE ANSWER FOR REMOTE SITES?
R. Van Cauwenberghe, Atmospheric Environment Service, Downsview
- 143 MODELLING SOLAR RADIATION FOR DAYS WITH CLOUD
Philip W. Suckling, University of British Columbia, Vancouver
- 144 FLUX-GRADIENT RELATIONSHIPS OVER SNOW
D. H. Male and R. J. Granger, University of Saskatchewan, Saskatoon
- 145 ON THE DEVELOPMENT OF SECONDARY CIRCULATION IN THE CANADIAN ARCTIC
E. R. Reinelt and B. C. Green, University of Alberta, Edmonton

Coffee 1000 - 1030

SESSION M.9 Air Quality Fri 1030 - 1200

Chairman M. Kwizak Room 13

- 146 THE DISTRIBUTION OF ATMOSPHERIC SULPHATES IN CANADA AND ITS RELATIONSHIP TO LONG-RANGE TRANSPORT OF AIR POLLUTANTS
Y. S. Chung, Atmospheric Environment Service, Downsview
- 147 PLUME DISPERSION AND ASSOCIATED TURBULENCE CHARACTERISTICS FROM A LARGE INDUSTRIAL SITE IN THE ATHABASCA OIL SANDS
D. S. Davison, C. C. Fortems and K. L. Grandia, Intera Environmental Consultants, Calgary

- 148 CALCULATIONS OF SEASONAL AND ANNUAL POLLUTION CONCENTRATIONS
IN THE ALBERTA OIL SANDS
John L. Walmsley and Dave Bagg, Atmospheric Environment Service, Downsview
- 149 A PRELIMINARY EXAMINATION OF POOR AIR QUALITY LEVELS IN CALGARY
IN RELATION TO MOUNTAIN GENERATED WIND SYSTEMS
Douglas Leahey, Western Research and Development Ltd, Calgary
- 150 INFLUENCE OF IONS IN GAS-TO-PARTICLE REACTIONS
D. Corr, G. Diamond, C. Banic, and J. V. Iribarne, University of Toronto

Lunch 1200 - 1330

SESSION O.6 *Canadian Arctic - Operations* Fri 1400 - 1710

Chairman R. H. Goodman Room 16

- 031 INDUSTRY AND GOVERNMENT CONSTRAINTS AND REQUIREMENTS IN
ARCTIC OPERATIONS (Invited Paper - Tentative Title)
A. E. Collin, Assistant Deputy Minister, Ocean and Aquatic Sciences, Fisheries
and Environment Canada
- 032 SATELLITE DATA RETRANSMISSION FOR ARCTIC STUDIES
R. A. Atkins and R. H. Goodman, Innovative Ventures Limited, Calgary
- 033 THE BEHAVIOUR OF OIL IN ICE-COVERED AND ICE-INFESTED SEAS
George Greene, Imperial Oil, Calgary
- 034 THE BIOLOGICAL OCEANOGRAPHY PROGRAM FOR IMPERIAL OIL IN DAVIS
STRAIT (Tentative Title)
Shirley M. Conover, MacLaren-Atlantic, Halifax and Evan Birchard, Imperial
Oil, Toronto
- 035 EFFECT OF FLUORIDE ON PHOSPHORITE SOLUBILITY BEHAVIOUR IN
SEAWATER
Scott MacKnight, Royal Roads Military College, Victoria
- 036 TURBULENT DIFFUSION VARIABILITY AND THE MARINE ENVIRONMENT
D. P. Krauel, Royal Roads Military College, Victoria
- ENVIRONMENTAL PREDICTION FOR ARCTIC MARINE OPERATIONS
J. C. O'Rourke, Canadian Marine Drilling Ltd, Calgary

Coffee 1500 - 1530

SESSION M.10 *Cloud Physics* Fri 1330 - 1500

Chairman W. Hitschfeld Room 13

- 151 THE THERMODYNAMIC AND DYNAMIC EFFECTS OF CUMULUS CLOUDS
OBSERVED IN AMTEX '74
H. R. Cho and T. C. Yip, University of Toronto

- 152 EMPIRICAL RELATIONSHIP BETWEEN PARCEL CONVECTIVE ENERGY AND
MAXIMUM RAINFALL RATE
C. U. Ro and I. Zawatzki, Université du Québec à Montréal
- 153 SIMULATION OF GRAUPEL GROWTH IN A LABORATORY CLOUD CHAMBER
M. M. Oleskiw and E. P. Lozowski, University of Alberta, Edmonton
- 154 THE FATE OF ELECTRICAL CHARGES IN CLOUD DROPLETS
B. A. Thompson and J. V. Iribarne, University of Toronto
- 155 COMPARISONS OF CALCULATIONS AND OBSERVATIONS OF ICE CRYSTAL
GROWTH FOLLOWING SEEDING
J. W. Strapp and H. G. Leighton, McGill University, Montreal

Coffee 1500 - 1530

<i>SESSION M.11</i>	<i>Hail</i>	Fri 1530 - 1700
Chairman	J. Renick	Room 13
156	A NUMERICAL MODEL FOR NON-STEADY HEAT TRANSFER DURING HAILSTONE ICING R. D'Amours and E. Lozowski, University of Alberta, Edmonton	
157	EVALUATION OF HAILFALL FROM HAILPAD AND RADAR DATA Peter Wrenshall and Robert Charlton, University of Alberta, Edmonton	
158	ANALYSIS OF AN ALBERTA MULTICELL STORM K. L. Grandia, D. S. Davison and D. R. Inkster, Intera Environmental Consultants Ltd, Calgary	
159	THE SASKATCHEWAN HAIL RESEARCH PROJECT, 1973-1976 Alexander H. Paul, University of Regina	
160	HAIL SUPPRESSION: WHERE DO WE GO FROM HERE? Peter W. Summers, National Center for Atmospheric Research, Boulder, Colorado	

Session O.1

Offshore oceanography

Wed 1100 - 1300

ON THE STABILITY OF EASTERN BOUNDARY CURRENTS

Lawrence A. Mysak

Recent hydrographic and current observations of the Norwegian Current show a considerable amount of low-frequency variability. In particular, many of the current spectra are peaked at around 2-3 days. Associated with these motions are eddy-like patterns in the isopycnals, with horizontal scales of order 50 km. Eddy-like patterns with similar length scales have also been observed in the density field off the west coast of Vancouver island and appear to be related to variations in the California Undercurrent. I will present evidence which suggests that, in both cases, the observations are a manifestation of baroclinic instability of the mean flow along the continental slope region.

AIR-SEA INTERACTION: MEASUREMENTS AT A STABLE TOWER OFF HALIFAX HARBOUR, NOVA SCOTIA

R. J. Anderson and S. D. Smith

We are measuring wind stress and heat exchanges between air and water in the open ocean with particular interest in storm conditions. These are derived from the fluctuations of wind velocity, temperature, humidity, and wave height measured at a location with unlimited fetch, deep-water waves, and negligible land interference. For these reasons a stable tower was anchored in 58m of water near the approaches to Halifax Harbour, Nova Scotia.

This paper describes the tower design and operation to date and the sensors and data collection system used. Some preliminary results of 76/77 winter operations will be presented.

CURRENT MEASUREMENTS BENEATH THE GULF STREAM

Ross Hendry

One year of moored current measurements from three sites along 40° 30' N has now been recovered from a planned 18-month experiment. Moorings equipped with Aanderaa current meters at 4000 m and 4700 m depth were set with 30 and 40 km zonal separations in water 5150 m deep, between 55° and 56° W under the mean axis of the Gulf Stream. The experiment was designed to explore the time scales and short zonal spatial scales of the energetic low frequency fluctuations in the deep water, and to attempt to measure the mean flow to add to the knowledge of abyssal circulation patterns in the deep western North Atlantic. Mean flows with a westward component of several cm/s were observed in a fluctuating background with horizontal root-mean-square currents of about 10 cm/s. The fluctuations were coherent over the zonal separations involved, and a dominant zonal scale of about 90 km was suggested. Although the deep motions are not directly coupled to the strong eastward flows in the surface Gulf Stream above 2000 m, work is continuing to resolve the relationship between the surface stream and the energetic deep motions.

DIRECT AIR-SEA CO₂ GAS FLUX MEASUREMENTS USING THE EDDY CORRELATION TECHNIQUE

E. P. Jones and S. D. Smith

With the measurement of a CO₂ flux between the air and sea using the eddy correlation method, we have demonstrated that direct gas flux measurements can be made over a short enough time and a small enough geographical area to be correlated with weather and other conditions that can change rapidly. The measurements were made in July 1976 on Sable Island, Nova Scotia, during on-shore winds at a beach site similar to one used for previous eddy correlation measurements of heat, moisture, and momentum fluxes. Both time series and Fourier transform methods of analysis were applied to the data. CO₂ fluxes were typically about 10⁻⁶ moles/(m² s), always out of the ocean as expected from CO₂ supersaturation indicated by our alkalinity analysis of the water samples and consistent with CO₂ supersaturation as a result of the seasonal warming of the ocean. The frequency spectrum of the CO₂ concentration fluctuations, which shows a maximum at about 0.2 Hz tailing off to nearly zero at 1 Hz, is generally similar to the spectrum observed for vertical wind and temperature. Typical wind speeds during the period of measurements were about 8 m/s. Unfortunately, conditions did not vary enough to draw conclusions with respect to the gas flux dependence on wind speed or other environmental quantities.

BAROCLINIC INSTABILITY IN SHALLOW SEAS

C. L. Tang

Residual currents in a shallow sea usually have large fluctuations with horizontal scales much smaller than the dimension of the sea. One of the mechanisms that can cause such small-scale motions is the baroclinic instability. In the deep ocean outside the area of strong boundary currents, baroclinic instabilities are believed not to occur because of the weak mean shear and the strong β -effect. In the shallow seas, the mean currents are of the same order of magnitude as the fluctuations and the β -effect is negligible, hence the environment for instability to occur is more favourable. In fact, it is shown that for $\beta=0$ shears of any magnitude and direction can produce baroclinic instability.

The baroclinic instability of a two-layer system with a linear bottom friction is investigated by analyzing the linearized quasi-geostrophic equations for the system. It is found that the bottom friction has a strong effect on the growth rates of the baroclinic waves. For a baroclinic radius of deformation of 5 km, a vertical shear of 10 cm s⁻¹, the e -fold time, T_e , increases from 2 days to 25 days as the bottom friction coefficient is changed from 0 to 0.25 cm s⁻¹. The transient development of the instability from a weak disturbance to a monochromatic wave is studied by solving the initial value problem analytically. The results show that the magnitude of the initial eddy grows linearly for $t \ll T_e$. Gradually two weaker eddies rotating in opposite sense to that of the primary eddy centred along the direction of the shear are developed. These eddies are slightly elongated in the cross-stream direction. As t increases, more and more eddies with alternative sense of rotation appear and the elongations become more pronounced. The whole pattern of eddies moves with the mean current. At $t \gg T_e$, the eddies are transformed into a wave with an exponentially growing amplitude.

ABYSSAL OCEAN CIRCULATION EFFECTS IN AN ENERGY BALANCE MODEL

Anne O'Toole and George J. Boer

A time dependent energy balance model (Gal-Chen and Schneider, 1976) was extended to include effects from the abyssal ocean circulation. A zonally averaged form of Stommel and Arons' (1960) model for the abyssal circulation was used with the assumption of uniform upwelling through the base of the mixed layer and concentrated sources for this upwelling bottom water at high latitudes.

Experiments were performed with the extended energy balance model to examine its response to solar constant changes and changes in internal model conditions. Comparisons of the results from these experiments were made with the results of similar experiments with the energy balance model having no abyssal circulation effects.

In other experiments with the extended model, theories of climate change proposed by Weyl (1968) and Newell (1974) were investigated. Our calculation, although crude, did not support these hypotheses, which appeal to abyssal circulation effects to explain cyclic glaciation.

Session M.1

Weather forecasting

Wed 1100 - 1200

ON THE USE OF GRAVITY WAVES IN OPERATIONAL CONVECTIVE FORECASTING

Richard P. McNulty

The use of gravity-wave phenomena in convective forecasting is addressed. The observed characteristics of gravity waves are examined and comments made on the description of a gravity wave in the atmosphere as compared to the theoretical version. The theoretical approach to the gravity-wave convection concept is briefly reviewed. Simplified gravity model is used to examine the properties of a typical "trapped" gravity wave. These properties are discussed in terms of the initiation of convection. The conclusion is drawn that the use of gravity waves in operational forecasting is severely limited by the observing network.

NUMERICAL PREDICTIONS OF SURFACE AIR TEMPERATURE AND MOISTURE

A. Maarouf

A numerical module is developed to compute the surface air temperature and dew-point temperature predictions hour by hour out to 24 hours. The forecast values are generated over a 19 x 22 grid centred nearly over the Beaufort Sea. The grid interval is 127 km at 60 N. A quasi-Lagrangian advective scheme is used to compute temperature and dew point values that follow air trajectories terminating at grid points. The two-dimensional trajectories are computed from geostrophic wind forecasts generated by a Regional Update Model (RUM) operational at the Arctic Weather Centre. A non-advective component determined from the diurnal cycles of temperature and dew point is added each hour. The normal diurnal variation has been obtained from a short climatological record and the approximate departure from the normal is assessed by the amount of cloud cover, moisture content in the surface layer, and the lapse rate of temperature between the surface and 850-mb level. The forecasts of cloud cover and 850-mb temperature are generated from a Multi-Level Spectral Primitive Equation Model of the Canadian Meteorological Centre (CMC). Sensible heat flux between the surface layer and an underlying sea surface is taken into account along the surface trajectory. Subsequent changes in surface air temperature are assumed to be a function of initial lapse rate, initial air temperature, sea-surface temperature, and length of over-water trajectory. Verification statistics of forecasts made on historical data for 180 days from 1974 and 1975 indicate significantly higher skill over persistence, climatology, and a combination of the two. This module is part of a Computerized Prediction Support System (CPSS) designed for application in the Beaufort Sea drilling operations.

STATISTICAL AIDS IN OPERATIONAL METEOROLOGY

A. W. Cott, R. L. Raddatz, and K. Fluto

Statistical techniques are being developed to aid forecasters in the decision-making process. Some of these techniques are discussed. A multivariate statistical method of discriminant analysis was used to objectively forecast the probability of thunderstorm occurrences over an area of southern Manitoba. This technique showed skill in resolving the days into those with and without thunderstorms. Multiple linear techniques have also been found useful in operational meteorology. Local work on the use of multiple linear regression in the forecasting of maximum and minimum temperatures will be presented.

VERIFICATION OF FORECASTS IN A MAJOR FORECAST OFFICE

J. Blouin, Y. Bernier, P. Dubreuil, J. Irwin, H. Woronko, N. Yacowar, and the Staff of the Québec Weather Office

The development of any verification abstract scheme should have two goals: to determine the state of the art of forecasting, or the relative skill of methods of forecasting, and to improve the quality of future forecasts. Weaknesses in the forecast system, such as bias or basic misinterpretations may be uncovered by verifications. Forecasters will be more alert and interested in the accuracy of their products if they are aware that their forecasts are being verified. A system of control must also be set up to determine the skill or operational value of a type of forecast in comparison with an already available forecast technique or from any other available unskilled forecast procedures. The control may be in the form of automated objective forecasts, persistence, or climatology.

The verification of individual parameters discussed will include temperatures, snow amounts, gradient scores, cloud cover, probability of precipitation, and aviation terminal forecasts. The controls used are the automated objective machine forecasts and climatology. Where possible, an annual summary will be given.

VÉRIFICATION DES PRÉVISIONS DANS UN BUREAU MÉTÉOROLOGIQUE

J. Blouin, Y. Bernier, P. Dubreuil, J. Irwin, H. Woronko, N. Yacowar, et le personnel du bureau des prévisions du Québec.

Les buts premiers d'un système de vérification sont d'une part de comparer la valeur relative de différentes techniques de prévision et d'autre part, d'améliorer les prévisions. Les faiblesses inhérentes à une technique de prévision particulière peuvent souvent être mises à jour lors des vérifications. Les prévisionnistes eux-mêmes resteront sur le qui-vive s'ils savent que leur travail est vérifié. Une norme de référence est de plus nécessaire pour comparer la valeur d'une technique de prévision à une autre déjà disponible, ou pour la comparer à des "prévisions" statistiques ou climatologiques. La norme utilisée sera selon le cas, la climatologie, la persistance, ou une prévision objective automatisée.

Nous discuterons ici la vérification des paramètres suivants: la température, la quantité de neige, la nébulosité, la probabilité de précipitation, les prévisions des aérodromes, et le gradient isobarique. Les normes de comparaison utilisées seront les prévisions objectives automatisées et la climatologie. Un sommaire annuel de la vérification est disponible pour certains paramètres.

AN OPERATIONAL TECHNIQUE FOR THE VERIFICATION OF SUBJECTIVE FORECASTS

H. T. Beal

A theoretical verification of probability forecasts, recently described in the literature, has been implemented for operational use at the Prairie Weather Centre. This report describes, in detail, the application of the technique to verify the subjectively described cloud and precipitation parameters of the public forecasts and the prognostic weather-depiction charts. The elements are verified for seven localities across the prairie region. The formulation is based essentially on the partitioning of the probability, or Brier, score. The resultant terms of the partitioning give a useful measure of the skill of the forecasts as well as other useful information.

VERIFICATION OF WORDED PUBLIC FORECASTS

J. Gariépy, L. Garand, N. Yacowar, and the Staff of the Québec Forecast Office.

It is difficult to prepare any verification system that can adequately measure skill and usefulness, taking into account all weather factors. It is recognizably difficult to design a scheme that can classify the observed weather for a given day; the element of subjectivity in deciding what is important is too high. The forecasts discussed here are the public forecasts for days two (tomorrow), three, four, and five.

A simple contingency table verification was made of precipitation forecasts, comparing the forecasts to occurrences. These can be verified on the basis of a percentage correct, Heidke score or other verification plan. A further attempt was made to classify the weather into six categories, ranging from sunny to overcast with precipitation. A utility matrix was developed to assign weights or credits to each element in the verification matrix, forecast versus observed, based on a consensus of opinions among our staff. Verifications will be presented and suggested modifications to the utility matrix discussed.

VÉRIFICATION DES PRÉVISIONS PUBLIQUES

J. Gariépy, L. Garand, N. Yacowar, et le personnel du bureau de prévision du Québec.

Il est difficile de développer un système de vérification qui sache mesurer l'utilité de la prévision ainsi que l'habileté du prévisionniste et la valeur opérationnelle d'une prévision, tout en tenant compte de tous les paramètres prévus. La simple opération qui consiste à classer par catégories le temps observé sur une région durant toute une journée présente déjà de la difficulté, car la subjectivité de chacun entre en ligne de compte. Nous discuterons ici une méthode de vérification adaptée aux prévisions publiques du lendemain (jour 2), et aux aperçus des trois jours suivants.

Une grille de vérification a été établie pour les prévisions de précipitation. On compare les prévisions aux observations. On assigne à ces prévisions une note qui peut n'être que le pourcentage de prévisions correctes ou bien une note dérivée de la méthode de Heidke ou de toute autre méthode. Une autre approche utilisée consiste à classer le temps observé ou prévu en six catégories allant de "ensoleillé" à "couvert" avec des précipitations. Une matrice de vérification où l'on retrouve en abscisse les prévisions et en ordonnée les observations a été développée pour enregistrer toutes les possibilités. Une valeur pondérée relative a été allouée à chaque élément de la matrice. Les résultats de cette méthode seront présentés et nous discuterons des modifications possibles à y apporter.

MEASUREMENTS OF THE CONCENTRATION OF FALLING SNOW

J. R. Stallabass

Little data are available on the frequency distribution of the mass concentration of snow in the atmosphere. Such a deficiency became apparent as the result of engine malfunctions in helicopters while operating in falling snow. To help rectify this situation and so allow meaningful design, testing, and qualification of aircraft engine intake systems for operation in snow, a program was initiated to measure the snow content of the air just above the roof of the laboratory in Ottawa.

A description of the snow sampling apparatus is given and the results obtained over a six-winter period are presented. These suggest a 50% probability of exceeding a mass concentration 0.15 g/m^3 and a 10% probability of exceeding 0.6 g/m^3 .

In conjunction with these measurements various other meteorological parameters were measured. It was found that the snow concentration may be estimated from the visibility with reasonable accuracy, thus permitting concentration statistics to be derived for locations where visibility data exist. A back-scattering visibility meter (Videograph) was found to be a useful instrument for estimating snow concentration.

RELATING ALBERTA THUNDERSTORMS TO SYNOPTIC SHORT WAVES

G. S. Strong

Hail occurs in the Alberta Hail Project target area (an 80-mile radius of Red Deer, Alberta) on approximately 50% of the days in June through August. However, significant convection (towering cumulus) is reported on about 95% of the days in this period.

Recent results will be shown which demonstrate that when such instability is present in Alberta, the occurrence of *hail* or *no hail* is determined at least as much by synoptic-scale changes in the troposphere as it is by surface air-mass characteristics. This is particularly true of the

larger thunderstorms. Some specific case studies will be presented that may hopefully dispel any notion that thunderstorms and hailfall are highly localized phenomena, little related to the larger-scale synoptic waves in the atmosphere.

Session M.3

Acoustic sounding of the atmosphere

Wed 1530 - 1700

TYPICAL FEATURES OF ATMOSPHERIC TURBULENCE PROFILES ASSOCIATED WITH CHINOOKS

T. Mathews and R. B. Hicks

A monostatic acoustic sounder was operated during several Chinook periods. Subsidence of warm air aloft has been observed during pre-Chinook conditions. The turbulence profile itself shows descending multiple layers. These features are compared with typical summer profiles and their correlations with ground-level temperature changes are discussed.

THE LAKE BREEZE AT TORONTO

Richard C. Bennett and Roland List

Acoustic echo sounding is a convenient technique for remotely monitoring the distribution of thermal turbulence in the lower troposphere. An acoustic echo sounder was constructed at the University of Toronto, and since 1973 it has been used to study the planetary boundary layer over Toronto.

Lake breezes were detected on numerous occasions during this study. The acoustic echo sounder showed that as the lake breeze front passed, convective plume activity was suppressed abruptly and replaced by a shallow zone of intense thermal turbulence associated with the internal boundary layer developing in the onshore flow of cool air. Of the 21 lake breezes that were monitored at the University of Toronto (2.8 km from Lake Ontario) during the spring and summer of 1974, only three penetrated far enough to reach the Toronto International Airport, 13.3 km from the lake. Fifty-four per cent of the lake breezes that arrived before 1200 EST interrupted the lifting of the scattering layer associated with the nocturnal inversion. An elevated stable layer often developed and limited the region of strong thermal turbulence as the lake breeze moved inland. Although in all cases a low-level zone of intense thermal turbulence followed the lake breeze front, the acoustic echo sounder showed other aspects of the lake breeze structure to be quite variable. The lake breezes were observed to retreat as the circulation weakened. Convective activity was re-established following the retreat of the front on six of the seven occasions when the front retreated before 1800 EST. Passage of the lake breeze produced an abrupt shift in wind direction at 60 m but had little influence on the temperature at 30 m.

