ATMOSPHERE-OCEAN

13th ANNUAL CONGRESS
30 May–1 June 1979
University of Victoria

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

Volume 17 13th Annual Congress Issue 1979

ATMOSPHERE-OCEAN

Contents

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THIRTEENTH ANNUAL CONGRESS

CANADIAN METEOROLOGICAL AND OCEANOGRAPHIC SOCIETY

The Thirteenth Congress and Annual General Meeting of the Canadian Meteorological and Oceanographic Society will be held at the University of Victoria, Victoria, British Columbia from May 30 to June 1, 1979. The theme of the Congress is *Dynamic Similarities of Oceans and Atmospheres.*

The ocean and the atmosphere are distinct, mutually interacting fluid environments encompassing the broad spectrum and physical processes whose scale ranges from the molecular to the planetary. Too often meteorologists and oceanographers become so locked into the confines of their respective disciplines that they ignore the commonality of the two systems, thereby failing to discover analogies that could be exploited to the benefit of their own research. The purpose of the theme of this year's Congress is to encourage contributors to reflect upon the similarities between the two fluid dynamical systems and to elucidate their thoughts for the edification of others during the conference.

The Thirteenth Congress is being hosted, on behalf of the Victoria Chapter of CMOS, by a committee chaired by R.C. Bennett. The organizing committee included M. Blake and A. Gargett (Scientific Programme), R.E. Thomson (Treasurer), R.G. Wilson (Local Arrangements), G. Gabel (Commercial Displays), R. Chilton, S. Tabata, S.E. Tuller, R.H. Silversides, A. McQuarrie and E.R. Walker.

TREIZIÈME CONGRÈS

SOCIÉTÉ CANADIENNE DE MÉTÉOROLOGIE ET D'OCÉANOGRAPHIE

Le treizième congrès et l'assemblée générale annuelle de la Société Canadienne de Météorologie et d'Océanographie auront lieu à l'Université de Victoria, Victoria, Colombie-Britannique, du 30 mai au 1 juin 1979. Le thème du congrès cette année est *Les Similarités Dynamiques entre l'Océan et l'Atmosphère.*

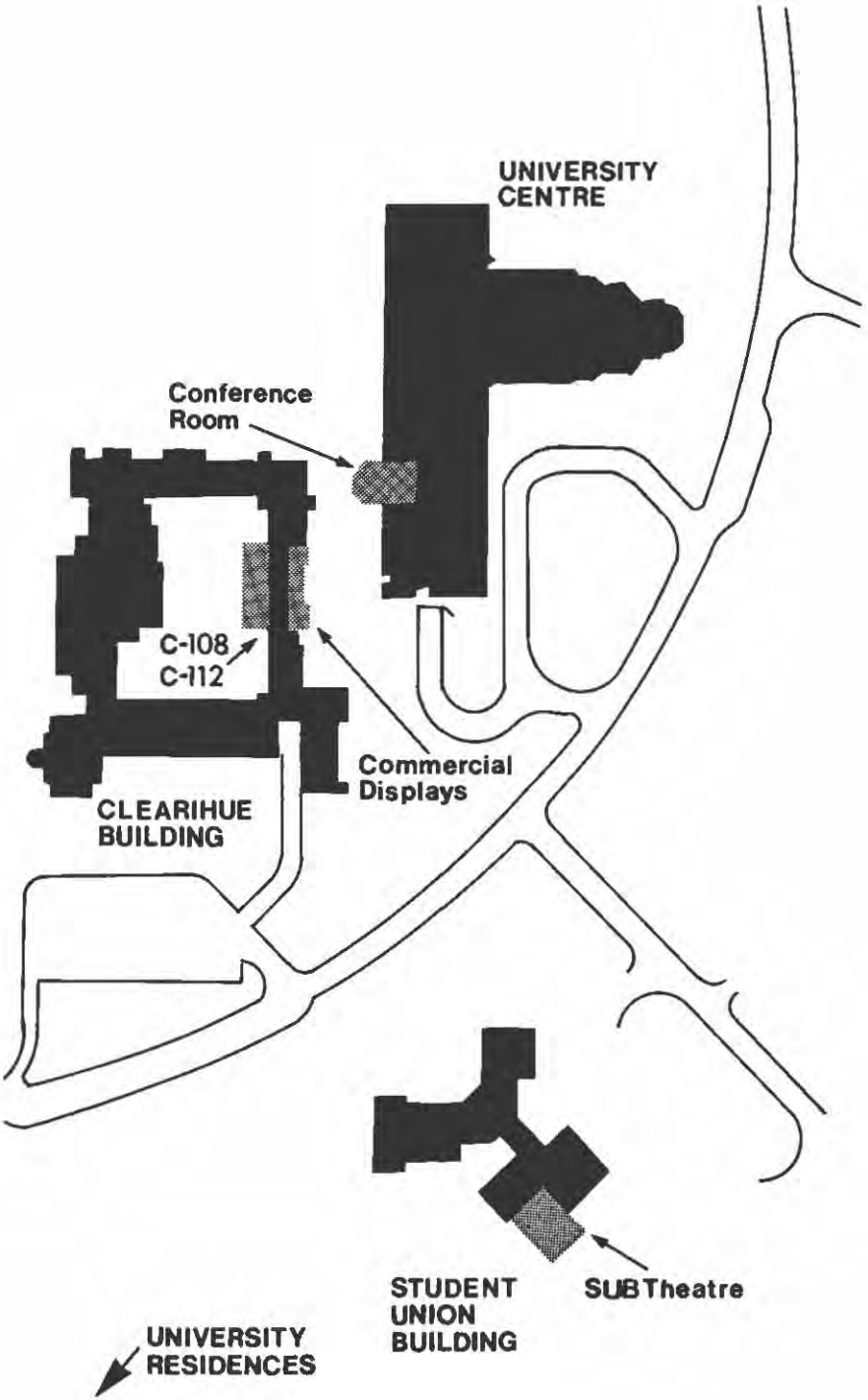
L'océan et l'atmosphère sont des fluides distincts, mais dont les interactions embrassent un spectre étendu de processus physiques qui vont du moléculaire au planétaire. Trop souvent hélas les météorologues et les océanographes se confinent trop étroitement à leur propre discipline, en viennent à oublier le terrain commun aux deux systèmes, et ne voient pas les analogies dont pourrait profiter leur propre recherche. Le but du thème du congrès de cette année est d'encourager les participants à se pencher sur les similarités entre les deux systèmes de dynamique des fluides et à faire profiter leurs collègues de leurs découvertes.

R.C. Bennett est le président du comité qui se fait, au nom du chapitre de Victoria de la SCMO, l'hôte du congrès. Le comité organisateur inclut aussi M. Blake et A. Gargett (au programme scientifique), R.E. Thomson (trésorier), R.G. Wilson (organisation locale), G. Gabel (exhibitions commerciales), R. Chilton, S. Tabata, S.E. Tuller, R.H. Silversides, A. McQuarrie et E.R. Walker.

SUMMARY OF SESSIONS

Tuesday, May 29			Location*
0930-1200		Editorial Committee Meeting	Conference Room
1300-1415		GARP Scientific Committee Meeting	Conference Room
1415-1700		Scientific Committee Meeting	Conference Room
1930-2300		CMOS Council Meeting	Conference Room
Wednesday, May 30			
0830-0845		Opening Welcome	SUB Theatre
0845-0945		Theme Session I – Dynamic Similarities of Oceans and Atmospheres	SUB Theatre
1030-1200	1A	Ocean-Atmosphere Interaction	Conference Room
	1B	Air Pollution Meteorology I	C-108
	1C	Buoy Networks	C-112
1330-1500	2A	Urban Meteorology	Conference Room
	2B	Circulation I	C-108
	2C	Atmospheric Dynamics	C-112
1530-1700	3A	Air Pollution Meteorology II	Conference Room
	3B	Circulation II	C-108
	3C	Hail and Ice Accretion	C-112
1900-2030		Wine and Cheese	Auditorium Lobby University Centre
2030-2300		Annual General Meeting of CMOS	Conference Room
Thursday, May 31			
0830-0930		Special Session – Climatic Change	SUB Theatre
1015-1200	4A	Dynamic Meteorology – Modelling	Conference Room
	4B	Mixing Processes	C-108
	4C	Forest and Agricultural Meteorology	C-112
1330-1630		Poster Session	C-108 and C-112
1330-1500	5	Arctic Oceanography I	Conference Room
1530-1700	6	Arctic Oceanography II	Conference Room
1730		No Host Bar	
1830		Awards Banquet	Commons Building – University Residence
Friday, June 1			
0830-0930		Theme Session II – Dynamic Similarities of Oceans and Atmospheres	SUB Theatre
1015-1200	7A	Satellite Meteorology	Conference Room
	7B	Boundary Layer	C-108
	7C	Tides	C-112
1330-1500	8A	Air-Sea Interaction I	Conference Room
	8B	Cloud Physics	C-108
	8C	Waves I	C-112
1530-1700	9A	Air-Sea Interaction II	Conference Room
	9B	Precipitation	C-108
	9C	Waves II	C-112

*Locations: Student Union Building – SUB Theatre
University Centre – Conference Room
Clearihue Building – C-108 and C-112



Map of Campus and Room Locations / 3

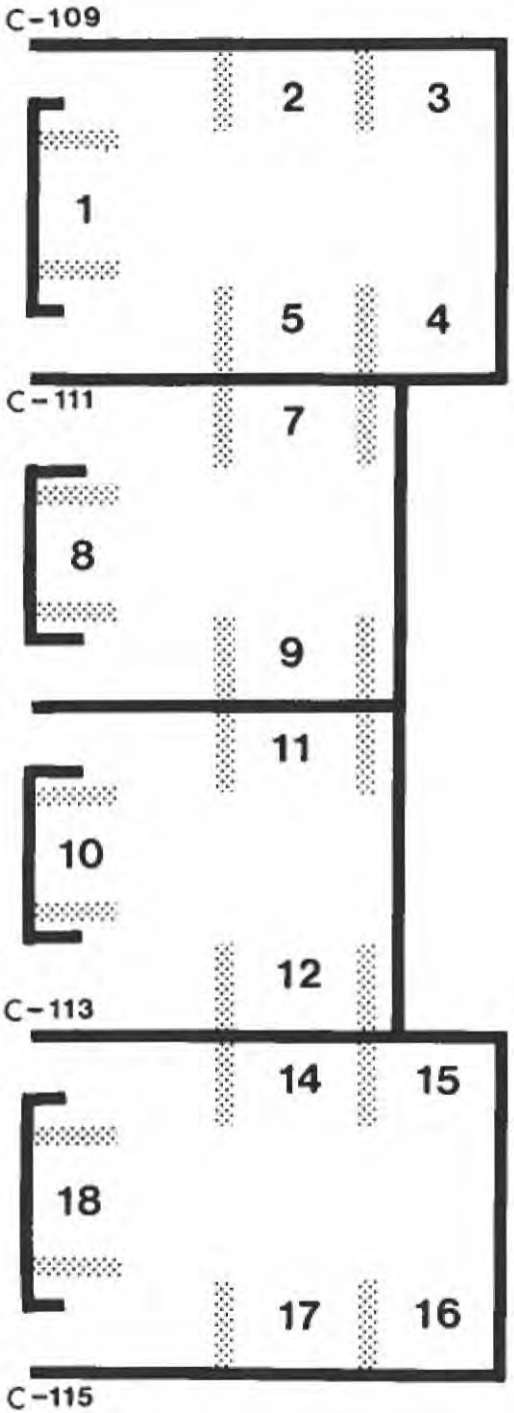
RÉSUMÉ DES SESSIONS

			Salle*
Mardi le 29 mai			
0930-1200		Réunion du Comité de rédaction	Salle de Conférences
1300-1415		Réunion du Comité scientifique de GARP	Salle de Conférences
1415-1700		Réunion du Comité scientifique	Salle de Conférences
1930-2300		Réunion du Conseil de la SCMO	Salle de Conférences
Mercredi le 30 mai			
0830-0845		Ouverture du congrès	Salle de théatre de SUB
0845-0945		Session thématique – I – Similarités Dynamiques entre l'Océan et l'Atmosphère	Salle de théatre de SUB
1030-1200	1A	Interactions océan-atmosphère	Salle de Conférences
	1B	Météorologie de la pollution de l'air – I	C-108
	1C	Réseaux de bouées	C-112
1330-1500	2A	Météorologie urbaine	Salle de Conférences
	2B	Circulation – I	C-108
	2C	Dynamique de l'atmosphère	C-112
1530-1700	3A	Météorologie de la pollution de l'air – II	Salle de Conférences
	3B	Circulation – II	C-108
	3C	Grêle et glace	C-112
1900-2030		Vins et fromages	Vestibule de l'Auditorium Centre Universitaire
2030-2300		Assemblée générale annuelle de la SCMO	Salle de Conférences
Jeudi le 31 mai			
0830-0930		Séance spéciale: Variations Climatiques	Salle de théatre de SUB
1015-1200	4A	Météorologie dynamique: modèles	Salle de Conférences
	4B	Processus de mélange	C-108
	4C	Météorologie Forestière et Agricole	C-112
1330-1630		Posters	C-108 et C-112
1330-1500	5	Océanographie de l'Arctique – I	Salle de Conférences
1530-1700	6	Océanographie de l'Arctique – II	Salle de Conférences
1730		Bar ouvert	
1830		Banquet – Prix et Citations	Résidence Universitaire
Vendredi le 1 juin			
0830-0930		Session thématique – II – Similarités Dynamiques entre l'Océan et l'Atmosphère	Salle de théatre de SUB
1015-1200	7A	Météorologie satellitaires	Salle de Conférences
	7B	Couches limites	C-108
	7C	Marées	C-112
1330-1500	8A	Interaction air-océan – I	Salle de Conférences
	8B	Physique des nuages	C-108
	8C	Ondes – I	C-112
1530-1700	9A	Interaction air-océan – II	Salle de Conférences
	9B	Précipitation	C-108
	9C	Ondes – II	C-112

*Salles: Student Union Building – Salle de théatre de SUB
University Centre – Salle de Conférences
Clearihue Building – C-108 et C-112

Clerihue Building

1. Inter Ocean Systems Ltd
2. Campbell Scientific Inc.
3. Jon B. Jolly Inc.
4. Dobrocky Seatech Ltd
5. Aanderaa Instruments Ltd
7. Airflow Developments (Canada) Ltd
8. Sonatech Inc.
9. Enercorp Instruments Ltd
10. Navitron Communications Ltd
11. International Submarine Engineering Ltd
12. Paroscientific Inc.
14. Arctic Sciences Ltd
15. T. Thompson Ltd
16. World Ocean Systems
17. Frederick Goertz Ltd
18. R.A.E. Industrial Electronics Ltd



PROGRAMME

Wednesday Morning, May 30, 1979

Opening Welcome:	Dr. Ian McTaggart-Cowan Chancellor, University of Victoria Dr. R.W. Burling, President Canadian Meteorological and Oceanographic Society	Wed. 0830-0845 SUB Theatre

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THEME SESSION I	*Dynamic Similarities of Oceans and Atmospheres*	Wed. 0845-0945 SUB Theatre
Chairman:	R. List	

MIXING
F. Bretherton, National Center for Atmospheric Research
Boulder, Colorado 80307

Coffee (0945-1030)

SESSION 1A	*Ocean-Atmosphere Interaction*	Wed. 1030-1200
Chairman:	G.T. Needler	Conference Room

A LONG TIME SCALE, NON-LINEAR, WIND DRIVEN OCEAN CIRCULATION MODEL
A.J. Willmott, Institute of Oceanography, University of British Columbia, Vancouver, British Columbia V6T 1W5

COUPLING OF THE WARM SEA CURRENT AND THE COLD AIR OUTBREAKS IN THE MAINTENANCE OF THE NORTHERN HEMISPHERIC WINTER CIRCULATION
E.C. Kung, Department of Atmospheric Science, University of Missouri-Columbia, Columbia, Missouri 65211

INERTIAL OSCILLATIONS IN FLOE MOTION OVER THE BEAUFORT SEA – OBSERVATIONS AND ANALYSIS
M.L. Khandekar, Atmospheric Environment Service, Downsview, Ontario M3H 5T4

ATMOSPHERIC FORCING OF OCEANIC EDDIES
C. Frankignoul, Department of Meteorology, MIT, and P. Müller, Center for Earth and Planetary Physics, Harvard University, Cambridge, Massachusetts 02138

SESSION 1B *Air Pollution Meteorology I* Wed. 1030-1200

Chairman: T.R. Oke Room C-108

GROUND-BASED INVERSION FREQUENCIES DETERMINED FROM SURFACE CLIMATOLOGICAL DATA

J.H. Emslie, Scientific Services Unit, Atmospheric Environment Service, Pacific Region, Vancouver, British Columbia V6C 1A1

ANALYSIS OF SO_2 DATA ON A RIDGE

S.F. Benjamin and R.D. Rowe, Department of Chemical Engineering, The University of Calgary, Calgary, Alberta T2N 1N4

THE AIR POLLUTION POTENTIAL OF KANANASKIS VALLEY

D.C. Reynolds, Control Data Corporation, Monterey, California 93940

THE EFFECT OF CHINOOKS ON THE ATMOSPHERIC AEROSOL SIZE SPECTRA AND LIGHT SCATTERING COEFFICIENT IN DOWNTOWN CALGARY DURING THE WINTER OF 1978-79

C.V. Mathai, A.W. Harrison and T. Mathews, Department of Physics, University of Calgary, Calgary, Alberta T2N 1N4

SESSION 1C *Buoy Networks* Wed. 1030-1200

Chairman: P.W. Nasmyth Room C-112

A PROTOTYPE GLOBAL SCALE AIR-SEA OBSERVING SYSTEM

J. Garrett, Institute of Ocean Sciences, Sidney, British Columbia V8L 4B2

THE GLOBAL EXPERIMENT DRIFTING BUOY SYSTEM – PERFORMANCE DURING THE FIRST SPECIAL OBSERVING PERIOD

N. Boston, Ocean Sciences, Beak Consultants Limited, Vancouver, British Columbia V6X 2W5

PRELIMINARY DIRECT RESULTS FROM THE FGGE DRIFTING BUOY SYSTEM

J. Garrett, Institute of Ocean Sciences, Sidney, British Columbia V8L 4B2
J.R. Wilson, Marine Environmental Data Services Branch, DFE, Ottawa, Ontario K1A 0E6

THE HUDSON BAY METEOROLOGICAL DRIFTING BUOY EXPERIMENT

R.G. Stark and A.H. Campbell, Atmospheric Environment Service, Downsview, Ontario M3H 5T4

ECONOMIC BENEFITS DERIVED FROM THE DEPLOYMENT OF METEOROLOGICAL BUOYS

J. Donegani, Surface Standards Unit, Atmospheric Environment Service, Downsview, Ontario M3H 5T4

Lunch (1200-1330)

Wednesday Afternoon, May 30, 1979

SESSION 2A *Urban Meteorology* Wed. 1330-1500

Chairman: G.A. McBean Conference Room

SIMULATION OF NOCTURNAL URBAN HEAT ISLAND DEVELOPMENT IN COLD CHAMBER EXPERIMENTS: THE ROLE OF RADIATION GEOMETRY
T.R. Oke, Department of Geography, University of British Columbia, Vancouver, British Columbia V6T 1W5

THE LAKE BREEZE AT TORONTO
R.C. Bennett, Ministry of Environment, Resource Analysis Branch, Victoria, British Columbia V8V 1X4

CHARACTERISTICS OF VERTICAL VELOCITY FLUCTUATIONS IN A CONVECTIVE URBAN BOUNDARY LAYER
H. Melling, Institute of Ocean Sciences, Sidney, British Columbia V8L 4B2

OBSERVATIONS OF SEA BREEZE FRONTAL SLOPES AND VERTICAL VELOCITIES OVER AN URBAN AREA
S. Anderson and R.S. Bornstein, Department of Meteorology, San Jose State University, San Jose, California 95192

URBAN GREENSPACE AS "OASES"
T.R. Oke, Department of Geography, University of British Columbia, Vancouver, British Columbia V6T 1W5

SUBURBAN ENERGY BALANCE ESTIMATES IN VANCOUVER, B.C.
B. Kalanda and T.R. Oke, Department of Geography, University of British Columbia, Vancouver, British Columbia V6T 1W5

SESSION 2B *Circulation I* Wed. 1330-1500

Chairman: D.P. Krauel Room C-108

THE STRATOSPHERE OF THE ATLANTIC OCEAN BY GEORG WÜST: A REVIEW
W.J. Emery, Institute of Oceanography, University of British Columbia, Vancouver, British Columbia V6T 1W5

GEOSTROPHIC CALCULATION FOR THE LABRADOR CURRENT
B. Keeley, Marine Environmental Data Services Branch, DFE, Ottawa, Ontario K1A 0E6

CIRCULATION IN AN OPEN BAY
K. Drinkwater and B. Petrie, Ocean and Aquatic Sciences, Bedford Institute of Oceanography, Dartmouth, Nova Scotia B2Y 4A2

THE STRUCTURE OF THE GASPÉ CURRENT
J. Benoit, M.I. El-Sabh and C. Tang, Département d'Océanographie, Université du Québec à Rimouski, Rimouski, Québec G5L 3A1

SESSION 2C *Atmospheric Dynamics* Wed. 1330-1500

Chairman: G.J. Boer Room C-112

LATENT HEAT RELEASE AS A POSSIBLE FORCING MECHANISM FOR ATMOSPHERIC TIDES
K. Hamilton, Geophysical Fluid Dynamics Program, Princeton University, Princeton, New Jersey 08540

THE TRANSPORT OF MOMENTUM BY CUMULUS CONVECTION
H.-R. Cho, Department of Physics, University of Toronto, Toronto, Ontario M5S 1A7

ATMOSPHERIC BLOCKING PATTERNS
J. Knox, Department of Geography, University of British Columbia, Vancouver, British Columbia V6T 1W5

THE AMPLIFICATION OF FORCED ROSSBY WAVES IN THE PRESENCE OF A NON-LINEAR CRITICAL LAYER
H. Ritchie and T. Warn, Department of Meteorology, McGill University, Montreal, Quebec H3A 2K6

Coffee (1500-1530)