OBSERVATIONS OF NOCTURNAL INVERSION LAYERS BY REMOTE ACOUSTIC AND TETHERED BALLOON SOUNDING

R. B. Hicks and T. Mathews

The atmospheric acoustic sounder shows a potential for monitoring the duration, vertical extent, and strength of atmospheric temperature inversions. In-situ measurements of temperature and wind profiles during inversions have been made in the close vicinity of an acoustic sounder by means of a sensor package carried aloft by a tethered blimp. A sequence of profiles performed during the break-up of the inversion provides a more detailed picture than can be obtained using data from isolated radiosonde flights. The tethersonde data are used to interpret the corresponding acoustic sounder records, and to determine the reliability of the sounder in monitoring inversions.

QUANTITATIVE MEASUREMENTS WITHIN THE TROPICAL MARINE BOUNDARY LAYER DURING GATE USING A SHIP-MOUNTED ECHO SOUNDER

John E. Gaynor

Atmospheric structures within the mixed and lower cloud layers as seen in backscattered intensities from a monostatic acoustic echo sounder mounted on the NOAA ship Oceanographer during the entire period of the 1974 GARP Atlantic Tropical Experiment (GATE) are described. The structures consisted of three basic types: (1) moist and predominantly warm, buoyant thermal plumes associated with suppressed conditions; (2) "hat-" or "hummock-" shaped echoes associated with low-level tropical cumuli; and (3) echoes with stratified layers associated with low-level temperature inversions caused by cool-air outflows from cumulonimbi. We obtained good acoustic Doppler vertical velocities within each of the three structure types even in a noisy ship environment (40 db above Johnson noise at 2,000 Hz). Vertical Doppler-differencing techniques were used to calculate averaged profiles of the rate of turbulent kinetic energy dissipation, ϵ , and the appearance of these profiles is related to the apparent convergence of sea surface sensible heat flux, H , within the inversion structures. Interesting temporal variations in sea surface sensible heat flux, latent heat flux, E , and momentum flux, τ , (all calculated using bulk aerodynamic methods) occur with the changing structures seen on the acoustic facsimile records. Time series of these changes are presented, as well as average statistics.

Of special interest to acoustic scattering theorists and those interested in very small scale (~ 0.1 m) atmospheric turbulence are profiles of acoustic refractive index fluctuations, C_n^2 . Strong indication is given that in such a moist mixed layer as that in GATE, these fluctuations are a combination of small-scale fluctuations in both temperature (C_T^2) and moisture (C_e^2). Measurements indicating a larger decrease with height of C_n^2 than predicted from models appropriate to a relatively dry convective boundary layer overland suggest that co-fluctuations of temperature and moisture are contributing negatively to C_n^2 in the upper levels of the mixed layer.

THE RELATIONSHIP OF SFERICS AND CONVECTIVE ACTIVITY OVER NORTH AMERICA

R. D. Grimes and Dr Bhartendu

Sferic measurements made from a VLF analyzer for 1975 at the AES station for Atmospheric Experiments, Toronto are reported. From the synoptic charts, the areas of towering cumulus and cumulonimbus clouds are considered as representing a measure of the convective activity. A comparison of both the sferic and convective activity indicates good agreement and a few of these cases will be discussed.

Session O.2

Limnology

Wed 1400 - 1710

THE EVOLUTION OF A NUMERICAL MODEL FOR ESTIMATING PHYTOPLANKTON PRIMARY PRODUCTION IN LAKES (Invited Paper)

Everett J. Fee

The aim of this work has been to develop a method of estimating the growth of algae in lakes — particularly in large lakes where in-situ experimentation is difficult. The basic hypotheses of the model are that the growth rate at any instant in time is solely a function of the instantaneous irradiance and that the lake is biologically homogeneous. Given these assumptions, then a direct measurement of the relationship between photosynthesis and irradiance together with meteorological data on irradiance and knowledge of the transparency of the lake are necessary and sufficient to define a unique value of production. This original model was used to estimate annual primary production in Lake Michigan.

All further work on this model was done at the Experimental Lakes Area in northwestern

Ontario. The first step was to eliminate unnecessary mathematics; this simplified the application of the model and made it more general. Next, the assumptions of biological homogeneity and temporal invariance of the photosynthesis vs light curve were removed. Further work is needed on the effect of the spectral composition of irradiance on photosynthesis. The assumption that the optical properties of a lake are constant over a day is also untrue and must be corrected.

The model has been a valuable method of systematizing investigation of factors that control planktonic ecosystems. Testing hypotheses of the model has led to the discovery of important phenomena that had escaped detection for years with direct in-situ measurement.

SOME FEATURES OF THE THERMAL STRUCTURE OF LAKE ONTARIO

F. M. Boyce

Lake Ontario is a large ($18,500 \text{ km}^2$) deep (85 m) lake, which exhibits marked seasonal stratification. Many dynamic processes ranging from coastal upwelling to small-scale vertical mixing in the presence of internal waves have their signatures in the thermal structure of the lake. A considerable body of data now exists on these features. The intent of this paper is to present examples of some of the many observed phenomena and to describe briefly the nature of the data collected so far in the hope that other workers may be encouraged to take advantage of it.

MIGRATING TEMPERATURE STRUCTURE IN STRATIFIED FRESH WATER LAKES

J. R. Lazier and H. Sandstrom

Data from temperature profiles and temperature time series from moored thermistor chains show that much of the structure in the thermocline migrates vertically through the water column with time. Analysis suggests that the structures are distortions of the temperature field which are created by the natural internal oscillations of the lake. The migrating behaviour is an effect of the vertical phase profile of those oscillations.

A theory for the wind forced internal oscillations of a viscous non-rotating lake of constant stratification is presented. The introduction of viscosity gives a smooth change of phase across the nodes of the vertical displacement profiles. This smeared phase profile enables the theory to qualitatively model the observed vertical migration of structure in the lake.

The phase profiles calculated from some thermistor chain data are compared to the predicted phase profiles, and in the diurnal frequency band where the wind forcing is strongest the agreement is good for values of viscosity of about $0.1 \text{ cm}^2 \text{ s}^{-1}$.

NUMERICAL STUDIES OF AIRFLOW OVER SHORT STEEP WIND WAVES

P. A. Taylor

A numerical model developed by Gent and Taylor (*J. Fluid Mech.* 77: 105-25) is used to investigate the possible behaviour of airflow over short steep waves. Typical examples of sea waves and wind wave tunnel waves are considered. The effects of near-surface drift velocities are included and found to have quite strong effects in the short sea-wave case.

TRENDS IN SEDIMENTATION RATES IN THE SAGUENAY RIVER AS DETERMINED BY THE Pb-210 METHOD

J. N. Smith and A. Walton

Studies of the natural radioisotope, Pb-210 (half life = 22.3 yr) have been carried out on sediment cores obtained by gravity coring at a series of stations in the Saguenay River in 1976. Activities of Pb-210 were measured using an alpha particle spectrometer and surface barrier detectors by alpha counting Po-210 and Po-208, the latter added as an internal standard. The Ra-226 support contribution to the Pb-210 activity was measured by the radon gas emanation technique.

Lead-210 profiles are characterized by a surface layer (about 10 cm deep) of anomalous activities that reflect physical and biological mixing processes. Below this surface mixed layer the Pb-210 activity decreases exponentially with depth as a consequence of radioactive decay.

Sedimentation rates determined from the logarithmic portion of the activity profiles are of the order of 0.4 cm/yr of compacted sediment which corresponds to a sediment accumulation flux of 0.3 gm/(cm² yr). Observed decreases in the sedimentation rates for stations closer to the mouth of the Saguenay River corroborates previous studies of geochemical profiles measured in these sediments.

WHITECAPS AND MOMENTUM TRANSFER

M. A. Donelan

This paper describes field and laboratory experiments aimed at accessing the rate at which wind-generated waves release momentum to the underlying currents. The primary measuring tool is a miniature drag sphere velocimeter designed expressly for this purpose. The momentum transfer process is considerably more intermittent beneath the waves than it is in the air, being governed by local instabilities of the surface. Far enough (a few wave heights) beneath the surface, sudden downward pulses of momentum are quickly diffused, and the momentum transfer appears to be somewhat steadier with its peak frequency about an order of magnitude less than that of the surface waves.

A short slowed-motion film illustrates the depth of the disturbance caused by a single "white-cap."

Session O.3

Estuaries

Thur 0900 - 1200

A REVIEW OF STUDIES IN ESTUARIES (Invited Paper - Tentative Title)

D. M. Farmer

Abstract not available.

A STUDY OF PHYSICAL PROCESSES IN THE RUPERT BAY ESTUARY

R. G. Ingram, B. d'Anglejan, and J.-C. Deguise

In summer 1976, an extensive field program was conducted in Rupert Bay, a large estuary located off the southeast corner of James Bay. The variable part of circulation was dominated by strong tidal currents and local effects of diurnal wind forcing. Mean and tidal circulation patterns for varying conditions are presented. The three dimensional distribution and the transport of salt and suspended matter have been determined. The presence of large bottom currents allows for a significant resuspension of suspended matter in the Bay.

As a result of the large freshwater discharge at the head of the Bay, the mixing zone is displaced some 25 km downstream. Seaward of this region, numerous surface fronts are observed. The importance of lateral inhomogeneities in the downstream area are discussed.

GÉOCHIMIE DU SOUFRE DANS DES SÉDIMENTS DE L'ESTUAIRE DU ST-LAURENT ET DU SAGUENAY

André Ouellet et Bjørn Sundby

La distribution verticale du soufre (sulfate, monosulfures, pyrite) et de paramètres associés (granulométrie, carbone organique) fut mesurée dans des carottes provenant du Chenail Laurentien et du Fjord du Saguenay dans le but de décrire chimiquement les sédiments et de calculer un taux probable d'accumulation de soufre dans les sédiments de l'estuaire.

Dans le Saguenay, le soufre s'accumule principalement sous forme de monosulfures de fer, atteignant la concentration de 3300 ppm, alors que la concentration de pyrite n'excède jamais 1800 ppm. Dans les sédiments du Chenail Laurentien au contraire, la pyrite abonde (maximum: 5000 ppm) alors que les monosulfures sont rares (maximum: 900 ppm). Ces différences sont attribuées à un taux de sédimentation beaucoup plus élevé dans le Saguenay que dans le Chenail Laurentien.

La présence d'une couche sablonneuse localisée à 20 cm de profondeur, dans la carotte du Saguenay, est associée à une discontinuité marquée des paramètres du système du soufre (% carbone organique, monosulfures, pyrite).

Nous avons tenté d'utiliser la distribution verticale d'un traceur récent (le mercure) pour calculer le taux de sédimentation dans les sédiments du Chenail Laurentien. Cependant, la profondeur où la concentration dépasse le niveau de base (environ 20 cm) est nettement affectée par l'activité des organismes benthiques. Le taux de sédimentation calculé de cette façon est si élevé qu'il est inacceptable.

Si on suppose stables les taux de réduction du soufre et de sédimentation et qu'on accepte une valeur de 0.1 mm/an pour le taux de sédimentation, le calcul du taux d'accumulation du soufre nous donne une valeur de $1-3 \times 10^{-4}$ mg/(cm³ an). Ce résultat beaucoup plus faible que celui trouvé dans le Golfe de Californie s'explique par la petitesse du taux de sédimentation et le faible contenu en matière organique.

GEOCHEMISTRY OF SULFUR IN SEDIMENTS FROM THE ST LAWRENCE ESTUARY AND SAGUENAY FJORD

André Ouellet and Bjørn Sundby

The vertical distribution of parameters related to the reduction of sulfate (granulometry, organic carbon, sulfate, sulfide, pyrite) was measured in cores from the Laurentian Channel and the Saguenay Fjord in order to describe the sediments chemically, and to estimate the rate of sulfur accumulation in these sediments.

In the Saguenay sediment sulfur accumulates principally as iron monosulfide which reached a maximum concentration of 3300 ppm. The pyrite content never exceeded 1800 ppm. In contrast, pyrite was abundant in the Laurentian Channel sediment (up to 5000 ppm), while the iron sulfide content was low (less than 900 ppm). These differences are attributed to the higher rate of sedimentation in the Saguenay Fjord.

A discontinuity in the vertical distribution of the parameters related to the sulfur system occurred at 20 cm depth in the Saguenay core. This is related to a layer of sand at this depth.

An attempt was made to utilize the vertical distribution of a recent tracer (mercury) to measure the rate of sediment accumulation. However, the depth to which higher than background levels of mercury occurred (ca. 20 cm in the St Lawrence Estuary sediment), is affected by the activity of burrowing organisms. The calculation based on the mercury distribution therefore gave unacceptably high rates of sediment accumulation.

A calculation of the rate of sulfur accumulation in the Laurentian Channel sediment, assuming constant rates of sedimentation and sulfate reduction, and using 0.1 mm/yr as an estimate of the sedimentation rate, gives $1-3 \times 10^{-4}$ mg S/(cm³ yr) at a depth of 50 cm. This is much lower than corresponding estimates from the Gulf of California, probably due to the lower rate of sedimentation and the lesser content of organic matter in sediments of the St Lawrence system.

OBSERVATIONS IN THE SUSPENDED MATTER MAXIMUM OF THE ST LAWRENCE ESTUARY

Bjørn Sundby and Norman Silverberg

The zone of high turbidity in the North Channel of the St Lawrence Estuary extends approximately 65 km downstream from Ile d'Orléans, almost half the length of the channel and flats region of the upper estuary. The zone was examined during periods of both high and low river discharge (early May and late November 1976), using STD profiling, gravimetric and particle size analysis of suspended particulate matter, and bottom sampling.

In May, particle concentrations on a station in the river itself were found to vary between 5 - 25 mg/l over a tidal cycle. The pulses in concentration were generally homogeneous over the water column, and no distinctions were observed in the particle size spectra. On a station downstream of the zone, particle concentrations varied between 7 - 25 mg/l. In contrast, during the same cruise concentrations of 18 - 220 mg/l were observed in the zone of maximum turbidity. Temporal, longitudinal, and vertical variations were recorded within this zone during both sea-

sons. The highest concentrations (up to 480 mg/l) were observed near the bottom and in the upstream end of the zone, and maximum concentrations at each station occurred during periods of low salinity (end of ebb, beginning of the flood tides). In general, surface waters contained more fine particles (less than 4 micron), while bottom waters contained more silt particles (4 - 30 micron). The STD data showed that the water column was stratified (although continually changing) over the tidal cycle, except for periods of 1-2 hours just after the beginning of the flood tide, when stratification broke down completely. Particle concentrations and size spectrum differences also broke down during these periods of intense mixing.

SUSPENDED AND BOTTOM SEDIMENT INTERACTION IN THE MIRAMICHI ESTUARY, N.B.

Kate Kranck

Grain size, concentration, organic-inorganic ratio, and flocculation state of suspended particulate matter was measured along with temperature salinity and currents in the Miramichi Inlet from fresh water to the open Gulf of St Lawrence.

At the fresh-salt water boundary, the landward bottom and seaward surface currents retain particulate matter in the estuary owing to the settling of particles from the upper layer into the lower layer. More settling occurs during high tide than during low tide producing a well-developed turbidity maximum. Where concentrations increase above a critical value, flocculation promotes further settling and entrapment of fine-grained material.

Comparison of grain sizes of suspended and bottom sediment samples indicates areas of deposition and dynamic interaction between the bottom and water. Some mud deposition occurs at both ends of the turbidity maximum. The loci of mud deposition is the Grand Dune Flats where deposition and resuspension occurs associated with both seaward and landward moving currents. Their slightly divergent path in response to the Coriolis force can be traced in the pattern of bottom sediment modal sizes.

THE CAUSE OF THE MID-DEPTH TEMPERATURE MINIMUM IN SOME B.C. INLETS

M. R. MacNeill and G. L. Pickard

A feature of the temperature structure in many of the major fjord inlets of the British Columbia mainland coast is a temperature minimum centered at 10 to 100 m depth in the spring to fall period. The thickness of the cold layer and the value of the temperature minimum vary from year to year. An attempt was made to test the hypothesis that the minimum results from winter cooling at the surface, particularly from outbreaks of continental arctic air flowing down the inlets, followed by warming from the surface during the following spring and summer, rather than from sub-surface advection in the water mass. In the absence of serial meteorological observations in most of the inlets it was necessary to estimate the winter cooling from meteorological data from locations away from the inlets. We found a sufficiently close correlation between our estimates of surface cooling and the observed winter heat loss in the mid-depth layer in Bute Inlet to indicate that the hypothesis of surface cooling, with emphasis on the cold air outbreaks, is reasonable. More direct tests with meteorological observations in the inlets themselves would be needed to determine the relative importance of the different heat loss processes, i.e. radiation, evaporation, and sensible heat conduction.

Session O.4

Coastal processes

Thur 1020 - 1200

SOME PERSPECTIVES ON COASTAL OCEANOGRAPHY

D. M. Farmer

Abstract not available.

FACTORS INFLUENCING TRACE METAL CONCENTRATIONS IN COASTAL WATERS

P. A. Yeats, J. M. Bewers, and A. Walton

Studies of trace metal distributions in eastern Canadian coastal waters have been conducted during the period 1970-76. The levels and variability of iron, manganese, cobalt, nickel, copper, zinc and cadmium in the waters of the St Lawrence Estuary and Gulf and the Scotian Shelf have been established. These results have been compared with corresponding data from other marginal seas and continental shelf waters. An attempt has been made to assess the sensitivity of coastal surface waters of eastern Canada to changes in the composition of freshwater runoff and the results are discussed in the context of monitoring of marine environmental quality.

WATER EXCHANGE AT THE EDGE OF THE CONTINENTAL SHELF

H. Sandstrom

Given the locally wind-driven barotropic response of the water column, the topographically controlled response of the stratified system of shelf, slope, and adjacent deep ocean is investigated. With assumed longshore homogeneity, a two-dimensional model is used, including effects of both density stratification and variable bottom topography. Analytic solutions can be derived for some simple but representative bottom shapes. The structure of the solutions is discussed, with emphasis on aspects such as upwelling at the shelf edge with resulting intrusion of slope water on the shelf and the offshore length scale for the baroclinic response.

A NOTE ON FREE OSCILLATIONS OF CHEDABUCTO BAY

F. G. Barber and J. D. Taylor

A short series of current observations at nine positions in Lennox Passage are analyzed using spectrum analysis techniques (maximum entropy, fourier periodogram, least squares), and comparisons are made with an analysis of sea-level data from Point Tupper and with output of a numerical model of the system. All of the analyses indicate short-period oscillations. The periods determined from the current and sea-level data match well and confirm the numerical model.

The current observations were made during a period of relatively strong wind which led to the self-oscillations observed, at least that is the speculation. If so, then these natural modes of oscillation would likely occur in fairly short "bursts" when excited. A method of analyzing and presenting the data in order to examine this is given.

Some tests of the maximum entropy method of spectrum analysis were made in the course of the project and include such topics as choice of filter length and shifting of spectral peaks.

PHYSICAL OCEANOGRAPHY OF JAMES BAY

S. J. Prinsenbergh

During the summer, the salt exchange between James and Hudson Bay is studied using oceanographic station data (1972-75) within James Bay and in-situ current meter data across its entrance. The preliminary current meter analysis shows a mean outward drift ranging from 5 to 15 cm/s in the eastern surface layers and a small 4 cm/s inward drift in the bottom layers. These currents and salinity gradients suggest that the horizontal advection in the salt conservation equation can be, in places, two orders of magnitude higher than the horizontal diffusion. When the total cross-section is considered, diffusion may become significant, since it is into the bay over the entire cross-section, while advection changes sign from the bottom to surface.

The circulation of James Bay can be broken down into the freshwater discharge mode required for disposal of the input of fresh water, the gravitational convection mode due to the density difference between fresh and salt water, and the wind-driven mode mostly confined to the surface layers. The gravitational and wind-driven mode mainly determine the circulation in James Bay. The wind-driven mode becomes the major contributor at wind strengths over 10 knots, as the resulting surface current can then reverse the direction of the gravitational surface drift producing a three-layered velocity profile.

The Coriolis effect, ignored in the analytical models, causes the isopycnals to dip down towards the eastern shore. The change in velocity with depth, calculated from the slopes of the observed isopycnals, correlates well with the observed vertical velocity distribution.

LOW-FREQUENCY FLUXES OF MOMENTUM, HEAT, SALT, AND NUTRIENTS AT THE EDGE OF THE SCOTIAN SHELF

Peter C. Smith

Measurements of current velocity, temperature and salinity from a single mooring at the edge of the Scotian Shelf are analyzed for the period from December 1975 to April 1976. The subtidal Reynold's stresses consist of contributions from the wind-driven circulations (periods 2-10 days) and shoreward-propagating topographic Rossby waves (periods 10-30 days), which may be distinguished by the sign of the onshore momentum flux. Uniform divergence of these stresses across the shelf would not be significant to the general circulation.

The subtidal variance of temperature and salinity at the shelf break is concentrated at the lowest frequencies as are the shoreward transports of heat and salt. If considered uniform at the open boundary, these fluxes would raise the temperature and salinity of a slice of shelf water by roughly 1.0°C and 0.5 to 1.0‰ as it advected down the coast of Nova Scotia.

Estimates of the nutrient fluxes at the shelf break are made by establishing a relationship between nutrients and T/S properties via the concentration of dissolved oxygen. The shoreward transport of nitrogen is found to exceed Fournier's (1977) estimate of the springtime phytoplankton requirements on the shelf.

Session M.4

Numerical modelling of the atmosphere

Thur 0830 - 1000

A CANADIAN GCM

G. J. Boer, N. McFarlane, and L. Steinberg

A modest resolution GCM has been produced by combining the 5-level, spectral, CMC forecast model, after some rearrangement, with those physical calculations necessary for climate simulation. These include calculations of long- and short-wave radiative heating rates, boundary-layer and surface-heat balance terms, and energy dissipation rates. In addition, a reasonably complete analysis package is required to analyze the simulation results. The model is described and preliminary results of a winter simulation are presented.

SIMULATION OF THE ZONALLY AVERAGED ATMOSPHERIC CIRCULATION

N. McFarlane

A two-level quasi-geostrophic zonally averaged model is used to simulate some features of the tropospheric general circulation. Eddy transports are parameterized in the model by means of baroclinic stability theory. Results from an attempt to simulate the annual cycle of the zonally averaged circulation will be presented.

THE IMPORTANCE OF VERTICAL RESOLUTION IN PLANETARY WAVE MODELLING

J. Derome, E. Kirkwood, and J. G. Desmarais

The structure of forced planetary waves in a numerical model using a low vertical resolution has been compared with that of a model using a high vertical resolution. The difference has been found to be significant, which raises the possibility that the use of a relatively low number of levels in current numerical weather prediction models may lead to important forecast errors on the planetary scale. A forecast experiment has been performed with a simple model using first a high and then a low vertical resolution. The difference, or forecast error of the low-resolution model, has been compared with the forecast error found in an operational model. Remarkable similarities have been observed.

A THREE-DIMENSIONAL STUDY OF ATMOSPHERIC FRONTOGENESIS

G. V. Price

A jet-based model is proposed to study the dynamics of the polar frontal zone jet stream system. Equations are developed to show that the potential temperature and surface pressure are sufficient to determine the state of the model atmosphere in non-orthogonal stream axis coordinates with a normalized pressure-independent variable, subject to a condition of gradient flow in the direction of the jet. Three-dimensional approximating functions are used to represent the spatial dependence of the variables, and a Galerkin technique with an Euler-backward time extrapolation scheme is used to advance the dependent variables in time.