SESSION 3A *Air Pollution Meteorology II* Wed. 1530-1700

Chairman: H. Melling Conference Room

OPTIMUM PLUME SIGMA SPECIFICATION PROCEDURES FOR AN INDUSTRIAL SOURCE
D.S. Davison and E.D. Leavitt, Intera Environmental Consultants Ltd, Calgary, Alberta T2H 1X9

AN EXPERIMENTAL STUDY OF THE MICROMETEOROLOGY AT NANTICOKE
P.Y. Lui, Ontario Hydro, Environmental and Inorganic Research Section, Toronto, Ontario M8Z 5S4

METEOROLOGICAL CONDITIONS ACCOMPANYING POOR AIR QUALITY AT NANTICOKE, ONTARIO
R.G. Lawford, Atmospheric Environment Service, Ontario Region, Toronto, Ontario M4T 1M2

ON THE LONG-RANGE TRANSPORT OF A TALL STACK PLUME
Y.S. Chung, Atmospheric Environment Service, Downsview, Ontario M3H 5T4

SESSION 3B *Circulation II* Wed. 1530-1700

Chairman: S. Tabata Room C-108

CIRCULATION AT THE HEAD OF THE LAURENTIAN CHANNEL
R.G. Ingram, Marine Sciences Centre, McGill University, Montreal, Quebec H3A 2T8

ENVIRONMENTAL FORCING OF THE MIRAMICHI ESTUARY
D.P. Krauel, Royal Roads Military College, F.M.O. Victoria, British Columbia V0S 1B0

FLOW BETWEEN THE CENTRAL AND EASTERN BASINS OF LAKE ERIE
F.M. Boyce, F. Chiocchio, F. Penicka, and B. Eid, National Water Research Institute, CCIW, Burlington, Ontario L7R 4A6

DEEP WATER REPLACEMENT IN INDIAN ARM
L.W. Davidson, Fenco (Nfld) Ltd, St. John's, Newfoundland A1B 3N4

SESSION 3C *Hail and Ice Accretion* Wed. 1530-1700

Chairman: G.A. Isaac Room C-112

"BIRDS EYE VIEW" OF A LARGE FUNNEL CLOUD IN ALBERTA
C.M. Sackiw, F.E. Robitaille, Atmospheric Sciences Division, Alberta Research Council, Edmonton, Alberta T6G 1K8
E.P. Lozowski, Department of Geography, University of Alberta, Edmonton, Alberta T6G 2H4

INVESTIGATION OF THE ICE ACCRETION PROCESS
R. List, P.I. Joe and G.B. Lesins, Department of Physics, University of Toronto, Toronto, Ontario M5S 1A7

THE SASKATCHEWAN HAIL RESEARCH PROJECT – SOME PRELIMINARY RESULTS
A.H. Paul, Department of Geography, University of Regina, Regina, Saskatchewan S4S 0A2

COMPUTER SIMULATION OF HELICOPTER ROTOR BLADE ICING – A PROBLEM IN AERODYNAMIC METEOROLOGY
M.M. Oleskiw and E.P. Lozowski, Department of Geography, University of Alberta, Edmonton, Alberta T6G 2H4

Wine and Cheese Wed. 1900
Auditorium Lobby
University Centre

Annual General Meeting of CMOS Wed. 2030
Conference Room

Thursday Morning, May 31, 1979

SPECIAL SESSION *Climatic Change* Thurs. 0830-0930

Chairman: J.A.W. McCulloch SUB Theatre

AN EXPERIMENTAL CLIMATE FORECASTING MODEL
R.A. Bryson, Center for Climatic Research, University of Wisconsin, Madison, Wisconsin 53706

Co-authored by: E.W. Wahl and T.B. Starr

Coffee (0930-1015)

SESSION 4A *Dynamic Meteorology – Modelling* Thurs. 1015-1200

Chairman: A. Robert Conference Room

EXPERIMENTS WITH A THREE-DIMENSIONAL ATMOSPHERIC BOUNDARY-LAYER MODEL FOR MESOSCALE FLOW
J.L. Walmsley, Atmospheric Environment Service, Downsview, Ontario M3H 5T4

DIAGNOSTIC STUDY OF OBSERVATIONS FROM REAL AND MODEL ATMOSPHERES
G.J. Boer and J.D. Henderson, Numerical Modelling Division, Canadian Climate Centre, Atmospheric Environment Service, Downsview, Ontario M3H 5T4

A NEW NUMERICAL METHOD FOR HANDLING QUASI-DISCONTINUOUS FLOW PROBLEMS
H. Warn and A. Staniforth, Atmospheric Environment Service, Dorval, Quebec H9P 1J3

THE APPLICATION OF NORMAL MODE ANALYSIS TO FOUR-DIMENSIONAL DATA ASSIMILATION
R. Daley and K. Puri, National Center for Atmospheric Research, Boulder, Colorado 80307

IMPORTANCE OF THE INCLUSION OF MOUNTAINS IN SHORT-RANGE NWP
C. Girard, M. LeBlanc and R. Moffet, Recherche en Prévision Numérique, CMC, Service de l'Environnement atmosphérique, Dorval, Québec H9P 1J3

A PROCEDURE TO PREDICT THE MESOSCALE WIND DISTRIBUTION FOR SITING WIND-POWERED GENERATORS
M. Danard, University of Waterloo, Waterloo, Ontario N2L 3G1

SESSION 4B *Mixing Processes* Thurs. 1015-1200

Chairman: S.D. Smith Room C-108

SEPARATION OF STRATIFIED FLOW OVER AN OBSTACLE
D. Farmer, Institute of Ocean Sciences, Sidney, British Columbia V8W 1Y4

OCEANIC DISSIPATION AND DIFFUSION
T.R. Osborn, Institute of Oceanography, The University of British Columbia, Vancouver, British Columbia V6T 1W5

TEMPERATURE-SALINITY-DENSITY STRUCTURE NEAR THE SCOTIAN SHELF-BREAK OBSERVED WITH A BATFISH
A.S. Bennett, Bedford Institute of Oceanography, Dartmouth, Nova Scotia B2Y 4A2

ON MODELLING THE PHYSICAL AND CHEMICAL PROPERTIES OF THE BERING SEA
G.T. Needler and J. Shepard, Bedford Institute of Oceanography, Dartmouth, Nova Scotia B2Y 4A2

BEDFORD INSTITUTE'S PHYSICAL OCEANOGRAPHIC PROGRAM IN THE LABRADOR CURRENT
J.R.N. Lazier, Bedford Institute of Oceanography, Dartmouth, Nova Scotia B2Y 4A2

SESSION 4C *Forest and Agricultural Meteorology* Thurs. 1015-1200

Chairman: W.G. Bailey Room C-112

EVALUATION OF THE BOWEN RATIO/ENERGY BALANCE METHOD FOR DETERMINING EVAPOTRANSPIRATION IN FOREST WATER BALANCE STUDIES
D.L. Spittlehouse and T.A. Black, Department of Soil Science, University of British Columbia, Vancouver, British Columbia V6T 1W5

RADIATION BALANCES OF CONIFEROUS FOREST AND LOGGED SITES AT MONTMORENCY, P.Q.
H.J. McCaughey, Queen's University, Kingston, Ontario K7L 3N6

ESTIMATION OF THE SURFACE ENERGY BUDGET BY DISTRIBUTION OF RESIDUALS
D.G. Steyn, Department of Geography, University of British Columbia, Vancouver, British Columbia V6T 1W5

ACTUAL AND POTENTIAL EVAPOTRANSPIRATION FROM IRRIGATED ALFALFA
R.J. Williams, Resource Analysis Branch, B.C. Ministry of Environment, Kamloops, British Columbia V2B 8A9

ESTIMATING PASTURE PRODUCTIVITY FROM CLIMATOLOGICAL MODELS
R.L. Davis, Resource Analysis Branch, B.C. Ministry of Environment, Kelowna, British Columbia V1Y 4R2
J.A. Davies, Department of Geography, McMaster University, Hamilton, Ontario L8S 4K1

USE OF THE β-GAUZING TECHNIQUE TO STUDY PLANT-WATER RELATIONS
N. Barthakur, Department of Agricultural Chemistry and Physics, Macdonald College of McGill University, Ste-Anne-de-Bellevue, Quebec H9X 1C0

Lunch (1200-1330)

Thursday Afternoon, May 31, 1979

POSTER SESSION Thurs. 1330-1630

Rooms C-108 and C-112

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THE ATMOSPHERIC ENVIRONMENT SERVICE ENERGY PROGRAMME
T.K. Won, Energy and Industrial Applications Section, Canadian Climate Centre, Atmospheric Environment Service, Downsview, Ontario M3H 5T4

Poster 2

CLIMATOLOGICAL ANALYSES FOR PLANNING WIND AND SOLAR ENERGY SYSTEMS IN ONTARIO
R.G. Lawford, T. Eschle and M. Helferty, Scientific Services, Ontario Region, Atmospheric Environment Service, Toronto, Ontario M4T 1M2

Poster 3

MODELLING SOLAR RADIATION COMPONENTS IN AEROSOL ATMOSPHERES
F. Barlow, Alberta Research Council, Edmonton, Alberta T6G 1K8

Poster 4

A COMPUTER PROGRAM USED TO MAP THE SPATIAL DISTRIBUTION OF "CLEAR-SKY" SOLAR RADIATION IN THE OKANAGAN VALLEY OF BRITISH COLUMBIA

R.L. Davis, Resource Analysis Branch, B.C. Ministry of Environment, Kelowna, British Columbia V1Y 4R2

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A TECHNIQUE FOR MAPPING THE DISTRIBUTION OF DIFFUSE SOLAR RADIATION OVER THE SKY HEMISPHERE

L.J. Bruce McArthur, Department of Geography, McMaster University, Hamilton, Ontario L8S 4K1

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AN ANALYSIS OF ERRORS IN THE CALCULATION OF EVAPOTRANSPIRATION BY THE BOWEN RATIO AND COMBINATION MODEL METHODS

W.G. Bailey, Agriculture Canada Research Station, Beaverlodge, Alberta T0H 0C0

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AN ANALYSIS OF FREEZE-FREE PERIODS IN BRITISH COLUMBIA

G.E. Cheesman, Resource Analysis Branch, B.C. Ministry of Environment, Prince George, British Columbia

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UPSLOPE ENHANCED EXTREME RAINFALL EVENTS OVER THE CANADIAN WESTERN PLAINS – A MESOSCALE NUMERICAL SIMULATION

R.L. Raddatz, Prairie Weather Centre, Atmospheric Environment Service, Winnipeg, Manitoba R2R 0S7

M.L. Khandekar, Atmospheric Environment Service, Downsview, Ontario M3H 5T4

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A GRID POINT WAVE CLIMATOLOGY FROM DIGITIZED WAVE ANALYSES

V.R. Swail, Lakes and Marine Applications Unit, Canadian Climate Centre, Atmospheric Environment Service, Downsview, Ontario M3H 5T4

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LONG-RANGE TRANSPORT MODELLING – MODEL DESCRIPTION AND APPLICATION

M.P. Olson, E.C. Voldner and K.K. Oikawa, Atmospheric Dispersion Division, Atmospheric Environment Service, Downsview, Ontario M3H 5T4

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TEMPERATURE SPECTRA IN THE UNSTABLE ATMOSPHERIC SURFACE LAYER

J. Rollefson, Physics Department, Laval University, Quebec, Quebec G1K 7P4

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A NEW AES AIRCRAFT INSTRUMENTATION PACKAGE FOR MEASURING SIZE, CONCENTRATION AND PHASE OF PARTICLES IN CLOUD

J.W. Strapp, R.S. Schemanauer, G.A. Isaac, and C.L. Crozier, Atmospheric Environment Service, Downsview, Ontario M3H 5T4

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LINEAR INTERPOLATION SCHEMES AND THEIR APPLICATION TO HAIL ENERGY DATA

R.A. Stuart and G.M. Cheung, Atmospheric Environment Service, Downsview, Ontario M3H 5T4

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A TOPOGRAPHICAL MODEL TO PREDICT SPRINGTIME CLEAR NIGHT TEMPERATURES ON THE SAANICH PENINSULA

R. Chilton, Resource Analysis Branch, B.C. Ministry of Environment, Victoria, British Columbia V8V 1X4

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FREEZINGS OF THE LOWER FRASER AND COLUMBIA RIVERS

E. Karanka, Resource Analysis Branch, B.C. Ministry of Environment, Victoria, British Columbia V8V 1X4

SESSION 5 *Arctic Oceanography I* Thurs. 1330-1500

Chairman: F.M. Boyce Conference Room

PHYSICAL OCEANOGRAPHY OF JAMES BAY DURING WINTER

G.S. Peck and S.J. Prinsenberg, Research and Development Division, Ocean and Aquatic Sciences, Environment Canada, Burlington, Ontario L7R 4A6

CURRENT OBSERVATIONS IN CROZIER STRAIT, CENTRAL ARCTIC

P. Greisman and R.A. Lake, Institute of Ocean Sciences, Sidney, British Columbia V8W 1Y4

HELIUM AND TRITIUM IN THE CANADIAN EASTERN ARCTIC

W.B. Clarke, W.C. Eismont, E.P. Jones and Z. Top, McMaster University, Hamilton, Ontario L8S 4K1

ON THE USE OF COMPOSITE HISTOGRAMS IN DETERMINING THE SURFACE TEMPERATURE DISTRIBUTION OF THE BEAUFORT SEA

R. Cross and E.R. Reinelt, University of Alberta, Edmonton, Alberta T6G 2H4

Coffee (1500-1530)

SESSION 6 *Arctic Oceanography II* Thurs. 1530-1700

Chairman: P. Greisman Conference Room

THE CIRCULATION OF NORTHWESTERN BAFFIN BAY – SUMMER 1978

D.B. Fissel and D.D. Lemon, Arctic Sciences Ltd, Sidney, British Columbia V8L 3S1

STATISTICAL CRITERIA FOR THE ESTIMATION OF CLOUD HEIGHT IN THE CANADIAN ARCTIC

E.R. Reinelt and R. Cross, Department of Geography, University of Alberta, Edmonton, Alberta T6G 2H4

DRIFT AND DEFORMATION OF PACK ICE IN THE BOUNDARY SHEAR ZONE OF THE SOUTH-EASTERN BEAUFORT SEA

H. Melling, Institute of Ocean Sciences, Sidney, British Columbia V8W 1Y4

INCORPORATION OF REALISTIC INTERNAL ICE STRESS FORMULATION IN THE STUDY OF DYNAMICS OF SEA ICE MOTION

V.R. Neralla and W.S. Liu, Atmospheric Environment Service, Downsview, Ontario M3H 5T4

AN ARCTIC ATLAS: BACKGROUND INFORMATION FOR DEVELOPING MARINE OILSPILL COUNTERMEASURES
L.W. Davidson, Fenco (Nfld) Ltd, St. John's, Newfoundland A1B 3N4

	No Host Bar	Thurs. 1730
		Commons Building University Residence
	Awards Banquet	Thurs. 1830

Friday Morning, June 1, 1979

THEME SESSION II	*Dynamic Similarities of Oceans and Atmospheres*	Fri. 0830-0930
		SUB Theatre
Chairman:	R.E. Thomson	

DYNAMICAL ASPECTS OF OCEANIC FRONTS
C. Garrett, Department of Oceanography, Dalhousie University, Halifax, Nova Scotia B3H 4J1

Coffee (0930-1015)

SESSION 7A	*Satellite Meteorology*	Fri. 1015-1200
Chairman:	J.R. Mathieson	Conference Room

HIGH RESOLUTION SATELLITE DETECTION OF LOW LEVEL MOISTURE IN THE ATMOSPHERE ABOVE THE OCEAN IN VISIBLE AND INFRARED IMAGERY
R.W. Fett, Naval Environmental Prediction Research Facility, Monterey, California 93940

PACIFIC WEATHER CENTRE EXPERIMENTAL SATELLITE PROGRAM
M.M. Horita, J. Spagnol and P. Haering, Pacific Weather Centre, Atmospheric Environment Service, Vancouver International Airport, Richmond, British Columbia V7B 1B8

CALCULATIONS OF NORTH-EAST PACIFIC DATA-ASSIMILATION ERRORS WITH AND WITHOUT OCEAN WEATHER SHIP P
H.J. Thiébaux, Dalhousie University, Halifax, Nova Scotia B3H 4J1

SEA-SURFACE TEMPERATURE ESTIMATE FROM SEASAT-A MICROWAVE MEASUREMENTS
C. Gautier, INRS-Océanologie, Rimouski, Québec G5L 3A1

OBSERVATIONS ON COASTAL PHENOMENA FROM REMOTE SENSING SYSTEM
S. Aranuvachapun, Institute of Oceanography, University of British Columbia, Vancouver, British Columbia V6T 1W5

A POTENTIAL UTILIZATION OF SATELLITE DATA FOR CLIMATIC STUDIES
C. Gautier, INRS-Océanologie, Rimouski, Québec G5L 3A1

SESSION 7B *Boundary Layer* Fri. 1015-1200

Chairman: D. Davison Room C-108

ON WAKES AND DRAG IN THE NEUTRALLY STRATIFIED ATMOSPHERIC BOUNDARY LAYER

P.A. Taylor, Boundary Layer Research Division, Atmospheric Environment Service, Downsview, Ontario M3H 5T4

COMPARISON OF WIND MEASUREMENTS FROM A TOWER AND A BALLOON-BORNE SONDE

J. Dionne, Université du Québec à Rimouski, Rimouski, Québec G5L 3A1

ON THE DETERMINATION OF BOUNDARY LAYER PARAMETERS USING THE VELOCITY PROFILE AS THE SOLE INFORMATION

A.K. Lo, Boundary Layer Research Division, Atmospheric Environment Service, Downsview, Ontario M3H 5T4

REFRACTIVE-INDEX FLUCTUATIONS IN THE SURFACE BOUNDARY LAYER

G.A. McBean, Boundary Layer Research Division, Atmospheric Environment Service, Downsview, Ontario M3H 5T4
J.A. Elliott, Atlantic Oceanographic Laboratory, Dartmouth, Nova Scotia B2Y 4A2

A DIODE PSYCHROMETER SYSTEM FOR BOUNDARY-LAYER WORK

D.S. Munro, Erindale College, University of Toronto, Mississauga, Ontario L5L 1C6

SESSION 7C *Tides* Fri. 1015-1200

Chairman: W. Rapatz Room C-112

FORCED FORTNIGHTLY TIDES IN SHALLOW RIVERS

P.H. LeBlond, Institute of Oceanography, University of British Columbia, Vancouver, British Columbia V6T 1W5

AN EXAMINATION OF THE TEMPORAL VARIATIONS OF THE BAROCLINIC TIDE IN DOUGLAS CHANNEL, B.C.

I. Webster, Dobrocky Seatech Limited, Victoria, British Columbia V8V 1V4

M_2 BAROCLINIC TIDES IN A DEEP/NARROW CHANNEL

R.E. Thomson and S. Huggett, Institute of Ocean Sciences, Sidney, British Columbia V8W 1Y4

THE STRUCTURE OF THREE-DIMENSIONAL TIDAL CURRENTS

K.T. Tee, Bedford Institute of Oceanography, Dartmouth, Nova Scotia B2Y 4A2

INTERACTION BETWEEN ASTRONOMICAL TIDE AND STORM SURGE

T.S. Murty, Institute of Ocean Sciences, Victoria, British Columbia
M.I. El-Sabh, Section d'Océanographie, Université du Québec à Rimouski
P.A. Bolduc, Marine Environmental Data Services, DFE, Ottawa, Ontario K1A 0E6
J.-M. Briand, Section d'Océanographie, Université du Québec à Rimouski, Québec G5L 3A1

Lunch (1200-1330)

Friday Afternoon, June 1, 1979

SESSION 8A — *Air-Sea Interaction I* — Fri. 1330-1500

Chairman: C. Frankignoul — Conference Room

THE TURBULENT FLUXES OF MOMENTUM AND SENSIBLE HEAT OVER THE OPEN SEA AS DETERMINED BY THE DISSIPATION METHOD
W.G. Large and S. Pond, Institute of Oceanography, University of British Columbia, Vancouver, British Columbia V6T 1W5

SURFACE WIND STRESS AND HEAT FLUX MEASURED OVER THE ATLANTIC OCEAN IN GALE FORCE WINDS
S.D. Smith, Bedford Institute of Oceanography, DFE, Dartmouth, Nova Scotia B2Y 4A2

DRAG COEFFICIENTS OVER LAKES
P.F. Hamblin, National Water Research Institute, Canada Centre for Inland Waters, Burlington, Ontario L7R 4A6

THE LOWER LIMIT OF THE LOGARITHMIC LAYER IN THE ATMOSPHERE AND OCEAN
A.R.M. Nowell, Department of Oceanography, University of Washington, Seattle, Washington 98195

SESSION 8B — *Cloud Physics* — Fri. 1330-1500

Chairman: R.G. Humphries — Room C-108

LOW-LEVEL FLOW NEAR THUNDERSTORM FORMATION AREAS – AN OBSERVATIONAL STUDY IN ALBERTA
F.E. Robitaille, Alberta Research Council, Atmospheric Sciences Division, Edmonton, Alberta T6G 1K8

COLLISION ENHANCEMENT FOR DROPLET PAIRS WITH ELECTRICALLY REDUCED APPROACH SPEED
E. Freire and R. List, Department of Physics, University of Toronto, Toronto, Ontario M5S 1A7

THE WARM RAIN PROCESS IN CANADIAN SUMMER CUMULUS CLOUDS
G.A. Isaac, R.S. Schemenauer, J.W. Strapp, and C.L. Crozier, Atmospheric Environment Service, Downsview, Ontario M3H 5T4

THE OCCURRENCE OF ICE PARTICLES IN SUMMER CUMULI IN CANADA
R.S. Schemenauer, G.A. Isaac, C.L. Crozier and J.W. Strapp, Atmospheric Environment Service, Downsview, Ontario M3H 5T4

SESSION 8C *Waves I* Fri. 1330-1500

Chairman: H.L. Grant Room C-112

LOW-FREQUENCY VARIABILITY OF CURRENTS IN THE STRAIT OF GEORGIA
J. Helbig, Institute of Oceanography, University of British Columbia, Vancouver, British Columbia V6T 1W5