Three-dimensional frontogenesis experiments are performed using a baroclinic zonal jet and a three-dimensional perturbation of the type studied numerically by Mudrick (1974). Subject to a suitable method of determining the curvature used to compute the gradient wind, the model is shown to develop both surface and mid-tropospheric frontal zones which compare well with the results obtained numerically by Mudrick. The surface frontal zones in the forecast experiments arise from stretching and shearing deformation contributions to the horizontal frontogenesis, and the vertical circulation pattern that accompanies the deformation frontogenesis is thermally direct in nature. The mid-tropospheric frontal zones in the forecasts are found to be characterized by frontogenesis upstream of the front due to horizontal deformation effects and frontogenesis downstream of the front due to the "tilting" mechanism. The associated circulation patterns in the cross-front plane are thermally direct and indirect in the regions upstream and downstream of the front, respectively. Comparisons with wind and temperature gradients observed in atmospheric frontal zones indicate that the model frontal zones are relatively weak. This is possibly due to the coarse horizontal resolution used in the forecast model, together with the mild strength of the zonal jet in the initial condition. Modifications to the rate of development of the forecast due to various streamline and trajectory curvature effects are considered.

EVALUATION OF NUMERICAL APPROXIMATIONS FOR ESTIMATING THE GROUND HEAT FLUX IN MESOSCALE NUMERICAL MODELLING

John D. Reid

Recent studies have indicated the importance of incorporating an interactive surface energy balance in numerical mesoscale models. Past models have incorporated a variety of approximate treatments of the ground heat flux component. An evaluation of these techniques for simple situations is performed which reveals problems with some of these approximations. A simple technique to optimize treatment of this flux component while minimizing computer storage requirements is recommended.

Session M.5

Climatology

Thur 1030 - 1200

NATIONAL ARCHIVAL DATA FOR CLIMATOLOGICAL AND METEOROLOGICAL APPLICATIONS

Jack Edward Donegani

An outline of the primary and secondary data stored in the National Digitized Climatic Archive of the Atmospheric Environment Service of Environment Canada will be outlined, accompanied by a brief sketch of quality control and collection procedures.

The utility programs of the AES Computing Centre will be examined with regard to derived output fields, such as frequency, stability, and statistical analyses. Internal and external users of these data will be discussed as well as the potential applicability of these records to a variety of areas, among which are air quality studies, climatological modelling, micro and mesoscale analyses, agroclimatological mapping, and construction engineering. The user community will

be made aware of new developments to enhance their accessibility to the data files for both retrieval and manipulation.

NEW QUALITY CONTROL PROCEDURES FOR CLIMATOLOGICAL DATA

D. W. Buss

New procedures introduced into the data processing system in Central Services Directorate are outlined. These make greater use of computer power for time-space checks. Reference will be made to improved station history files, which will include some feedback as to the quality of archival data. A brief overview of plans to improve the efficiency and effectiveness of quality control on other AES observing networks will be given.

A CLIMATIC CLASSIFICATION OF THE NORTHWEST TERRITORIES FOR RECREATION AND TOURISM

R. B. Crowe

This paper was prepared in 1970 by the AES for the Government of the Northwest Territories as part of an overview study of the total recreation and tourism potential of the Territories.

The main climatic factors relative to recreational use of the Arctic will be discussed. These include how climate affects recreation and tourism, the nature of recreational activities in the Northwest Territories, and the impact of climate on regional access, on local access, and on outdoor activity in general.

The development of a recreation-tourism climatic classification system will be given. A two-season approach will be identified based on mobility, while the classification system will be detailed. Examples will be shown of climatic classes and descriptive terminology charts at selected times during the winter and summer season.

CLIMATIC CLASSIFICATIONS OF THE PRAIRIE PROVINCES

J. M. Powell

Various climatic or related classifications have been produced for all, or portions of, the Prairie provinces, often based on Köppen's or Thornwaite's system or modifications. Many of these classifications were discipline-oriented – for example, for agricultural activities – and were based on predetermined climatic parameter class limits or have included subjective biases with reference to vegetation or physiographic features. Examples of these classifications are given along with their uses and limitations for the area as a whole.

Recently a factor analysis approach was used to establish homogeneous summer climatic zones for the forested areas of the Prairie provinces and was extended for the whole area on a more limited scale. This approach involved the use of over 300 stations for the years 1961 to 1970, each with a matrix of 22 independent variables based on daily temperature and precipitation records for the months May to September. These variables were used as input for the factor analysis to develop eigenvalues and eigenvectors for each station and factor scores. The factor scores then became input for a hierarchical profile grouping procedure to delineate stations having similar summer climatic regimes. Discriminant analysis was then used to test whether the groups were significantly different, to establish the degree of stability within and between groups, and to position the boundaries between groups. This approach provides a more rational statistical process of analyzing climatic data and more efficiently delineates climatic groups than the more traditional a priori climatic classifications.

LAPSE RATES IN THE LOWER 250 METRES NEAR WINNIPEG

W. C. Bell

This study is based on temperatures for the period October 1969-July 1972, obtained from aspirated platinum thermometers installed on a rural television tower near Winnipeg at heights of 11, 61, 122, 163, and 247 m.

Lapse rate frequencies show increased grouping towards weak lapse conditions with increasing height and the extremes are much less severe. Superadiabatic conditions increase sharply in spring and decrease in late autumn. Inversion conditions show a maximum in winter/early spring.

The percentage frequency of occurrence of superadiabatic conditions decreases rapidly with increasing height in winter but there is little change in summer. The maximum percentage occurrence of inversions decreases with increasing height.

Values for the average lapse rate vary greatly. Winter midday lapse rates are less than the DALR, while summer conditions reach twice the DALR. The morning changeover to positive lapse rates occurs quickly, especially in summer. The annual average lapse rate for the year is an inversion close to the ground with neutral conditions at higher levels. Maximum values of positive lapse rates show great variations and can reach values of eight times the DALR in the 11-61 m layer, before decreasing quickly with increasing height.

Inversion intensities are highest in the surface layer, and decrease with increasing height. Most inversions form in the late afternoon/early evening period, with much greater dispersion of times at higher levels. Inversion durations of up to 138 hours have been observed.

Session M.6

Meteorological applications

Thur 1430 - 1700

PHYSICAL VS MATHEMATICAL MODELS IN AGROMETEOROLOGY

P. H. Schuepp

An attempt is made to illustrate and summarize advantages and disadvantages of physical and mathematical modeling as a tool in agrometeorology, particularly for those meteorologists not working in that field. The main points are that

- Unlike most other meteorological disciplines, agrometeorology contains a strong biological component. Field experiments are therefore subject to simultaneous variations of meteorological and biological parameters, making it difficult to isolate effects of any given parameter of interest. Model experiments on the other hand allow controlled variation of parameters.

- Mathematical models are based on the fundamental assumption that all physical laws governing the parameters and their interrelationship, as well as all boundary conditions, can be specified in mathematical language. This assumption has done miracles for Newton's falling apple, has encountered some difficulties in many meteorological applications (e.g. Numerical Weather Prediction), and may be even more difficult to satisfy for the complexity of canopy flow, not to mention biological pathways to mass and energy fluxes. The model could be said to approximate complexity by simplicity.

- Physical models of finite dimension in air or water encounter great difficulties in scaling the atmospheric boundary layer and the characteristics of flow around vegetative elements at the same time. On the other hand, they do match the complexity of the real agrometeorological phenomenon by an almost equally complex (though not entirely realistic) physical phenomenon under approximately similar boundary conditions.

The applicability of both approaches will be discussed.

RELATIONSHIP BETWEEN THE SMALL NEGATIVE AIR IONS AND THE RESPIRATION OF MOUSE LIVER CELLS IN VITRO

Dr Bhartendu

In view of the central role of oxygen consumption in cellular metabolism, the effects of air ions on the oxygen uptake by mouse liver cells were studied. The mouse liver cells were isolated by dispersion of liver tissue in medium 199. Atmospheric ions were produced from a radioactive linear ion generator. The liver cells were exposed to small negative ions of varying concentrations up to the maximum value of 1.2×10^5 per ml. The oxygen uptake (respiration) was measured by an Oxygraph. The relationship between the ion concentration and oxygen uptake was found to be complex. The oxygen uptake increased by 14% when liver cells were exposed to ion con-

centrations of values 1-9 times the normal, by 9% when exposed to 10-99 times the normal, and by 38% when exposed to 100-999 times the normal. Possible implications of these results to human health are discussed.

IMPACT OF AIR IONS ON BIOLOGICAL ACTIVITIES OF PLANTS

T. M. Elkley, R. L. Pelletier, Bhartendu, and N. Barthakur

A polonium-210 based linear ion generator and two glass chambers essentially formed the physical arrangement for controlled experiments to study biological effects of small air ions on plants. Preliminary studies on barley leaves showed that the rate of photosynthesis of normal leaves, exposed to an atmosphere of small positive air ion concentration of about 2×10^4 ions/cm³, was higher than those of infected leaves similarly exposed. Respiration rate of exposed infected leaves was found to be lower than those of exposed normal leaves. These results will be discussed.

Effects of air ions on germination of *Helminthosporium teres*, the fungus of the net blotch disease of barley, was studied under relatively high concentrations inside plant growth chambers in the phytorium. Spore germination was delayed by about 6 hours when the spores were exposed to positive air ions in the culture medium or sprayed on actual leaf surfaces; negative air ions produced no such effect.

METEOROLOGICAL INFLUENCES ON THE DISPERSION OF GRAIN DUST INTO COMMUNITIES ON THE CANADIAN GREAT PLAINS

S. R. Shewchuk

The grain dust particles are considered to have free-fall velocities similar to or greater than the commonly occurring vertical eddy velocities (i.e. in the order of tens of cm per s). Here gravitational settling is the controlling factor. An equation to predict the dispersion of particulate material over climatologically long periods in the order of months and years will be outlined. The diffusion equations have been effectively solved assuming that the eddy diffusivity is proportional to height above the ground. The average rate of dust deposition was accounted for by consideration of the fall speeds of dust fractions and the wind-direction climatology. The position of maximum deposition will get closer to the elevators as the falling speed of particulate matter increases. The source strength is determined by taking a given percentage of the mass of grain handled.

The area about the dust source was divided into eight 45-degree sectors according to points of the compass. The fraction of the time per working month that the wind blows into this sector was determined by constructing a hodograph from hourly observations of wind speed and direction. Once-monthly wind frequency distribution, mean horizontal wind speeds, and volume mean diameter of dust particles were determined. A calculation was made for the mass of grain dust deposition in each sampler. It is seen that dust concentrations are predicted close to what is observed and the low virtual source heights produce more realistic data. The implication is that most of the settleable fraction of the grain dust occurs within the immediate vicinity of the elevator.

Directionality of the wind has an enormous influence on the deposition of dust within a town. Since most prairie towns are located such that the grain elevators are established on one of their boundaries, the problem of grain dust contamination levels in the town environment tends to be quite sporadic. Stability considerations were less critical, largely due to the fact that the study was confined to the winter months. Large effects in this regard are to be expected on a seasonal basis. However it is fair to say that this study has considered the worst case as far as ground deposition is concerned.

AGRICULTURAL WEATHER IN THE RED RIVER BASIN OF SOUTHERN MANITOBA OVER THE PERIOD 1800 to 1975

T. R. Allsopp

Meteorological information obtained from Hudson's Bay Company archives, explorers' and

settlers' diaries and journals, dendrochronological analysis, and lake level variations has been combined with instrumental data recorded at Winnipeg from 1872 to 1975 to derive a chronological sequence of agricultural weather in the Red River Valley of Southern Manitoba over the period 1800 to 1975. The agricultural weather has been broadly categorized as dry, average, or wet. Generally, the climate has been favourable to agriculture for approximately the past 35 years, and especially since 1964. A return to the past dry agricultural climate, which occurred in the 1840s, and from 1883 to 1894, or to the generally dry though variable 1920s and early 1930s, or to the wet agricultural climate, which occurred in the 1850s and from 1875 to 1881, would have an adverse effect on crop production.

DROUGHTS ON THE CANADIAN PRAIRIES

Henry Stanski, Dale Henry, and H. M. Fraser

The period July to December 1976 was the driest six-month period on record over the south-eastern Canadian prairies. This extreme dry period is compared to other similar periods in the past 100 years. The effects on various economic activities and a method of utilizing climatic knowledge for planning purposes are discussed.

PRECIPITATION NETWORK REQUIREMENTS FOR HYDROLOGICAL FORECASTING - AN APPLICATION OF OBJECTIVE TECHNIQUES

L. O. Mapanao and W. I. Pugsley

The Atmospheric Environment Service is one of several provincial, state, and federal agencies engaged in assessing the application of World Weather Watch to operational hydrology in the Saint John River Basin - the only North American basin so selected. One study described in this paper quantitatively measures the adequacy of precipitation networks on a seasonal and daily time scale to meet the requirements of water supply and river forecasting. Two methods are applied: one, independently of the observed precipitation field, physically defines a seasonal topographic index whose spatial variation determines gauge density as a function of a specified error tolerance; the second method, a modification of Gandin's statistical approach, specifies the areal representativeness of each reporting station in terms of the spatial and temporal variations of storm rainfall.

In addition to satisfying the general WMO guideline requirements for the basin as a whole, these objective techniques pinpoint the particular needs of a sub-basin or region, and the area over which each observing station in the network can be used to estimate the mean precipitation within a given uncertainty. This study demonstrates the feasibility of simulating the spatial variations of a field from known physical relationships to assess the requirement without the necessity of first establishing a dense observational network.

A REGRESSION MODEL FOR THE PREDICTION OF WIND INDUCED SET-UP ON LAKE WINNIPEG

E. Einarsson, K. A. Fluto, G. B. Atkinson, and H. T. Beal

Significant set-ups, one to four feet, were identified at the southern extremity of Lake Winnipeg over a 10-year period. In order to predict the height of the perturbed water level, a regression program correlated the departures from the mean water level against pertinent meteorological parameters. The parameters empirically investigated included the mean sea-level pressure gradient, and the gradient of the heights of the 1000 and 500 mb constant pressure surfaces. Also considered was the cyclonic or anticyclonic curvature of the mean sea-level pressure distribution, as well as the effect of air stability over water. It was found that the set-up could be forecast quite accurately using the gradients of the 1000 and 500 mb surfaces. The resultant regression equation is currently used to provide the Prairie Weather Centre with forecasts, twice daily, of the lake level up to 36 hours. The forecasts are fully automated and use as data input the 1000 mb analyses and forecasts from the Canadian Meteorological Centre's spectral prognostic model. Also discussed is the result of a verification on one season's forecasts.

A MODEL OF THE ATMOSPHERIC BOUNDARY LAYER OVER AN EXTENSIVE SNOWFIELD AND ITS RELATION TO AIR MASS TRANSFORMATION OVER THE CANADIAN AND AMERICAN PLAINS

Isidore Halberstam

A numerical model of the interaction between the atmosphere and a snowfield has been developed. The model includes the various radiative, convective, and conductive fluxes that influence the snow and the overlying air mass. It attempts to simulate the turbulent processes that occur near the surface of the snow under conditions of varying atmospheric stability. Results indicate that warm air masses lose heat and moisture during the night, but little is regained during the day in winter through turbulent transfer of heat and moisture from the surface. Turbulence is fairly well damped during the night and surface temperatures tend towards radiative equilibrium, but occasional "bursts" bring the surface layer temperatures and wind back up again. Conclusions are inferred concerning the relative importance of evaporation as opposed to melt as a process of snow ablation. Conclusions are also drawn concerning the role of boundary-layer processes and their role in air-mass transformation over the Canadian and American Plains

A MESOSCALE BOUNDARY-LAYER MODEL FOR THE STUDY OF UPSLOPE WEATHER OVER THE CANADIAN WESTERN PLAINS

R. L. Raddatz and M. L. Khandekar

A limited area numerical model (LAM) was developed to simulate upslope precipitation patterns over the Canadian Western Plains. Following Lavoie (1972) the atmospheric structure is represented by three layers: a constant flux layer in contact with the earth's surface, a well-mixed planetary boundary layer capped by an inversion, and a deep stratum of overlying stable air. Averaging the set of governing primitive equations through the depth of the mixed layer yields predictive equations for the horizontal wind components, potential temperature, specific humidity, and the height of the inversion. Time-dependent calculations are limited to this layer by parameterizing the interaction between the mixed layer and both the underlying and overlying layers.

A 47.6 km by 47.6 km grid mesh of 1369 points covering the Prairie provinces was used to represent the variables in the mesoscale. The governing equations are solved numerically with terrain influences, surface roughness, temperature variations, moisture fluxes, and the release of latent heat allowed to perturb the mixed layer from its initial condition.

The mean spring topographic precipitation pattern was successfully reproduced by the simulation of a shallow east-northeasterly flow over a warmer sloping surface. A case study based on observed initial conditions showed that the model could reproduce a limited convective precipitation pattern maintained by upslope flow.

The upslope component of extreme rainfall events over some Prairie river basins and the application of this LAM to short-term streamflow forecasting are discussed.

ON THE PREDICTION OF MESOSCALE WINDS AT YORKTON, SASKATCHEWAN AND VICINITY

S. Venkatesh

Application of a simple one-level primitive equations model to predict mesoscale surface winds at Yorkton, Saskatchewan and vicinity is described. The wind prediction was in support of the launching of balloons to gather data from the stratospheric ozone layer. The effects of orientation of topographic features on the wind are investigated. A case study in the summer is examined in detail.

DETERMINATION OF SURFACE WINDS IN THE ALBERTA OIL SANDS AREA FROM A MESOSCALE MODEL

John L. Walmsley and John D. Reid

A three-dimensional mesoscale model of the planetary boundary layer is applied to the Alberta Oil Sands area. The effect of regional scale topography (the Birch, Muskeg and Stony Mountains, and the interlying upland plains) on modelled surface winds is examined for several different geostrophic wind directions. Relationships between surface wind directions calculated by the model at locations corresponding to Fort McMurray Airport and Mildred Lake are compared with observed correlations between the two weather stations.

GATE CLOUD CLUSTERS – DYNAMIC AND CONVECTIVE STRUCTURE

Catherine Gautier

The long-term objective of this work is to provide a detailed description of the mass circulation and convective organization within GATE clusters on various scales. Such a description is expected to help understanding (1) the processes that organize and maintain (or destroy) deep convection; (2) how these processes are related to mesoscale forcings; and (3) what is the feedback of cloud formation and intensification on mesoscale circulation.

For this study a cloud cluster will be defined as a compact ensemble of convectively active cells or lines. The structure of the cluster and its internal organization will be analyzed from SMS 1 Satellite data (a combination of visible and IR data allows to determine and locate cells or lines). The structure of the cells or lines is expected to be deduced from a combination of in-situ data (radar, aircraft, and tethered balloons data).

Data of well-documented cases are being analyzed from a cloud-scale perspective and from a larger scale perspective. Early results of this analysis will be presented.

A CRITICAL REVIEW ON THE SIGNIFICANCE OF THE DIABATIC INFLUENCE FUNCTIONS AND THE VON KARMAN CONSTANT

A. K. Lo and G. A. McBean

In studies of flux-profile relationships for wind velocity and temperature, the Monin-Oboukhov similarity theory for the constant flux layer is frequently used. There have been a number of widely accepted forms for the diabatic influence functions proposed in the literature. In many cases different values for the von Karman constant, k , were used to achieve agreement with experimental data.

The objective of this study is to determine the differences in fluxes computed from the same profile data but using different flux-profile relationships. Possible reasons for these differences are also examined.

EFFECTS OF AEROSOL INDUCED HEATING ON THE CONVECTIVE BOUNDARY LAYER

A. Venkatram

A two-stream solar radiation model was combined with a mixed-layer model of the PBL to study the effects of slightly absorbing aerosols on the thermal structure of the daytime convective boundary layer. A series of simulations were conducted with the model and the results showed that aerosol absorption increased the mixed-layer temperature while cooling the surface. As the effective albedo of the surface PBL was reduced to values below the surface albedo during the major portion of the day it was concluded that the primary effect of aerosols was that of warming of the earth PBL system. The results also showed that the growth of the mixed layer was relatively insensitive to aerosol participation because of negative feedback effects. It was found that an increase in surface albedo or surface wetness leads to an increase of the warming influence of aerosols.

FIELD MEASUREMENTS OF DRY REMOVAL RATES OF AIR POLLUTANTS OVER VEGETATION SURFACES

J. G. Droppo

Determination of dry removal rates of pollutants from the atmosphere is a topic of concern in current regional air pollution modeling efforts. This paper describes field studies of dry removal rates over the semi-arid region found on the Hanford Reservation. Instrumentation and results are described for SO_2 , NO_x , NO , O_3 , and aerosol dry deposition systems. The experimental accuracy is identified as an important consideration in evaluating the results of each test. The results of proof tests of aerosol measurement systems for direct field determination of sulfur removal rates are presented. The evaluation of the experimental accuracy of these results indicate the technique is viable. Deposition velocities are obtained in the order of a few centimetres per second. These are consistent with previous tests of aerosol deposition in wind tunnels.

Session O.5

Canadian arctic — research

Fri 0900 — 1210

RECENT ADVANCES IN ARCTIC OCEANOGRAPHY (Invited Paper)

E. L. Lewis

Abstract not available.

OCEANOGRAPHIC OBSERVATIONS IN PENNY STRAIT, NWT

G. S. Peck

Penny Strait is aligned northwest-southeast between Grinnell Peninsula (Devon Island) and Bathurst Island. The average dimensions are 100 km long, 30 km wide, and 200 m deep. Results of data collected across one transect in April 1976 provide an idea of the scales of motion and general physical oceanography of the strait.

The mean internal pressure field, obtained by averaging four sets of data collected at six stations over two days, is characterized by a downward slope of the isopycnals from northeast to southwest and indicates net flow to the southeast. Fourteen hourly CTD profiles taken at two sites show internal waves of periods from three to four hours. Since a transect took three hours to complete, there could be some contamination of the mean internal pressure field due to these higher frequency effects.

Power spectra of the current records (18-23 days), obtained 1-2 m beneath the ice, show peaks at tidal frequencies up to the seventh diurnal. Although the sixth is small, there is an increase in energy at the seventh diurnal frequency which could be due to a reinforcing of the signal by bathymetric effects and may be the source of the internal disturbances noted in the hourly profiles.

Total current speeds reached 60 cm/s, of which tidal contributions were 30-35 cm/s. A low-pass filter was applied to remove the tidal frequencies (periods less than 25 hours), leaving an oscillating current of four to eight day periodicity and amplitudes of 25 cm/s. While the total records were short, this motion appears to be related to atmospheric systems. The net currents were 5 cm/s to the southeast.