BAROCLINIC AND BAROTROPIC INSTABILITIES IN COASTAL CURRENTS
E.R. Johnson and L.A. Mysak, Department of Mathematics, University of British Columbia, Vancouver, British Columbia V6T 1W5

ON THE PROPAGATION OF SHELF WAVES IN A LATERALLY SHEARED MEAN FLOW
J. Helbig, Institute of Oceanography, University of British Columbia, Vancouver, British Columbia V6T 1W5

BOTTOM CURRENTS NEAR THE SHELF EDGE
B. Petrie, Bedford Institute of Oceanography, Dartmouth, Nova Scotia B2Y 4A2
A.J. Bowen, Department of Oceanography, Dalhousie University, Halifax, Nova Scotia B3H 4J1

Coffee (1500-1530)

SESSION 9A *Air-Sea Interaction II* Fri. 1530-1700

Chairman: K.L. Denman Conference Room

AIRFLOW OVER WATER WAVES AND WATER FLOW OVER SAND WAVES
P.A. Taylor, Boundary Layer Research Division, Atmospheric Environment Service, Downsview, Ontario M3H 5T4
K.J. Richards, Department of Applied Mathematics, University of Cambridge, England

MABLES WC – EXPERIMENTAL DESIGN, DATA AVAILABILITY AND PRELIMINARY ANALYSIS
P.F. Lester, Department of Meteorology, San Jose State University, San Jose, California 95192

A WELL-OBSERVED MARINE FOG OFF SOUTHERN CALIFORNIA AND A FORECASTING TRIAL
D.F. Leipper, D.A. Backes and L.J.B. White, Naval Postgraduate School, Monterey, California 93940

SESSION 9B *Precipitation* Fri. 1530-1700

Chairman: G. McPherson Room C-108

WEATHER RADAR DEVELOPMENTS AT THE ALBERTA RESEARCH COUNCIL
R.G. Humphries and B.L. Barge, Alberta Research Council, Atmospheric Sciences Division, Edmonton, Alberta T6G 1K8

TEMPORAL VARIATIONS IN THE TIME OF MAXIMUM PRECIPITATION IN SOUTHERN BRITISH COLUMBIA
D.A. Faulkner, Atmospheric Environment Service, Pacific Region, Vancouver, British Columbia V6C 1A1

STATISTICAL TECHNIQUES FOR FORECASTING PROBABILITY OF PRECIPITATION AMOUNT
T. Agnew, Forecast Research Division, Atmospheric Environment Service, Downsview, Ontario M3H 5T4

RELATIONSHIPS BETWEEN CONVECTIVE ENERGY AND RAINFALL RATES
L. Prévost and I.I. Zawadzki, Université du Québec à Montréal, Département de Physique, Montréal, Québec H3C 3P8

SESSION 9C *Waves II* Fri. 1530-1700

Chairman: P.H. LeBlond Room C-112

ON THE NON-LINEAR WAVE-WAVE INTERACTIONS IN THE EQUATORIAL β-PLANE
P. Ripa, U.S. Department of Commerce, Environmental Research Laboratories, Seattle, Washington 98105

TRENCH WAVES
L.A. Mysak, P.H. LeBlond and W.J. Emery, Institute of Oceanography, University of British Columbia, Vancouver, British Columbia V6T 1W5

TRENCH WAVES II: VERIFICATION IN COASTAL SEA-LEVEL RECORDS
W.J. Emery, Institute of Oceanography, University of British Columbia, Vancouver, British Columbia V6T 1W5

ABSTRACTS

Theme Session I — Dynamic Similarities of Oceans and Atmospheres — Wed. 0845-0945

MIXING

F. Bretherton

Comparative review of various processes responsible for vertical mixing in the ocean.

Session 1A — Ocean-Atmosphere Interaction — Wed. 1030-1200

A LONG TIME SCALE, NON-LINEAR, WIND-DRIVEN OCEAN CIRCULATION MODEL

A.J. Willmott

A continuously stratified, three-layer ocean which is bounded east-west and unbounded north-south is studied. By considering time scales of the order of 20 years, the heat equation within the thermal layer retains all the terms apart from those of horizontal diffusion. By assuming an exponential similarity form for the thermal layer temperature profile, the problem can be reduced to solving a quasi-linear partial differential equation for the surface temperature, subject to an east coast boundary condition.

Investigation of the heat content and the potential energy per unit area of the ocean shows these quantities act like "stream-functions" for the horizontal velocity at the top of the thermal layer and the total horizontal mass transport within this layer, respectively. For a number of time-dependent wind stresses applicable to the North Atlantic, the evolution of the surface isotherms in time is produced. Further information about the flow is obtained from the evolution of the isolines of heat content and potential energy. Because the time dependence in the wind stresses is chosen to be sinusoidal, it is found that the flow evolution in time is also sinusoidal, which is to be expected for this wind-driven model. Also a close correspondence in the behaviour of the surface isotherms and the isolines of the heat content is found, which indicates the importance of advection by the currents.

COUPLING OF THE WARM SEA CURRENT AND THE COLD AIR OUTBREAKS IN THE MAINTENANCE OF THE NORTHERN HEMISPHERIC WINTER CIRCULATION

Ernest C. Kung

With the boundary-layer and upper-air data of the GARP Air Mass Transformation Experiment over the Kuroshio region the kinetic energy balance and budget of sensible and latent heat are analyzed and cross-examined for the volume of the cold air flow over the warm ocean current.

It has been shown that when the winter monsoon dominates over the warm sea area, most of the heat supplied from the sea through micro- and macro-scale convection directly interacts with the large-scale flow over the sea. On the other hand, it is also shown that intense winter circulation over the Kuroshio region is principally maintained by the internal energy source in the mid- and upper troposphere.

These indicate an important coupling mode of the warm sea current and the winter hemispheric circulation. Most of the enormous amount of energy transferred from the ocean east of the Asian and North American continents goes directly into the large-scale system of the Northern Hemispheric winter circulation after it is released through processes of micro- and macro-scale convection.

INERTIAL OSCILLATIONS IN FLOE MOTION OVER THE BEAUFORT SEA – OBSERVATIONS AND ANALYSIS

M.L. Khandekar

An analysis of the floe motion data collected at one of the drilling sites over the Beaufort Sea reveals oscillatory movement of the floes with a period of about 12 h. These oscillations are believed to be inertial and are induced through the variation of wind stress. An attempt is made to simulate these oscillations using an integrated momentum equation for the ice and the upper ocean driven by the surface wind stress. Oceanic transport in the model is obtained using an idealized current profile for the ocean boundary layer.

Using hourly wind values at the drilling site Kopanoar (70° 23′, 135° 06′ W), inertial oscillations in the ice velocity are simulated with reasonable success. The possibility of incorporating this model into the computerized prediction support system (CPSS) of the Atmospheric Environment Service is discussed.

ATMOSPHERIC FORCING OF OCEANIC EDDIES

C. Frankignoul and P. Müller

The quasi-geostrophic response of a stratified ocean to stochastic forcing by surface wind stress, buoyancy flux and pressure fluctuations is estimated, using a simple linear ocean model and a statistical representation of the forcing and response fields. Although there is a mismatch in the dominant space-time scales of atmospheric and oceanic disturbances, a significant response is found in the frequency-wavenumber range of oceanic eddies. Forcing by the wind stress has the dominant role, and is found to be much more efficient than buoyancy forcing.

Session 1B Air Pollution Meteorology I Wed. 1030-1200

GROUND-BASED INVERSION FREQUENCIES DETERMINED FROM SURFACE CLIMATOLOGICAL DATA

J.H. Emslie

A prime requisite in air pollution dispersion studies is a knowledge of the frequency of occurrence of ground-based inversions. Hostler (1961) and Munn et al. (1970) have prepared maps of frequencies of ground-based inversions for the United States and Canada, respectively, using radiosonde data. Both express concern for the sparcity of radiosonde data, for the unrepresentativeness of data in mountainous and coastal areas, and for the relationship between the radiosonde ascent times and the times of sunrise and sunset. Other studies have documented inversion frequencies using topographic transects employing instrumented automobiles or fixed instrumented sites, tethersondes, or minisondes, but these are usually on a short-term, project, basis.

The method presented here employs long-term climatological daily maximum and minimum temperature data recorded at climatological stations in British Columbia. Perusal of the Station Data Catologue produced 36 pairs of valley/ridge stations with at least several years of coincident data. Daily maximum and minimum temperatures at each pair of stations were compared. Monthly totals of positive temperature differences, (i.e. inversion occurrences) in these comparisons were totalled, and converted to seasonal percentages, over the period of record.

The resulting seasonal sets of inversion percentages at the times of maximum and minimum temperature are tabled. The effects of station separation, both horizontally and vertically are discussed, and the influence of adjacent water bodies, acting as heat sources in winter and heat sinks in summer, is illustrated.

Comparisons with the results obtained by other investigators are made. For example, the following table contains the seasonal percentages interpolated for Vernon, B.C. from Munn's study, which used 2300Z and 1100Z radiosonde ascents, and the results obtained by this investigation using data from Vernon Upper Air Station and Vernon South. These stations have a vertical separation of 174 m and a horizontal separation of 1.6 km.

	Winter	Spring	Summer	Fall
2300Z	24	2	1	8
1100Z	52	60	74	70
Max.	21	7	3	9
Min.	71	73	72	82

Guidelines are presented for the application of this method of inversion frequency determination, not only for mountainous and coastal areas of the continent, but also for the plains, which are often deeply indented by river valleys.

ANALYSIS OF SO_2 DATA ON A RIDGE

Stephen F. Benjamin and Richard D. Rowe

A detailed analysis had been made of the wind and SO_2 data collected at two trailers on a ridge, situated close to a sour gas processing plant, for the period October 1972 to December 1978. A new 102.1-m (335-ft) stack was commissioned at this plant in November 1974; the old stack was 68.6-m (225-ft) high. A comparison is made between the SO_2 data obtained with the old stack for the period October 1972 to September 1974 and those for January 1975 to December 1978. Although the SO_2 concentration data covering only a two-year period for the old stack are too few for reliable statistical inference, some valid trends can be discerned.

SO_2 concentrations greater than 0.1 ppm are referred to as "peak" concentrations. For example, during the summer months with the old stack, it is found that high-wind stable atmospheres at the trailer nearest the plant and lighter-wind stable atmospheres at the location farthest from the plant produce the highest frequencies of peak concentrations. The number of hours at each trailer when the SO_2 concentration was greater than 0.1 ppm has been significantly reduced by the new taller incinerator stack. The early morning light-wind stable peaks, and the late afternoon strong-wind neutral peaks have been virtually eliminated by the new stack. However, significant periods of peak concentration still persist for the new stack during the middle of a summer day; these periods are not significantly different from those for the old stack. The explanation of this lack of sensitivity of the midday peaks to stack height is that the boundary-layer structure is dominated by thermals on a summer day.

THE AIR POLLUTION POTENTIAL OF KANANASKIS VALLEY

David C. Reynolds

A rational plan for the recreational and/or resource development of Kananaskis Valley in Southwestern Alberta requires the consideration of the impact of the development on the air quality of the Valley. Toward this goal the air pollution potential of Kananaskis Valley has been investigated. An air pollution climatology for the Valley was obtained from available wind and temperature data covering a three and one-half year period. The data were also used to determine the seasonal probabilities of low wind speed and/or stable atmospheric episodes lasting longer than 24 h. Synoptic data for these periods were then analyzed to establish the characteristic synoptic conditions favourable for such episodes. Two EPA computer programs, VALLEY and HIWAY, were integrated to produce a model for the estimation of 24-h average pollutant concentrations from point, area or line sources in the Valley. Wind and stability frequencies determined from the air pollution climatology were used as the meteorological input, while both actual and potential emission sources were used as source inputs. Although the model-generated estimates appear "reasonable" in comparison to field data obtained from other areas, more local measurements and realistic numerical modelling of the airflow within the Valley would provide a useful extension of the present study.

THE EFFECT OF CHINOOKS ON THE ATMOSPHERIC AEROSOL SIZE SPECTRA AND LIGHT SCATTERING COEFFICIENT IN DOWNTOWN CALGARY DURING THE WINTER OF 1978-1979

C.V. Mathai, A.W. Harrison and T. Mathews

This paper presents the results of our simultaneous measurements of the atmospheric aerosol particle size spectra, light scattering coefficient, and the turbulence profile in downtown Calgary during the winter months of 1978-1979. A Meteorology Research Inc. (MRI) model 1550 integrating nephelometer measures the volume scattering coefficient, β, and Particle Measuring Systems Inc., model ASAS-300 particle size spectrometer measures the number-size distribution in the radius range 0.08 to 1.46 μm. For urban air pollution, as in our case, it has been established that only particles in the radius range ~0.1 to 1.0 μm are effective in reducing the visual range.

For the continental haze atmospheric aerosol model, the particle size distribution is represented by a power law distribution (Junge),

$$n(R) = c\,R^{-\nu}$$

where c is a constant whose value depends on the units chosen for the radius, R. From the measured spectrum of each aerosol sample, a plot of $\log n(R)$ vs $\log (R)$ is made and the method of least squares is employed to fit a straight line and the value of the exponent ν is deduced. A thorough investigation of the variation of β and ν under Chinook and non-Chinook conditions is undertaken.

An Aerovironment model 300 acoustic sounder was operated a few blocks away from the other instruments and this provided the turbulence profile. The acoustic recorder provides information on the stability of the atmospheric boundary layer and the effect of Chinooks on it. Changing atmospheric conditions therefore could be monitored continuously and their effect on aerosol data has been studied, the results of which are also presented.

A correlation analysis of the measured β is also conducted with NO_x, CO, COH and hydrocarbon data measured alongside our instruments by the Department of the Environment, Government of Alberta, the results of which will be presented.

Session 1C Buoy Networks Wed. 1030-1200

A PROTOTYPE GLOBAL SCALE AIR-SEA OBSERVING SYSTEM

J. Garrett

The FGGE drifting buoy system consists of more than 300 buoys in the Southern Hemisphere, tropics and arctic measuring barometric pressure and sea temperature. The potential of such a system to give uniform real-time coverage of large areas is evaluated on the basis of initial experience during FGGE.

THE GLOBAL EXPERIMENT DRIFTING BUOY SYSTEM – PERFORMANCE DURING THE FIRST SPECIAL OBSERVING PERIOD

Noël Boston

A component of the First GARP Global Experiment (FGGE) involves the deployment of drifting buoys in a uniform array in the oceans of the Southern Hemisphere between latitudes of 20°S and 65°S. The objective is to provide surface meteorological data (sea-surface temperature, atmospheric pressure) over the large southern ocean area for which such data are normally sparse.

Although FGGE takes place in 1979, two special observing periods (SOP's) were planned during which intensive observations would be made. These are designated SOP1 (5 January – 5 March, 1979) and SOP2 (1 May – 30 June, 1979). The performance of the drifting buoy system during SOP1 will be discussed.

Almost 200 buoys of seven nations have been deployed since September 1978. Of these 30% are drogued and the remainder surface drifting. To achieve a uniform 1,000-km grid array during SOP1 with available ship traffic, a wind-drift model was used as a planning base. Monthly mean winds were computed from world climatological data and used to drive buoys at a fraction of the wind speed. The drift factor depended on whether the buoy was drogued or not and on its configuration. Some empirical factors were available for Canadian buoys. Actual tracks of the buoys are compared with observed tracks from initial deployment position to the position on 30 April, 1979. The observed tracks cover periods from six months to a few days. The distribution of buoys achieved during SOP1, the departures from uniformity, and their causes and consequences will complete the discussion.

PRELIMINARY DIRECT RESULTS FROM THE FGGE DRIFTING BUOY SYSTEM

J. Garrett and J.R. Wilson

Although the FGGE Drifting Buoy System also contributes to global meteorological analyses its data can be used independently to study ocean temperature distributions and ocean currents. Preliminary results are presented.

THE HUDSON BAY METEOROLOGICAL DRIFTING BUOY EXPERIMENT

R.G. Stark and A.H. Campbell

The largest remaining gap in the Canadian weather observing network is Hudson Bay. It has been proposed that this gap could be reduced by having automatic weather stations along the shores and on some of the islands. However, the centre of the Bay could be instrumented only by using buoys during the open water season and ice-stations during the winter.

In 1978 the opportunity arose of deploying two drifting FGGE prototype buoys as a project under the Canadian Ocean Data System (CODS) Programme. The buoys were deployed in early August – one in the northeast section of the Bay, and the other near the centre. Atmospheric pressure and sea temperature were measured and the data were communicated via the Nimbus 6 satellite to Forecast Centres of the Atmospheric Environment Service. A description of the buoy, the deployment, telecommunication, paths, and the data are provided with operational evaluations by the Forecast Centres. In general the reports from the buoys would have improved surface analyses, if they had been received within three hours of the observing time.

Both buoys were still operating in December, although it appeared that they had gone ashore, the northern one on Wiegand Island of the Belchers, and the other on the Nastapoka Islands, north of Poste-de-la Baleine.

ECONOMIC BENEFITS DERIVED FROM THE DEPLOYMENT OF METEOROLOGICAL BUOYS

J. Donegani

An analysis will be presented of the economic value of the fishing and pleasure craft industries, along with costs incurred due to weather-related accidents.

Industry sources and related statistics will be used to estimate the reduction in costs likely to result from the implementation of a more dense data collection system incorporating meteorological buoys. These will be included with estimates of the expenses to be incurred in establishing alternate systems. A cost/benefit analysis will summarize the findings.

SIMULATION OF NOCTURNAL URBAN HEAT ISLAND DEVELOPMENT IN COLD CHAMBER EXPERIMENTS: THE ROLE OF RADIATION GEOMETRY

T.R. Oke

"Urban" and "rural" nocturnal cooling rates from sunset were simulated by inserting wooden models at an equilibrium temperature of approximately 20°C into an unlit cold room with an air temperature of about -5°C and a wall radiative temperature of about -8°C. The experiments were designed to simulate conditions considered to be ideal for nocturnal urban heat-island development in a temperate latitude city where anthropogenic heat releases are minor. Initially a model with a flat surface was introduced into the cold chamber to represent "rural" conditions. The resulting cooling curve was analyzed and found to conform to a simple energy-balance theory. Models with the same mass but different surface geometries were successively used to simulate urban areas having building height: street-width ratios of 0.25, 0.5, 1, 2, 3 and 4.

"Urban"/"rural" comparisons produced "heat islands" whose intensity and temporal dynamics conform well with field observations under calm and clear conditions. Similarly the net long-wave radiation budget on the floor of the "street canyons" is in good agreement with full-scale observations, being related to the sky view factor. The results also lend support to the model of Oke (1973) expressing the linkage between heat-island intensity and city size.

THE LAKE BREEZE AT TORONTO

Richard C. Bennett

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 3 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 of 6 of the 7 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.

CHARACTERISTICS OF VERTICAL VELOCITY FLUCTUATIONS IN A CONVECTIVE URBAN BOUNDARY LAYER

H. Melling

Vertical air motions within the convective boundary layer over Toronto have been observed using a monostatic Doppler echosonde. Data were acquired on sunny, summer days with light winds, when turbulence dynamics were buoyancy-dominated. Data were analyzed only for time periods with nearly constant wind, mixed-layer depth, and insolation. Scaling parameters of mixed-layer similarity theory were estimated from the amplitude of the acoustic echo. Upwind urban fetch averaged 9 km.

Non-dimensional mean profiles of vertical velocity variance, and of its vertical turbulent transport, of the dissipation rate of turbulence kinetic energy, and of the spectrum of vertical velocity were computed. These data support the validity of mixed-layer similarity theory in flow over an urbanized, inhomogeneous land surface, and thus suggest that adjustment to boundary changes in a convective layer is rapid. Indications of the importance, even for light winds, of turbulence generated by urban surface roughness were found in the large magnitude and high frequency of the peak in the variance spectrum.

Vertical motions were found to be vertically coherent, in the form of updrafts and downdrafts, with a log-normally distributed alongstream dimension. The median updraft separation lay close to the wavelength at the spectral peak. Since no representative updraft profile could be isolated, a stochastic, rather than a deterministic approach to dry convection seems preferable.

OBSERVATIONS OF SEA BREEZE FRONTAL SLOPES AND VERTICAL VELOCITIES OVER AN URBAN AREA

Steven Anderson and Robert D. Bornstein

The initiation, development, penetration, and dissipation of sea-breeze fronts in New York City is being studied using data collected during the NYU/NYC Urban Air Pollution Dynamics Project of 1964-69, which was under the direction of the late Dr Ben Davidson. Data used in the study consist of surface wind observations, pibal-derived wind profiles, tetroon trajectories, surface SO_2 measurements, and helicopter soundings of SO_2 and temperature.

It has been previously reported that the movement of the sea-breeze front at the surface is slowed over the most built-up parts of the city because of the increased surface roughness of the urban area, as compared to that of the surrounding non-urban regions. In the current work the position of the front at about 500 m was determined by the positions of the helicopter-tracked tetroons. When these positions were combined with the concurrent surface frontal positions, as deduced from surface wind observations, frontal slopes could be computed. Results revealed frontal slopes ranging from 1:150 outside of the city to 1:18 over the city. The steepening of the front over the city resulted mainly from the deceleration of the front at the surface.

Vertical variations in the observed tetroon positions were assumed to represent those of air parcels; the spatial distribution of their absolute magnitudes was found to be strongly correlated to the magnitude of the spatial distribution of the area source anthropogenic heat emission over the city. This latter distribution was known from an SO_2 source emission inventory.

URBAN GREENSPACE AS "OASES"

T.R. Oke

On *a priori* rather than empirical grounds it has commonly been assumed that urban areas are relatively "dry" compared to their rural (non-settled) environs because of the removal of vegetation and the waterproofing of the surface by construction of many kinds. Recent observational evidence from Vancouver, Uppsala, St Louis and Adelaide reveals that suburban evapotranspiration rates are only slightly less than typical rural values. These results raise the obvious question as to where the moisture originates.

An irrigated lawn in suburban Vancouver was instrumented to study its energy balance. The net all-wave radiation, soil heat and latent heat flux densities were measured directly and the sensible heat flux density was found by residual. The diurnal behaviour of the energy balance components is consistent with the idea that the lawn is acting as an "oasis". On a daily basis actual evapotranspiration exceeded the potential value by approximately 30%. It therefore seems possible, as suggested by Oke (1972), that although evapotranspiration source areas are decreased by urbanization the advective augmentation of available energy to the remaining (especially irrigated) greenspace at least partially compensates. The significance of these findings to urban meteorology will be discussed.