OCEANOGRAPHIC OBSERVATIONS IN BARROW STRAIT, NWT

R. H. Herlinveaux and D. B. Fissel

Vertical profiles of current speed and directions, temperatures and salinity were observed in the eastern portion of Barrow Strait in 1973. The measurements were made in April through a solid ice cover and again in August and September under open water conditions. In April, repeated current profiles at one position showed that the currents through the upper 50 m of the water column are variable in direction with speeds up to 47 cm/s. In many of the profiles, a pronounced

ed vertical shear in the current was observed at depths between 10 and 20 m. The salinity was nearly uniform through the upper 20 m with a pronounced halocline between 20 and 45 m depth. The upper 25 m of the water column was near the freezing point while a temperature maximum of -1.4°C was often found at about 60 m depth. In the open water conditions of August and September, the halocline was found to be nearer the surface at depths of 20 m or less. Over a period of two days, time series measurements of current profiles observed in Barrow Strait off Gascoyne Inlet revealed a westerly current with a typical speed of 50 cm/s in the upper layer above the halocline. Below the halocline the currents were reduced in strength and more variable in direction. The relation of these oceanographic observations to the tidal height and wind measurements will be discussed.

WATER STRUCTURE IN THE GREELY FIORD SYSTEM

R. A. Lake and E. R. Walker

The water structure in channels of the northwestern part of the Canadian Arctic Archipelago is described, and is shown to be very similar to that of water offshore in the Arctic Ocean. The water in the Greely Fiord system is characterized by a persistent layer of warmer water at shallow depths. The reasons for this warm layer are discussed with the aid of one-dimensional heat balance modelling. In parts of the Greely system containing sea-level glaciers, an anomalously cold layer is ascribed to cooling on the bottom of the glacier tongue. An attempt is made to relate these features to estuarine circulations in the system.

RECTILINEAR LEADS AND INTERNAL MOTIONS IN THE ICE PACK OF THE WESTERN ARCTIC OCEAN

J. R. Marko and R. E. Thomson

Large-scale (100 km) rectilinear lead patterns are a common feature of the Arctic Ocean ice cover. We show that many of the characteristics of these patterns can be explained by analogy with rock mechanics. In particular, the existence of two intersecting leads sets, the typical intersection angles of 28° and the observed relative shearing motions are consistent with faulting associated with semi-brittle failure. Further support for this explanation has been obtained using NOAA and Landsat satellite imagery over an approximately 100 km square area of the Beaufort Sea. These provide coverage of two days of ice deformation prior to the formation of a lead at 14° to the axis of compression. Strains of 4% over the two-day period are within the range attributed to rock distortion preceding semi-brittle failure. Finally, we suggest that the range from brittle to plastic type behaviour is feasible within the Arctic Ocean sea-ice, depending upon the applied rate of strain and/or the ambient confining pressures.

THE WINTER ENERGY REQUIREMENT OF AN OPEN WATER CHANNEL IN THE GULF OF ST LAWRENCE

Fabiola Renaud

The available heat energy of the Gulf of St Lawrence in the fall was calculated. From these calculations potential open water sites were selected.

At locations along the Laurentian Channel, winter energy budget calculations were carried out for an open water lead by means of a computer model. Ice was not allowed to form, and when the limiting temperature of -1.5°C was reached, mixing of water from below was induced. It was found that if the heat from the deep Laurentian Channel was not spread over a large portion of the Gulf, it was sufficient to prevent the ice formation even under rather severe meteorological conditions such as the winter of 1971-72 along the Laurentian Channel between Gaspé and Anticosti Island to Cabot Strait.

For sites in the Estuary, the available energy did not seem large enough to extend the open water season later than early March. For average winter temperature, however, the total winter loss was approximately 20% less than the cold winter 1971-72. This makes it more feasible for the deepest section of the Estuary to remain ice free during a whole winter. Also early fall mix-

ing from below the cold-intermediate layer was found to be quite effective as it delayed the onset of Estuary ice by more than three weeks.

Session M.8

Solar and wind energy

Fri 0830 - 1000

WIND POWER AND SOLAR ENERGY RELATED TO A SUBURBAN OR FARM HOME

A. H. Lamont

With rising concern over energy problems, the use of wind power and energy from the sun directly becomes a subject of interest. The possibility of utilizing these power sources in local installations to meet the needs of a home in the country in a place where the natural surroundings are likely to be favourable have been investigated. The paper is concerned with making a comparison between energy needs and the energy that might be obtained from a modest installation using the energy of either or both of the wind and sun directly.

SOLAR POWER - IS IT THE ANSWER FOR REMOTE SITES?

R. Van Cauwenbergh

Solar charging of batteries operating low-powered systems in remote locations is becoming cost effective. The amount of energy available for this purpose though, has been difficult to predict and has thus limited its use. A quantitative method resulting in predicted cell output and optimum cell inclination is presented. It is based on observations of co-located global solar radiation sensors and photo-voltaic solar panels. Since global solar radiation is the most commonly measured radiation parameter this technique permits solar power predictions for most areas of Canada.

MODELLING SOLAR RADIATION FOR DAYS WITH CLOUD

P. W. Suckling and J. E. Hay

A new cloud layer-sunshine model is presented to calculate daily totals of solar radiation. Input to this model includes cloudless sky solar radiation and its direct and diffuse components as calculated by the procedure of Suckling and Hay (1976). The differences between this new model and the cloud layer-only model of Davies et al. (1975) are shown in diagrams and equations. This new model has the advantage of calculating the direct and diffuse components separately. However, the new model requires the additional information of hourly values of total sunshine as well as cloud-layer amounts and cloud types required by the Davies model.

The performances of the Davies model and this new model for calculating daily totals of solar radiation at Goose, Nwfd, Edmonton, Alta, Summerland, B.C., Vancouver, B.C., and Sandspit, B.C. for the period 1968-70 are discussed and compared. Performance by the Davies model showed average root mean square error values ranging from 12.2% for Summerland to 22.9% for Sandspit (1.48 to $2.25 \text{ MJ m}^{-2} \text{ day}^{-1}$ in absolute terms) with an overall average of 17.9%. The new model showed improvement for every location with average root mean square error values ranging from 10.4% for Summerland to 16.7% for Edmonton (1.25 to $2.02 \text{ MJ m}^{-2} \text{ day}^{-1}$ in absolute terms) with an overall average of 14.2%.

The performance of the new model for estimating daily totals of the direct and diffuse components of solar radiation at Goose is also shown. Whereas solar radiation was estimated with a root mean square error of 15.3% ($1.67 \text{ MJ m}^{-2} \text{ day}^{-1}$), the direct and diffuse components had much higher relative errors (28.7% and 30.4% respectively) but similar absolute errors (1.43 and $1.79 \text{ MJ m}^{-2} \text{ day}^{-1}$ respectively).

For 5- and 10-day averaging periods, the new model still showed slight improvement for solar radiation estimation compared to the Davies model. Performance for daily means averaged over five days was 8.8% on the average with all locations better than 11.6%. For 10-day daily means, solar radiation was estimated within 10.4% at all locations with an average performance of 7.6%.

FLUX-GRADIENT RELATIONSHIPS OVER SNOW

R. J. Granger and D. H. Male

On the basis of data collected at the Bad Lake micrometeorological installation located in the southwest region of Saskatchewan during three consecutive spring-melt periods, the flux-gradient relationships for heat and water vapour are investigated. The results indicate that the ratio of transfer coefficients for heat and momentum, K_h/K_m , remains constant and equal to unity in the stable range $0 \leq Z/L \leq 1.0$. For the unstable range $0 \geq Z/L > -0.1$, the ratio K_h/K_m increases with increasing instability according to $K_h/K_m = (1.58 Z/L)^{2.5}$.

The analysis for the transfer of water vapour is based on the direct measurement of evaporation obtained with the use of a weighing lysimeter. The results indicate that the ratio K_e/K_h is generally less than unity, and can be as small as 0.5. No universal relationships are presented since the transfer coefficient for water vapour is influenced by external factors such as the surface boundary condition and the large-scale circulation.

During each melt period all energy fluxes were measured independently on a 24-hr basis. It is shown that use of the derived relationships for the transfer coefficients significantly reduce the total error in the energy budget.

ON THE DEVELOPMENT OF SECONDARY CIRCULATION IN THE CANADIAN ARCTIC

E. R. Reinelt and B. C. Green

Climatic contrasts are sharply displayed in the Canadian Arctic, particularly as they ensue from variations in the thermal structure of the lower levels of the atmosphere. With the melting of the snow cover in summer, great differences appear in the albedo of land and sea. Temperature-satellite IR imagery reveals the presence of strong temperature gradients along the Arctic coast, and along the shores of the more southerly Arctic islands, especially Banks and Victoria. The marked temperature contrasts give rise to a complicated pattern of secondary circulations, including a pronounced sea-breeze regime, thermal lows, and vorticity transport from sea to land.

Session M.9

Air quality

Fri 1030 - 1200

THE DISTRIBUTION OF ATMOSPHERIC SULPHATES IN CANADA AND ITS RELATIONSHIP TO LONG-RANGE TRANSPORT OF AIR POLLUTANTS

Y. S. Chung

Analysis of the distribution of airborne sulphates in Canada has been carried out using data obtained for April-May 1975. Present observations indicated that atmospheric sulphate loadings were relatively lower ($< 8 \mu\text{g m}^{-3}$) in the western provinces, while high values ($> 15 \mu\text{g m}^{-3}$) were frequently observed in the eastern provinces. The natural background level of ambient sulphates appeared to be less than $1.5 \mu\text{g m}^{-3}$ in Canada.

The analysis also suggested that the observations could be subdivided into three types of typical synoptic situations with associated sulphate levels: (a) extratropical cyclones, or cold northerly flows (low sulphates); (b) in the rear side of anticyclones (high sulphates); and (c) quasi-stationary fronts (mixed). Air-parcel trajectory analysis of the low-level atmosphere showed that high sulphate levels were often associated with S-SW airflows on the rear side of a warm air mass. The results indicated the long-distance transport of airborne sulfur pollutants, mainly from several industrial areas in the USA.

PLUME DISPERSION AND ASSOCIATED TURBULENCE CHARACTERISTICS FROM A LARGE INDUSTRIAL SITE IN THE ATHABASCA OIL SANDS

D. S. Davison, C. C. Fortems, and K. L. Grandia

During March 1976, an aerial plume survey was conducted about the effluent plume from the

Great Canadian Oil Sands (GCOS) development in the Athabasca Oil Sands in northeastern Alberta. Airborne measurements were made of SO_2 concentrations, of the plume structure, and of the associated turbulence intensities and fluxes. This study was part of the multi-year Alberta Oil Sands Environmental Research Program directed by the provincial and federal governments.

The observed plume dispersion coefficients showed various discrepancies from the widely-used Pasquill-Gifford values. These differences could be attributed to the combined effects of multiple sources at the GCOS site and enhanced dispersion due to topography. The plume spread coefficients, non-dimensionalized by the appropriate component of the turbulent velocity standard deviations, were compared with the predictions of Taylor's dispersion theory for homogeneous turbulence. The observed plume spread in both the vertical and lateral directions exhibited the predicted one-half power dependence on the total dispersion time. The use of this type of data for evaluating Pasquill's universal dispersion functions is discussed.

CALCULATIONS OF SEASONAL AND ANNUAL POLLUTION CONCENTRATIONS IN THE ALBERTA OIL SANDS

John L. Walmsley and David L. Bagg

A long-term joint frequency distribution of winds in the Alberta Oil Sands area is computed from the statistics of the wind correlation (stratified by direction, speed, and thermal stability) between Fort McMurray and Mildred Lake. This joint frequency distribution is used along with source emission data as input to the Climatological Dispersion Model (CDM) which computes long-term pollution concentrations. The CDM has been modified to incorporate terrain features and results of calculations with terrain are compared with those obtained from the unmodified version. Calculations are performed incorporating both existing and future pollution sources.

A PRELIMINARY EXAMINATION OF POOR AIR QUALITY LEVELS IN CALGARY IN RELATION TO MOUNTAIN GENERATED WIND SYSTEMS

Douglas Leahey

The city of Calgary, which has a population of about 450,000 people, is located in southern Alberta amid irregular terrain about 80 km east of the Rocky Mountains. Its air quality is influenced by wind systems that are generated to some extent by the mountains. The two such phenomena that are most noticeable in its wind climatology are the Chinook and diurnal wind variations. The Chinook is popularly identified as a strong warm westerly wind while the diurnal wind variations are associated with daily predictable changes in wind direction.

Calgary's air quality has sometimes been unfavourably compared with that of Edmonton which is similar in size but has appreciably more industry. Edmonton is located on flat terrain about 270 km north of Calgary and 280 km east of the Rocky Mountains. The influence of these mountains on the behaviour of observed winds is much less in Edmonton than in Calgary.

This report presents the results of a preliminary investigation into the manner in which the presence of the nearby mountains might adversely affect air quality in Calgary. The study has involved a detailed comparison of meteorological data collected from instrumented towers in Edmonton and Calgary for the two winters 1974-75 and 1975-76. An examination has been made of poor air quality days which occurred in Calgary during these two winters. Poor air quality days have been defined as those on which observed hourly average ground-level carbon monoxide concentrations in downtown Calgary exceeded the Alberta government standard of 13 ppm.

The examination showed that Calgary's poor air quality episodes tend to occur in the evening during synoptic situations typified by light south-southwesterly geostrophic winds at the surface. The episodes appear to be related to the tendency for northwesterly katabatic winds to occur in the late evening. The forces which produce these winds counterbalance the existing synoptic horizontal pressure gradient forces leading to a stagnating air mass with a consequential high meteorological urban air pollution potential.

Results of the investigation also indicated that the Chinook has a beneficial effect on air quality levels in Calgary. This result was expected as Chinooks are associated with relatively high winds and hence low meteorological urban air pollution potentials.

INFLUENCE OF IONS IN GAS-TO-PARTICLE REACTIONS

D. Corr, G. Diamond, C. Banic and J. V. Iribarne

It has been found that atmospheric ions can catalyse nucleation of solid particles produced by a gaseous reaction.

A set of preliminary measurements has been obtained for two gaseous systems: (A) $\text{HCl-NH}_3\text{-H}_2\text{O}$ and (B) $\text{SO}_2\text{-NH}_3\text{-H}_2\text{O}$. The reactant gases are introduced into a stream of purified air as carrier gas, at variable humidities and reactant concentrations. Nucleation is followed with a General Electric condensation nuclei counter, and nucleation curves as a function of concentration are obtained.

It has been found that in system A, for equimolecular concentrations of reactants, the threshold for reaction is considerably reduced by negative ions, while positive ions are almost inactive. In system B, nucleation starts on the walls (concentrations in the order of 100 ppm) before a threshold for homogeneous nucleation is reached. Production of ions in the stream lower this threshold to ~ 0.5 to 10 ppm, varying with humidity. The action may be due to secondary radicals rather than the ions themselves.

Session O.6

Canadian arctic — operations

Fri 1400 1710

INDUSTRY AND GOVERNMENT CONSTRAINTS AND

REQUIREMENTS IN ARCTIC OPERATIONS (Invited paper — Tentative Title)

A. E. Collins

Abstract not available.

SATELLITE DATA RETRANSMISSION FOR ARCTIC STUDIES

R. A. Atkins and R. H. Goodman

The ever-increasing demand for hydrocarbon resources has extended the search for oil and gas to even more remote regions of the earth. In such areas, the collection of environmental and engineering data becomes difficult and expensive. The Canadian Arctic presents an additional challenge of extreme environmental conditions, which further complicate the data collection process.

There are essentially three approaches to Arctic data collection; manned observation posts, unmanned data acquisition systems, and data telemetry. The cost of manned systems precludes their use in a data network, hence unmanned systems have been developed. Remote recording systems are inexpensive, but due to the harsh environment, suffer from a moderate rate of failure. This can result in the unacceptable loss or invalidation of data.

For short distances from a base camp, VHF telemetry system can be used, but for truly remote operation, satellite-based data-retransmission systems are an ideal solution. This paper will describe the use of GOES and NIMBUS six data platforms operating in the Arctic and off-shore Labrador. These platforms have been used to retransmit meteorological, oceanographic, and ice data from remote locations for two seasons.

Techniques and applications will be discussed and a description of the hardware required will be presented. Typical data will be used to illustrate the methods.

THE BEHAVIOUR OF OIL IN ICE-COVERED AND ICE-INFESTED SEAS

G. D. Greene

Oil and gas exploration activities in the western Arctic have progressed in recent years from land-based operations, to drilling from artificial islands in the shore-fast zone, and from drill ships further offshore in the active ice zone during the open water season. Environmental factors such as low temperatures, poor visibility, and storms make exploratory drilling difficult. Exten-

sive engineering studies and design work are necessary to ensure the integrity of structures and vessels against sea-ice forces. These factors markedly alter the behaviour of oil released to the marine environment, and may hamper clean-up operations.

Oil in the natural environment is weathered and transported by the processes of evaporation, dissolution, biodegradation, dispersion, sedimentation, and emulsion formation. At low temperatures evaporation and biodegradation are greatly slowed. Oil trapped in ice is shielded from evaporation and dissolution. On seawater at temperatures near 0°C, crude oil stabilizes at a much greater thickness than in temperate waters due to a zero or negative spreading coefficient. The range of equilibrium thicknesses which have been observed is 0.1 to 1.0 cm. Thus an oil slick on cold water would cover a smaller area than in temperate regions, facilitating containment and recovery.

Oil spilled onto a smooth ice surface reaches a relatively large equilibrium thickness, 0.3 and 1.0 cm. However, as sea ice tends to be rough and somewhat porous, oil pooling, dependent on ice-surface topography and absorption into the surface of the ice, may dominate spreading. The result is some measure of natural containment of spilled oil governed by ice-surface features.

Oil under ice comes to rest at the ice-water interface, where it has a strong negative spreading tendency. The slick thickness ranges from 0.5 to 1.3 cm under smooth ice. Since the under surface of sea ice is irregular, oil may form thicker pools at depressions and between keels. Ice growth continues under an oil slick, trapping the oil in lenses in the ice. This may aid control operations by reducing spreading. While land-fast ice provides a temporary, stable sink for the oil, ice in the active zone which is moving, may spread this trapped oil over a larger area.

During spring melt, brine channels form in first-year ice and permit the oil in these lenses to migrate to the surface, where it can be collected or burned in situ. This does not occur in multi-year ice. Oil recovery in such a situation from in or under ice, is difficult.

Clean-up techniques are still very limited. Experimental burning has been successful. No present equipment has proven effective in ice-infested waters. The approach has been to adapt clean-up equipment developed for temperate regions. A major industry-government research program is now proposed to develop equipment and methods more suitable to the conditions dictated by ice and temperatures.

THE BIOLOGICAL OCEANOGRAPHY PROGRAM FOR IMPERIAL OIL IN DAVIS STRAIT 1976-77 (Tentative Title)

Shirley M. Conover, and Evan Birchard

Abstract not available.

EFFECT OF FLUORIDE ON PHOSPHORITE SOLUBILITY BEHAVIOUR IN SEAWATER Scott MacKnight

The solubility behaviour of phosphorite in seawater was investigated. Exposure of phosphorite to solutions of altered fluoride ionic activity led to the formation of new phases at the solid-solution interface. As reaction proceeded, changes in the mineral surface were monitored by a number of analytical techniques (ESCA, SEM). Re-exposure to regular seawater showed that these new phases could be altered to yet other phases as a result of the change in the chemical environment. The alteration in solution fluoride ion activity was also found to decrease pressure-induced dissolution of phosphorite. The altered surface, and not the bulk mineral phase, was found to control subsequent solubility behaviour and dissolution kinetics.

TURBULENT DIFFUSION VARIABILITY AND THE MARINE ENVIRONMENT D. P. Krauel

Numerical values of horizontal and vertical eddy diffusivities, determined by diverse methods, vary temporally and spatially in the ocean. This variability has been attributed to many factors such as wind, current shears, wave, stratification, boundary influences, and depth. A model is developed which draws together the results of both theoretical and experimental investigations

into the dependence of the diffusivities upon readily measurable environmental factors. Some interesting features of diffusing plumes in diverse marine environments are predicted by the derived model.

ENVIRONMENTAL PREDICTIONS FOR ARCTIC MARINE OPERATIONS

J. C. O'Rourke

Canmar is a Calgary based company that operates a fleet of three ice-reinforced drillships, four icebreaker supply boats, two supply boats, one tug boat, three barges, three helicopters, and one fixed-wing aircraft for the purpose of drilling exploratory wells in the Beaufort Sea in Canada's arctic. The polar ice pack is continuously within 100 mi or so of the drill fleet while it is drilling exploratory wells in the open water that exists between the land and the polar pack. Canmar operates an environmental monitoring and prediction system to predict the state of ice, wind, and waves in the vicinity of its operations. The system consists of automatic weather stations on the pack ice, radio ice stations to track ice floes up to 50 mi away from the drillships, current meters, wave buoys, a radar and video equipped aircraft, and a shore base office staffed full time by three meteorologists with full communications with the Canadian weather office in Edmonton which provides up-to-date weather charts and satellite photographs of the operating region.

This presentation describes the basic details of the prediction system and its performance during the 1976 drilling season. Canmar's warning and action plan for ice operations are described. The division between government and private industry responsibilities for development and implementation of environmental prediction systems is discussed. The need for additional ice and weather observations for the Beaufort and Arctic Islands is discussed. Based on Canmar's recent experience, eight conclusions are drawn concerning federal responsibility, performance of moored drillships, ingredients for environmental prediction in ice-infested waters, and areas in which there are immediate needs for more data and/or research.

Session M.10

Cloud physics

Fri 1330 - 1500

THE THERMODYNAMIC AND DYNAMIC EFFECTS OF CUMULUS CLOUDS OBSERVED IN AMTEX '74

H. R. Cho and T. C. Yip

The large-scale heat, moisture, vorticity, and potential vorticity budgets have been analyzed for a warm period (14-16 February) of the Air Mass Transformation Experiment of 1974 (AMTEX '74).

During the analyzed period, the observational area was capped by a strong temperature inversion layer lying between 800 mb and 720 mb. The results of the large-scale heat and moisture budget analyses indicate that there were strong convective activities during the period. Cumulus clouds have strong cooling and moistening effects near the inversion layer and heating and moistening effects in the layer of air below the inversion. Through cloud population analysis, it was found that the atmospheric air near the inversion layer was completely recycled by cumulus clouds about once a day. This recycling rate increased to about 3.7 day^{-1} near the cloud base level. This was much stronger than what is usually observed in a typical trade-wind weather situation.

The large-scale vorticity field showed a pronounced minimum near the inversion layer. The potential vorticity budget analysis indicates that cumulus clouds transported potential vorticity from above the inversion into the layer of air below the inversion. The total cumulus cloud mass flux determined through the large-scale potential vorticity budget agrees favourably with that determined through heat and moisture considerations.

EMPIRICAL RELATIONSHIP BETWEEN PARCEL CONVECTIVE ENERGIES AND MAXIMUM RAINFALL RATE

C. U. Ro and I. I. Zawadzki

Parcel convective energies have been correlated with daily maximum rainfall rates in the Montreal area. The rain rates were obtained from records of 14 gauges in conjunction with radar data. For

calculations of energies the Maniwaki soundings were combined with daily maximums of surface wet-bulb potential temperatures as given by four standard surface stations in the Montreal region. With data from two summer seasons the correlation between surface parcel energies and maximum rain rate is very high, providing a useful forecasting method as well as suggesting means of rain parametrization in cloud convection studies.