SUBURBAN ENERGY BALANCE ESTIMATES IN VANCOUVER, B.C.

B. Kalanda and T.R. Oke

The energy balance of suburban terrain has been investigated utilizing summer and fall observations from a tower in south Vancouver. The site is surrounded by residential land use to at least 2 km in all directions. The net all-wave radiant flux density was measured directly and the heat storage in the urban building-air-soil volume was parameterized. The turbulent heat flux densities (sensible and latent) were determined using the Bowen ratio-energy balance technique. The Bowen ratio was evaluated using a reversing differential psychrometer system mounted above roof level.

Examples of the diurnal energy balances will be presented. Special attention will be drawn to the role of evapotranspiration in these budgets, including the magnitude and diurnal variation of the Bowen ratio and the response of the suburban area to a period of drying following precipitation. The possible importance of urban irrigation practices will be discussed.

Session 2B Circulation I Wed. 1330-1500

THE STRATOSPHERE OF THE ATLANTIC OCEAN BY GEORG WÜST: A REVIEW

W.J. Emery

The translation into English of this fundamental description of Atlantic deep and bottom waters makes this previously little-known information available to a wider audience. Based on the data collected by the German research vessel *Meteor* from 1925 to 1927 this description of the deep Atlantic introduces the "core layer" method for identifying and tracing water masses. Applying this method to the *Meteor* data, along with all other available data, Wüst identified the various deep waters, located their formation regions and traced their most probable spreading paths. A coloured map of the spreading of Antarctic Bottom Water revealed the role of topography in restricting the flow of Antarctic Bottom Water into the deep eastern Atlantic. In addition to maps of core-layer properties, meridional and zonal sections carefully document the vertical, east-west and north-south distributions of the major water masses. The strong asymmetries of the Atlantic, due to the influx of deep water from the Mediterranean are discussed. A section on periodic and aperiodic changes provides insight into the modes of variability present in the Atlantic, but not completely sampled by the available data. Deep currents, inferred from density, represent well our present level of understanding of the long-term circulation of the Atlantic.

GEOSTROPHIC CALCULATION FOR THE LABRADOR CURRENT

B. Keeley

The techniques of geophysical inverse theory can be applied to conservation equations to calculate geostrophic velocities. This has been done for a triangular section east of Newfoundland through which passes the Labrador Current. The calculated flow is in basic agreement with past estimates. Comparisons of the transport over weeks and years show some interesting variations.

CIRCULATION IN AN OPEN BAY

K. Drinkwater and B. Petrie

The circulation in St Georges Bay, N.S. was monitored during the summer of 1974 and 1975. The mean surface circulation is characterized by a clockwise eddy with velocities of order 0.1 m s^{-1}. Bottom (30 m) flow at the mouth is found to be <0.02 m s^{-1} out of the Bay. Depth-averaged currents still exhibit the clockwise gyre. A barotropic, steady-state numerical model of the bay forced by an alongshore current is discussed.

Significant energy was observed in the frequency band corresponding to atmospheric forcing (periods of 27 days) but this motion was in general uncorrelated in the Bay at scales as close as 5 km horizontally and 10 m vertically. An exception occurred with the passage of a tropical storm in July, 1975. A simple model of the response of the Bay to this storm is presented.

THE STRUCTURE OF THE GASPÉ CURRENT

J. Benoit, M.I. El-Sabh and C. Tang

The Gaspé current is situated along the northern coast of the Gaspé Peninsula, Gulf of St Lawrence. An analysis of historal data has shown the existence of a strong eastward narrow current extending to about 20 to 40 m from the surface with a width of about 10 km. In order to understand better the structure and mechanisms related to this important current for the physical and biological aspects of the Gulf of St Lawrence, a joint study was undertaken between the Bedford Institute of Oceanography and the Université du Québec à Rimouski during the summer of 1978.

A series of 34 current meters were moored in two sections perpendicular to each other at 49°15′N 66°60′W. Two other current meter stations were moored, one at the entrance of the St Lawrence estuary near Matane and the other in the Gaspé Passage.

Results have shown a mean current of about 0.6 m s^{-1} with maximum speeds of up to 1.6 m s^{-1}. Analysis of the current-meter record has indicated that the core of the current oscillates on and off the shore. Further evidence of this can be seen in a series of satellite pictures taken simultaneously.

A series of STD cross-sections were taken at different times during the period of observation from which geostrophic velocities were calculated and found to be in agreement with the current-meter record. Finally, T-S distribution diagrams clearly identified the waters of the Gaspé Currents as being warmer (~6.5°C) and of a lesser salinity (~29.0°/₀₀) than the waters farther off-shore (~4.0°C and ~31.0°/₀₀).

Session 2C Atmospheric Dynamics Wed. 1330-1500

LATENT HEAT RELEASE AS A POSSIBLE FORCING MECHANISM FOR ATMOSPHERIC TIDES

Kevin Hamilton

In a series of papers in the late 1960's it was shown that most of the features of the observed diurnal and semidiurnal tidal oscillations in the atmosphere can be accounted for with the "classical" tidal theory by including forcing from direct absorption of solar insolation by both O_3 and H_2O. However, the theory predicted that the semidiurnal surface pressure oscillation should have its maxima at about 8:45 a.m. and p.m. local time, while the observations show that the maxima occur at about 10:00 a.m. and p.m. Recently Lindzen (1978) has shown that this discrepency between theory and observation could be eliminated if the theory were to include an additional semidiurnal component of heating in the troposphere with maxima at about 4:00 a.m. and p.m. He was able to show that the semidiurnal component of the observed rainfall rates at several tropical stations all had their maxima remarkably close to four o'clock local time. Thus Lindzen suggests that the release of latent heat may be an important forcing mechanism for the solar semidiurnal atmospheric tide.

In the present work Lindzen's hypothesis has been closely examined. Analysis of hourly rainfall data at about seventy stations has shown that in the tropics the semidiurnal variation does indeed have its maxima at roughly four o'clock local time. The observations of the semidiurnal variation of precipitation in mid-latitudes show a similar (though not so dramatic) pattern.

The details of the surface-pressure oscillation that would result from tidal forcing in the troposphere have been studied theoretically. It has been shown that the grographical distribution of the magnitude of the semidiurnal component of the surface-pressure variation is very nearly the same as that of the forcing. The implications of this result for both the seasonal variation and the magnitude of the non-migrating components of the semidiurnal tide will be discussed.

THE TRANSPORT OF MOMENTUM BY CUMULUS CONVECTION

H.-R. Cho

A formulation is proposed to represent the effects of cumulus clouds in the large-scale vorticity equation. Cumulus clouds are found to modify the large-scale vorticity field through two processes. The first process is the vertical advection of mean vorticity by the cumulus vertical cloud-mass flux. The second process is the twisting of horizontal vorticity into the vertical direction caused by the inhomogeneous spatial distribution of the cloud population. The net effect of cumulus clouds can be completely specified in terms of the total cloud mass flux alone. No detailed knowledge of the dynamic fields of cumulus clouds is needed.

GATE A/B-scale heat, moisture and vorticity budgets have been analyzed for a one-day period (00-24 GMT, 9 September) during Phase III to verify the validity of the theoretical formulation. The agreement between the theoretically predicted and the observed cloud effects appears very encouraging.

Another important conclusion of this study is that the cloud vorticity when averaged over a cloud cross-sectional area is of the same order of magnitude as the large-scale mean vorticity, despite the smallness of the horizontal scale of cumulus clouds. This has some important implications on the analysis of mesoscale dynamic fields using observational data.

ATMOSPHERIC BLOCKING PATTERNS

J.L. Knox

An understanding of the processes causing blocking waves in the extratropical latitudes is surely one of the central goals of meteorology. These slow-moving waves are an anomalous (though by no means infrequent) manifestation of the general circulation, and prolonged episodes cause unusual regional weather regimes, often with serious social and economic consequences.

Why does the zonal circulation occasionally exhibit the remarkable large-scale deformations characteristic of blocking episodes? To what extent are they related to large-scale topography, to land-ocean distribution, to ocean-temperature anomalies?

Do Global Circulation Models generate realistic blocking episodes, and if so, have diagnostic studies been successful in isolating primary causative factors? With what degree of success can Numerical Weather Prediction forecast the growth and, equally important, the decay of blocking waves?

This paper will summarize the observational evidence of Northern Hemisphere blocking during the past 30 years, in the form of time (monthly) and space (longitudinal) frequency distributions. This inventory and statistical analysis will then be used to comment on diagnostic studies of blocking which have been published during the past ten years.

THE AMPLIFICATION OF FORCED ROSSBY WAVES IN THE PRESENCE OF A NON-LINEAR CRITICAL LAYER

H. Ritchie and T. Warn

While it is well known that long planetary waves in the troposphere interact strongly with shorter synoptic scales (resulting in steering, blocking, etc.), the exact nature of this interaction is obscured because of our poor understanding of the long waves and their response to topographical and thermal forcing. In this paper an amplification mechanism arising from the non-linear interaction of quasi-stationary, forced Rossby waves at a zero wind line (critical layer) is explored with the aid of a barotropic model. It is shown that large amplitude waves can be produced in response to rather weak forcing when the non-linearities dominate in the critical layer – a marked contrast to the small amplitudes predicted by linear theory.

OPTIMUM PLUME SIGMA SPECIFICATION PROCEDURES FOR AN INDUSTRIAL SOURCE

D.S. Davison and E.D. Leavitt

A detailed review and analysis of the available plume dispersion sigma values and related meteorology was undertaken as part of the Alberta Oil Sands Environmental Research Program (AOSERP). The data base consisted of measurements made by various research groups during the three intensive field studies undertaken as part of the AOSERP in the vicinity of the CGOS site in the Athabasca Oil Sands area. This paper discusses some of the findings of that study.

A review of the theory and previous experimental results of plume rise and dispersion showed that diffusion from an industrial stack should be treated as a 2-stage process: a source-dominated stage, and an environmentally dominated stage.

The transition from the source-dominated to the environmentally dominated stages, the sigma transition probably occurs when the plume and environmental dissipation rates are equal. Beyond the sigma transition point, the concept of plume entrainment is inappropriate. The sigma transition point, although clear theoretically, is difficult to specify accurately in practice. Typically it occurs at about 1 or 2 km downwind from the stack but closer to the stack in vigorously convective situations.

In the source-dominated region, plume rise and σ_z could be specified fairly well using the procedures recommended by Briggs (1975). There were uncertainties in the σ_y/σ_z ratio, but a tentative value of 1.4 is recommended based upon a very limited data set.

In the environmentally dominated phase of dispersion, σ_y was best estimated using the Pasquill-1976 or Draxler formulations. These schemes involve σ_y specification in terms of the wind direction fluctuation standard deviation, σ_θ, and are modifications of Taylor's statistical theory.

In the environmentally dominated stage of dispersion, σ_z is estimated adequately in stable conditions by the TVA scheme. In convective conditions, the Draxler scheme is tentatively recommended.

AN EXPERIMENTAL STUDY OF THE MICROMETEOROLOGY AT NANTICOKE

Patrick Y. Lui

During the period May-July 1977, a field study was conducted at Nanticoke, Ontario on the north shore of Lake Erie. The purpose was to investigate the effect of the lake on the diffusive capacity of the atmosphere. On most days with on-shore wind, an internal boundary layer was observed to be formed by the differential heating of land and water. The boundary layer sometimes interfered with the upward spread of the plume from the fossil-fuel power plant located at the shore. Surface meteorological stations were set up within 25 km of the plant and pibal-minisondes were used to document the temporal and spatial variations of the structure of the atmosphere. Accumulations of particulates in the stable layers permitted the lidar, which was an optical laser operated in radar fashion, to obtain instantaneous cross-sections of the atmosphere perpendicular to the shore. The lidar results were found to be comparable to those obtained by the conventional minisonde technique.

METEOROLOGICAL CONDITIONS ACCOMPANYING POOR AIR QUALITY AT NANTICOKE, ONTARIO

R.G. Lawford

Ontario Hydro air pollution measurements are related to meteorological conditions in the vicinity of Nanticoke, Ontario during three summers. Synoptic patterns and the values of local meteorological parameters are compared for days with good and poor air quality. The conditions which are most frequently present on days with poor air quality are identified.

ON THE LONG-RANGE TRANSPORT OF A TALL STACK PLUME

Y.S. Chung

The damage to forest resources near Sudbury, Ontario caused by sulphur pollution generated from smelter activity is relatively well known. It has been suggested recently, however, that improved air quality in this region has led to decreased tree injury, after construction of a tall stack (381 m) and installation of pollution-reduction devices (electrostatic precipitators) in 1973 at the International Nickel Co. (INCO) smelter. This implies that the tall stack plume (present emission ~ 1 Mton year^{-1}; the largest single source in North America) is continuously transported elsewhere from the source region by the prevailing winds so that the possibility now exists of pollution damage farther downstream.

The detection of the smoke plume at about 400 km from this tall stack has been reported (*Atmos. Environ.*, 11, p. 939). We now have several more observations of this plume. Measurements with a remote-sensing Correlation Spectrometer (COSPEC) and a camera have been obtained. Verification of these are made by comparison with the output of an air-parcel trajectory model for the boundary layer. It is shown that the meteorological conditions favourable for long-range transport of the INCO plume into southern Ontario occur with a neutral atmosphere, N-NNW airflows and cold air outbreaks, especially during the warm and transitional seasons.

Session 3B Circulation II Wed. 1530-1700

CIRCULATION AT THE HEAD OF THE LAURENTIAN CHANNEL

R. Grant Ingram

Results from both current-meter and thermistor chain moorings and long-term anchor stations in the area of the St Lawrence estuary from the Saguenay River mouth to the Manicouagan Peninsula are discussed. The structure of the internal tide and the water mass characteristics in its generation region are found to vary substantially over longer periods, principally the fortnightly cycle. The influence of these changes on water column stability and surface nutrient distribution is examined.

ENVIRONMENTAL FORCING OF THE MIRAMICHI ESTUARY

David P. Krauel

The Miramichi River forms a shallow funnel-shaped estuary, consisting of a river estuary portion which is 55 km long and 1 000 m or less wide, and a triangular inner bay 25 km long which fans out to width of 25 km at the mouth where a series of barrier islands forms a seaward boundary. The river drains a basin of 1.4×10^4 km^2 area into the southwest side of the Gulf of St Lawrence.

Temperature, salinity and water-current data which were collected intermittently over a four-year period from 1973 to 1977 have been analyzed to determine the relative importance of the three main driving forces: freshwater input, tide, and wind. The mean and variance of salinity and of ebb and flood currents were calculated as functions of depth at various locations in the estuary, for fluctuations at time scales comparable to tidal oscillations, and at time scales comparable to the seasonal changes in freshwater input. The ratio of the energies at the two time scales varied with location. The tidal forcing was greater in the river estuary than it was in the inner bay. However, the freshwater forcing was more important than the tidal forcing throughout the estuary.

The influence of the wind on the circulation was more difficult to isolate from the observations. Extreme wind events were extracted from the data set and were used to calibrate and verify a numerical model. The model enabled an examination of the influence of the freshwater input and wind stress on the horizontal circulation of the inner bay.

FLOW BETWEEN THE CENTRAL AND EASTERN BASINS OF LAKE ERIE

F.M. Boyce, F. Chiocchio, F. Penicka and B. Eid

The shallow Central Basin of Lake Erie (mean depth 19 m) is separated from the deeper basin (mean depth 28.5 m) by the Pennsylvania Ridge which extends southward from the base of Long Point to Erie, Pennsylvania. The sill depth of this ridge is approximately 15 m except for a relatively narrow notch near Erie, Pennsylvania where communication between the two basins extends to 22 m depth. Both basins are stratified in summer and the thin (2 m) hypolimnion of the Central Basin becomes depleted of oxygen by late summer. Flows to the hypolimnion of the Central Basin from the mid-thermocline water of the eastern basin appear at times to be an important source of dissolved oxygen.

In 1977 and 1978 moored current meters and thermistor arrays were placed in the vicinity of the Pennsylvania Ridge. From these data we have computed the transport of water between the two basins, we have attempted to determine the spatial and temporal patterns of flow as an example of the interaction of topography, stratification, and rotation in a closed basin, and we have considered the feasibility of various approaches towards modelling these flows.

DEEP WATER REPLACEMENT IN INDIAN ARM

L.W. Davidson

Surveys of the distributions of temperature, salinity and dissolved oxygen in Burrard Inlet and Indian Arm were conducted at least monthly from May 1974 to October 1975. Through the winter portion of this interval, a recording current meter was moored near bottom on the Indian Arm sill. Analyses of seasonal changes in the property distributions first identified water from Burrard Inlet penetrating significantly below sill depth in Indian Arm in October 1974. In the interval October through April, intermittent replacement of deep water continued.

Series of longitudinal sections are here presented to illustrate the sequence of changes. The most dramatic effect is seen in the distribution of dissolved oxygen, however, lesser changes in temperature and salinity values support the same conclusions drawn from the oxygen data. Exchange volumes deduced from the property distributions are shown to compare favourably with exchange volumes estimated from the current-meter record for two specific intervals of exchange.

Session 3C Hail and Ice Accretion Wed. 1530-1700

"BIRDS EYE VIEW" OF A LARGE FUNNEL CLOUD IN ALBERTA

C.M. Sackiw, F.E. Robitaille and E.P. Lozowski

On August 7, 1976 a large funnel cloud formed within a few kilometres of the Alberta Hail Project field headquarters at the Red Deer Industrial Airport. This rare occurrence was extensively photographed and filmed by Hail Project staff during its 15-min life cycle. Evidence of smaller vortices embedded in the main funnel cloud is presented. Photogrammetric estimates of vortex velocities are computed. A dramatic colour movie, taken by one of the authors, showing this funnel cloud less than two km away, will be shown.

INVESTIGATION OF THE ICE ACCRETION PROCESS

R. List, P.I. Joe and G.B. Lesins

Experiments were performed to study the accretion of supercooled water droplets onto a rotating cylinder under simulated atmospheric conditions. The effects of temperature, velocity, rotation rate, liquid water content and droplet size distribution were investigated. Heat and mass transfer budgets, using a 2-D Knollenberg cloud-droplet spectrometer and an infrared microscope, were obtained in order to quantify the growth rate of the ice deposits. The study helps in understanding the role of hail formation.

THE SASKATCHEWAN HAIL RESEARCH PROJECT – SOME PRELIMINARY RESULTS

Alec H. Paul

The Saskatchewan Hail Research Project (SHARP) has been active in south-eastern and south-central Saskatchewan since the summer of 1973. During this time hail reports have been collected from farmers and other rural residents in an attempt to define the climatology of hail in the area. Particular storms have been studied in some detail in order to assess the synoptic situations in which most hail damage occurs. The information gathered will contribute to better forecasting of hail situations and will be of great value should the question of hail suppression arise in the province. Data analysis is now under way, and this paper reports some initial results.

COMPUTER SIMULATION OF HELICOPTER ROTOR BLADE ICING – A PROBLEM IN AERODYNAMIC METEOROLOGY

M.M. Oleskiw and E.P. Lozowski

Icing conditions still place constraints on the operation of helicopters. Next in importance to the engine intakes, the region of primary concern remains the leading edge of the main rotor blade, where ice accumulation changes its aerodynamic characteristics, and asymmetrical shedding may severely imbalance the blade. In an effort to optimize energy consumption for the thermal de-icing approach, we have undertaken a computer simulation of the rotor blade ice-accretion process.

A surface vorticity method is used to generate the stream-function of an incompressible two-dimensional flow about an arbitrarily-shaped aerofoil. The trajectories of droplets introduced upstream are calculated to determine the variation of the collision efficiency with location. The results are compared with other theoretical and experimental data in order to test the accuracy of the present method.

The thermodynamic balance of the accretion process is calculated, leading to a determination of the spatial distribution of the ice deposit. The resulting change in aerofoil shape influences the flow field, and new droplet trajectories are calculated for the modified flow regime. Comparisons are drawn between the present results and experimental ones.

Special Session Climatic Change

Thurs. 0830-0930

AN EXPERIMENTAL CLIMATE FORECASTING MODEL

Reid A. Bryson, E.W. Wahl and T.B. Starr

A model has been constructed on the assumption that climatic variations on the order of decades in length are thermodynamically driven while those on the order of months to a few years (except for the annual variation) are mechanical in origin (such as might be produced by atmospheric tides).

The thermodynamic drive submodel is based on the Bryson-Dittberner one-dimensional hemispheric surface-temperature model with volcanic and anthropogenic inputs as control parameters (*J. Atmos. Sci.*, November 1976). To this Wahl has added a statistical submodel that converts the five-year mean surface temperature and its first two derivatives with time into a pattern of five-year mean sea-level pressure anomalies. These we call the trend anomalies of pressure.

To the trend anomalies we add the sea-level monthly mean pressure anomalies produced by pole tides generated by the Chandler motion of the earth's rotational axis (Bryson and Starr, *J. Atmos. Sci.*, December 1977), and obtain the Northern Hemisphere sea-level pressure anomaly prediction for specific months. Tests, with lead times greater than one year, on 49 months of independent data from 1975 to date give the correct sign of the pressure anomaly at 180 grid points more than three standard deviations above chance. An example is given in Figures 1-3.