SIMULATION OF GRAUPEL GROWTH IN A LABORATORY CLOUD CHAMBER

M. M. Oleskiw and E. P. Lozowski

Graupel particles are now believed to play a significant role in the hail and cold-rain formation processes. Although various hypotheses have been advanced to explain the growth of conical graupel, they have received little experimental verification. We therefore devised a laboratory cloud chamber simulation experiment to examine the 1973 hypothesis of Knight and Knight, that several conical graupel embryos are formed simultaneously near the corners of a hexagonal plate, and that they subsequently break off to grow independently.

A unique sprayer system was built to produce a droplet cloud with a mass median diameter between 7 and 15 μm , and with a liquid water content of up to 3 g/kg. A nylon hexagonal plate of diameter 1 mm and thickness 50 μm was attached to the tip of a very fine needle and rotated on the end of a boom through the cloud at speeds of 50 to 250 cm/s. The air temperature for different experiments varied between -5 and -18°C. Possible electrical effects were ignored.

The experiments confirmed that the initial riming on these simulated hexagonal ice crystals occurs at the edges and primarily near the corners of the plate. As the individual corner deposits continue to grow, they fan out into the wind, but possess few, if any, common points of attachment. This structure has little mechanical strength, and with time fracture has been noted to occur at the point of attachment to the plate. The deposit densities were in the range 0.05 to 0.2 g cm⁻³, and they showed a tendency to increase with increasing velocity and temperature. Although the calculated collection efficiencies were relatively high (a mean of 0.5 for all experiments), no consistent relationship to temperature or velocity was found.

THE FATE OF ELECTRICAL CHARGES IN CLOUD DROPLETS

B.A. Thomson and J.V. Iribarne

Thunderclouds act as electrostatic generators that separate massive amounts of charges of both signs into different regions, with the charges residing mainly on cloud droplets and ice particles. While from a macroscopic point of view the charged regions become neutralized partly by electrical discharges and partly by ion currents, the problem remains of understanding the evolution of charges in the individual charged particles. When the cloud droplets evaporate, the charges must either remain on the solid residue which is left, or else leak off into the air. We have considered the relative efficiencies of three processes which may discharge a cloud droplet as it evaporates: (1) capture of ions of the opposite sign; (2) Rayleigh instability; and (3) ion evaporation.

The first process ought to be rather inefficient in a cloud due to the low conductivity of the air. The second process will always occur before the third for drop radii greater than about 0.01 μm . The maximum cloud droplet charges that have been measured in a thundercloud would require a 5 μm radius drop to evaporate to a radius of 0.037 μm before charge loss could occur by Rayleigh instability. Drops in the vicinity of lightning channels and in screening layers may become highly charged by capture of ions of one sign in a large electric field. A drop of radius R which is charged to a fraction f of its saturation in a field of E V/m, and which contains a solute of dry density ρ_g/cm^3 in a concentration of x mg/l, may only lose charge (by the Rayleigh process) when it evaporates if:

$$R > 3.6 \times 10^3 \frac{x}{\rho} f^2 E^{-2}$$

It appears that only for highly charged droplets composed of rather pure water will charge loss occur. In all other cases the droplets should leave their charge on the solid residue when they evaporate. This charge will be ultimately transferred to the air by capture of ions of opposite sign, leaving a free excess of compensating ions in the air.

COMPARISONS OF CALCULATIONS AND OBSERVATIONS OF ICE CRYSTAL GROWTH FOLLOWING SEEDING

J. W. Strapp and H. G. Leighton

For the past several years, the Atmospheric Environment Service, The National Aeronautical Establishment, and The Canadian Forestry Service have been involved in a joint program to study the feasibility of inducing precipitation in cumulus clouds by AgI seeding. The immediate economic incentive would be the suppression of large fires by downwind seeding of suitable clouds.

The Yellowknife Cumulus Seeding Experiment has provided detailed microphysical information of rapid particle growth after seeding in several cases. The rate of growth of these particles has been compared to predictions of an ice crystal growth model, and good agreement has been found. The model has also been useful in estimating the delay in activation of the AgI in these cases, and has provided evidence supporting aggregation of crystals in two cases studied.

Session M.11

Hail

Fri 1530 - 1700

HAILSTONE ICING

R. D'Amours and E. Lozowski

Existing models of hailstone heat transfer during icing are deficient in several respects. All of them ignore the discrete nature of accretion, treating it instead as if the supercooled cloud water were a continuous medium. Most models do not take into account the internal heat conduction within the stone, and those that do are prone to treat the thermal conductivity as infinite. Finally, many models make the steady-state assumption that implies that the deposit temperature is time-invariant.

A new spherically symmetric numerical model has been devised that simulates certain aspects of the discrete nature of the accretion process, while considering the heat transfers, including internal conduction, to be time-dependent. As a first approximation, a uniform layer of given thickness is accreted instantaneously over the entire surface of a spherical hailstone with initially homogeneous properties. The subsequent history of the deposit before the accretion of the next layer is divided into two stages. During the *freezing stage*, the deposit warms to 0°C owing to the formation of ice dendrites and it exchanges heat with the environment and the interior of the stone while the remainder of the supercooled water freezes. If the entire deposit is frozen before the accretion of the next layer, it enters the *cooling stage*, where exchanges of heat with the environment and the interior give rise to a changing deposit temperature. During both of these stages, the internal temperature profile of the hailstone is also calculated as a function of time.

It is found that the final surface temperature is colder than is predicted by the steady-state continuum models, and that the final surface temperature is lower when the deposit is thicker. Using the model in conjunction with a two-dimensional kinematic thunderstorm model and making simple assumptions about the collection efficiency, it is possible to investigate the detailed thermal history of a developing hailstone.

EVALUATION OF HAILFALL FROM HAILPAD AND RADAR DATA

Peter Wrenshall and Robert Charlton

A study was conducted for the Alberta Hail Project to determine whether hailfall data from hailpads could be supplemented by radar observations to better define the spatial variation of hailfall. The findings of this study will be used in the evaluation of the hail suppression project.

Data from the hailstorms of 1974 included analyses of daily hailfall on hailpads and taped radar data from the C-band radar. The density of hailpads was between one and two per township (92 km²). The resolution of the radar was of the order of 1 km³, sampled every 3.5 min.

A formula for converting the radar reflectivities into units of hailfall energy flux density was developed. These energy flux densities were integrated over altitudes between 1.5 and 4 km and summed for the hail day to give estimates of daily hailfall impact energy density at points of interest such as hailpad locations. In order to eliminate echoes produced by rainfall, various threshold reflectivities between 30 and 45 dBZ were tried as indicators of hailfall.

The radar-derived impact energy densities were found to be well correlated with the hailpad energy densities for a given storm. However, the relationship varied between hailstorms of different dates. This study showed that hailpad and radar data can be used to estimate hailfall at a point if it is known that hail actually fell at that point. Farmers' reports of hailfall were useful in determining where hail had occurred since these telephone-solicited reports are much denser than the hailpad network.

ANALYSIS OF AN ALBERTA MULTICELL STORM

K. L. Grandia, D. S. Davison, and D. R. Inkster

On 24 August 1976, an isolated multicellular storm passed through the project area of the Alberta Hail Project. This storm persisted for approximately 2.5 hours, and was the subject of an intensive investigation using an instrumented aircraft, radar, and aerial photography.

The instrumented aircraft made numerous subcloud and incloud passes to identify and trace the thermodynamic fields associated with the inflow structure. Radar-chaff was released into the inflow region in order to map the inflow circulation. Auto-correlation analysis was performed on the three-dimensional turbulent velocity field measured by the aircraft to determine the mixing potential for seeding agents within and in the vicinity of the storm. In order to describe the precipitation reaching the ground, low-level radar reflectivity and polarization fields of the storm were investigated.

Results of this case study will be discussed with relevance to the hail suppression experiment in Alberta.

THE SASKATCHEWAN HAIL RESEARCH PROJECT, 1973-76

Alexander H. Paul

This paper describes some preliminary results of a climatological study of hailstorms in south-eastern Saskatchewan. Comparisons are drawn between data on the Saskatchewan hail, derived from farmers' reports in the same manner as Alberta Hail's surface hailfall data, and data from other hail research projects. Case studies of a number of Saskatchewan storms are briefly reviewed and the variety of synoptic situations in which damaging hail may occur is emphasized. The implications of the findings regarding the logistics of any potential cloud-seeding program to suppress hail in southern Saskatchewan are examined. While the general behaviour of the Saskatchewan storms is similar to that of Alberta, certain factors such as the greater length of the Saskatchewan hail season, the occurrence of multiple storms on the same day, and the greater frequency of night-time storms appear to militate against the possible success of a modification program.

HAIL SUPPRESSION: WHERE DO WE GO FROM HERE?

Peter W. Summers

The results of hail suppression programs around the world still continue to give conflicting and controversial results. The recent results of the U.S. National Hail Suppression Experiment, while substantially enhancing basic knowledge of hailstorms, failed to show any significant effects due to seeding. On the other hand major operational programs in South Africa and Alberta are claiming considerable success. Certain critical differences in the cloud microphysics (frozen droplet vs graupel embryos) and in the storm structure (supercell vs multicell) may offer the explanation why seeding sometimes appears to decrease hail and at other times appears to increase hail. Some fundamental questions that still need to be answered about hailstone formation, hailstorms, and hail suppression in order to resolve these issues are presented and the various options for carrying out this research are discussed.

**ELEVENTH ANNUAL GENERAL MEETING
CANADIAN METEOROLOGICAL SOCIETY**

**WINNIPEG CONVENTION CENTRE, WINNIPEG
1 JUNE 1977**

AGENDA

- 1 Minutes of the Annual General Meeting, 26 May 1976
- 2 Annual Reports from the Executive
 - a) President's Report
 - b) Treasurer's Report
- 3 Annual Reports from the committees
 - a) Editorial Committee
 - b) Awards Committee
 - c) Citations Committee
 - d) Standing Committee on Public Information
 - e) Scientific Committee
- 4 Annual Reports from Local Centres and Oceanography Division
- 5 Budget for 1978
- 6 Membership Fees for 1978
- 7 Motions from Council
- 8 Locations of Future Congresses
- 9 Other Business
- 10 Report of Nominating Committee
- 11 Installation of Officers for 1977-78

**ONZIÈME ASSEMBLÉE GÉNÉRALE ANNUELLE
DE LA SOCIÉTÉ MÉTÉOROLOGIQUE DU CANADA**

**CENTRE DES CONVENTIONS DE WINNIPEG
LE 1^{er} JUIN 1977**

ORDRE DU JOUR

- 1 Procès-verbal de l'assemblée générale annuelle, 26 mai 1976
- 2 Rapports annuels du bureau d'administration
 - a) rapport du président
 - b) rapport du trésorier
- 3 Rapports annuels des comités
 - a) Comité de rédaction
 - b) Comité des récompenses
 - c) Comité des citations
 - d) Comité permanent responsable de l'information du public
 - e) Comité chargé des questions scientifiques
- 4 Rapports annuels des centres locaux et de la division de l'océanographie
- 5 Budget 1978
- 6 Cotisations en 1977
- 7 Propositions du conseil d'administration
- 8 Emplacement des congrès à venir
- 9 Divers
- 10 Rapport du comité de mise en candidature
- 11 Investiture des membres du bureau d'administration pour 1977-78

Minutes of the 10th AGM, 26 May 1976 are missing

**They have been replaced by the minutes of Council Meeting
held 25 May 1976 – which follow**



CANADIAN METEOROLOGICAL SOCIETY

SOCIÉTÉ MÉTÉOROLOGIQUE DU CANADA

MINUTES OF THE THIRD COUNCIL MEETING HELD AT 8 PM

EDT TUESDAY, MAY 2, 1976 IN ROOM 1045C, PAVILLON

VACHON, UNIVERSITE DE LAVAL, QUEBEC, QUEBEC

MEMBERS PRESENT:

P.E. Merilees, President
J. Hay, Vice President
J.G. Cantin, Treasurer
H. Leighton, Corresponding Secretary
P. Zwack, Recording Secretary
R.M. Gagnon, Councillor-at-large
C. Mann, Chairman of Oceanography Division
B. Watson, Chairman of Ottawa Centre
M. Ferland, Chairman of Quebec Centre
R. Fichaud, Chairman of Montreal Centre
M. Hacksley, Vice Chairman of Winnipeg Centre

OBSERVERS:

I. Rutherford, Chairman of the Editorial Committee
J. Vanier, Chairman of Public Information Committee
J. Maybank, Chairman of Scientific Committee
S. Smith, Secretary of Oceanography Division
G. Goyer, Secretary of Scientific Committee
E. Lozowski, Alberta Centre
D.M. Leahey, Toronto Centre
G. McBean, Toronto Centre
J. Derome, Montreal Centre
R. Asselin, Montreal Centre

1. Minutes of the second Council Meeting of February 20, 1976

The following change was made:

Page 7, item 7, part 2 to read:

"2) A motion to ammend the by-laws which would permit the Treasurer to pay bills less than \$500 without prior Executive approval."

2. Reports from the Executive

2a) President

Andrew Thomson Prize

The President recounted the history of the discussions and actions taken over the past year to honour Andrew Thomson. J. Hay then moved the following motion which was seconded by B. Watson.

"It is proposed that the CMS Prize in Applied Meteorology be renamed the Andrew Thomson Prize in Applied Meteorology."

The motion was adopted unanimously.

Development Fund

The President reported that the name of the fund started by D. McIntyre with a \$4000 donation has been changed from "Anonymous Fund" to "Development Fund". The fund has received a donation of \$150 from M. Khandakar.

AMS/CMS Speaker's Tour

The President reported that the Society had suggested to the AES that the 1976-77 speaker be an oceanographer. His goal would be hopefully to learn about meteorology and inform the local centres of the scope of oceanography. The AES Management Committee warmly received the suggestion and has agreed to provide support. The Executive will work with the Oceanography Division to prepare a list of names for submission to AES. The speaker and exact topic are likely to be announced in the CMS Newsletter in early summer.

2b) Vice President

Vancouver Island Chapter

The Vice President reported that the Executive is still waiting for a letter for members from Vancouver Island requesting the establishment of a chapter.

Consulting Standards

Fulfilling his mandate from the Executive, the Vice President presented a proposal (Appendix 1) for the formation of an adhoc committee to consider the standard of meteorological consulting in Canada. J. Hay then moved and P. Zwack seconded the following motion.

"An adhoc committee shall be formed to study the standard of meteorological consulting in Canada under the terms of reference presented (to be found in Appendix 1)".

A general discussion followed. The major points brought up were:

- Certification does not work well in the U.S. and is not a viable alternative.
- Consultants will succeed over a long period only if they perform their jobs well.
- The society is learned and not professional and, therefore, has no role in certification.
- No problem in consulting standards has been proved as yet, however, a problem may exist now or in the future.
- Committee should look at TV and Radio meteorologists.

The President pointed out that the aim of the society is to promote the science of meteorology and, therefore, to promote quality consulting work. It was pointed out by council, that item 2 in the terms of reference refer to improving standards as if they were not now high. J. Hay accepted the following addition to that item: "...for maintaining or improving the standard..." The President called the question and the motion was adopted by a vote of 9 to 1.

The composition of the committee was discussed. After some concern was expressed as to the balance on the committee between consultants, users and the society, J. Hay pointed out that A. Boyer, although now with Ontario Hydro (potential user), has had an extensive career in consulting. J. Hay would perform a neutral role representing the society. P. Merilees felt there is a good balance. He also pointed out that the committee would certainly request feedback from other users and consultants as well as the CMS membership.

2c) Past President-The Past President was absent due to illness.

2d) Treasurer

J.G. Cantin moved and B. Watson seconded a motion "to approve payment of \$656.02 to J. Hay for travel expenses for his trips to Ottawa, Quebec, and Montreal". The motion was adopted unanimously.

H. Leighton reminded the centres to be conscientious in submitting financial reports. For example, the Regina Centre made no mention in its report of the subvention received from the National Executive. He pointed out that financial report guidelines exist.

The Treasurer asked if there were any questions about the financial report in the Congress Issue. There were no questions.

2e) Corresponding Secretary

Membership

The Corresponding Secretary reported that the latest membership figures are (1975 figures in parenthesis): 703 (634) members including 71 (42) students. These numbers break down to approximately 633 meteorologists and 70 (10) oceanographers. He concluded that the increase in membership size was mainly due to the influx of oceanographers.

Youth Science Foundation

The Corresponding Secretary received a letter from the Youth Science Foundation indicating that their budget had been cut by 60% (41,000) by the Federal Government. They have written to the P.M. and have asked the Society for support. P. Merilees reviewed our contact with YSF. K. Clark is the CMS representative to its board. The Ottawa Centre has donated \$50 to help send the Ottawa Science Fair winner to Brandon, Manitoba for the national fair. He also pointed out that Quebec has allocated \$100,000 for a Quebec program and that maybe the Federal Government wants the provinces to take over the program. B. Watson reported that the Ottawa Centre had also formed a committee to study meteorological activities in the capital region and that the committee found that the YSF was the best activity promoting meteorology in the high schools. He recommended that CMS take strong action. H. Leighton moved and B. Watson seconded the following motion:

"The National Executive shall be instructed to write a letter of support for the Youth Science Foundation to the Prime Minister and the Minister of Science and Technology and that the local centres also be encouraged to respond in a similar manner".

The motion passed unanimously.

3. Reports from the Standing Committees

3a) Editorial Committee

The editor of Atmosphere reported on the progress in the last year. Since the beginning of 1976, Atmosphere is getting larger and the quality is improving. The second and third issues (stratospheric balloon project) are completed and will be out in time. Because of the increase in size (last issue in 1975 was \$5000), the projected budget for 1976 may be on

the low side. However, the bill for the last issue may be paid in the beginning of 1977. The editor also indicated that he will be taking a leave of absence from RPN and will be resigning as Chairman of the Editorial Committee at that time (August, 1976). The President asked for suggestions for the next editor and indicated that the Executive has some names under active consideration. It was suggested that the technical and scientific editing be separated. The President responded that this idea is also under consideration and that the former could be provided for a fee from U. of T. Press.

3b) Public Information

Mention was made of the newspaper story quoting a CIA report that forecast climatic changes in the future. The President indicated that the CMS is co-sponsoring a symposium of "Living with Climatic Change" (June) which will help to correct misconceptions.

3c) Newsletter - No business.

3d) Scientific Committee

The new Chairman of the Scientific Committee, John Haybank, indicated that a report will be presented the following day at the AGM. He reported that A. Boutard of the University of Quebec at Montreal has resigned. He suggested that the following people be elected to the committee:

Dr. T. Warn, UQAM
Dr. R. Rogers, McGill U.
Dr. Pelletier, U of T
Dr. Kwizak, AES, Toronto

J. Hay moved the election of these names. The motion was seconded by H. Leighton. It was adopted unanimously.

4. Report from the Oceanography Division

The report was presented by the chairman, C. Mann. He indicated that 1975-76 was a good year. There are about 50 papers at the Congress. There are now about 70 oceanographers in the CMS which clearly indicates that the oceanographic community, with the exception of biologists, is interested in the CMS. He felt that with current interest growing in oceanography, there are a larger number of possible members for a learned society like the CMS. The Executive of the Division has made plans for a new Executive. At the general meeting of oceanographers he will recommend strongly that they formalize their relationship with the CMS. He felt that a national division is probably more natural and does not see much greater participation than that which already exists with the local centres. He suggested that the arrangements for CMS structure changes could be considered in the coming year.

5. 1978 Congress Location

H. Leighton reported that members in London, Ontario have agreed to host the 1978 Congress at the University of Western Ontario (with the Learned Societies).

6. CMS Booklet

Since A. Robert, the member of the Executive responsible for the booklet, was absent, the President reported briefly on the booklet progress as of the last Executive Meeting (23 April).

7. Awards and Citations

The President turned the chair to the Vice President and left the meeting room. The Vice President read the report of the Awards Committee that can be found in the Congress Issue. He pointed out that P. Merilees, the President, was recommended for the President's Prize. R. Gagnon, a member of the Awards Committee, expressed the opinion that the report was produced by one person. He was not consulted, and if he would have been, he would have opposed the recommendation of the President for the President's Prize on the grounds that it is strange and the President is officially (although he did not participate) an ex-officio member of the committee. He is also a member of Council which awards the prize. Otherwise, he certainly did not object to the recommended recipient on scientific grounds. He indicated that he will announce at the AGM that he was not associated with the committee. He also felt that similar events had happened in the past and that he will propose to the AGM that the society eliminate the possibility that current members of the committees or the Council receive awards. J. Hay responded by indicating that the Executive was very upset by the lack of communication within the committee and has taken steps to avoid the problem in the future by planning to place a member of the Executive on each committee to insure its functioning. He also noted that the by-law regulating the President's Prize does not exclude the President and that the award is for exceptional work in a particular year. 1975 was a particularly productive year for P. Merilees and he felt it would be unjust to deny him the prize.

A general discussion followed with the following points brought out:

- Since members felt that although deserved, it seems strange and is perhaps an unfortunate recommendation.
- It is too late for any alternative action such as a special award.
- There are similar cases in other institutions and that the best man should get the award.

- If the by-law had excluded such a possibility, no problem would now exist.

P. Zwack pointed out that the final date for the report of the Awards and Citations Committee will be moved up in the future so that the Council will have time to really consider the reports and, if necessary, find alternates.

The Vice President, as chairman separated the issues and called for a motion on the President's Prize. H. Leighton moved and P. Zwack seconded a motion to accept the Awards Committee report on the President's Prize. The by-law governing the award was read. The motion was defeated (2 for, 3 opposed, 4 abstentions). R. Gagnon asked that the reason for this decision be explained fully at the AGM.

P. Zwack moved and M. Ferland seconded the acceptance of the Awards Committee report for the other three prizes (see Congress Issue). The motion was adopted unanimously.

The Vice President then returned the chair to the President who returned to the meeting room. J. Hay moved and M. Ferland seconded the acceptance of the Citations Committee Report. It was adopted unanimously.

8. Motions from Council to the AGM

H. Leighton moved and J. Hay seconded that the motion to the AGM to ammend the constitution (non-profit status) be ammended by replacing the word "non-profit" by "charitable" and replacing "organismes sans but lucratif" to "oeuvres de charités". It was pointed out that this new wording was required by the government and that the change does not alter at all the sense of the ammendment. The motion was adopted unanimously.

9. New Members

H. Leighton moved and P. Zwack seconded the election of the following people to membership in the CMS. The motion was adopted unanimously.

Mr. R.A. Gorski (student)
Windsor, Ontario

Dr. D.W. Forrester (oceanographer)
Ottawa, Ontario

Mr. H.L. Mitchell (student)
Cote St. Luc, Quebec

Mr. Gilles Babin
Chicoutimi, Quebec

Mr. H.H. Watson
Ottawa, Ontario

Mr. A.J. MacLatchy
Porters Lake, Halifax County

10. New Business

R. Gagnon moved and B. Watson seconded the following motion:

"No members of the Citations and Awards Committee nor members of Council shall be eligible to receive awards or citations during their term of office".