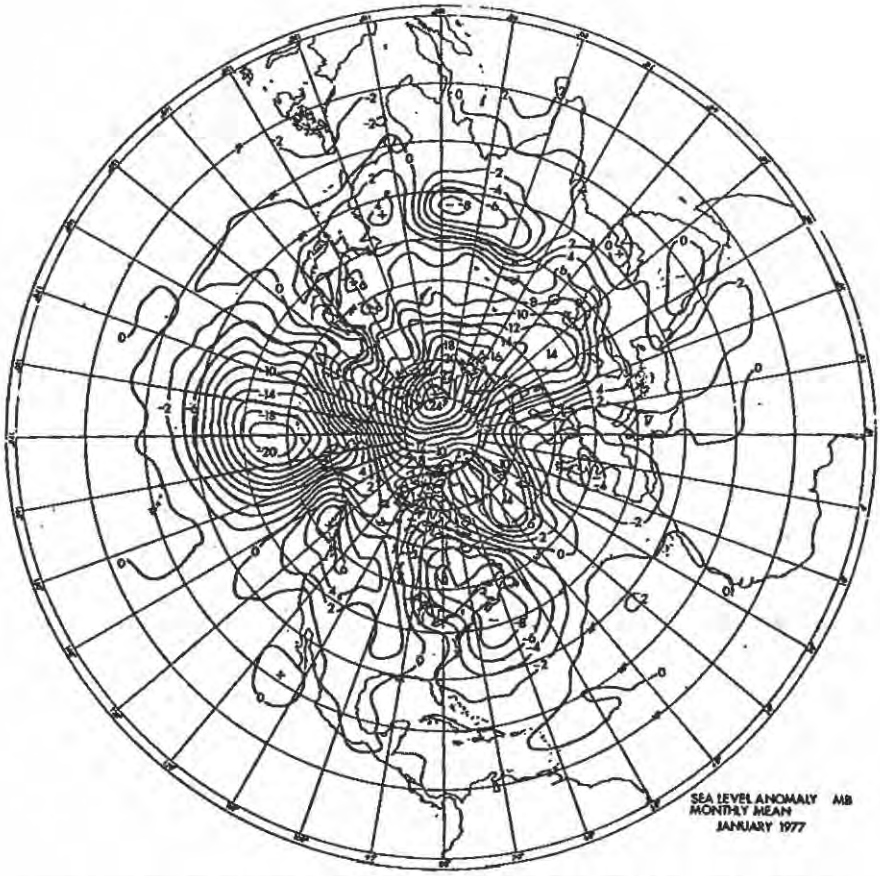

Figure 1. Observed-sea level pressure anomaly (mb) for January 1977, courtesy NOAA.

Skill scores for predicted monthly precipitation departures from the median (two classes) using the Mark I Trend plus Chandler Tide Model on independent data

Table 1 – North America: 120 Stations

Month	1st 5 Years	2nd 5 Years	Individual Months	1978 21 Stations*
January	0.08	0.23	0.00	
April	0.19	0.26	0.04	
July	0.26	0.28	0.10	0.29
October	0.14	0.19	0.01	
Overall	0.17	0.24	0.04	

Table 2 – India: 60 Stations

Month	1st 5 Years	2nd 5 Years	3rd 5 Years	Individual Months	1978 14 Stations*
June	0.14	0.18	0.00	0.17	
July	0.45	0.20	0.17	0.02	0.29
August	0.08	0.14	0.48	0.04	
Overall	0.22	0.17	0.25	0.08	

*Stations which showed best fit on dependent data.

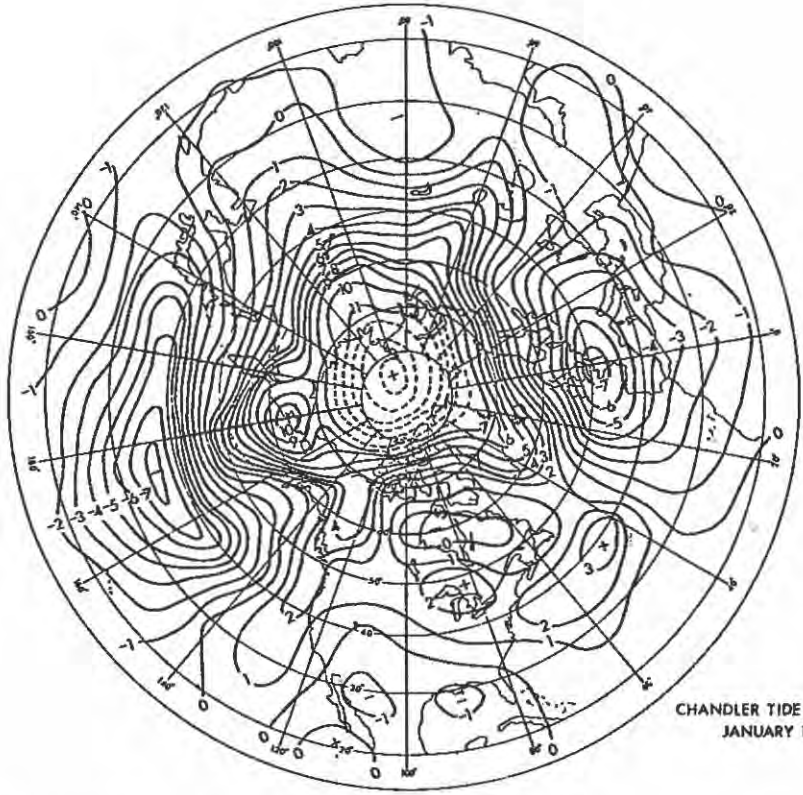

Figure 2. Chandler tide pressure anomalies at sea level, for January 1977, in whole millibars, calculated from data prior to 1970.

While we have not yet fully tested precipitation forecasts based on the pressure-anomaly forecasts, we have developed regression models for precipitation based on calculated hemispheric mean temperature, its derivatives, and the Chandler tide modulation of the local precipitation at stations around the hemisphere. Thus the regression is based on the same parameters as the pressure-pattern model. Tests on ten years of independent data for 120 stations in North America have been completed. For five-year mean monthly precipitation (for January, April, July, and October) skill scores for above and below median (NOAA criterion) average about 0.21. For individual months the skill scores average about 0.03-0.04. Best results are obtained for July precipitation with the corresponding skill scores being 0.27 for five-year July station means and 0.09 for individual July station totals (Table 1). Tests on 60 stations in India give similar results, again with July forecasts producing the highest scores (Table 2).

Improvements in the volcanic prediction model and the Chandler tide model are currently being sought, and other factors are being tested, for a fundamental assumption in this research is that climate has multiple causes.

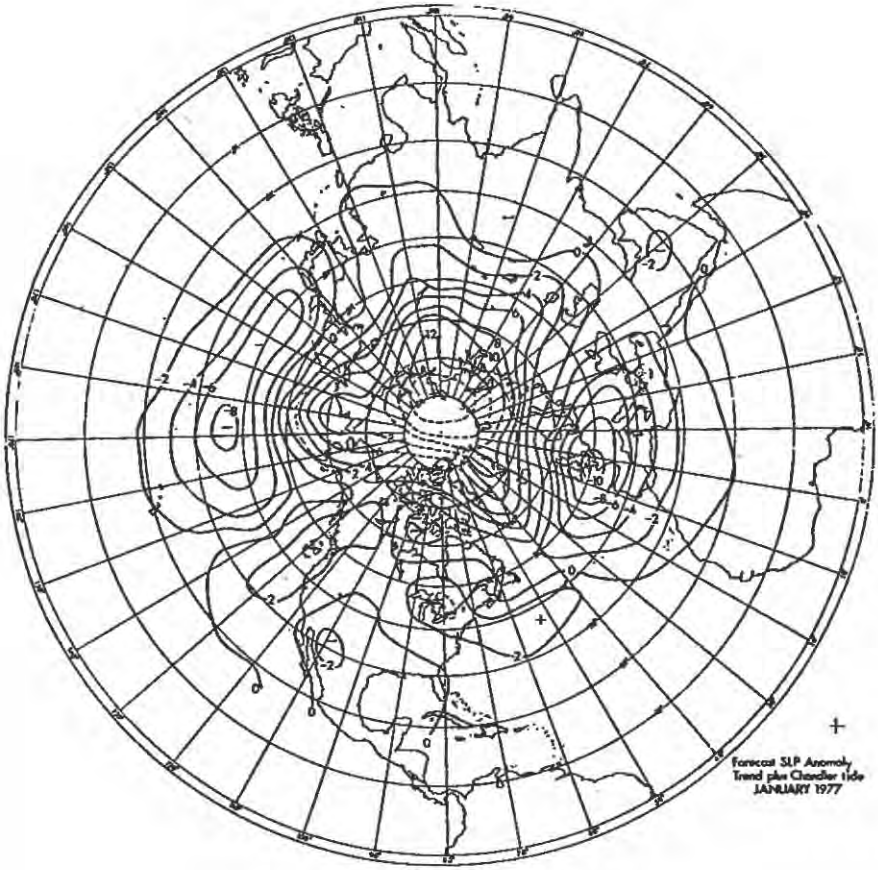

Figure 3. Trend plus Chandler tide calculated sea-level pressure anomaly pattern for January 1977, in millibars, based on hemispheric mean temperature data prior to 1975 and Chandler tide data prior to 1970.

Session 4A Dynamic Meteorology – Modelling Thurs. 1015-1200

EXPERIMENTS WITH A THREE-DIMENSIONAL ATMOSPHERIC BOUNDARY-LAYER MODEL FOR MESOSCALE FLOW

John L. Walmsley

Accurate model simulation of mesoscale (horizontal scales of order 100 km) transport and dispersion of atmospheric pollutants depends primarily on accurate representations of wind and turbulence. A boundary-layer model to produce meteorological fields for this purpose is currently under development at AES. This model simulates an atmosphere which is bounded above by a movable material surface and below by terrain. Horizontal wind velocity and fluid thickness are computed prognostically; vertical wind speed and hydrostatic pressure are obtained from diagnostic equations at each time step.

Numerical experiments with the model serve to illustrate the effect of horizontal variations in surface conditions (e.g., terrain height and roughness length) on the three-dimensional wind field. Results from some of these experiments are presented.

DIAGNOSTIC STUDY OF OBSERVATIONS FROM REAL AND MODEL ATMOSPHERES

G.J. Boer and J.D. Henderson

Despite the fact that the basic dynamical and thermodynamical equations governing atmospheric flow are known, the details of the actual behaviour of the real or a model atmosphere must generally be obtained from an analysis of a large number of observations from that atmosphere.

A body of general diagnostic programs has been developed and has been applied to GCM output and data from the Canadian Meteorological Centre operational analysis. Initial efforts have focused on the basic budgets of mass, angular momentum, heat, moisture, and kinetic and available potential energies.

Some results of these analyses will be presented and other areas of possible application of similar analyses (such as forecast verification, climate monitoring, case studies, etc.) will be pointed out.

A NEW NUMERICAL METHOD FOR HANDLING QUASI-DISCONTINUOUS FLOW PROBLEMS

Helen Warn and Andrew Staniforth

Flow problems which develop quasi-discontinuities are notoriously difficult to handle numerically; this is because spurious numerical noise is generated in the vicinity of sharp gradients which rapidly spreads out to contaminate the whole flow field. In this paper we investigate a new method for dealing with such problems which allows quasi-discontinuities to develop within the flow field with minimal noise generation.

The procedure is essentially an application of the finite-element method, using discontinuous functions as basis functions. The method is used to investigate two problems which are known to develop high gradients – the evolution of a linear critical level for Rossby waves, and the evolution of a non-linear critical layer for forced waves on a shear flow. The results are compared with the existing theory for these problems, and also with numerical solutions obtained using conventional finite-element methods.

THE APPLICATION OF NORMAL MODE ANALYSIS TO FOUR-DIMENSIONAL DATA ASSIMILATION

Roger Daley and Kamal Puri

One of the most commonly used techniques for providing analyses of the atmosphere is the four-dimensional data assimilation technique. In this method a numerical weather prediction model is integrated in time with observed data being inserted into the model whenever it becomes available. Thus, in regions of high data density the resulting analyses are very close to the observations, while in regions of low data density the analyses at least have time continuity and are qualitatively like the atmosphere.

A serious difficulty with this technique is the so-called rejection problem. When data are inserted into the model, they are very often rejected by the model, resulting only in the spurious excitation of gravity waves. In recent years some very powerful techniques for preventing the spurious excitation of gravity waves have been developed. These techniques employ the normal modes of a linearized model; the suppression of gravity waves is done directly on the basis of frequency.

Various experiments will be described in which the normal mode technique is applied to the rejection problem.

IMPORTANCE OF THE INCLUSION OF MOUNTAINS IN SHORT-RANGE NWP

C. Girard, M. LeBlanc and R. Moffet

In order to estimate the relative importance of the inclusion or exclusion of mountains for short-range numerical forecasting, two types of experiments were made using the Canadian Operational Spectral Model. The atmospheric numerical simulation problem especially in an

operational environment requires, in effect, that a great deal of simplifying approximations be made even on the largest available computers. These approximations lead to errors of relative magnitude among which are the horizontal as well as vertical truncation errors and errors caused by the lack or inadequacy of the parameterization of physical effects such as boundary-layer and precipitation processes, mountain and radiation effects.

Sensitivity experiments consist in modifying the simplifying approximations and measuring the differences between model integrations. They show that the model is, for example, as sensitive to the inclusion (exclusion) of mountains as to a change of horizontal resolution from 15 to 30 waves (approximately equivalent to a change of grid-length from 500 to 250 km), and that the inclusion of mountains is second only to surface drag among physical processes.

Forecast experiments consist in making the same type of modifications, but comparing the results with the atmosphere by measuring the level of the error incurred. A set of parallel integrations with and without mountains was made during the month of November 1977 (26 cases). The experiments show a marked superiority for the integrations with mountains over those without mountains. For example, over a region that covers essentially the North American continent, the root-mean-square height error at 100 kPa is slightly smaller at 48 h with mountains than at 24 h without mountains.

A PROCEDURE TO PREDICT THE MESOSCALE WIND DISTRIBUTION FOR SITING WIND-POWERED GENERATORS

Maurice Danard

In choosing sites for wind-powered generators, one should know the wind distribution. However, there are relatively few stations in Canada with sufficient observations to supply this information. Moreover, the horizontal length scale of wind variations is often smaller than the distance between stations, especially in complex terrain. The purpose of this study is to provide techniques for calculating wind statistics in the vicinity of a reference station for which long-term records are available. The procedures are applied to southwestern Alberta.

Surface winds are computed using a mesoscale primitive equations one-level model. The meteorological input data consist of the surface wind and temperature, and 850- and 700-mb heights and temperatures at Lethbridge. The initial geostrophic wind is calculated assuming a balance between pressure gradient, Coriolis and frictional forces. This geostrophic wind is then employed to compute a balanced initial wind everywhere in the model domain. Effects of stability and horizontal variations in roughness are included. Starting from this balanced initial state, there is then a dynamical adjustment using the thermodynamic, hydrostatic and momentum equations. Influences of thermally induced upslope and downslope winds as well as adiabatic orographic effects are included.

The 10 and 50% exceedance speeds are calculated using the corresponding speeds at Lethbridge from each of eight octants. Each simulated speed array is weighted in proportion to the frequency of winds from that octant at Lethbridge. A Weibull probability distribution is then fitted to the overall 10 and 50% speeds. Results are verified using independent data at Pincher Creek, Calgary and Banff.

Session 4B Mixing Processes Thurs. 1015-1200

SEPARATION OF STRATIFIED FLOW OVER AN OBSTACLE

D. Farmer

Separation of flow past a bluff obstacle is examined with reference to the influence of stratification. While this phenomenon has recently become the subject of theoretical and laboratory study motivated by problems of atmospheric pollution, it has not been previously examined in the ocean. We present data showing flow separation in the tidal wake of a sill in Knight Inlet. Unlike an isolated hill, the sill is essentially two-dimensional: fluid cannot flow around the obstacle. The response is complicated by the great height of the sill relative to the total fluid depth

and by the non-linear density stratification. Separation has been observed to be coupled to lee waves during periods of relatively weak stratification in winter, but has also been observed in the absence of lee waves during a period of strong stratification in summer. Under certain conditions separation is suppressed. We discuss some of the similarities and distinctions between those results and those that have been predicted for atmospheric flow over mountains.

OCEANIC DISSIPATION AND DIFFUSION

T.R. Osborn

Measurements of small-scale oceanic velocity fluctuations can be used to estimate the local rate of turbulent energy dissipation. These values can be combined with models of oceanic mixing to estimate local cross-isopycnal diffusion rates. Two models are considered: Kelvin-Helmholz billows and turbulent production by the Reynolds Stress working against the mean shear. Both models are consistent with an upper bound on the eddy coefficient for density of

$$K_\rho = 0.15\epsilon/0.85N^2$$

where N is the Väisälä frequency. Oceanic measurements leading to estimates of ϵ produce values of K_ρ which vary from 0.005 to 5 $cm^2 s^{-1}$. The results of applying the model to presently available data are outlined.

TEMPERATURE-SALINITY-DENSITY STRUCTURE NEAR THE SCOTIAN SHELF-BREAK OBSERVED WITH A BATFISH

A.S. Bennett

Contoured sections observed with a Guideline CTD mounted in a Batfish towed body are presented for a number of tows in the vicinity of the Scotian Shelf-Break. As well as sections showing major or minor frontal activity, a number of sections showing internal waves are discussed: some of these show spatially localized internal waves of large amplitude.

ON MODELLING THE PHYSICAL AND CHEMICAL PROPERTIES OF THE BERING SEA

G.T. Needler and J. Shepard

During GEOSECS, one station was taken inside the Bering Sea. In comparison with the open Pacific, this station showed high silicates and differences in most of the geochemical parameters. While it is possible to model the Bering Sea geochemistry in terms of the often-applied, one-dimensional vertical model, it is clear that at least in this case such a model is not valid. A simplistic model including lateral changes will be discussed along with the resulting implications on the magnitudes of vertical diffusion and various source terms.

BEDFORD INSTITUTE'S PHYSICAL OCEANOGRAPHIC PROGRAM IN THE LABRADOR CURRENT

J.R.N. Lazier

During four expeditions aboard *C.S.S. Hudson* in 1977 and 1978, 220 CTD stations were occupied in and near the Labrador Current from Frobisher Bay to Fogo Island. The stations are arranged in 22 lines perpendicular to the shelf break, and run from the 50-m isobath or the ice edge to the 2000- or 3000-m isobath. At each station, dissolved oxygen, silicate, phosphate and nitrate analyses were run at a maximum of 10 depths. These data are being used to describe the parameter distributions in order to study the mixing across the current between the deep ocean and the coastal waters and the relative importance of the various source waters that converge to make up the current. Direct current measurements have also been obtained from 10 instruments at 5 mooring sites on the continental slope off Nain Labrador, between October 1977 and July 1978. Preliminary analyses indicate that the mean flow of the offshore branch of the current is parallel to the isobaths (115° True) and decreases from maximum values of 0.35 m s^{-1} at 100 m over the 600-m isobath to 0.10 m s^{-1} near the bottom.

EVALUATION OF THE BOWEN RATIO/ENERGY BALANCE METHOD FOR DETERMINING EVAPOTRANSPIRATION IN FOREST WATER BALANCE STUDIES

D.L. Spittlehouse and T.A. Black

Measurements of evapotranspiration are a necessary part of our continuing study of the forest water balance. As part of our forest micrometeorological research programme, Bowen ratio/energy balance (BREB) measurements have been made at two different Douglas-fir forests on the southern coast of British Columbia. Concurrent with this work our research group has made independent measurements of evapotranspiration that can be compared against our BREB measurements. A water balance (WB) method requiring measurements of precipitation, soil-water storage and drainage provided weekly average values of evapotranspiration. Comparison between the BREB and WB methods in 1970 at Haney, a wet forest site, and in 1974 and 1975 at Courtenay, a much drier forest site, gave agreement to within ±8%. In 1975 at the Courtenay site evapotranspiration was calculated on a half-hourly basis using a water-vapour diffusion (WVD) model which requires measurements of leaf-area index, vapour-pressure deficit and leaf resistance to water-vapour diffusion. The WVD and BREB methods agreed to within ±10% for high soil-water content and to within ±30% for low soil-water content. In 1976 a short study showed an agreement of ±0.07 mm h^{-1} between the BREB and an eddy correlation/energy balance (ECEB) method. The generally low forest wind speeds were found to limit the usefulness of the ECEB method due to the stalling of the Gill anemometers. In using the BREB method we have used 1- and 3-m separations of the psychrometric sensors, and germanium and silicon diodes as temperature sensors. We have found that symmetry in construction and periodic reversal of the sensing heads are important in removing systematic errors. Our BREB measurements have shown that under non-limiting soil-water conditions the daily evapotranspiration rate for Douglas-fir stands on the southern coast of British Columbia is less than or equal to the equilibrium evaporation rate.

RADIATION BALANCES OF CONIFEROUS FOREST AND LOGGED SITES AT MONTMORENCY, P.Q.

J.H. McCaughey

In July and August, 1978 a comparative study of the radiation balances of forested and logged sites was conducted at Montmorency, P.Q. The forest is composed of balsam fir with small amounts of both black and white spruce; the logged site had been clear-cut in 1975. Simultaneous measurements of the components of the radiation balance of both sites were taken for forty days from July 17 to August 25.

During the sample period the values of daily net radiation at the logged site (Q^*_c) are significantly lower than at the forest site (Q^*_f). On average, in terms of daily totals, Q^*_c is 25% less than Q^*_f. Earlier work in this area had shown that Q^*_c was 10% less than Q^*_f, and that this difference was explainable in terms of differences between the reflection coefficient at the sites (7% for the forested and 18% for the cleared sites). The reflection coefficients in 1978 are not significantly different from the earlier estimates. However, there is evidence of a significant difference in upward terrestrial radiation between the sites in 1978, so that $L\uparrow_c > L\uparrow_f$. The relative importance of differences in $L\uparrow$ and $K\uparrow$ between the sites is shown from an analysis of twelve days of hourly data in August. During this period, the differences in Q^* caused by differences in $K\uparrow$ were approximately twice as important as those caused by differences in $L\uparrow$. On average, the difference in $K\uparrow$ accounted for 69% of the difference in Q^*, while the difference in $L\uparrow$ accounted for 31%.

ESTIMATION OF THE SURFACE ENERGY BUDGET BY DISTRIBUTION OF RESIDUALS

D.G. Steyn

The determination of the surface energy budget over a surface as aerodynamically rough and materially inhomogeneous as a city presents two major problems, viz, indeterminacy of the ground heat storage and large uncertainties in both turbulent fluxes. These problems can be solved by parameterizing the ground heat storage from the net radiation, and then distributing the budget residual between the turbulent terms in order to achieve closure. This method will be illustrated by application to a series of energy budgets measured over south Vancouver during the summer of 1978.