P. Zwack pointed out that changes to the by-laws require passage by the AGM and that council must give the required notice before bringing motions to the AGM. J. Maybank pointed out that this motion is just a change to the terms of reference which needs only council approval. However, it was also pointed out that the latter is true for the awards but that a change to the citations terms of reference requires a by-law change. H. Leighton suggested that this important issue should be discussed more thoroughly with feedback from the membership. P. Zwack asked that the Executive should discuss it thoroughly and bring a motion to Council at its next meeting. P. Merilees indicated that he found the motion too restrictive and agreed with the previous two speakers. The President called the question. The motion was defeated (3 in favor, 4 opposed, 3 abstentions). The President indicated that the issue will be thoroughly examined by the Executive which will recommend action at the next Council meeting.

The meeting was adjourned at 23:45 EDT. The time and place of the next meeting will be decided in the near future.



Peter Zwack
Recording Secretary



CANADIAN METEOROLOGICAL SOCIETY

SOCIÉTÉ MÉTÉOROLOGIQUE DU CANADA

Meteorological Consulting Standards in Canada

Background

Concern has been expressed by some members of the meteorological community that there is too infrequent use of qualified meteorologists in areas of environmental consulting where such expertise would be desirable if not necessary. There is also the question of the standard of the work performed by meteorologists when they are employed on these projects.

Action

The recommendation is that an ad hoc committee be struck to consider the standard of meteorological consulting in Canada.

Terms of Reference of Ad Hoc Committee

1. To review the current extent of, the requirements for and the standard of meteorological consulting in Canada.
2. To review and recommend procedures for maintaining or improving the standard of meteorological consulting in Canada.
3. To provide a report to the National Executive by December 31, 1976.

Membership of Ad Hoc Committee

It is imperative that both the Society, the consultants and the users be well represented. It is recommended that membership be as follows:

P. Summers (AES)*
D. McIntyre (Consultant)*
D. Yap (Ontario Air Resources Branch)
or
M. Ferland (S.M.Q.)
A. Boyer (Ontario Hydro)
J. Hay (CMS; ex officio)*

*Approached and willing to serve

Financial Requirements

An attempt has been made to keep all active members of the committee within the Ontario/Quebec area in order to limit travel costs. Nevertheless some costs will be incurred including probably the cost of one member visiting the operators of the AMS certification programme. Thus I believe a budget allocation of \$500 should be made to this ad hoc committee, for use if necessary.

John E. Hay
Vice President, CMS
May, 1976

PRESIDENT'S REPORT

The Canadian Meteorological Society in 1976

This year the Society's activities have been a healthy mix of attention to present needs and planning for future requirements. Such rationality is a consequence of the Society's greater maturity and increased cash flow.

Administratively the most notable event of the year was the moving of the National Executive from Montreal to Vancouver, a move aimed at strengthening the national bonds which exist within the Society. A conscious effort to maintain continuity between the outgoing and incoming Executives resulted in a smooth exchange of responsibilities. Few problems resulting from the peripheral location of the Executive have arisen and those that did were soon resolved. This year saw the establishment of two Chapters; one in Saskatoon, which was more an official recognition of an existing situation and one in Victoria, which was a recognition of a substantial membership in that area and the inability of the Vancouver-based B.C. Centre to adequately serve that group. Centres continue to make good use of their annual subventions with numerous communities benefitting from the many local initiatives.

The Society's committees have continued to work effectively. The Scientific Committee is now operating under the by-law adopted at the 1976 annual meeting and has completed its transformation from SOMAS/ACGG. As a result of a request from the membership the Society has established an ad hoc committee to examine the standard of meteorological consulting in Canada and to suggest methods for the maintenance or improvement of that standard. The committee is scheduled to report in early 1977. The Society was fortunate in finding a person capable of maintaining the high standards required of the Chairman of the Editorial Committee and Editor of *Atmosphere*. Ian Rutherford resigned from those positions with the justified satisfaction of having brought *Atmosphere* up-to-date and to a standard which is gaining it considerable recognition in the scientific community. Such achievements have not been without substantial cost and will require careful control to ensure financial stability in future years. At this time it is appropriate to acknowledge the financial assistance of the Canadian Government made through the Atmospheric Environment Service. The \$16,000 grant this year met a substantial portion of the costs of *Atmosphere* and the Scientific Committee, two important institutions in Canadian meteorology.

Manuscript preparation for the CMS booklet is now well advanced and it is with confidence that I predict its publication in 1977. Planning for 1977 has also included the preparation of proposals to amend the Society's constitution to more accurately reflect the role the Society is playing in Canadian oceanography. These considerations will be the culmination of the actions which established the oceanographic division for a trial period of two years.

The CMS continues to provide a useful service to its membership through its activities at both the local and national levels. Of equal importance is the fact that the Society is effective in bringing the opinions and expertise of a broadly-based and well-qualified membership to the attention of various sectors of our society and the community at large.

John E. Hay
President

Cette année, les activités de la Société ont porté à la fois sur la satisfaction des besoins actuels, ainsi que sur la planification afin de répondre aux besoins futurs. Ce comportement rationnel est la conséquence directe du mûrissement de la Société et, bien sûr, d'une augmentation de ses ressources pécuniaires.

Du point de vue administratif, l'événement le plus important de l'année fut sans aucun doute le déménagement du bureau d'administration de la Société de Montréal à Vancouver, ce geste ayant pour but de resserrer les liens nationaux qui existent déjà dans la Société. A la suite d'un effort particulier visant à assurer la continuité entre le bureau d'administration sortant et celui qui le remplacera, la passation des pouvoirs s'est effectuée de façon idéale. L'emplacement périphérique du bureau d'administration n'a suscité que peu de problèmes, et ceux-ci furent résolus rapidement. Deux nouvelles sections virent le jour cette année; l'une à Saskatoon, ce qui n'était que la reconnaissance officielle d'un fait déjà établi, et l'autre à Victoria, où la présence de nombreux membres, et l'incapacité du centre de la Colombie Britannique à Vancouver de les servir adéquatement nécessitaient ce geste. Les centres ont fait bon usage de leurs subventions annuelles, de nombreuses communautés bénéficiant des initiatives prises au niveau des centres locaux.

Les comités de la Société ont également accompli du bon travail. Le Comité chargé des questions scientifiques fonctionne maintenant selon le règlement adopté par l'assemblée annuelle de 1976, et il a complété sa transformation SOMAS/ACGG. De plus, tel que demandé par les membres, la Société a créé un comité ad hoc chargé d'étudier les normes que respectent les consultants en météorologie au Canada, celui-ci devant également suggérer des moyens de maintenir ou d'améliorer ces normes. Le Comité devra faire un rapport au début de 1977. La Société a également eu la chance de trouver un candidat capable de satisfaire aux critères exigeants qu'imposent le poste de directeur du comité de rédaction, et de rédacteur de la revue *Atmosphère*. Ian Rutherford avait en effet remis sa démission, avec la satisfaction d'avoir complètement renoué la revue *Atmosphère*, l'amenant à un niveau de qualité suffisant pour que la communauté scientifique lui porte une attention grandissante. De tels résultats ont cependant entraîné des dépenses substantielles, et il faudra un contrôle serré des dépenses pour assurer la stabilité financière de la revue au cours des prochaines années. Il serait bon de mentionner à ce moment-ci l'aide financière du gouvernement canadien, par l'intermédiaire du Service de l'environnement atmosphérique. La subvention de \$16.000.00 qu'ils nous ont accordée cette année a couvert une partie importante des frais d'*Atmosphère* et du Comité chargé des questions scientifiques, tous deux des institutions importantes pour la météorologie au Canada.

La préparation du livret de la SMC est en bonne voie, et je peux affirmer qu'il sera publié en 1977. La planification pour l'année 1977 inclut également la rédaction d'amendements à la constitution de la Société, de sorte que celle-ci puisse mieux refléter le rôle que la Société compte jouer en océanographie au Canada. Ces amendements sont l'aboutissement ultime des décisions qui ont amené la formation de la Division de l'océanographie pour une période d'essai de deux ans.

La SMC continue finalement de rendre service à ses membres par ses activités à l'échelle nationale et locale. Parallèlement, la Société est tout aussi efficace lorsqu'il s'agit d'exprimer et d'expliquer les opinions et les expertises de ses membres à différents secteurs de la population, aussi bien qu'aux citoyens en général.

Le président
John E. Hay

TREASURER'S REPORT

Transactions of the Society increased from \$57,000 in 1975 to \$80,000 in 1976, reflecting substantial increases both in the cost of publishing *Atmosphere* and in the amount of the subvention received from the Atmospheric Environment Service.

The efforts of the previous Treasurer in establishing a more formal accounting system proved of great value during and following the move of the executive to Vancouver. Apart from minor difficulties with the mechanics of the transfer, continuity was maintained and year-end closure proved accurate.

The structure of the financial and budget statements of 1976 follow those of 1975, permitting a direct comparison of major items of income and expenditure.

Financial Statement for 1976

As in previous years, the INCOME STATEMENT for 1976 reflects items entered into the accounts during the fiscal year. Dues and subscriptions cover the period from 30 September 1975 to 30 September 1976. Charges for *Atmosphere* include issues to Volume 14, Number 3. Due to a catch-up in billing for *Atmosphere*, along with the increased cost of its publication, a substantial net loss was incurred in 1976. This fact is clearly indicated in the INCOME STATEMENT and in the STATEMENT OF FINANCIAL POSITION, which shows the assets and liabilities of the Society.

The year-end balance of each account is given in APPENDIX I.

Budget for 1977-78

Of necessity, the budget for 1977 indicates a hold-the-line posture. A further operating loss of \$1,100 is anticipated implying an equivalent reduction in the current assets of the Society.

It is clear that the continued operation of the Society at its current or hoped for level will require an increased financial commitment by its membership. The budget for 1978, reflecting minimal change in many areas and the need for continuing tight control on publications costs, is based upon an increase in dues to \$25 per year.

D. G. Schaefer
Treasurer

RAPPORT DU TRÉSORIER

Les transactions de la Société ont passé de \$57,000 en 1975 à \$80,000 en 1976. Cette augmentation substantielle est due aux coûts de la publication de la revue *Atmosphère* et au montant plus élevé en 1976 de la subvention du Service de l'environnement atmosphérique.

Les efforts du trésorier précédant à instaurer un système de comptabilité plus adéquat se sont révélés utiles pendant et après le déplacement du bureau d'administration à Vancouver. Mis à part quelques difficultés causées par le mécanisme de transfert, une continuité fut assurée et la fermeture des livres pour la fin de l'année 1976 s'est faite sans erreur.

Comme les états financiers et le budget de 1976 sont accolés à ceux de 1975, on peut comparer rapidement les éléments importants des revenus et des dépenses.

État financier pour l'année 1976

Comme par les années passées, L'ÉTAT DU REVENU pour 1976 représente des items enregistrés dans des comptes pendant l'année fiscale. Les cotisations et les souscriptions couvrent la période du 30 septembre 1975 au 30 septembre 1976. Les coûts de la revue *Atmosphère* incluent les numéros jusqu'au volume 14, numéro 3. En raison d'un rattrapage dans le payment de la revue *Atmosphère* et d'une augmentation du coût de sa publication, une perte nette importante fut encourue en 1976. Cette constatation se reflète clairement à L'ÉTAT DU REVENU et au BILAN qui montrent l'actif et le passif de la Société.

En APPENDICE I, on trouve le solde de chaque compte pour l'année se terminant le 31 décembre 1976.

Budget de 1977-78

Forcément, le budget de 1977 reflète une politique de prudence. On anticipe une perte future de \$1,100 au niveau des opérations impliquant ainsi une réduction équivalente dans les disponibilités de la Société.

Il est évident que la poursuite des opérations de la Société à son niveau actuel ou souhaité nécessitera un engagement de la part des membres pour un support financier. Le budget de 1978, soumis à quelques changements mineurs dans plusieurs domaines et à un besoin continu d'un contrôle serré sur les coûts de publication, est basé sur une augmentation des cotisations à \$25 par année.

Le trésorier
D. G. Schaefer

**SOCIÉTÉ MÉTÉOROLOGIQUE DU CANADA/
CANADIAN METEOROLOGICAL SOCIETY
ÉTAT DU REVENU/INCOME STATEMENT
POUR L'EXERCICE FINANCIER TERMINÉ LE 31 DÉCEMBRE 1976/
FOR THE FISCAL YEAR ENDED 31 DECEMBER 1976**

REVENU/INCOME

Cotisations et souscriptions	\$16,788.41	
Dues and subscriptions ¹		
Subvention SEA/AES Grant	16,000.00	
Revenu Congrès/Congress revenue	1,491.46	
Revenu reproduction d'articles/Sale of reprints	1,806.50	
Autre/Other ²	<u>1,280.68</u>	
		\$37,367.05

DÉPENSES/EXPENDITURES

Publications ³	28,937.91	
U of T Press (commissions)	2,898.68	
Dépenses centres/Centres expenses	2,944.75	
Opérations/Operations ⁴	5,284.98	
U of T Press (Reproduction/Reprints)	1,025.60	
Comité scientifique/Scientific Committee	1,664.18	
Dépenses du Congrès/Congress expenses	<u>500.00</u>	
		<u>43,256.10</u>

REVENU NET/NET GAIN

(\$ 5,889.05)

¹ Comptes/Accounts no. 106, 120

² Comptes/Accounts no. 20, 21, 22, 61

³ Comptes/Accounts no. 99, 100, 101, 103, 105

⁴ Comptes/Accounts no. 23, 24, 25, 26, 27, 28, 29, 30, 45

**SOCIÉTÉ MÉTÉOROLOGIQUE DU CANADA/
CANADIAN METEOROLOGICAL SOCIETY
BILAN/STATEMENT OF FINANCIAL POSITION
31 DÉCEMBRE 1976/31 DECEMBER 1976**

ACTIF/ASSETS

DISPONIBILITÉS/CURRENT ASSETS

Caisse/Cash (Banque Royale/Royal Bank)	\$ 2,641.25	
Banque Royale/Royal Bank—Dépôt à court terme/ Short-term deposit	10,000.00	
Fonds de développement/Development fund	4,150.00	
Intérêts du fonds de développement/ Development fund interest	407.12	
Fonds Hornstein/Horstein Fund	1,000.00	
Intérêt du fonds Hornstein/Hornstein Fund interest	128.13	
Obligations d'épargnes du Canada I/ Canada Savings Bonds I	950.00	
Obligations d'épargnes du Canada II/ Canada Savings Bonds II (Coupons)	593.75	
Parts de Bell Canada/Bell Canada Shares ¹	576.00	
Comptes à recevoir/Accounts receivable	44.00	
		<u>\$20,490.25</u>

PASSIF ET AVOIR DE LA SOCIÉTÉ/LIABILITIES AND SOCIETY'S EQUITY

EXIGIBILITÉS/CURRENT LIABILITIES

Comptes à payer / Accounts payable ²	\$ 6,754.22
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AVOIR DE LA SOCIÉTÉ/SOCIETY'S EQUITY

Avoir de la société/Society's Equity	<u>13,736.03</u>
31 décembre 1976/31 December 1976	

TOTAL PASSIF ET AVOIR DE LA SOCIÉTÉ/ LIABILITIES AND SOCIETY'S EQUITY	<u>\$20,490.25</u>
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¹ Valeur des parts au 31 décembre 1976/Value of shares as of 31 December 1976

² U of T Press

APPENDICE I/APPENDIX I

SOCIÉTÉ MÉTÉOROLOGIQUE DU CANADA/ CANADIAN METEOROLOGICAL SOCIETY SOLDE DE CHAQUE COMPTE/BALANCE OF EACH ACCOUNT POUR L'ANNÉE TÉRMINÉE LE 31 DÉCEMBRE 1976/ FOR THE YEAR ENDED 31 DECEMBER 1976

N¹

1	Caisse/Cash (Banque Royale/Royal Bank)	\$ 2,641.25
20	Revenus annonces/Advertising revenue	55.00
21	Revenus intérêts/Interest earned	1,042.19
22	Revenus divers/Miscellaneous revenue	0.00
23	Dépenses intérêts/Interest expenses	17.64
24	Dépenses-frais d'échanges/Exchange expenses	0.72
25	Dépenses-frais de services/Service expenses	67.65
26	Dépenses de bureau/Office expenses	80.86
27	Dépenses-prix, dons/Prize, gift expenses	397.03
28	Dépenses de communications/Communication expenses	119.16
29	Dépenses de voyages/Travel expenses	4,526.92
30	Dépenses de traduction/Translation expenses	0.00
31	Banque Royale/Royal Bank - Dépôt à court terme/Short-term deposit	10,000.00
41	Revenu reproduction d'articles/Sale of reprints	1,806.50
45	Dépenses-vérificateur/Auditor expenses	75.00
50	Dépenses Congrès/Congress expenses	500.00
51	Revenu Congrès/Congress Revenue	1,491.46
61	Dividendes encaissés/Dividends cashed	42.12
70	Fonds de développement/Development fund	4,150.00
71	Intérêt du fonds de développement/Development fund interest	407.12
72	Fonds Hornstein/Hornstein Fund	1,000.00
73	Intérêt du fonds Hornstein/Hornstein fund interest	128.12
75	Obligations d'épargne du Canada I/Canada Savings Bonds I	950.00
76	Obligations d'épargne du Canada II/Canada Savings Bonds II (Coupons)	593.75
77	Parts de Bell Canada/Bell Canada Shares	576.00
80	Comptes à payer/Accounts payable	6,754.22
81	Comptes à recevoir/Accounts receivable	44.00
85	Avoir de la société/Society's equity	13,736.03
86	Subvention SEA/AES Grant	16,000.00
99	U of T Press (<i>Atmosphere</i>)	28,056.37
100	U of T Press (Nouvelles/Newsletter)	598.23
101	U of T Press (Etiquette, en-tête de lettres/Labels, letterheads)	165.03
102	U of T Press (Reproduction/Reprints)	1,025.60
103	U of T Press (Citation)	78.63
104	U of T Press (Commissions)	2,898.68
105	U of T Press (Divers/Other)	39.65
106	U of T Press (Cotisations et souscriptions/Dues and subscriptions)	16,493.41
110	Comité scientifique/Scientific Committee	1,664.18
120	Revenu membre de soutien/Revenue sustaining member	295.00
130	Dépenses-centres/Centres expenses	2,944.75

¹ Numéro de compte/Account number

**SOCIÉTÉ MÉTÉOROLOGIQUE DU CANADA/
CANADIAN METEOROLOGICAL SOCIETY
BUDGET DE L'ÉTAT DU REVENU/
INCOME STATEMENT BUDGET**

REVENU/INCOME	1977	1978
Cotisations et souscriptions/Dues and subscriptions ¹	\$18,000	\$22,000
Subvention SEA/AES Grant	16,000	16,000
Revenu Congrès/Congress revenue	2,000	2,500
Revenu reproduction d'articles/Sale of reprints	2,000	2,500
Autre/Other ²	1,300	1,400
	<u>\$39,300</u>	<u>\$44,400</u>
 DÉPENSES/EXPENDITURES		
Publications ³	\$22,000	\$25,000
U of T Press (Commissions)	3,200	3,800
Dépenses Centres/Centres expenses	3,200	3,400
Opérations/Operations ⁴	3,500	3,800
U of T Press (Reproduction/Reprints)	1,500	1,800
Comité scientifique/Scientific Committee	2,500	3,000
Dépenses du Congrès/Congress expenses	2,000	2,500
Services d'information/Information Services	2,500	1,100
	<u>\$40,400</u>	<u>\$44,400</u>
 NET LOSS/PERTE NETTE	 <u>(\$ 1,100)</u>	 <u>\$ 0</u>

¹ Comptes/Accounts no. 106, 120

² Comptes/Accounts no. 20, 21, 22, 61

³ Comptes/Accounts no. 99, 100, 101, 103, 105

⁴ Comptes/Accounts no. 23, 24, 25, 26, 27, 28, 29, 30, 45

AUDITOR'S REPORT

I have examined the Statement of Financial Position of the Canadian Meteorological Society as of 31 December 1976, and the related Income Statement for the year then ended. My examination was made in accordance with generally accepted auditing standards and according to procedures as I considered necessary in the circumstances.

In my opinion the accompanying Statement of Financial Position and Income Statement present fairly the financial position of the Canadian Meteorological Society at 31 December 1976, and the results of its operations for the year then ended, in conformity with generally accepted accounting principles applied on a basis consistent with that of the preceding year.

J. G. Langlois, RIA

RAPPORT DU VÉRIFICATEUR

J'ai examiné le bilan de la Société météorologique du Canada au 31 décembre 1976 et l'état du revenu pour l'année se terminant à cette date. J'ai fait mon examen en respectant les normes généralement acceptées et en utilisant les méthodes que je considérais nécessaires dans les circonstances.

A mon avis le bilan et l'état du revenu présentent équitablement la situation financière de la Société au 31 décembre 1976 et les résultats de ses activités en 1976, conformément aux principes comptables généralement acceptés tels qu'appliqués d'une façon compatible avec celle de l'an passé.

J. G. Langlois

REPORT OF THE NOMINATING COMMITTEE RAPPORT DU COMITÉ DE MISE EN CANDIDATURE

The Nominating Committee is unanimous in nominating the following persons to the 1977-78 CMS Council. All nominees have agreed to serve.

A l'unanimité le Comité de mise en candidature soumet la liste suivante des candidats aux postes de conseillers pour le terme 1977-78. Tous ont consenti à occuper le poste indiqué.

President/Président
Vice-president/Vice-président
Treasurer/Trésorier
Corresponding secretary/Secrétaire correspondant
Recording secretary/Secrétaire d'assemblée
Councillors-at-large/Conseillers

K. F. Harry
R. W. Burling
D. G. Schaefer
R. B. Sagar
P. Sagert
F. Dobson
E. Einarson
H. L. Ferguson

Paul H. LeBlond
Chairman/Président

EDITORIAL COMMITTEE REPORT

In previous years the biggest problem facing *Atmosphere* has been to obtain an adequate supply of material to maintain a regular publication schedule. For several successive years the hoped-for growth failed to materialize and costs were significantly under budget, sometimes to our embarrassment. Now suddenly in 1976 this picture was radically altered. Partly because of a decision

to publish several longer than usual articles but mainly because of the excellent response to requests for papers for the "Stratoprobe" issue, an explosive growth in the number of pages occurred (316 versus 208 in 1975). Naturally, the costs rose in proportion. Another consequence was that at last it was possible to catch up to a regular quarterly schedule.

Although the Society faces unusually high publication costs for 1976, the circumstances responsible for this need not recur. Nevertheless, *Atmosphere* is now on average considerably larger than three years ago and perhaps the time has come to reconsider the question of page charges or other ways of financing an expanded journal. In the meantime it will be necessary to limit the size of each issue to about 60 pages. This should permit a small backlog of papers and allow a more regular publication both in timing and in size.

As editor for the past three years I have enjoyed the cooperation of a very able committee who did reviews, found referees, solicited papers, wrote articles and made suggestions, for all of which I am deeply grateful. Ed Truhlar's help with the "Stratoprobe" issue was particularly appreciated. No editor can function without considerable secretarial support and this one was saved many times from total disaster by Lise Paradis.

Finally, I am grateful to Jacques Derome, the new editor, who agreed to relieve me before the final issue of Volume 14 was through the press.

Ian D. Rutherford
Editor, *Atmosphere*

RAPPORT DU COMITÉ DE LA RÉDACTION

Au cours des années passées le problème majeur auquel la revue *Atmosphère* devait faire face était d'obtenir assez d'articles pour paraître régulièrement. Pendant plusieurs années la croissance espérée ne s'est pas réalisée et les coûts restèrent inférieurs aux prévisions, nous causant parfois un certain embarras. Soudainement en 1976 cet état de choses s'est transformé. D'une part parce que nous avons décidé de publier plusieurs articles plus longs que ceux acceptés jusque là, mais surtout à cause de l'excellente réaction à notre sollicitation d'articles pour le numéro "Stratoprobe," il s'est produit une croissance explosive du nombre de pages publiées (316 contre 208 en 1975). Evidemment les coûts ont augmenté en proportion. Cette croissance nous a permis de publier la revue comme prévu à tous les trimestres.

Il est vrai que la Société fait face à des coûts de publication très élevés mais il n'est pas forcé que cette situation se répète. De toute façon, la revue *Atmosphère* est maintenant en moyenne beaucoup plus épaisse qu'il y a trois ans et le temps est peut-être venu de reconsidérer la question des frais de publication pour les auteurs ou d'envisager d'autres façons de financer notre revue en croissance. Pour le moment il sera nécessaire de limiter le nombre de pages par numéro à 60. Cela devrait nous permettre d'accumuler une petite réserve d'articles et d'arriver à une certaine régularité quant aux dates de parution et au nombre de pages par numéro.

Comme directeur de la revue au cours des trois dernières années j'ai bénéficié de la collaboration des membres du Comité qui ont fait des critiques de livres, trouvé des arbitres, sollicité ou écrit des articles et fait des suggestions; je leur en suis profondément reconnaissant. L'aide que m'a apportée Ed Truhlar dans la préparation du numéro "Stratoprobe" a été tout spécialement appréciée. Il est impossible pour un éditeur de travailler sans la collaboration d'une secrétaire et le soussigné a échappé au désastre à plusieurs occasions grâce à Lise Paradis.

Enfin je remercie Jacques Derome, le nouveau directeur, qui a accepté de s'occuper des derniers stades de production du numéro 4 de 1976.

Le directeur
Ian D. Rutherford

AWARDS COMMITTEE REPORT

The Awards Committee (composed of R. W. Burling, K. D. Hage, G. A. McBean, D. G. Schaeffer, E. Walker, and T. Warn) offers the following recommendations for 1976:

President's Prize: W. F. J. Evans

For his important contributions to the AES Stratospheric Pollution program (Project Strato-probe) both as a member of the program and in communicating the results which appeared in the special issue of *Atmosphere* 14 (3).

Graduate Student Prize: Humphrey Melling

For the development of a zero-level crossing method to extract Doppler velocities from acoustic echoes and the establishment of multiple acoustic scattering with the help of Doppler measurements on falling snow.

The Prize in Applied Meteorology: E. Wovinkel and S. Orvig

For their contributions to northern hydrology and climatology through their developments of energy budget and analysis models of the hydrological environment; and their experiments with the surface heat and water budgets of the Canadian Middle North. The results of these studies have direct application to planning the use of water storage areas in tundra and their model has been used extensively.

The Rube Hornstein Prize in Operational Meteorology: S. V. A. Gordon

For long and meritorious service in and for pioneering the development of important techniques in operational meteorology. In particular, for instigating and being the driving force in the development of techniques for severe weather forecasting and the application of the small computer day-to-day operations in a weather office.

R. W. Burling
Chairman

RAPPORT DU COMITÉ DES RÉCOMPENSES

Le Comité des récompenses (composé de R. W. Burling, K. D. Hage, G. A. McBean, D. G. Schaeffer, E. Walker, et T. Warn) fait les recommandations suivantes pour l'année 1976:

Prix du président: W. F. J. Evans

Pour la contribution importante qu'il a apportée au programme "Pollution stratosphérique SEA" (Project "Stratoprobe") comme participant au projet et aussi pour la communication des résultats qui ont paru dans le numéro spécial d'*Atmosphère* 14 (3).

Prix aux étudiants gradués: Humphrey Melling

Pour l'élaboration d'une méthode "zero-level crossing" pour l'extraction des vitesses Doppler à partir d'échos acoustiques et la constatation de dispersions acoustiques multiples à l'aide de mesures Doppler dans des précipitations neigeuses.

Prix de météorologie appliquée: E. Vowinkel et S. Orvig

Pour leurs contributions à l'hydrologie et à la climatologie du nord à l'aide de l'élaboration de modèles pour l'étude de budgets énergétiques et l'analyse de l'environnement hydrologique; aussi pour leur étude expérimentale des budgets de chaleur et d'eau dans le Moyen-nord canadien. Les résultats de ces études ont des applications directes au niveau de la planification des réservoirs hydrologiques dans la toundra et leur modèle a été grandement utilisé.

Le prix de météorologie opérationnelle Rube Hornstein: S. V. A. Gordon

Pour de longs et méritoires services en météorologie opérationnelle et pour y avoir été à l'avant-garde dans l'élaboration d'importantes techniques. En particulier, pour avoir été le promoteur et la force motrice responsable de l'élaboration de méthodes de prévision d'orages et de l'application de petits ordinateurs aux activités quotidiennes d'un bureau météorologique.

Le directeur
R. W. Burling

CITATIONS COMMITTEE REPORT

The Committee recommends that the following citations be made

To Professor Douglas H. Pimlott (University of Toronto) for his interesting and vigorous dedication to the maintenance of environmental quality and ethics, in particular his activities in support of the rationale and humane development of the Canadian Arctic.

To the Conseil Québécois de l'Environnement for the excellence of their program dedicated to the maintenance of environmental quality, in particular as achieved through colloquia and their publication *De toute urgence*.

RAPPORT DU COMITÉ DES CITATIONS

Le Comité recommande les citations suivantes:

Au professeur Douglas H. Pimlott de l'Université de Toronto, en reconnaissance du dévouement et de la vigueur qu'il a apportés au maintien de la qualité et de l'éthique en matière d'environnement, particulièrement pour son travail à l'appui d'un développement raisonné et humain de l'Arctique canadien.

Au Conseil québécois de l'environnement, en reconnaissance de la qualité de son programme axé sur le maintien de la qualité de l'environnement et particulièrement pour ses colloques et sa publication intitulée *De toute urgence*.

REPORT FROM THE STANDING COMMITTEE ON PUBLIC INFORMATION

On 12 August 1976 the incumbent Chairman, Jacques Vanier, wrote to the President, Dr John Hay, noting that the National Executive had moved from Montreal to Vancouver, and suggested that it would be highly desirable for the Chairman to be co-located with the National Executive Council. For that reason, Jacques Vanier indicated he did not wish to serve another term.

The Executive accepted his resignation with regret and tendered thanks for his services as Member and Chairman of the Public Information Committee.

At time of writing the membership of the PIC is as follows:

J. L. Knox	Chairman
H. B. Kruger	Liaison Officer (AES Headquarters)
Dr A. J. Chisholm	Toronto Centre
Garry Schaefer	Vancouver Centre
M. G. Ferland	Quebec Centre
H. M. Fraser	Winnipeg Centre
A. D. Gates	Halifax Centre
To be named	Regina Centre
A. Ouellet	Montreal Centre
D. J. Webster	Ottawa Centre
H. P. Wilson	Alberta Centre
Dr G. K. Sato	Officer, National Ocean Science Affairs, Ottawa.

We urge all CMS members either individually or through their centres, to bring the attention of their PIC representative all matters within the concern of the Society and which involve or require the provision of information to the public in general or to specific groups.

Two items currently before the National Executive for consideration are:

1 The desirability of the CMS instituting a program of certification of Canadian Radio and TV weathercasters.

2 The possibility of the CMS formulating policy statements on climate change, weather modification, and weather forecasting in a manner similar to the American Meteorological Society.

The Public Information Committee would welcome receiving the views of the membership on these and other matters.

John L. Knox
Chairman

RAPPORT DU COMITÉ CHARGÉ DE L'INFORMATION DU PUBLIC

Le 12 août 1976, Jacques Vanier, alors directeur, a communiqué par écrit avec le président, le Docteur John Hay, pour lui faire remarquer que, vu le déménagement du bureau d'administration de la Société de Montréal à Vancouver, il serait souhaitable que le directeur réside dans la même région. Par conséquent, Jacques Vanier lui fit part de sa décision de ne pas conserver ce poste l'année suivante.

Le bureau d'administration a accepté sa démission avec regret, non sans l'avoir remercié pour ses services comme membre et directeur du Comité chargé de l'information du public.

Actuellement, la liste des membres de ce comité se lit comme suit:

J. L. Knox	Directeur
H. B. Kruger	Agent de liaison (Direction Centrale, SEA)
A. J. Chisholm	Centre de Toronto
Garry Schaeffer	Centre de Colombie Britannique
M. G. Ferland	Centre de Québec
H. M. Fraser	Centre de Winnipeg
A. D. Gates	Centre de Halifax
A. nommer	Centre de Regina
A. Ouellet	Centre de Montréal
D. J. Webster	Centre d'Ottawa
H. P. Wilson	Centre d'Alberta
G. K. Sato	National Ocean Science Affairs, Ottawa.

Nous invitons fortement les membres de la SMC, soit individuellement, soit par l'intermédiaire de leurs centres, à attirer l'attention du représentant local du comité sur tout sujet susceptible d'intéresser la Société, et qui nécessiterait une information du public en général, ou de groupes particuliers.

Le bureau d'administration de la Société se penche actuellement sur les deux sujets suivants:

1 L'opportunité pour la SMC d'instituer un programme de certification à l'intention des annonceurs de radio ou de télévision qui font des émissions sur la météorologie.

2 La possibilité pour la SMC de se prononcer officiellement sur des sujets comme les changements climatiques; la modification du temps et la prévision du temps, comme le fait par exemple la Société météorologique américaine.

Le comité chargé de l'information du public accueillera avec plaisir l'opinion des membres sur ces deux points, et sur tout autre sujet en général.

Le directeur
John L. Knox

REPORT FROM THE SCIENTIFIC COMMITTEE

The Scientific Committee met twice during the year to consider several problems of concern to the CMS and to make recommendations, where appropriate, to the Executive Committee.

The need for a manpower survey and for a certification program was again considered, and judged to be insufficient at the present time to launch a major effort in this area. The Garp Scientific Committee's continuing efforts concerning the Gate Task Force and the Polar Sub-Program were endorsed by the SC.

Other areas of concern included Weather Modification in Canada, Canadian participation in PEP, fluorocarbon research in Canada and metrication.

The participation of the CMS in the "Living with Climatic Change" meetings and in the AGU meeting planned for Toronto in 1980 was reviewed, and fully endorsed.

Finally the future direction of the *Geophysical Bulletin* and of *Atmosphere* was considered and recommendations made.

Dr J. Maybank assumed the Chairmanship of the SC and three new members were appointed to the SC in May 1976.

G. Goyer
Secretary SC

RAPPORT DU COMITÉ SCIENTIFIQUE

Le Comité chargé des questions scientifiques s'est réuni à deux reprises au cours de l'année pour se pencher sur plusieurs problèmes qui concernent la Société météorologique du Canada et, lorsque jugé utile, pour faire des recommandations au bureau d'administration.

On considéra la possibilité de faire une enquête sur les ressources humaines ainsi que d'établir un programme de certification et on en arriva à la conclusion qu'il n'y avait pas lieu d'y consacrer des efforts importants à ce moment-ci. Les efforts soutenus du Comité chargé des questions scientifiques de "GARP" en ce qui concerne le groupe de travail "GATE" et le sous-programme polaire furent appuyés par notre comité.

Parmi les autres questions d'intérêt on peut mentionner la modification du temps au Canada, la participation canadienne au programme PEP, la recherche en fluorures de carbone au Canada et la conversion au système métrique.

La participation de la Société aux réunions "Living with Climatic Change" et à la réunion de l'AGU qui doit avoir lieu à Toronto en 1980 fut examinée et entièrement appuyée.

Enfin le Comité a discuté de l'orientation future du *Bulletin de Géophysique* et d'*Atmosphère* et il a fait des recommandations.

Le Dr J. Maybank fut le directeur du Comité et trois nouveaux membres furent nommés en mai 1976.

Le secrétaire
G. Goyer

REPORT FROM THE OCEANOGRAPHY DIVISION

At the conclusion of its first year of membership in the CMS, the Oceanographic Division resolved, at the Quebec City Congress, to continue its association with the CMS. The new executive (Chairman: David Farmer, Secretary: Paul LeBlond; Members at large: Bjorn Sundby, Peter Jones; Congress Convenor: Noel Boston) was elected with the general mandate of bringing about the permanent incorporation of oceanographers within the CMS, and with the task of formulating suitable proposals to this effect to be presented to the 1977 Congress. These proposals, in the form of a series of amendments to the constitution, were prepared and discussed extensively with the CMS executive, and are now put forward for ratification by the membership of the Society. Adoption of the proposed amendments would transform the CMS into a Canadian Meteorological and Oceanographic Society.

In order to increase membership, a recruitment campaign was launched during the summer; about fifty prospective members, mostly physical oceanographers, were personally solicited. About half of those approached joined the society. Oceanographic membership is now in excess of one hundred.

Participation in the activities of the Society by oceanographic members is approaching a normal level. Oceanographers are active in a number of local centres; ocean-oriented submissions for publication to *Atmosphere* continue to come in (about ten last year), and the CMS tour speaker for 1977 was an oceanographer, Dr Huntley. The active participation of oceanographers within the CMS augurs well for the future of a Society modified to include oceanography within its terms of reference.

P. H. LeBlond

RAPPORT DE LA DIVISION DE L'Océanographie

Au terme de sa première année d'adhésion à la SMC, la Division de l'océanographie a résolu, lors du congrès tenu à Québec, de continuer son association avec la SMC. Le nouveau bureau d'administration (composé de David Farmer, président; Paul LeBlond, secrétaire; et Bjorn Sundby et Peter Jones comme membres; et Noel Boston, convocateur) était élu avec le mandat de favoriser l'incorporation permanente des océanographes à la SMC. Le bureau avait pour tâche de formuler et de présenter des propositions convenables au congrès 1977. Ces propositions, rédigées sous forme d'une série d'amendements à la constitution furent préparées et discutées longuement avec le bureau d'administration de la SMC. L'adoption des amendements proposés ferait de la SMC la Société canadienne de météorologie et d'océanographie.

A l'occasion d'une campagne de recrutement lancée en été environ 50 candidats, en majorité des océanographes physiques, furent sollicités. Près de la moitié d'entre eux se joignirent à la Société, qui compte maintenant plus de cent membres dans la Division de l'océanographie.

La participation des membres aux activités de la Société a presque atteint un niveau normal. Les océanographes travaillent dans un certain nombre de centres locaux; le nombre d'articles scientifiques en océanographie qui sont soumis à la revue *Atmosphere* est soutenu; on en a compté une dizaine l'an dernier. Il est à noter aussi que le Docteur Huntley, conférencier national de la SMC pour l'année 1977, est un océanographe. La participation active des océanographes au sein de la SMC est pleine de promesses pour l'avenir d'une Société modifiée afin d'intégrer l'océanographie dans son programme.

P. H. LeBlond

NOTICE OF MOTION FROM COUNCIL

**It is proposed that the Constitution and By-Laws of the
Canadian Meteorological Society
be amended as follows:**

- ARTICLE 1** Name be changed to:
The name of this Society shall be the Canadian Meteorological and Oceanographic Society.
- ARTICLE 2** Aim be changed to:
The Society exists for the advancement of meteorology and oceanography (the term oceanography as used here includes limnology).
- ARTICLE 3** Membership be changed to:
Membership is open to persons and organizations having an interest in meteorology and or oceanography.
- ARTICLE 6** Non-profit status be amended by adding:
"and oceanography" at the end of the first sentence.
- BY-LAW 2c)** Be amended by changing:
"in promoting meteorology and its application" to "in promoting meteorology and or oceanography and their application."
- BY-LAW 4b)** Be amended by adding the following sentence:
The Nominating Committee shall take into consideration the need for proper representation of the two fields of interest of the Society.

- BY-LAW 6f)** Be amended by deleting:
"Atmosphere" and inserting "Atmosphere-Ocean" in the third sentence.
- BY-LAW 9b)** Be amended by deleting:
"the Canadian Meteorological Society" and inserting "the Canadian Meteorological and Oceanographic Society."
- BY-LAW 10a)** Be amended by deleting:
"of meteorological interest" and inserting "of meteorological and or oceanographic interest."
- BY-LAW 12a)** Be amended by deleting:
"of meteorological interest" and inserting "of meteorological and or oceanographic interest" in the first sentence.
- BY-LAW 14a)** Be amended by deleting:
"interest in meteorology" and inserting "interest in meteorology and or oceanography."
- BY-LAW 14d)** Be amended by deleting:
"from national Canadian Meteorological Society or Canadian Meteorological Society sponsored meetings" and inserting
"from national Canadian Meteorological and Oceanographic Society or Canadian Meteorological and Oceanographic Society sponsored meetings" in the last sentence.
- BY-LAW 14e)** Be amended by deleting:
"Atmosphere" and inserting "Atmosphere-Ocean" in the first sentence.

For Information Only

At the first appropriate meeting Council will be asked to make the following amendments to the Appendix to By-Laws:

- 1 Change the title to "Canadian Meteorological and Oceanographic Society Awards and Prizes."
- 2 President's Prize: Change "in the field of meteorology" to "in the fields of meteorology and/or oceanography."
- 3 Graduate Student Prize:
 - i Change title to read "Graduate Student Prizes"
 - ii Change "of special merit" to "of special merit in meteorology and or oceanography."

AVIS DES PROPOSITIONS DU CONSEIL D'ADMINISTRATION

On propose les changements suivants à la constitution et aux règlements de la Société météorologique du Canada

- ARTICLE 1** Nom. Remplacer par:
Le nom de la société est la Société canadienne de météorologie et d'océanographie.
- ARTICLE 2** But. Remplacer par:
Cette Société a pour but de stimuler l'intérêt pour la météorologie et l'océanographie (le terme océanographie ici inclut la limnologie).
- ARTICLE 3** Adhésion. Remplacer par:
Toute personne ou tout organisme intéressé à la météorologie ou à l'océanographie peut devenir membre de la Société.
- ARTICLE 6** Société sans but lucratif. Ajouter:
"et l'océanographie" à la fin de la première phrase.
- RÈGLEMENT 2c)** Remplacer:
"l'intérêt pour la météorologie et ses applications" par "l'intérêt pour la météorologie, l'océanographie et leurs applications."

- RÈGLEMENT 4b)** Ajouter la phrase suivante:
Le Comité de mise en candidature s'efforcera d'assurer une juste représentation des deux sphères d'intérêt de la Société.
- RÈGLEMENT 6f)** Remplacer:
"Atmosphère" par "Atmosphère-Océan" dans la troisième phrase.
- RÈGLEMENT 9b)** Remplacer:
"la Société météorologique du Canada" par "la Société canadienne de météorologie et d'océanographie."
- RÈGLEMENT 10a)** Remplacer:
"d'intérêt météorologique" par "d'intérêt météorologique ou océanographique."
- RÈGLEMENT 12a)** Remplacer:
"d'intérêt météorologique" par "d'intérêt météorologique ou océanographique."
- RÈGLEMENT 14a)** Remplacer:
"l'intérêt envers la météorologie" par "l'intérêt envers la météorologie et l'océanographie."
- RÈGLEMENT 14d)** Remplacer:
"la Société météorologique du Canada" par "la Société canadienne de météorologie et d'océanographie" dans la dernière phrase.
- RÈGLEMENT 14e)** Remplacer:
"Atmosphère" par "Atmosphère-Océan."

A titre d'information

On demandera au Conseil d'administration d'approuver, à bref délai, les amendements suivants à l'Appendice aux règlements:

- 1 Remplacer le titre par:
"Prix et récompenses de la Société canadienne de météorologie et d'océanographie."
- 2 Prix du président. Remplacer:
"en météorologie" par "en météorologie ou en océanographie."
- 3 Prix aux étudiants. Remplacer:
"d'une qualité exceptionnelle" par "d'une qualité exceptionnelle en météorologie ou en océanographie."

REPORTS FROM LOCAL CENTRES

B.C. CENTRE

Chairman	D. Faulkner	AES, Pacific Headquarters
Vice-Chairman	M. Horita	AES, Pacific Weather Centre
Past Chairman	Dr J. Hay	UBC, Dept of Geography
Secretary-Treasurer	V. Puss	AES, Pacific Weather Centre
Program Director	Dr P. LeBlond	UBC, Inst. of Oceanography

Election of officers for the 1976-77 season took place at the spring general meeting. The fall executive meeting was called to discuss the program of activities for the coming season, and to determine uses for the subvention grant. Once again it was decided to canvass the membership for suggestions. Of several proposals at the meeting, the most promising appeared to be the production of a video-tape on the operations at the Pacific Weather Centre. This tape would be

made available to schools and other interested groups. It was also decided to fund the newly organized Vancouver Island Chapter by means of a modified per capita grant.

During the year, ten meetings were open to the public. A list of the dates, speakers and topics follows:

28 Jan	Dr J. Maybank,	"Atmospheric diffusion and deposition of agricultural spray"
26 Feb	Dr J. Hay,	"Feasibility of solar energy as a domestic heat source"
22 Mar	Dr T. Black, R. Mackenzie, Dr T. Parsons, Dr J. Hay, Mr D. G. Schaefer,	panel on Meteorology and Food Production
4 May	Mr P. Sagert,	"Hat Creek air quality"
27 May	Dr E. W. Hewson,	"Wind-power generation"
27 Sept	Mr G. Bugden,	"Ice movement and modification in the Gulf of St Lawrence"
4 Nov	Dr R. F. Henry,	"Storm surges in the Beaufort Sea"
18 Nov	Mr L. Hubbert,	"The Canadian Meteorological Centre"
16 Dec	Dr P. H. LeBlond,	"Geomorphological evolution of beaches"

Financial Statement 1976

Income

Cash on hand 1 Jan 1976	\$569.32
Bank Interest, Apr	1.84
Grant from National Executive, Oct	332.00
Bank Interest, Oct	6.76
Total	\$909.92

Expenses

10 notices to membership including postage	49.14
Refreshments at meetings	12.35
Honorarium to Wendel Hewson	100.00
Total	\$161.49

Credit Balance as of 31 December 1976 \$748.43

V. Puss
Secretary-Treasurer

ALBERTA CENTRE

The following is a report on the activities of the Alberta centre for the *calendar* year 1976, as well as the financial statement to cover the same period.