ACTUAL AND POTENTIAL EVAPOTRANSPIRATION FROM IRRIGATED ALFALFA

R.J. Williams

Measurements of evapotranspiration from irrigated alfalfa in the Kamloops area of south central British Columbia were undertaken during the summer of 1978. Actual evapotranspiration was determined using the Bowen ratio/energy balance technique, while potential evapotranspiration was calculated using the "equilibrium" model with the Priestley-Taylor α value of 1.26. A simplified model, using global radiation and an estimate of net radiation, was examined and its usefulness in topoclimatic mapping is discussed.

ESTIMATING PASTURE PRODUCTIVITY FROM CLIMATOLOGICAL MODELS

R.L. Davis and J.A. Davies

A micrometeorological study was conducted in the Peace River region during the growing season of 1977 to examine the application of specific climatological models in estimating forage productivity. Evapotranspiration was calculated using the energy balance/Bowen ratio method, and a relationship between cumulative evapotranspiration and dry matter yield was developed. The Priestley and Taylor potential evapotranspiration model using an α-value of 1.26 estimated potential evapotranspiration from the forage pasture to within 10%. Net radiation flux density estimated from component solar and long-wave radiation models overestimated measured net radiation by 7%; this is attributable to overestimation of the solar radiation component model. The model estimates of net radiation used in the Priestley and Taylor formula overestimated potential evapotranspiration by 8% resulting in a comparable overestimation in dry matter yield. It is concluded that the solar-radiation model overestimation could be corrected by calibration of the aerosol coefficient using normal incidence direct beam measurements.

USE OF THE β-GAUZING TECHNIQUE TO STUDY PLANT-WATER RELATIONS

N. Barthakur

The non-destructive nature of the beta-absorption method is described for measuring the moisture content of plant leaves in order to determine the onset of moisture stress under drought conditions. Improvements in the counting technique led to increased sensitivity and accuracy of measurement to the extent that stomatal movement of leaves could also be studied. Evaporation of water from attached leaves, under various environmental conditions in the laboratory, have been measured. These results will be discussed and evaluated with respect to other researchers' field measurements of dew on soil and plant surfaces.

Poster 1

THE ATMOSPHERIC ENVIRONMENT SERVICE ENERGY PROGRAMME

Thorne K. Won

As a result of the world oil crisis of 1973, the Federal Government formed the Interdepartmental Panel on Energy Research and Development (PERD). The role of the PERD is to review and coordinate energy research and development activities as well as to advise Treasury Board on the allocation of funds for such activities. Five main tasks were identified by the Panel: Conservation, Fossil Fuels, Renewables, Nuclear and Transmission. Of these tasks, the Atmospheric Environment Service has direct funding for one – Renewables. Within this task, programmes were developed in specific areas of study of which the AES has direct involvement in two, solar and wind. Other programmes include: hydraulic, biomass and geothermal. Indirect funding and in-house resources are used to conduct studies within the Conservation and the Transmission tasks.

The Atmospheric Environment Service has developed an orderly programme of energy research and related scientific activity to span several years in support of the Federal Energy Programme. Six distinct phases of development were identified with the initial phases dealing predominantly with data-base development to support energy related studies. The remaining phases evolve from data analyses to site specific feasibility studies.

This paper discusses the organization and the development of the Atmospheric Environment Service Energy Programme as well as projects within the Programme currently underway and some of those planned to be undertaken in the near future.

Poster 2

CLIMATOLOGICAL ANALYSES FOR PLANNING WIND AND SOLAR ENERGY SYSTEMS IN ONTARIO

R.G. Lawford, T. Eschle and M. Helferty

This presentation provides a review of climatological analyses prepared for use in planning wind energy and solar heating systems in Ontario.

Estimates of the heating demand and the availability of solar radiation in different localities are discussed. The maximum climatic stresses expected once every 100 years for heating systems in Toronto and Ottawa are also estimated.

Maps delineating areas in Ontario with large wind energy potentials are presented. In addition, the frequencies of periods with small potential are documented for five major centres.

Poster 3

MODELLING SOLAR RADIATION COMPONENTS IN AEROSOL ATMOSPHERES

Frederick Barlow

A model of clear sky solar radiation diffuse and direct beam components is presented with special emphasis on aerosol effects. Aerosol and molecular scattered irradiance is calculated using a two hemisphere single scatter model with simple accommodation of anisotropy and zenith angle effects. Aerosol absorption values are determined by iteratively-derived single scattering albedo values for urban and non-urban conditions. Model estimates of instantaneous, hourly, and daily radiant energy flux density values are calculated for representative ranges of sites and conditions in Canada. Results showed very good agreement with measured direct beam and global components. Diffuse values were generally within ±20% with large errors at low optical depths. Average background aerosol optical depths for Canadian non-urban conditions are determined to be close to 0.06. The model estimates the recovery of aerosol depleted direct beam irradiance as surface diffuse irradiance to range from 35 to 50% and from 45 to 65% for

the urban and non-urban cases, respectively. The model is also used with Mie scattering theory to estimate the particle size distribution Junge exponent ν for an urban aerosol. A ν-value of close to three fits Hamilton conditions.

Poster 4

A COMPUTER PROGRAM USED TO MAP THE SPATIAL DISTRIBUTION OF "CLEAR-SKY" SOLAR RADIATION IN THE OKANAGAN VALLEY OF BRITISH COLUMBIA

R.L. Davis

The measurement of solar radiation at meteorological stations in the Okanagan Valley is inadequate to elucidate the spatial variation over mountainous topography. A computer program was developed to calculate "clear-sky" daily solar radiation values at 0.5-km grid points in order to draw solar radiation isolines on 1:50,000 topographic maps. The computer model calculates the direct and diffuse beam components and their variations with slope and azimuth of the topography and calculates the effects of topographic shading. This computer model has applications in defining the spatial variations in energy available for agriculture, forestry, land disposal of sewerage, and design of buildings and solar collectors.

Poster 5

A TECHNIQUE FOR MAPPING THE DISTRIBUTION OF DIFFUSE SOLAR RADIATION OVER THE SKY HEMISPHERE

L.J. Bruce McArthur

A technique for mapping the distribution of diffuse solar radiation over the sky hemisphere is described. The method is based on an analysis of all-sky, visible photographs and concurrent actinometric measurements of diffuse solar radiance. The photographs were digitized and the relative density values correlated with known radiances. The resulting equation was then utilized to determine the radiance for each density value. From these radiance data a map of diffuse solar radiation was constructed for the celestial dome.

The utility of the approach is assessed by several tests. In the first test, the estimated radiances were integrated and compared with the measured diffuse irradiances incident on a horizontal surface. These were found to be within ±10 percent for the sky conditions examined. A second test, under clear-sky conditions, was performed to estimate the short-wave irradiances on several south-facing inclined surfaces. The results were found to be within ±5 percent of the measured irradiances. In a third test, comparisons with the normalized radiance distributions of Steven (1977) indicated good qualitative agreement.

Finally, problems and deficiencies in the technique are elaborated upon and possible means of surmounting them are discussed.

Poster 6

AN ANALYSIS OF ERRORS IN THE CALCULATION OF EVAPOTRANSPIRATION BY THE BOWEN RATIO AND COMBINATION MODEL METHODS

W.G. Bailey

An analysis of probable and relative errors was performed on Bowen ratio and combination model calculations of evapotranspiration for data collected above a cropped surface during a ten-day drying cycle. For the Bowen ratio method, when vapour-pressure gradients are large ($>$ 25 Pa), latent-heat flux densities are estimated with relative errors between ±5 and ±12%. With small vapour-pressure gradients, errors become very large. The difficulty of obtaining reliable evapotranspiration estimates during conditions which promote small vapour-pressure gradients is apparent.

The sensitivity of combination model estimations to errors in the aerodynamic resistance to heat and water-vapour exchange is found to be small. The consequence of errors in surface roughness, zero plane displacement, atmospheric stability and horizontal wind speed is therefore minimal. Combination model estimates show greater sensitivity to errors in bulk stomatal resistance. Resulting relative errors reach a maximum for conditions with a small aerodynamic resistance and a large bulk stomatal resistance. This is characteristic of a moisture stressed crop under windy conditions. The difficulty of assessing the probably error in bulk stomatal resistance derived from stomatal resistance and leaf-area measurements is also examined.

Poster 7

AN ANALYSIS OF FREEZE-FREE PERIODS IN BRITISH COLUMBIA

Greg E. Cheesman

The average freeze-free periods were found to be increasing quite steadily over the past twenty-five years at Prince George Airport. As this parameter is an important input to the climate mapping program of the Resource Analysis Branch, British Columbia Ministry of Environment, and in many cases is also necessary for proper resource planning and management, an analysis of the freeze-free period at a number of long-term Atmospheric Environment Service climatological stations in British Columbia was undertaken. Data were analyzed to determine whether there were any significant trends and whether any trend may have been caused by a station location. Of 53 stations finally selected, only 9 showed a significant trend. Four other stations also exhibited significant trends, but these were not considered to be valid because of changes in station locations. It is suggested that the freeze-free period parameter is particularly susceptible to station site changes.

Poster 8

UPSLOPE ENHANCED EXTREME RAINFALL EVENTS OVER THE CANADIAN WESTERN PLAINS – A MESOSCALE NUMERICAL SIMULATION

R.L. Raddatz and M.L. Khandekar

A limited area numerical model, previously applied to the study of cold easterly circulations over the Canadian Western Plains, is used to simulate upslope enhanced extreme rainfall events over the Saskatchewan River and adjacent drainage basins. Following Lavoie (1972) the atmospheric structure was 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. The governing primitive equations were averaged throughout the depth of the mixed layer and the interactions between the mixed layer and the underlying and overlying air layers were suitably parameterized.

A 47.6 km grid mesh of 1369 (37 x 37) points covering the Prairie Provinces was used for representing the variables. The governing equations were solved numerically for the mixed layer with terrain influences, surface roughness, temperature variations, moisture fluxes and the release of latent heat being allowed to perturb the mixed layer from its initial conditions.

The three-day mean annual extreme rainfall distribution over the Saskatchewan River Basin was successfully simulated by the model. A case study based on observed initial conditions showed that the model could reproduce mesoscale rainfall distributions associated with an individual storm.

Application of this model to short-term streamflow forecasts and related hydrological analyses is indicated.

Poster 9

A GRID POINT WAVE CLIMATOLOGY FROM DIGITIZED WAVE ANALYSES

V.R. Swail

A method is described for preparing a wave-height climatology based on contoured synoptic wave-height analyses. In the present study the wave-height analyses considered are those prepared by the Meteorological and Oceanographic Centre (METOC) of the Department of National Defence in Halifax. These charts are produced every 12 h for the entire North Atlantic with a contour interval of 1 m. The analyses are based partly on available ship data and partly on hindcasting techniques derived from the Sverdrup-Munk-Bretschneider relationships.

The climatological procedure is to digitize automatically the contours of each analysis at a rate of 100 points per linear inch, using an interpolation scheme to create a grid of wave heights. These grid points then become fixed "stations" and all of the statistical analyses which can be performed on a time series at a point can be applied; for example, mean and maximum values of the significant wave-height for a particular month, a collective month, or the length of record, exceedence diagrams of wave-height greater than a specified value, and return period statistics. Also, by performing these analyses on all grid points, maps of various statistics can be produced.

Poster 10

LONG-RANGE TRANSPORT MODELLING – MODEL DESCRIPTION AND APPLICATION

M.P. Olson, E.C. Voldner and K.K. Oikawa

A concentration/deposition model has been developed for application to the Long-Range Transport of Air Pollutant (LRTAP) program within the Federal Department of the Environment. The Lagrangian model computes concentration and deposition fields of sulfur compounds as well as pH in precipitation over North America.

The trajectories are based on a three-dimensional wind analysis and the pollutants are assumed to be well mixed throughout the variable mixing layer. The required precipitation data are obtained from objective analyses and SO_2 source emissions from a North American emissions inventory.

Results obtained from the model have been compared with measurements from different monitoring networks in North America. The agreement between measured and computed quantities are generally good. Air pollution episodes are duplicated in space and time. Average computed and measured concentration/deposition fields are generally within 60% and pH values within a few percent of each other.

A description of the model and results from a comparison study will be presented.

Poster 11

TEMPERATURE SPECTRA IN THE UNSTABLE ATMOSPHERIC SURFACE LAYER

Jim Rollefson

An explicit expression is given for the temperature spectral density for reduced frequencies, $f = nz/U > 0.01$. This depends upon the use of two length scales at lower wavenumbers plus the Kolmogoroff length $\eta = (\nu^3/\epsilon)^{1/4}$ in the dissipation range. The evolution of the form of the spectra from $Z/L \simeq 0.1$ to $Z/L > 1$ (where L is the Monin-Obukhov length) agrees well with experimental results. The reasons for the introduction of these length scales are given in terms of the physical processes involved.

Poster 12

A NEW AES AIRCRAFT INSTRUMENTATION PACKAGE FOR MEASURING SIZE, CONCENTRATION AND PHASE OF PARTICLES IN CLOUD

J.W. Strapp, R.S. Schemenauer, G.A. Isaac, and C.L. Crozier

Recent scientific and technological advances have revolutionized the form, quantity, and analysis of cloud microphysical measurements. "State of the art" instruments supply particle sizes, concentrations, phase, and two-dimensional images of detected particles. Short sampling intervals allow an enormous amount of data with excellent spatial resolution to be compiled. Special data acquisition systems enable data to be available in real time, and to be stored on magnetic tape for future analysis with the aid of computers.

The AES, with the cooperation of the National Aeronautical Establishment, has for the past few years directed the development of an aircraft instrumentation system for cloud physics research purposes. As a part of this package, a set of probes has been utilized to determine particle spectra and phase. Of special interest are 5 probes manufactured by Particle Measuring Systems, which size and count particles in overlapping size ranges. A forward scattering spectrometer (FSSP) measures particles in the cloud droplet size range (0.5-45 μm). The 1D-C and 1D-P optical array spectrometers count and size particles in the 20-300 μm and 300-4500 μm ranges, respectively, using a laser shadowing technique for particle measurement. The 2D-C (25-800 μm) and the 2D-P (250-6400 μm) probes are logical extensions of the simple one-dimensional probes. Laser shadowing is sampled at a rapid rate, processing particle time slices which can be subsequently integrated to produce two-dimensional particle images. The 2D-C probe also includes a phase discrimination feature using a depolarization technique. In addition to these probes, an AES designed 5-level ice particle pulse-height analysis system is used in conjunction with MEE Industries polarization optics to determine particle phase. A MEE Industries cloud-particle replicator provides high resolution impressions of small particles collected on a formvar coated film. This produces information on particle phase, concentration, and shape. An overview is given of the design, capabilities, limitations and outputs from the various probes presently being used.

Poster 13

LINEAR INTERPOLATION SCHEMES AND THEIR APPLICATION TO HAIL ENERGY DATA

R.A. Stuart and G.M. Cheung

Various interpolation schemes are available to estimate any variable $E(x,y)$ given measurements of E at N points $(x_1, y_1), (x_2, y_2), \ldots, (x_N, y_N)$. If the grid scheme of data points is sufficiently dense to capture the predominant features of E then any reasonable interpolation scheme may be expected to give an acceptable estimate of E. On the other hand, if the data points are very sparse, the variation in the estimates of different interpolation schemes provides a lower limit on the uncertainty with which the field variable is estimated by the grid.

The use of several interpolation schemes to estimate uncertainty is valuable when little is known about the field variable in advance or when the data gathering experiment is not repeatable. In this report the method is applied to the estimation of average kinetic energy per unit area of falling hailstones. Data from several Alberta hailstorms are used as input for this procedure.

Four interpolation schemes are introduced. Monte Carlo tests are performed on a known function sampled by randomly placed grid points of varying resolution. These tests are then used in conjunction with the hailpad data.

Poster 14

A TOPOGRAPHICAL MODEL TO PREDICT SPRINGTIME CLEAR NIGHT TEMPERATURES ON THE SAANICH PENINSULA

Rod Chilton

Minimum temperatures in a small area can be accurately predicted based upon specific topographical factors. Mobile temperature traverses, temporary and permanent weather stations were used to determine the clear night springtime temperature distribution on the Saanich Peninsula near Victoria. It was discovered that before accurate minimum temperature predictions are possible, an area as diversified as the Saanich Peninsula must be divided into smaller land units.

Having determined the minimum temperature distribution, tables of frost risk can be produced for frost sensitive crops and some recommendations provided concerning land and crop management with respect to frost.

Poster 15

FREEZINGS OF THE LOWER FRASER AND COLUMBIA RIVERS

Eero Karanka

Freezings of the Lower Fraser and Columbia Rivers occurred every second winter, on average, in the nineteenth century from the beginning of continuous river observations at New Westminster, B.C. and Vancouver, Wash. Associated meteorological observations suggest that outbreaks of Arctic air were more frequent and prolonged in the Pacific Northwest prior to 1895.

River freezings in the Northwest coincide frequently with flooding along rivers farther south because the synoptic pattern associated with prolonged Arctic outbreaks also favours heavy precipitation from Oregon to Southern California.

Models of global circulation may provide some insight into the conditions which favour the development of this synoptic pattern. The winter of 1861-62, the record winter for both kinds of river disruptions along the west coast of North America, is used as an example.

Session 5 Arctic Oceanography I Thurs. 1330-1500

PHYSICAL OCEANOGRAPHY OF JAMES BAY DURING WINTER

G.S. Peck and S.J. Prinsenberg

Hydro-electric development in the James Bay Territory will significantly alter the freshwater input in James Bay, affecting both large-scale and local (estuarine) environments. The post-project run off will be regulated to about 3,400 $m^3 s^{-1}$, or an increase of 88% over the mean annual pre-project outflow, and four to five times greater than the natural winter run off.

To form a basis from which post-project effects could be predicted, winter surveys were conducted in 1975 and 1976. The cyclonic circulation of James Bay is governed almost entirely by the gravitational mode. High salinity (31-32 $^{o}/_{oo}$) water flows into James Bay along the west coast and is gradually diluted through the addition of run off from rivers along the southwestern, southern and eastern coasts. The Coriolis force restricts the outflow (28 $^{o}/_{oo}$) to a northward-flowing surface current along the east coast.

Large, shallow lenses or plumes of nearly fresh water were found off the La Grande and Eastmain Rivers. The La Grande plume is about 80 km long, with salinities less than 2 $^{o}/_{oo}$ observed 20 km from the river mouth. Dispersion within the plume is accomplished by tidal action along a NNW/SSE axis while the entire plume is advected by the coastal current.

An analytical estuarine model was applied to James Bay under natural and future conditions. The friction of the ice cover on surface currents is treated as a negative wind stress opposing the outflowing surface layer. Results show that the cross-sectional mean current speeds

across the mouth of the Bay more than double from the maximum pre-project values of 1.4 cm s^{-1} to 3.2 cm s^{-1}. Because these are means over the entire cross-section, the surface currents along the Quebec coast are underestimated by about half. Thus the mean pre-project surface currents off Quebec should be 2.8 cm s^{-1} and, under future run off conditions, about 7.5 cm s^{-1}.

CURRENT OBSERVATIONS IN CROZIER STRAIT, CENTRAL ARCTIC

P. Greisman and R.A. Lake

Since the summer of 1976 the Frozen Sea Research Group of I.O.S. Pat Bay has been involved in current measurements in the channels in the vicinity of Bathurst Island: Austin Channel, Byam Channel, Crozier Strait, Pullen Strait and Wellington Channel. The most complete sampling program was performed in Crozier Strait utilizing 24 Aanderaa current meters deployed for periods up to one year.

Two current-meter records show a marked variation in weekly average velocities over the year, which may be interpreted as a seasonal cycle in the transports. Although not significantly correlated with changes in the atmospheric pressure gradients or the wind stress, the period of most energetic flow corresponds with the stormy season.

The mean flow is southward on average, but a weak cyclonic tendency is apparent: the current meters near the eastern shore showed a net northerly flow. There is significant vertical shear in the mean current, only a fraction of which can be explained by the mass field measurements. The apparent failure of the geostrophic approximation in this region necessitates direct current measurements in order to form an accurate picture of the flow regime.

Several current meters were located within the planetary boundary layers below the ice and near the bottom. These records showed that the boundary affected the mean flows very slightly; Ekman veering and a decrease in speed were nearly absent. The tidal flows, however, (which were equal to or greater than the mean flows) show a very strong influence of the boundary. The near-boundary tidal flows validate a recent theory of viscous boundary layers in rotating fluids which predicts that the tidal ellipse orientations are determined by the sense of polarization of the free stream current.

The tidal currents have a much larger diurnal signal than do the tidal heights.

HELIUM AND TRITIUM IN THE CANADIAN EASTERN ARCTIC

W.B. Clarke, W.C. Eismont, E.P. Jones and Z. Top

Concentrations of tritium, helium-3, and helium-4 were measured at several locations in the Canadian Arctic Archipelago and in Baffin Bay. The results are consistent with the interpretation of silicate concentrations showing water flowing from the Arctic Ocean through Smith Sound to be different from that flowing through Lancaster Sound and Jones Sound. In Baffin Bay, high surface concentrations will be discussed in relation to the effect of ice cover on gas exchange while low bottom concentrations will be used to comment on the age of Baffin Bay bottom water.

ON THE USE OF COMPOSITE HISTOGRAMS IN DETERMINING THE SURFACE TEMPERATURE DISTRIBUTION OF THE BEAUFORT SEA

R. Cross and E.R. Reinelt

Sea- and ice-surface temperatures of the Beaufort Sea are deduced from scanning radiometer imagery transmitted by the NOAA-5 satellite. The digitized image is converted into a two-dimensional array of histograms of the distributions of relative infra-red radiances received from a corresponding array of surface elements. The sea-surface temperatures are then derived from the histograms, based on the assumption that the entries in each histogram are normally distributed about an appropriate common mean value.

Layers of cloud, islands and coastlines frequently complicate the analysis. Composite histograms may be used to filter out the effect of cloudiness, while "coldest mode" processing is effective in minimizing land-form "contamination". In practice, it has been found that a three-day compositing period will significantly reduce temperature errors due to the presence of cloud.

THE CIRCULATION OF NORTHWESTERN BAFFIN BAY – SUMMER 1978

D.B. Fissel and D.D. Lemon

From July to October, 1978, an intensive study of the physical oceanography of northwestern Baffin Bay was carried out from the *M.V. Theron*. Current measurements included time series records of speed and direction from 42 current meters located on fourteen subsurface moorings together with the position data from fifteen drogued, satellite tracked drifting buoys. As well, 194 vertical profiles of salinity and temperature were measured at 84 locations throughout the study area.