The executive of the Alberta centre from 1 January 1976 to 21 October 1976 were:

Mr D. B. Fraser, Chairman
Mr F. R. Bowkett, Secretary-Treasurer
Dr E. P. Lozowski, Past Chairman

and from 21 October 1976 till 31 December 1976:

Dr B. L. Barge, Chairman
Dr R. G. Humphries, Vice-Chairman
Mr L. Wojtiw, Secretary-Treasurer
Mr D. B. Fraser, Past Chairman
Mr N. C. Meadows, Calgary Representative

During 1976, five meetings of centre were held; the list of speakers and the subject of their presentation are as follows:

26 Jan	Dr John Maybank (AES/CMS Lecture Tour) "Air pollution problems from agricultural spraying operations"
4 Mar	Prof. John Hay "An applied radiation climatology of Canada: Information of interest to the solar energy engineer"
21 Oct	Mr Claude Labine "High arctic microclimatology"
16 Nov	Mr Len Hubbert "Current and future aspects of numerical weather prediction"
7 Dec	Dr F. Fanaki "Field studies in air pollution"

To date in 1977, two additional meetings of the centre have been held:

17 Jan	Prof. Choji Magono "Recent studies on natural snow crystals"
15 Feb	Mr Dave Fraser, Mr John Linton, and Mr Gary Wells, "Beaufort Sea observation and prediction system in 1976"

The meetings have averaged about 20 members in attendance, with a few of the meetings having over 30 members present.

Financial statement

For year ending 31 December 1976

<i>Balance</i>	Brought forward from 31 Dec 1975		\$581.28
<i>Income:</i>	Coffee Fund	\$ 13.70	
	1976-77 Subvention	351.50	
		<u>365.50</u>	
<i>Expenses:</i>	Mailings	\$ 29.20	
	Coffee, etc.	27.11	
		<u>56.31</u>	
	Difference		\$308.89
Balance as of 31 December 1976			\$890.17

As can be seen from the statement, the centre's expenses were minimal; many speakers on their way through Edmonton spoke to the centre's members. The present executive has now taken steps to contribute a meteorology prize at the regional science fair. This will appear in the 1977 budget.

L. Wojtiw

REGINA CENTRE

Chairman	L. S. Meeres, Regina Weather Office
Secretary-Treasurer	R. J. O'Brien, Regina Weather Office

The Regina Centre held four meetings in 1976. The speakers and topics were:

3 Feb	Dr John Maybank, Sask. Research Council, "Air pollution problems from spraying operations"
17 Feb	Dr John Hay, University of British Columbia, "Radiation climatology of Southern Saskatchewan"
21 Apr	Mr Randy Sentis, Director, Air Pollution Control Branch, Govt of Sask., "Air pollution in Saskatchewan"
23 Nov	Mr Al Schuster, Director, Qu'Appelle Implementation Branch, Govt of Sask., "Wascana Creek flood control"

Other activities during the year included some involvement in the Regina Science Fair. The Regina Centre gave an award for the best Meteorological exhibit in the fair. Mr Stew Meeres, our chairman, moved to Edmonton in August so the Centre was without a chairman for the last half of the year.

Since many of the CMS members in Saskatchewan live in Saskatoon and find it difficult to come to Regina for meetings, a chapter was formed in Saskatoon with Dr John Maybank as Secretary. This should prove to be an active chapter.

Financial Statement

1 January 1976 to 31 December 1976

		Credit	Debit	Balance
1 Jan				\$119.59
4 Feb	Subvention	255.00		
17 Feb	Rental of Projector		10.50	
30 Apr	Interest	1.79		
22 Apr	Regina Science Fair		15.00	
17 May	Rental of Meeting Room		5.50	
29 Oct	Interest	5.18		
4 Nov	Subvention	255.00		
31 Dec	Balance			\$605.56

SASKATOON CHAPTER

Following formal founding of this chapter early in the year, the undersigned was elected corresponding secretary (and sole officer). The CMS speakers tour lecture was given on 11 March to an audience of approximately 30 persons. In April the chapter co-sponsored, with the Plant Ecology Department of the University of Saskatchewan, a lecture by Dr Richard St Barbe-Baker on the topic "Creating microclimates in the Sahara;" the audience was around 50 for this talk.

In late May, members of the CMS chapter were invited to attend a meeting of the Sask. Committee on agriculture meteorology to discuss upcoming weather modification activities in North Dakota and Alberta and to consider the possible need for provincial regulatory action.

In September discussions were held with the Regina Centre regarding finances for the Chapter. It was agreed that a portion of the Centre subvention would be available for expenses incurred by the Chapter, and that the Centre treasurer would be responsible for their disbursement on instructions from the Chapter's corresponding secretary. The actual fund proportions were not specified, but it was expected that they could be roughly in relation to perspective membership members.

The first meeting in 1977 was announced in December. It was to be a guest lecture, co-sponsored by the University of Saskatchewan Physics Department, by Professor C. Magono of Hokkaido University on "Scavenging effects of snow crystals." A further seminar on a related topic is planned for February when the Hokkaido University field crews return to Saskatoon from their snow-drift and ice-fog field studies at Inuvik and North Battleford.

J. Maybank
Corresponding Secretary

WINNIPEG CENTRE

Chairman	M. Hacksley,	Prairie Weather Centre
Secretary-Treasurer	D. S. Siemieniuk,	Prairie Weather Centre

Financial statement

As of 1 January 1977

Cash on hand as of 1 January 1976	\$323.66
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Receipts

Dinner meeting 18 Feb 1976	\$ 30.00	
Dinner meeting 16 Mar 1976	103.50	
Dinner meeting 14 Oct 1976	189.00	
Dinner meeting 25 Nov 1976	116.50	
Subvention cheque	290.00	
Petty cash on hand	13.16	
TOTAL	\$742.16	742.16
		\$1065.82

Expenditures

Dinner meeting 18 Feb 1976	\$ 36.23	
Dinner meeting 16 Mar 1976	116.00	
Dinner meeting 14 Oct 1976	190.52	
Dinner meeting 25 Nov 1976	122.82	
Burn Lowe Award	12.95	
Science Fair trophies	45.15	
Annual meeting expenses	9.41	
Postage	18.00	
TOTAL	\$551.08	551.08
		\$514.74

Cash on hand as of 1 January 1977	<u>\$514.74</u>
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List of speakers:

- 18 Feb In the Horizon Room at the Winnipeg International Airport, Dr John Hay spoke on "An applied radiation climatology of Canada."
- 16 Mar In the Horizon Room at the Winnipeg International Airport, Dr John Maybank spoke on "Air pollution from agricultural spraying operations."
- 14 Oct In Salon 1 at the International Inn, Dr Gren Yuill spoke on "Solar energy applications in Manitoba."
- 25 Nov In the Officer's Mess at Canadian Forces Base Portage la Prairie, Jay Anderson spoke on "Atmospheres of the planets."

D. S. Siemieniuk
Secretary-treasurer

TORONTO CENTRE

Chairman	R. Lawford
Treasurer	N. Waller
Program Chairman	J. Donegani
Secretary	M. Hewson

List of speakers:

- 13 Jan Prof J. Iribarne, "Droplets, ions, and electrical charges"
- 13 Jan Prof H. U. Dutsh (Zurich), "Interaction between the photochemical systems grouped around the ozone, and the transport processes in the stratosphere"
- 26 Feb Dr John Maybank (Sask. Research Council), "Air pollution problems from crop spraying"
- 5 Apr G. Szeicz (U. of T.), "Dispersion and deposition of gaseous wastes"
- 20 Apr John E. Hay (UBC), "Solar heating for domestic power in the Toronto area"
- 20 May Lydia Dotto (*Globe and Mail*), "Scientific writing for the mass media"
- 5 Oct Dr P. Mc. Taggart-Cowan, "Climatic change and intelligent planning"
- 17 Nov Percy Saltzman, moderator, Debate: "Resolved that the responsibility of providing Wx information to specialized users, rests with the private sector of the Canadian economy." Affirmative: Mo Kestin and Maury Hirt. Negative: Don Smith and Herb Kruger

M. D. Hewson
Secretary

OTTAWA CENTRE

Chairman	H. H. Watson
Vice-Chairman	H. R. Armstrong
Past Chairman	W. B. Watson
Oceanographic Representative	Dr N. J. Campbell
Secretary-Treasurer	K. C. Morris

The Ottawa Centre held four meetings during 1976 and another four have been planned by the present executive for the first half of 1977.

On 8 January, Dr J. E. Hay spoke on the topic of "An applied radiation climatology of

Canada." Dr Hay's presentation was well illustrated with slides, many of them referring to data from the Ottawa area.

On 16 February Dr. J. Maybank, Head of Physics Division, Saskatchewan Research Council, spoke on the topic "Air pollution problems from agricultural spraying operations." His talk focused on pesticide drift hazards and the field trial approach in general.

On 19 October Brigadier General K. Greenaway (retired) addressed a social meeting of the Ottawa Centre. General Greenaway who is currently Senior Science Advisor to the Department of Indian Affairs and Northern Development, spoke on "The changing north and the effect on weather services." His presentation touched on a wide range of social, cultural, political, and economic problems, and he concluded that more specific weather forecasts are required for developing local activities.

On 30 November Dr Douglas Whelpdale of the Atmospheric Environment Service spoke on the "Long range transport of pollutants." He discussed documented cases of long range transport of gases, aerosols and dusts as well as the effects of acidic rain on lakes in the north eastern United States. Many of the approximately 45 persons in attendance participated in a lively "question-and-answer" period following the address.

Meetings that have been arranged for early 1977 include talks by W. Markham of the Ottawa Ice Forecasting Central, Dr J. H. Chapman, Assistant Deputy Minister, Department of Communications, Professor Huntley of Dalhousie University, and D. Williams of the Department of Agriculture.

The Ottawa Centre supported the Ottawa Regional Science Fair during 1976 through the donation of a sum of \$50. This support has been augmented for the Spring 1977 Fair, with the Centre to present, for the first time, awards for the best project on meteorology or physical oceanography. The awards will consist of an individual trophy to be retained by each member of the winning project, a plaque to be kept for one year at the school of the successful entrants, and a total cash award of up to \$50, depending on the number of exhibitors in the winning group.

Financial Statement

Income

Cash on hand 1 January 1976	\$508.06
Bank Interest, Apr and Oct	4.16
Sale of Tickets for Social Evening, 19 Oct	27.00
Subvention from National Executive, Oct	329.00
TOTAL	\$868.22

Expenses

Dinner, Dr Hay, 7 Jan	\$ 6.00
Bank Service Charge 31 Jan	.60
Donation to Ottawa Regional Science Fair, 14 Apr	50.00
Postage and envelopes	48.54
Room rental and refreshments for Social Evening, Oct	54.30
TOTAL	\$159.44

Unpaid Bills

Dinner, Dr Whelpdale, 30 Nov	\$ 12.96
Long Distance Telephone Charge	.32
Postage	1.38
TOTAL	\$ 14.66

Bank Balance 31 December 1976	\$708.78
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MONTREAL CENTRE

Chairman	R. J. Fichaud, Atmospheric Environment Service
Secretary	R. Rioux, Atmospheric Environment Service
Treasurer	S. Roy, Hydro-Québec
Past-Chairman	D. Davies, Atmospheric Environment Service

Rapport financier:

1er janvier au 31 décembre 1976

Revenus

Solde au 1er janvier 1976	\$325.09
Intérêt 30 avril 1976	0.74
Subvention annuelle (20 octobre 1976)	362.00
TOTAL	687.83

Dépenses

Timbres	19.84
Rafraîchissements	39.73
Location de salles (2 réunions au McGill Faculty Club)	161.63
Diners des conférenciers (8)	99.29
TOTAL	320.49

Actifs au 1er janvier 1976	325.09
Actifs au 31 décembre 1976	367.34

Serge Roy
Trésorier

List of speakers and the subject of their presentations for 1976 and January 1977:

20 Jan	M. Chandu, Directeur des Applications, Projet de traduction automatique, Université de Montréal, "Un système pour la traduction automatique des prévisions régionales"
19 Feb	Dr John Maybank, Chief, Physics Division, Saskatchewan Research Council; "Air pollution problems from agricultural spraying operations"
18 Mar	Dr Jolin Hay, Department of Geography, University of British Columbia: "Utilization of solar energy for domestic heating in Montreal"
1 Apr	Dr Kirk Bryan, Geophysical Fluid Dynamics Laboratory, Princeton University, "The ocean and climate"
11 May	Dr Claude Girard, Division de Recherche en Prévision Numérique, AES, "Les effets physiques dans le modèle spectral aux équations primitives en exploitation au Centre Météorologique Canadien"
23 Sept	Mr Simon M. Kevan, Geography Dept, John Abbott College, "The Study of Human Behaviour." The effects of Weather and Seasons on Canadians
14 Oct	Dr G. L. Austin, Department of Physics, McGill University: "The real-time test of the short-term radar prediction procedure (SHARP)"
24 Nov	Professeur Robert Garry, Département de Géographie, Université de Montréal; "La mousson et la vie"
27 Jan	Prof. Pierre-André Dubé, Département de Phytologie, Université Laval. "Possibilités de la phénologie pour le zonage climatique"

The following talks are planned:

- 9 Mar Prof. D. A. Huntley, Dept. of Oceanography, Dalhousie (AES touring speaker),
"Waves and currents on beaches"
- 12 Apr Prof. K. Hare, University of Toronto, "The spread of deserts — is climate the villain?"

Raymond Rioux
Secretary

CENTRE DE QUÉBEC

Le conseil d'administration de la Société de Météorologie de Québec se compose actuellement comme suit:

Président	MM. Gaston Paulin
Vice-Président	Paul Lamb
Conseillers	Marc Desruisseaux Pierre-André Dubé Michel Ferland Guy Lemelin Gilles Tardif
Secrétaire	Guy Bergeron
Trésorier	Gaétan Soucy

Conférenciers de la Société:

13 janvier	1976	Dr Conrad East, "Problèmes d'environnement atmosphérique urbain"
4 février		Dr Terry Gillespie, "Weather effects on 14 plant tests and diseases"
24 février		Dr John Maybank, "Air pollution problems from agricultural spraying operations"
23 mars		Dr Barney Boville, "Le climat et l'environnement"
28 octobre		M. Ghislain Jacques, "La prévision du temps à l'aide de modèles numériques, historique et problèmes actuels"
17 novembre		Dr André Csillé, "Etat de la qualité du fleuve St-Laurent"
15 décembre		Dr Keith Thomson, "L'avenir de la Télédétection"
26 janvier	1977	Dr André Plamondon, "Influence des facteurs hydrométéorologiques sur la production sève de l'érable à sucre"
16 février		Dr Claude Girard, "Les prévisions quantitatives de la précipitation émises par le Centre météorologique canadien"
7 mars		Dr D. A. Huntley, "Waves and currents on beaches"
13 avril		Dr Jean-Pierre Fortin. (Titre à venir).

Le conseil de la société a pris action cette année en vue de l'élaboration d'une station météorologique de démonstration qui sera utilisée à des fins éducatives. Cette station sera mobile et pourra être montée là où il s'avèrera utile de le faire. De plus, la SMQ remettra pour la première fois cette année son prix annuel attribué au mérite à une personnalité oeuvrant en Météorologie.

Le secrétaire
Guy Bergeron

Rapport du Trésorier

Exercice 1976

1er janvier au 31 décembre 1976

Actif

Actif en caisse au début de l'exercice	\$ 846.51
Cotisation des membres (30)	120.00
Octroi du MRN	600.00
Subvention de la SMC	206.00
Transfert du surplus budgétaire du congrès 1976	498.99
Intérêts	0.86
Remboursement de timbres	0.56
TOTAL	\$2272.92
Capital social	5.00
Actif total	\$2277.92

Passif

Frais de séjour et de déplacement des conférenciers	\$ 385.40
Location de salle	50.00
Achat de timbres et de matériel de bureau	164.59
Frais de secrétariat (dactylographie)	30.00
Frais de réception	150.00
Frais d'administration bancaire	0.20
TOTAL	\$ 780.19
Immobilisation du capital social	5.00
Passif total	\$ 785.19

Excédant de l'actif sur le passif \$1492.73

Le trésorier
Gaétan Soucy

HALIFAX CENTRE

Chairman	Dr P. Jones
Secretary	Mr P. Galbraith
Treasurer	Mr D. Dockendorff

Meetings Held

13 Jan 1976	Mr R. Hill, AES: Ice and Ice Forecasting
19 Feb	Dr. J. Maybank: Air pollution problems from agricultural spraying operations
11 Mar	Dr C. R. Mann, Bedford Institute of Oceanography: Oceanography in Eastern Canada
21 Apr	Dr J. E. Hay, Geography Dept., UBC: Utilization of solar energy for domestic heating in the Maritimes
13 Oct	Mr. T. Hennigar, IWD: Groundwater hydrology
1 Dec	Dr C. J. Garrett, Oceanography Dept., Dalhousie: Physical-oceanographic aspects of Fundy tidal power

Paul Galbraith
Secretary*Financial Statement*

1 January 1976 to 31 December 1976

Balance on Hand, 1 January 1976 \$ 952.33

Receipts

Interest 30 Apr 1976	\$ 9.38	
CMS Grant, 25 Oct 1976	345.50	
Interest, 25 Nov 1976	4.95	
	<u>\$359.83</u>	359.83
		<u>\$1312.16</u>

Expenditures

Outstanding Debts (postage and refreshments)	\$ 16.30	
Purchase of coffee percolator	14.85	
Postage	11.30	
Photocopying	4.00	
Refreshments	7.49	
	<u>\$ 53.59</u>	\$ 53.59
		<u>\$1258.22</u>

Cash on Hand, 31 December 1976 \$1258.22*Outstanding Expenditures*

Additional Queen Elizabeth High School	\$ 224.80
Weather Instruments	

D. C. Dockendorff
Treasurer

The Canadian Meteorological Society came into being on January 1, 1967, replacing the Canadian Branch of the Royal Meteorological Society, which had been established in 1940. The Society exists for the advancement of Meteorology, and membership is open to persons and organizations having an interest in Meteorology. At nine local centres of the Society, meetings are held on subjects of meteorological interest. *Atmosphere* as the scientific journal of the CMS is distributed free to all members. Each spring an annual congress is convened to serve as the National Meteorological Congress.

Correspondence regarding Society affairs should be directed to the Corresponding Secretary, Canadian Meteorological Society, c/o Dept. of Geography, Simon Fraser University, Burnaby 2, B.C.

There are three types of membership – Member, Student Member and Sustaining Member. For 1977 the dues are \$20.00, \$5.00 and \$60.00 (min.), respectively. The annual Institutional subscription rate for *Atmosphere* is \$15.00.

Correspondence relating to CMS membership or to institutional subscriptions should be directed to the University of Toronto Press, Journals Department, 5201 Dufferin St., Downsview, Ontario, Canada, M3H 5T8. Cheques should be made payable to the University of Toronto Press.

La Société météorologique du Canada a été fondée le 1^{er} janvier 1967, en remplacement de la Division canadienne de la Société royale de météorologie, établie en 1940. Cette société existe pour le progrès de la météorologie et toute personne ou organisation qui s'intéresse à la météorologie peut en faire partie. Aux neuf centres locaux de la Société, on peut y faire des conférences sur divers sujets d'intérêt météorologique. *Atmosphère*, la revue scientifique de la SMC, est distribuée gratuitement à tous les membres. A chaque printemps, la Société organise un congrès qui sert de Congrès national de météorologie.

Toute correspondance concernant les activités de la Société devrait être adressée au Secrétaire-correspondant, Société météorologique du Canada, Département de Géographie, L'Université Simon Fraser, Burnaby 2, B.C.

Il y a trois types de membres: Membre, Membre-étudiant, et Membre de soutien. La cotisation pour 1977 est de \$20.00, \$5.00 et \$60.00 (min.) respectivement. Les institutions peuvent souscrire à *Atmosphère* au coût de \$15.00 par année.

La correspondance concernant les souscriptions à la SMC ou les souscriptions des institutions doit être envoyée aux Presses de l'Université de Toronto, Département des périodiques, 5201 rue Dufferin, Downsview, Ontario, Canada, M3H 5T8. Les chèques doivent être payables aux Presses de l'Université de Toronto.

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Vice President/Vice-Président – K.F. Harry
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B. Sundby

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INFORMATION FOR AUTHORS

Editorial policy. *Atmosphere* is a medium for the publication of the results of original research, survey articles, essays and book reviews in all fields of atmospheric science. It is published quarterly by the CMS with the aid of a grant from the Canadian Government. Articles may be in either English or French. Contributors need not be members of the CMS nor need they be Canadian; foreign contributions are welcomed. All contributions will be subject to a critical review before acceptance. Because of space limitations articles should not exceed 16 printed pages and preferably should be shorter.

Manuscripts should be submitted to: *Atmosphere*, Dept. of Meteorology, McGill University, 805 Sherbrooke St W., Montreal, Quebec, H3A 2K6. Three copies should be submitted, typewritten with double spacing and wide margins. Heading and sub-headings should be clearly designated. A concise, relevant and substantial abstract is required.

Tables should be prepared on separate sheets, each with concise headings.

Figures should be provided in the form of three copies of an original which should be retained by the author for later revision if required. A list of legends should be typed separately. Labelling should be made in generous size so that characters after reduction are easy to read. Line drawings should be drafted with India ink at least twice the final size on white paper or tracing cloth. Photographs (halftones) should be glossy prints at least twice the final size.

Units. The International System (SI) of metric units is preferred. Units should be abbreviated only if accompanied by numerals, e.g., "10 m." but "several metres."

Footnotes to the text should be avoided.

Literature citations should be indicated in the text by author and date. The list of references should be arranged alphabetically by author, and chronologically for each author, if necessary.

RENSEIGNEMENTS POUR LES AUTEURS

Politique éditoriale. *Atmosphere* est un organe de publication de résultats de recherche originale, d'articles sommaires, d'essais et de critiques dans tous les domaines des sciences de l'atmosphère. Il est publié par la SMC à l'aide d'une subvention accordée par le gouvernement canadien. Les articles peuvent être en anglais ou en français. Il n'est pas nécessaire que les auteurs soient membre de la SMC; les contributions étrangères sont les bienvenues. A cause des limitations d'espace les articles ne doivent pas dépasser 16 pages dans le format final. Tout article sera soumis à un critique indépendant avant d'être accepté.

Les manuscrits doivent être envoyés à: *Atmosphere*, Dép. de météorologie, L'Université McGill, 805 Sherbrooke O., Montréal, Québec, H3A 2K6. Ils doivent être soumis en trois exemplaires dactylographiés à doubles interlignes avec de larges marges. Les titres et sous-titres doivent être clairement indiqués. Chaque article doit comporter un résumé qui soit concis, pertinent et substantiel.

Les tableaux doivent être préparés et présentés séparément accompagnés d'un titre concis et d'un numéro.

Les graphiques doivent être présentés en trois copies dont les originaux devraient être conservés par l'auteur au cas où ils seraient nécessaire de les reviser. Une liste des légendes des graphiques doit être dactylographiée séparément. L'étiquetage doit être de grand format de façon à ce qu'il soit facilement lisible après réduction du format. Le traçage des lignes doit s'effectuer au moyen d'encre de chine en doublant, au moins, le format final, le tout sur papier blanc ou sur papier à calquer et identifié adéquatement. Les photographies (demi-teintes) devraient être présentées sur épreuves glacées au double du format final.

Les unités. Le Système International (SI) d'unités métriques est préférable. Les unités devraient être abrégées seulement lorsqu'elles sont accompagnées de nombres, ex: "10m," mais "plusieurs mètres."

Les notes de renvoi au texte doivent être évitées.

Les citations littéraires doivent être indiquées dans le texte selon l'auteur et la date. La liste des références doit être présentée dans l'ordre alphabétique, par auteur et, si nécessaire, dans l'ordre chronologique pour chaque auteur.