Preliminary results of the study illustrate the importance of a southward flowing coastal current along the western side of northern Baffin Bay. The current is relatively intense with a mean speed of 0.2 m s^{-1} over a width of 30 to 40 km. Where the current extends into eastern Lancaster Sound as an anti-clockwise intrusion, it narrows and increases in average speed to approximately 0.5 m s^{-1}. Farther offshore, the currents are weaker and more variable in direction with a net southward drift. A comparison of geostrophic currents with simultaneous directly measured currents will be presented.

STATISTICAL CRITERIA FOR THE ESTIMATION OF CLOUD HEIGHT IN THE CANADIAN ARCTIC

E.R. Reinelt and R. Cross

Satellite infrared imagery is used to estimate cloud height in the Canadian Arctic. The method is based on the correlation of cloud height with the difference between the surface temperature and the radiation temperature of cloud measured by a satellite-borne IR scanning radiometer. The height and amount of cloud can be deduced from the shape of the histogram of the temperature distribution observed in the region under study.

It is shown that thick, high overcasts produce sharp peaks on the low-temperature side of the scale, while clouds at lower elevation shift the frequency peaks toward higher temperature. Flat distributions are usually indicative of multi-layered cloudiness.

DRIFT AND DEFORMATION OF PACK ICE IN THE BOUNDARY SHEAR ZONE OF THE SOUTH-EASTERN BEAUFORT SEA

H. Melling

A zone of velocity shear exists in the Beaufort Sea ice cover between the permanent pack which moves in a clockwise gyre, and the landfast ice. In the early part of 1978, 14 ADRAMS platforms were air-dropped onto the ice in 4 linear arrays, spanning this shear zone between Land's End on Prince Patrick Island and Richards Island in the Mackenzie Delta. The positions of these platforms were monitored up to 8 times daily, with an uncertainty of 2 km, using the Random Access Measurement System aboard the NIMBUS-6 satellite. Two platforms carried precision barometers for the measurement of atmospheric pressure. The median platform lifetime was 165 days.

Positional data have been analyzed to yield drift trajectories and Lagrangian time sequences of ice velocity. During the winter, ice in the observational region moved to the south and west on a path which was erratic but lacked major direction reversals. The maximum observed speed was 37 km d^{-1}. In the spring, there was greater high frequency motion and major direction reversals occurred. The degree of correlation of velocities over distance decreased.

Differential motions were used to investigate strain rate in the ice cover. Boundary shears were observed off Prince Patrick Island and along the southern boundary. Most of the shear occurred inshore of the deployed arrays. West of Banks Island, there was little alongshore movement, but significant westward motion. Strong divergence of the ice cover resulted from a north/south compressional strain, and an east/west dilational strain. Divergence repeatedly created a flaw lead inshore of the platform arrays.

Observed ice motions were interpreted in the light of geostrophic winds and vorticity, computed from regional surface-pressure observations.

The summer ice-drift data are of lower quality, and have not yet been analyzed.

INCORPORATION OF REALISTIC INTERNAL ICE STRESS FORMULATION IN THE STUDY OF DYNAMICS OF SEA ICE MOTION

V.R. Neralla and W.S. Liu

In order to assist the Arctic offshore activities, a real-time, short-range, small-scale dynamical ice-motion prediction methodology has been developed. The model assumes that the ice floe is unaccelerated. The momentum equation is based on a balance between air to ice stress, water to ice stress, Coriolis force, pressure-gradient force due to tilting of the sea surface, and the internal ice stress. Using the momentum and continuity equations, a simple method is devised for predicting compactness (fraction of area covered by ice) over a given area.

The treatment of internal ice stress is one of the important components of any ice-prediction methodology. Several investigators consider ice as an elastic-plastic material (e.g. Coon et al., 1974) or viscous-plastic continuum (e.g. Hibler II, 1977). Based on a recent argument by Hibler, we regard ice as a film of highly viscous fluid by taking both shear and bulk viscosities into account. Also, we have emphasized the importance of variable compactness in the internal ice-stress computations.

This new formulation has been tested with ice-drift and compactness models. The observed drift data are obtained from the satellite imagery and the observed compactness charts are derived from the daily ice-cover charts prepared at the Ice Forecasting Central, Ottawa. The results for a few cases in the Baeufort Sea area demonstrate the applicability of this internal ice-stress formulation for real-time, short-range ice-prediction problems.

AN ARCTIC ATLAS: BACKGROUND INFORMATION FOR DEVELOPING MARINE OILSPILL COUNTERMEASURES

L.W. Davidson

The Environmental Protection Service of the Federal Department of Fisheries and Oceans is currently involved in the Arctic Marine Oilspill Program (AMOP), designed to promote the development of oilspill countermeasures technology for Canada's marine Arctic and East Coast Sub-Arctic regions. An interdisciplinary marine environmental atlas entitled "An Arctic Atlas: Background Information for Developing Marine Oilspill Countermeasures" was published in 1978 as a baseline reference document for this program. Information was mapped in the general categories of "Geology and Petroleum Development", "Meteorology and Oceanography", "Ice", "Biology", "Social".

The brief description presented here is designed to provide an increased awareness of the content and format of this document.

Provision has been made to finance some number of revised editions of the atlas. To support such updates, appeals are being made through forums such as this for an identification of deficiencies and for the release of new or previously non-included data. Principal needs are here identified. Contacts and addresses are presented to facilitate the necessary exchanges of information.

Theme Session II — Dynamic Similarities of Oceans and Atmospheres — Fri. 0830-0930

DYNAMICAL ASPECTS OF OCEANIC FRONTS

C. Garrett

(Abstract not available)

HIGH RESOLUTION SATELLITE DETECTION OF LOW LEVEL MOISTURE IN THE ATMOSPHERE ABOVE THE OCEAN IN VISIBLE AND INFRARED IMAGERY

R.W. Fett

High resolution satellite data from the Defense Meteorological Satellite Program (DMSP) are more sensitive in both the visible and infrared channels to low-level moisture, in the form of haze and water vapour, than data from other presently operational U.S. satellite systems. This sensitivity appears to be a result of the visible channels band-width extension into the near infrared portion of the spectrum, and the extended band-width of the infrared channel which encompasses wavelengths where water-vapour absorption is appreciable.

Examples are shown which emphasize changes in the mesoscale distribution of low-level moisture resulting from drying effects imposed on air flowing over island and mountain barriers.

The effect of low-level moisture in masking actual sea-surface temperatures in the tropics through water-vapour absorption is illustrated. The usefulness of these data in determining low visibility areas, wind direction, inversion heights, and in investigating the limits of land- and sea-breeze circulations is described.

PACIFIC WEATHER CENTRE EXPERIMENTAL SATELLITE PROGRAM

M. Horita, J. Spagnol and P. Haering

The reception of half-hourly GOES-WEST Satellite imagery using a GOES-TAP through Seattle began at the Pacific Weather Centre in February 1978. The Spatial resolution of 1-8 km and the half-hourly temporal continuity allowed meteorologists to watch cloud-system changes and to ascertain their probable dynamic mechanisms. The GOES-WEST Satellite also provided an extensive new data source over the sparse meteorological data area of the eastern Pacific. As a result, the satellite image became one of the most important analysis tools at the Pacific Weather Centre.

In order to fully exploit the use of this large volume of satellite data for the forecast operations, an experimental program was run from November 1978 to January 1979. The main feature of this program was the implementation of an "operational satellite meteorologist" during the hours from 7:30 a.m. to 3:30 p.m. The Operational Satellite Meteorologist performed two primary functions. The first was the assessment of the accuracy of the numerical initial analyses; the second was the identification of cloud systems and their trends. The evaluations were made through the analysis of satellite imagery, using the implied characteristics of the imagery to identify features such as jet streams, major cloud systems, vorticity patterns and cloud boundaries.

CALCULATIONS OF NORTH-EAST PACIFIC DATA-ASSIMILATION ERRORS WITH AND WITHOUT OCEAN WEATHER SHIP P

H. Jean Thiébaux

The decision to remove Ocean Weather Ship P from its station in the north-east Pacific aroused considerable concern over the loss of meteorological information expected to occur, since it provides the only radiosonde observing station within a 1000 km radius. Full mandatory-level observations will not be provided by any (combination) of the proposed additions to the observing array. However, by varying the densities of single-level observing systems and of radiance sounding reports from polar-orbiting satellites, more economical data-recovery schemes may be found to provide equivalent accuracy. This paper reports estimates of errors in values used for assimilating data in numerical forecasting, for the north-east Pacific. Calculations were made both with the present array (including Ship) and with alternative observing arrays.

SEA SURFACE TEMPERATURE ESTIMATE FROM SEASAT-A MICROWAVE MEASUREMENTS

Catherine Gautier

The SEASAT-A *S*canning *M*ultifrequency *M*icrowave *R*adiometer provides brightness temperatures in five channels with two polarizations. The 6.6-GHz channel is the most sensitive channel to sea-surface temperature variations, but its readings are affected principally by surface properties (more specifically, surface wind speed) and slightly by atmospheric effects. Both of these effects can be corrected for, when inverting the brightness temperatures to obtain geophysical parameters, by an appropriate combination of the readings from various channels. This combination is represented by weighting factors applied to each brightness temperature in such a way that any geophysical parameter P_k can be expressed by:

$$P_k = \sum_{i=1}^{4} a_{i,k}\, T_{Bi,k} + \sum_{j=5}^{10} b_{j,k} \log (280 - T_{Bj,k})$$

The problem is to obtain these weighting factors $a_{i,k}$ for surface effects and $b_{j,k}$ for atmospheric effects. Because of the lack of experimental knowledge they have to be obtained from calculations using a multi-layer atmospheric model that solves the radiative transfer equations, in the Rayleigh-Jeans approximation. Our model (partly developed at MIT) treats resonant absorption for oxygen and water vapour almost completely, using spectral line theory. Non-resonant effects of liquid water (cloud droplets) are treated in the Rayleigh approximation for scattering by cloud droplets.

Perturbations are applied to each geophysical variable P_k and the corresponding perturbed brightness temperatures ($T_{Bj,k}$) are calculated for the SMMR frequencies using the model. A least-square fit solution is then calculated to deduce the weighting factors such that:

$$\vec{P}_k = A \cdot \vec{a}_k$$

where $\vec{a}_k$ is the vector of the weighting factors $a_k \ldots b_k \ldots$

A problem arises when the matrix A is singular or nearly singular because then its inverse is undefined. Some methods are being devised to avoid this singularity problem.

OBSERVATIONS ON COASTAL PHENOMENA FROM A REMOTE-SENSING SYSTEM

S. Aranuvachapun

Both the LANDSAT images and the digital data on computer-compatible tapes (CCT) are used to develop a simple method for classifying features in coastal regions. The method is based on an *ad hoc* decision-tree technique and is found to be more suitable than other statistical classifiers such as a Gaussian technique for the areas being investigated.

The decision-tree is applied to the digital data on CCT for the area of the Gulf of Martaban where the Salaween and Irrawaddy rivers run into the Andaman Sea. Maps of sediment distribution are produced, which reveal an interesting gyre, distinguished by a region of clear water surrounded by discharged turbid water from the rivers. There are also fine structures with regular oscillations, another unique feature of the imagery.

Using the same method, the estuary of the Fraser River is being studied and maps of sediment distribution are produced. The distribution patterns are to be related to the coastal environments and oceanographic data.

A POTENTIAL UTILIZATION OF SATELLITE DATA FOR CLIMATIC STUDIES

Catherine Gautier

A major unknown in climatic studies is the variation of the heat storage within the oceans. Present budget calculations indicate that important oceanic transports occur, particularly within the tropical regions.

Satellite measurements in the infrared or microwave regions can provide continuous fields of sea-surface temperature, and near-surface winds can be deduced from cloud motion.

The sea-surface temperature variations reflect the changes in the oceanic mixed layer in a very complicated way. It is assumed here that it is possible to estimate the variations of the mixed layer depth, and therefore the heat-storage changes within this layer, using a combined statistical and modelling approach. The local change with time of the oceanic mixed layer depth h is a non-linear function of both oceanic and atmospheric variables, sea-surface temperature, wind field (or stress), current field, humidity field, etc.:

$$\frac{\partial h}{\partial t} = f\,(h, T_s, \vec{V}, \vec{U}, q_s, \ldots)$$

The main hypothesis of this study is that the non-linear function f can be partitioned as: $f = f(\text{model}) + A\,\vec{P}$ where f(model) is a non-linear function obtained from a one-dimensional mixed layer model and is assumed to contain most of the non-linear variations. The remaining variations can then be calculated using regression techniques applied to the difference:

$$\frac{\partial h}{\partial t} - f\,(\text{model}) = A\,\vec{P}$$

A complete atmosphere/ocean data set from GFDL is used for testing the main hypothesis and for determining $\vec{P}$.

Session 7B Boundary Layer Fri. 1015-1200

ON WAKES AND DRAG IN THE NEUTRALLY STRATIFIED ATMOSPHERIC BOUNDARY LAYER

P.A. Taylor

Wakes well downstream of obstacles in the neutrally stratified atmospheric boundary layer are studied using two-dimensional models with eddy viscosity and mixing length closure hypotheses. Variations of eddy viscosity with height near the ground are shown to exert a major influence on the rates of decay of wakes in both surface and planetary boundary-layer models. In the latter case it is shown that, even in cases with constant eddy viscosity, significant proportions of the initial momentum-flux deficit in the wake are balanced by changes in the Coriolis force. There will thus be a net change in the total horizontal stress on the ground so that the drag on hills, fences or other obstacles in the planetary boundary layer need not be balanced, even approximately, by surface shear-stress reductions, as has been suggested by some recent papers on airflow over hills.

COMPARISON OF WIND MEASUREMENTS FROM A TOWER AND A BALLOON-BORNE SONDE

J. Dionne

Comparative wind measurements made in a mast between an anemometer bivane (GILL) and a balloon-borne sonde (BLIP) fixed on a tether line, both at the same height, are presented. The study reveals three major results:

1) The mean wind data and its horizontal variance from the BLIP sonde and the bivane are in very good agreement.
2) The momentum fluxes calculated from the data of both instruments differ by at least one order of magnitude. However, a calibration of the BLIP sonde with a high performance instrument is possible.
3) The spectra of fluctuating horizontal wind for both instruments are in good agreement and furthermore they are in accord with the theoretical predictions of similitude laws for the inertial subrange.

ON THE DETERMINATION OF BOUNDARY-LAYER PARAMETERS USING THE VELOCITY PROFILE AS THE SOLE INFORMATION

Aloysius K. Lo

This paper presents a numerical technique based on the "least square error method" for evaluating boundary-layer fluxes as well as other boundary-layer parameters.

As an extension of its earlier version (Lo, *Boundary-Layer Meteorol,* 1978), the special feature of the present approach is that it requires no *a priori* knowledge of either the temperature profile or the roughness length Z_o. The accuracy of the present method has been tested on both the Kansas and the Wangara experimental data. Results obtained in the present study compared favourably with those from direct measurements and from other studies using both wind speed and temperature profiles where the roughness length, Z_o, was specified.

REFRACTIVE-INDEX FLUCTUATIONS IN THE SURFACE BOUNDARY LAYER

G.A. McBean and J.A. Elliott

In order to better understand the propagation of optical waves through the atmosphere it is important to improve our knowledge of the fluctuations of optical refractive index. Although temperature effects are known to dominate the mean refractive index, Friehe et al. (1975) have shown that humidity also has an important influence on the fluctuations in refractive index. The more complete equation for fluctuations in refractive index, n^1, can be written as:

$$n^1 = -\theta + ap - bq$$

where θ, p and q are the temperature, pressure and humidity fluctuations, respectively, and a and b are known factors depending on the mean conditions and the optical wavelength. In all studies the effect of pressure fluctuations has been assumed to be small.

The data set collected at Suffield, Alta is unique in that it is the only known experimental set where simultaneous measurements of temperature, humidity and pressure fluctuations were made. This allowed for the direct evaluation of the relative importance of the pressure fluctuations and their correlations with temperature and humidity. Because of the dry nature of the site the humidity fluctuations were of lesser importance than shown in other studies. However, the measured importance of the pressure fluctuations should be generally relevant. The variances, covariances, spectra and cospectra of temperature, pressure and humidity will be compared to ascertain the importance at each frequency as well as in the overall range.

A DIODE PSYCHROMETER SYSTEM FOR BOUNDARY-LAYER WORK

D.S. Munro

An economical psychrometer system, employing diode thermometers at three measurement heights, is described. The system allows relative calibration of psychrometers at a reference height, and operates solely from DC power. Consequently, boundary-layer measurements of temperature and humidity may be made at remote field sites, where AC power is not available. Examples are given of Bowen ratio values obtained from the psychrometer system over a wooded swamp. The implications for micrometeorological determinations of surface resistance are discussed.

Session 7C Tides Fri. 1015-1200

FORCED FORTNIGHTLY TIDES IN SHALLOW RIVERS

P.H. LeBlond

The presence and the basic features of the forced fortnightly wave observed in some shallow rivers are explained through scaling arguments which show that this wave is generated by the fortnightly modulation of the frictional forces due to the variation in tidal velocities. Com-

parison of the results with sea-level records from a shallow reach of the St Lawrence River shows reasonable agreement between data and theory.

AN EXAMINATION OF THE TEMPORAL VARIATIONS OF THE BAROCLINIC TIDE IN DOUGLAS CHANNEL, B.C.

Ian Webster

Current-meter and thermistor chain measurements made in Douglas Channel, B.C. indicated the presence of a prominent semi-diurnal, baroclinic tide. The amplitude and phase of this tide varied not only seasonally, but also over time periods of a few days. At times the amplitude of the velocity field associated with the baroclinic tide near the surface exceeded the velocity amplitude of the semi-diurnal, barotropic tide, whereas at other times it was much smaller. Clearly such variability of the baroclinic tide has major consequences for the prediction of tidal currents in the channel. In this presentation, the temporal behaviour of the observed baroclinic tide is described. The importance of changes in the mean current shear and in the density structure of the water column to the variability of the tide is also discussed.

M_2 BAROCLINIC TIDES IN A DEEP/NARROW CHANNEL

R.E. Thomson and S. Huggett

Current-meter and time-series STD measurements in Johnstone Strait, B.C. yield strong evidence of a seaward propagating internal tide of predominantly semi-diurnal period. Generation of the baroclinic motions appears to originate through interaction of the progressive surface tide with a shallow (70 m) partial sill at the eastern end of the main basin of the channel. At a distance of 7.5 km seaward of the sill, currents associated with the first and second vertical modes have magnitudes of approximately 50 and 25%, respectively, of the 0.35 m s^{-1} barotropic mode and lag it in phase by roughly 140°. The near absence of M_2 baroclinic tidal currents 20 km seaward of the sill suggests high frictional dampening and/or momentum loss via critical layer absorption in the presence of the mean estuarine-type flow in the Strait.

THE STRUCTURE OF THREE-DIMENSIONAL TIDAL CURRENTS

K.T. Tee

A simple method for computing the three-dimensional tidal currents is presented. The computation includes both the first-order oscillating current and the second-order tidally-induced residual current. The method involves solving separately the equations for the depth-averaged velocity and the vertical velocity gradient. The interaction between these two equations is through the bottom friction. For the depth-averaged velocity, it was found that the equation of motion could be approximated by the shallow-water equation and thus could be solved easily by a numerical method. The vertical variations of the tidal current were computed for various forms of the vertical eddy viscosity and different dissipative systems, and compared to the observations which include the 1978 current-meter measurements at the head of the Bay of Fundy. The computed results can be used to discuss and explain various dynamics of the tidal current.

INTERACTION BETWEEN ASTRONOMICAL TIDE AND STORM SURGE

T.S. Murty, M.I. El-Sabh, P.A. Bolduc and J.-M. Briand

In Coastal Oceanographic Studies, at least from a practical point of view, storm surge at a given location, is defined as the difference between the observed water level and the predicted astronomical tide. This definition obviously assumes that there is no interaction (non-linear) between the surge and the tide and their combined amplitude at a given location for a specified time may be determined by linear superposition. Earlier studies by other authors (e.g. Rossiter, 1962; Keers, 1968) indicated that in the Thames estuary there is definitely an interaction between tide and surge.

We examined such a possible interaction in two distinctly different water bodies; namely the Suez Canal and the St Lawrence estuary. The Suez Canal joins the Gulf of Suez with the eastern basin of the Mediterranean Sea and the St Lawrence estuary (in Eastern Canada) joins the St Lawrence River with the Gulf of St Lawrence. Specifically for selected storm-surge episodes we examined whether the positive or negative surges are predominantly associated with any one of the four states of the tide, i.e. high water, falling tide, low water, and rising tide. Our preliminary results are somewhat different from those of the Thames estuary (in Thames estuary the surges are predominately associated with low water).

Making use of the concepts from the analytical studies of Proundman (1955, 1956, 1957) some explanation for the interaction was sought. The co-tidal chart for the St Lawrence estuary is well known from observations as well as from our earlier numerical models. On the other hand, the detailed nature of tidal propagation in the Suez Canal is not well understood. Hence following Redfield (1953) the concept of interference of tides from the Red Sea and the Mediterranean Sea has been invoked to account for the tides in the Suez Canal. The concepts of shallow water and ultra-shallow water surges are invoked (no inertial oscillations) in explaining some of the differences in behaviour.

Session 8A Air-Sea Interaction I Fri. 1330-1500

THE TURBULENT FLUXES OF MOMENTUM AND SENSIBLE HEAT OVER THE OPEN SEA AS DETERMINED BY THE DISSIPATION METHOD

W.G. Large and S. Pond

The dissipation and eddy-correlation methods of estimating the momentum and sensible heat fluxes are shown to be in excellent agreement, at winds up to 20 m s^{-1}, by comparing simultaneous measurements from a stable off-shore tower. The neutral drag coefficient, CDN, as determined by dissipation measurements from this tower and from *CCGS Quadra* at Ocean Weather Station P, is found to be nearly constant at about 1.2×10^{-3} for wind speeds between 5 and 10 m s^{-1} and to increase at higher winds.

Dissipation estimates of the sensible heat flux from both the tower and ship are presented and some difficulties in obtaining them are discussed.

SURFACE WIND STRESS AND HEAT FLUX MEASURED OVER THE ATLANTIC OCEAN IN GALE FORCE WINDS

S.D. Smith

A stable platform moored in 58 m of water in the approaches to Halifax Harbour has been instrumented with wind turbulence, temperature and wave-height sensors. Data from this platform have been analyzed by the eddy-flux method to obtain wind stress and heat flux at wind speeds from 8 to 22 m s^{-1} in a deep-water wave regime, significantly extending the range of available measurements. The sea-surface drag coefficient is seen to increase gradually with increasing wind speed. Heat-flux coefficients are slightly lower in stable than in unstable conditions.

DRAG COEFFICIENTS OVER LAKES

P.F. Hamblin

Predictions of circulation and free surface set-up in enclosed bodies of water reported in the literature over the past 10 years have relied upon values of the drag coefficient which are a factor of 2 larger than those observed by stress and wind-profile measurements. By considering transitional flow the aerodynamic roughness length is related to wind speed, fetch, water depth, and duration. The effect of the stability of the atmospheric boundary layer is incorpo-

rated through the empirical relations of Businger et al. (1971). Finally, a wave age dependency of the form drag coefficient is assumed according to the proposal of Donelan (1977).

For practical purposes the neutral drag coefficient referred to 10 m may be closely approximated by a linear relation

$$C_D \times 10^3 = 0.7 + (b)\, V$$

where the value of b ranges from 0.013 for large fetch and deep water to 0.017 for short fetch and shallow water and for wind speeds, V, up to 20 m s^{-1}. Stability effects are more non-linear and are not given by a simple relation. At a wind speed of 20 m s^{-1} and an air/water temperature difference of 15°C the drag coefficient is increased by 16% for unstable conditions and decreased by 25% for unstable conditions. For a large fetch and unsteady conditions this relation may be used for an accelerating wind field but leads to an overestimation for a decelerating wind field.

Application of the derived relations to the dynamical prediction of 24 storm surges in a lake results in the same coefficient of determination as that found by purely statistical methods.

THE LOWER LIMIT OF THE LOGARITHMIC LAYER IN THE ATMOSPHERE AND OCEAN

Arthur R.M. Nowell

The existence of the logarithmic layer in neutrally stratified flows is well documented by laboratory measurements both in depth-limited and unconstrained boundary layers. The lower limit of applicability of the logarithmic profile over rough walls whose roughness can be characterized in terms of a Nikaradse sand size has been established. Natural roughness in the atmospheric boundary layer and in the ocean rarely has a uniformly distributed dense-packed character. The effect of distributed roughness on the near-wall flow has been investigated in the atmosphere (cf. Garrett, 1978) and depth-limited water flows (Nowell and Church, 1979) but has been ignored in the ocean. Summaries (Wooding et al., 1973) attempt to collapse all the data in terms of roughness spacing.

Re-analysis of much of the data for distributed roughnesses presented by Wooding indicates the existence of a region approximately two roughness heights thick where the mean flow and turbulence characteristics significantly depart from those predicted by the simple logarithmic law of scaling. The lower limit of the logarithmic layer is $2h$ where h is the height of the roughness for three-dimensional obstacles, while is approximately $4h$ for two-dimensional obstacles such as fences. It is found moreover that relative roughness height (h/δ where δ is boundary-layer thickness) and Froude number also play a significant role.

In the atmosphere the roughness height is usually small compared to logarithmic layer thickness, but this is often not the case in the ocean. The implications of this for the existence of a logarithmic layer and hence for estimates of shear velocity are significant, especially in view of attempts to estimate sediment transport on the basis of such a scaling velocity. Application of this work to oceanic boundary-layer measurements will be discussed.

Session 8B Cloud Physics Fri. 1330-1500

LOW-LEVEL FLOW NEAR THUNDERSTORM FORMATION AREAS – AN OBSERVATIONAL STUDY IN ALBERTA

F.E. Robitaille

On the afternoon of 9 August 1978 the Alberta Hail Project conducted an observational study of the low-level flow associated with convective clouds near known thunderstorm formation areas. Horizontal winds were measured by the University of Wyoming *Queen Air* and by a network of pibal and rawinsonde stations. Data for two aircraft traverses over the foothills are presented and related to observed convective clouds.

A physical explanation for the formation of thunderstorms in preferred geographical locations within the Alberta foothills is presented. The importance of channelling of the low-level flow by river valleys is discussed.

COLLISION ENHANCEMENT FOR DROPLET PAIRS WITH ELECTRICALLY REDUCED APPROACH SPEED

E. Freire and Roland List

The collision efficiency of two droplet pairs (10,9) and (10,2) μm is radius, was computed as a function of background field strength for the following conditions: uniform background field pointed vertically downward, varying in strength from 300 V m^{-1} to 600 kV m^{-1}; and 10-μm droplet charge of -3.34×10^{-17}C or -3.34×10^{-16}C for the (10,9) pair, and of -3.34×10^{-16}C or -6.68×10^{-16}C for the (10,2) pair. The smaller droplet had a positive charge with a magnitude equal to the big droplets in the (10,9) pair, and 25 times smaller in the (10,2) pair. These moderate charges allowed reasonably strong critical background fields E° at which the droplets, when far apart, would fall with the same terminal speed.

With varying background field E°, the collision efficiency rises steeply on either side of the critical value E°, towards an asymptotic value of infinity. The maximum collision efficiencies computed were 19.0 for the (10,9) μm pair in a field of only 9 kV m^{-1}, and 11.2 for the (10,2) μm pair in a field of 45 kV m^{-1}. Both values are three orders of magnitude greater than the respective collision efficiencies obtained in the absence of electrical forces, namely, 0.013 and 0.0044.

The physics behind this electrical configuration suggests a considerable enhancement of the collision efficiency far beyond the investigated droplet sizes and into a range where electrical effects have hitherto been assumed unimportant.

THE WARM RAIN PROCESS IN CANADIAN SUMMER CUMULUS CLOUDS

G.A. Isaac, R.S. Schemenauer, J.W. Strapp, and C.L. Crozier

Aircraft observations in summer cumuli 1 to 4 km thick near Yellowknife, N.W.T., and Thunder Bay, Ont., have shown that a warm rain process produces large water drops in some of these clouds. Traditional theories suggest that a warm rain process would not be effective in such shallow continental clouds. The observations were made from 1975 to 1978 using two specially equipped National Aeronautical Establishment aircraft: a *Twin Otter* which flew mainly near cloud top, and a *Beech 18* which monitored the presence or absence of rain at cloud base. Significant concentrations ($> 1\ \ell^{-1}$) of large drops ($> 70\ \mu$m) were often found near the tops of Yellowknife cumuli and drops > 1 mm were found in concentrations $> 4\ m^{-3}$. Although the concentration of large drops ($> 70\ \mu$m) was lower in Thunder Bay cumuli, their cloud-droplet spectra were quite broad. A few of the Yellowknife and Thunder Bay clouds, which contained no ice particles, yielded rain at cloud base. Large water drops were detected in other clouds that were apparently precipitating through a cold rain process. This co-existence of the two precipitation formation processes may be quite important because interactions between large drops and ice crystals then become possible. Simple condensation-coalescence models cannot grow drops of the sizes observed within the apparent short lifetimes (> 20 min) of these cumuli. Explanations of this circumstance are proposed, but they require theoretical and/or observational confirmation.

THE OCCURRENCE OF ICE PARTICLES IN SUMMER CUMULI IN CANADA

R.S. Schemenauer, G. A. Isaac, C.L. Crozier and J.W. Strapp

It has been generally accepted that rain in Canada is produced by a cold rain process requiring the prior existence of ice in the cloud. Until very recently no observational evidence was available to confirm the importance of this process in Canadian summer cumuli. This paper describes the results of penetrations by instrumented aircraft through the supercooled regions of over 100 clouds near Yellowknife, N.W.T. and Thunder Bay, Ont. The presence or absence of ice in the clouds was documented with modern cloud physics instrumentation. As expected, the presence of ice particles in a cumulus cloud is strongly dependent on the summit temperature of the cloud. Clouds with summit temperatures warmer than -8°C rarely contained any ice. Extrapolation of the data indicates that all clouds with summit temperatures colder than -20°C will contain some ice particles. In only a few cases was the first appearance of ice due to

an interaction of the cloud with a cirrus deck or nearby cumulonimbus. The dependence of ice-particle presence on cloud-top temperature, cloud life cycle and air mass properties has been examined. The presence of ice in a cloud was not a sufficient or necessary condition for the cloud to rain. However, over 50% of summer cumuli (tops −6 to −18°C) containing ice did produce rain.

Session 8C Waves I Fri. 1330-1500

LOW-FREQUENCY VARIABILITY OF CURRENTS IN THE STRAIT OF GEORGIA

J. Helbig

Time series of currents and winds in the Strait of Georgia (GS) have been analyzed in an attempt to determine the cause of the low-frequency variability ($\geq$ 10 days) of observed currents. The results do not reveal a single, most important, forcing mechanism. However, the analysis does indicate several interesting features. The fluctuating currents tend to be linearly polarized, thus precluding the possibility that they are composed of simple wave-like motions (e.g. modified shelf waves). Their resemblance to the mean flow suggests a dynamical relationship between the two. Although the winds play some part in forcing the low-frequency currents their exact role is unclear. The speculation is offered that the observed variability in the currents is a manifestation of an estuarine circulation modulated by the combined influences of, and interactions among the tidal streams, Fraser River outflow, winds, and mixing in the restricted channels separating GS and the Strait of Juan de Fuca.

BAROCLINIC AND BAROTROPIC INSTABILITIES IN COASTAL CURRENTS

E.R. Johnson and L.A. Mysak

The baroclinic instability model of the Californian Undercurrent from Mysak (1977) is modified to investigate the effects of the lateral boundary conditions on the stability properties of the system. As is common in baroclinic stability calculations, Mysak (1977) assumes the flow to be bounded laterally by vertical rigid walls, thus allowing the cross-stream structure of the flow to be decomposed into a series of simple normal modes. Instability then occurs when waves of the same cross-stream structure interact. The dominant instability is that associated with the gravest mode.

In the first model presented here we consider the effect of replacing the rigid outer boundary of the flow with a quiescent, constant depth ocean of infinite horizontal extent. Waves of short long-shore wavelength are not greatly affected by the open seaward boundary. However, as consideration is turned to waves of longer and longer long-shore wavelength, the cross-stream wavenumber departs further and further from the integral values of the separable channel-flow problem and another class of baroclinic instabilities occurs due to interaction between waves of differing cross-stream structure. Nevertheless the dominant baroclinic instability remains that associated with the gravest mode. A new barotropic instability is also present, drawing energy from the horizontal shear between the coastal current and the quiescent ocean.

In the second model the rigid outer boundary is retained but the inner boundary is replaced by a shallow sloping region, modelling the effects of a sloping shelf adjoining the coastal current. Topographic waves are present above the sloping inshore region. These waves are coupled with the channel waves. Once again the cross-stream wavenumber departs from the integral values of the channel problem and instabilities are present due to interaction between waves of differing cross-stream structure. As in the previous model the dominant baroclinic instability is that of the gravest mode.

ON THE PROPAGATION OF SHELF WAVES IN A LATERALLY SHEARED MEAN FLOW

J. Helbig

A study has been made on the propagation of continental shelf waves in a steady, laterally sheared current. The mean flow is decomposed into the sum of a smooth profile $V(x)$ and a small irregular part $\epsilon W(x)$ where $\epsilon \ll 1$ and W is modelled by a centered, random function. If the correlation length of W is small compared with the shelf width, the waves are unstable. Their growth rate is largely determined by the magnitude of the correlation length, while the phase speed is given by the sum of weighted averages of V and the lateral gradient of potential vorticity. Application of the theory to a model of the Florida current yields wave parameters in accord with observations.

BOTTOM CURRENTS NEAR THE SHELF EDGE

Brian Petrie and Anthony J. Bowen

The movement of material, particularly the transport of bottom sediments, off the continental shelf into deep water is of very considerable interest to a wide variety of disciplines. Recent measurements at various stations on the Scotian Shelf and Slope provide near-bottom, current-meter data extending over a period of almost two years. These records show significant energy in the semi-diurnal and inertial bands, a suggestion of a response to 2-4 day wind forcing, but give a generally red spectrum due to the tendency of the low frequency flow, which is predominantly along isobaths, to change direction (Petrie and Smith, 1977: *Atmosphere*, 15, 117-140). However, in terms of the sediment transport which is thought to depend on some power of the magnitude of the current, something of the order of U^4 for suspended load, the system appears to be completely dominated by large but rare events. The most obvious example in these records is an event apparently associated with a major storm on the shelf.

Session 9A Air-Sea Interaction II Fri. 1530-1700

AIRFLOW OVER WATER WAVES AND WATER FLOW OVER SAND WAVES

P.A. Taylor and K.J. Richards

Numerical semi-empirical models of turbulent flow above wavy surfaces (e.g. Gent and Taylor, *J. Fluid Mech.* 77, 105-128) have been extended to include finite fluid depth, large variations in surface roughness with position relative to the wave and to apply to an extended range of wave shapes. Comparisons of model predictions for flow over sand waves with McLean and Smith's data for the Columbia River are encouraging but attempts to use the model to predict stable bedforms have so far been unsuccessful. Computations of flow above water waves indicate that shape is not a major factor in determining drag and the rate of energy transfer from wind to waves.

MABLES WC – EXPERIMENTAL DESIGN, DATA AVAILABILITY AND PRELIMINARY ANALYSIS

P.F. Lester

An observational program, Marine Boundary Layer Experiments, West Coast (MABLES WC) was conducted August 1-18, 1978, over a rectangular ocean area 80 km by 250 km, just west of the San Francisco peninsula. Experiments were carried out to study the vertical fluxes of heat, momentum, and moisture at the boundaries of the marine layer (ocean surface and elevated temperature inversion), as well as the spatial and temporal variations of the properties of the marine layer, and of the overriding inversion layer. Several groups cooperated in the field program, the principal ones being the Meteorology Department of San Jose State University (SJSU) and the U.S. Naval Postgraduate School (NPGS). Instrumented platforms included two oceanographic vessels (The *Cayuse* of Oregon State University, the *Acania* of NPGS), and three aircraft, provided by the National Center for Atmospheric Research (NCAR), SJSU, and the

Oceanic Society; a tower instrumented at 12 levels to 500 m *asl* (SJSU); southeast Farallon Island (SJSU); and a number of coastal land stations for surface and upper-air observations. The design of the experiment and the format and availability of reduced data are described and the results of a preliminary analysis of the mesoscale structure of the marine inversion are presented.

A WELL-OBSERVED MARINE FOG OFF SOUTHERN CALIFORNIA AND A FORECASTING TRIAL

Dale F. Leipper, Douglas A. Backes and Linda J.B. White

In an experiment called CEWCOM-76, (Oct., 1976), observations of fog were made off-shore from San Diego, California northward to Pt Conception and out to San Nicolas Island. Surface and upper-air data were obtained from coastal and island stations, and from the research vessel *Acania*. These were supplemented by data from satellite, ships of opportunity, and a dedicated aircraft. Several institutions collaborated. An NPS study involved the testing of an objective fog forecasting method utilizing these data.

The coastal fog forecasting method was first described in 1948 by Leipper, and was established for North Island at San Diego where it is still utilized. It was of interest to test whether or not the method could be successfully utilized in other locations; the data from CEWCOM-76 made such testing possible, The method did work for several other locations.

The coastal fog forecasting technique is based upon a conceptual physical model. In a coastal area having cool upwelled water and occasional off-shore warm air flow, a coastal sequential fog development may take place. The progress of this development may be measured by four indices which have predictive value. The indices are the height of the inversion base, the overall stability (a sea/air temperature comparison), the level of surface moisture compared to sea-surface saturation temperature, and the amount of moisture aloft (which affects radiation). Critical values of the indices indicate fog within the next 24-h period. The inversion base must be lower than 400 m, the air at some altitude must be warmer than the sea, the dew point must be within 5°C of the sea-surface temperature and the moisture content at 3000 m must be less than 3.5 g kg^{-1}.

Session 9B Precipitation Fri. 1530-1700

WEATHER RADAR DEVELOPMENTS AT THE ALBERTA RESEARCH COUNCIL

R.G. Humphries and B.L. Barge

Weather radars have been used since 1957 to study hailstorms in Alberta. The evaluation of the Alberta weather radar systems and progress in radar meteorology were reported at the 6th Annual Congress of the CMOS in 1972. To improve the scope and precision of analysis of radar data for the study of hailstorms and the measurement of precipitation, a computer system was interfaced to the radars. A unique interactive computer-generated display system has been developed which allows those (for example hydrologists, data analysts, meteorologists) who are not familiar with radar or computer technology, to quickly and easily access the archived digital radar data for analysis. This facility has also been adapted so that in real-time essentially instantaneous aircraft positions, determined by interrogating aircraft X-band transponders, are simultaneously shown in proper registration on computer-graphic displays of contoured equivalent radar reflectivity factors.

Data from the 10-cm polarization-diversity radar have been combined with data from a 5-cm weather radar in a first attempt to use both polarizations and dual-wavelength techniques to estimate remotely the type and size distribution of hydrometeors. Interpretation of these data is consistent with surface observations of rain and hail.

To demonstrate the feasibility of using the Alberta weather radars to measure rainfall operationally, a project was initiated whereby radar-derived maps of rainfall were provided to hydrologists of Alberta Environment to assist with forecasting stream flow in the foothills of Alberta. The radar is superior to the existing gauge network in showing the areal variability of precipitation.

TEMPORAL VARIATIONS IN THE TIME OF MAXIMUM PRECIPITATION IN SOUTHERN BRITISH COLUMBIA

D.A. Faulkner

Williams (1948) showed that the date of maximum precipitation on the west coast of North America varies spatially. An examination of two long-term precipitation records from south-western British Columbia indicates that this date also varies temporally. A particularly abrupt change which occurred during the period 1915-1920 is noted. It is suggested that the variations may be related to long-term changes in the frequency of occurrence of particular synoptic situations.

STATISTICAL TECHNIQUES FOR FORECASTING PROBABILITY OF PRECIPITATION AMOUNT

T. Agnew

Using a ten-year data base of CMC observations and objective analyses, two statistical techniques for predicting probability of precipitation amount in four categories over a 12-h period are compared. The first technique is known as Regression Estimate of Event Probability (REEP) and has been used extensively by the Techniques Development Laboratory in the United States. Almost all their MOS procedures are based on this technique. The second technique is Multiple Discriminant Analysis (MDA). Although MDA is mathematically more robust than REEP, it is more difficult to apply and more demanding of computer resources.

The results for 12 stations in Ontario are used to compare the two techniques. A more extensive test at the Ontario Weather Centre is presently being conducted.

RELATIONSHIPS BETWEEN CONVECTIVE ENERGY AND RAINFALL RATES

L. Prévost and I.I. Zawadzki

The empirical relationship between maximum daily rain rates, R_{max}, and maximum daily surface parcel convective energies, E_{max}, has been described by Ro and Zawadzki at the Eleventh Annual Congress of the CMOS. Their results have been verified for a larger data base and have been somewhat improved by using a more appropriate criterion for the calculation of energy. Furthermore, a relationship between daily mean rainfall rate and the mean of surface convective energy has been found to exist with a correlation coefficient of 0.76 with confidence limits of 0.65-0.84 for a significance level of 0.05. The mean rainfall rates have been obtained from daily amounts given by 74 raingauges in the Montreal region and the mean precipitation times from 14 tipping bucket raingauges located in the same region.

The simple parcel theory used to calculate convective energies could be a reasonable explanation for the relationship between R_{max} and E_{max}, but it is inadequate to explain the relationship between mean values of rainfall rate and convective energy. This coupled with the lack of a relationship between the time and place of occurrence of R_{max} and E_{max} suggests that parcel energy should be considered only to be a measure of convective potential energy which is in part transformed into turbulent energy and, in part, kinetic energy of vertical motion. Our results seem to indicate that the fraction of the potential energy converted into vertical motion is approximately constant.

ON THE NON-LINEAR WAVE-WAVE INTERACTIONS IN THE EQUATORIAL β-PLANE

P. Ripa

The theory of non-linear interactions for this problem is developed, from the model equations, without any need for perturbation expansions or multiple time-scale techniques. Thus, the state of the system is fully represented, at any time, by the set of wave amplitudes.

The evolution of the system is shown to be constrained by the conservation of two integrals of motion, E (the total of energy) and P. To lowest order, both integrals are quadratic and additive functions of the wave amplitudes. The quadratic part of P turns out to be the total eastward pseudo-momentum; this is shown to be related to the invariance of the problem under translations in that direction.

The evolution of a system with the energy initially distributed only in Kelvin modes is discussed.

The kinematic and dynamic properties of the resonant triads (which fall into 13 different classes) are also discussed.

The connection of this problem with that of the mid-latitude β-plane is also presented.

TRENCH WAVES

L.A. Mysak, P.H. LeBlond and W.J. Emery

The cross-sections of the main trenches peripheral to the Pacific Ocean can be fitted by a pair of exponential depth profiles with slopes of opposite sign. It can be shown that non-divergent barotropic trapped wave propagation can occur in two directions along such a combined profile. In addition to the familiar shelf waves, only slightly modified by the presence of the trench, "trench waves" propagating in the direction opposite to that of shelf waves and at speeds lower by an order of magnitude are also possible. From computations of the trench-wave eigenfunctions, it was found that each mode is strongly trapped over the deepest part of the trench. Lag correlation and cross-spectral analyses of sea-level data from the coasts of Japan and Peru have been performed in a statistical search for trench waves in the Japan-Kuril and the Peru trenches. In each region phase lags were observed in accord with the theoretically predicted phase speeds of low mode number trench waves.

TRENCH WAVES II: VERIFICATION IN COASTAL SEA-LEVEL RECORDS

W.J. Emery

Deep ocean trenches act as a wave guide for oceanic trench waves propagating opposite to shelf waves. Evidence for such tranch-wave propagation is searched for in coastal sea-level records along the Japan-Kuril and Peru Trenches. Ten years of mean monthly sea-level data from Japan, the Kuril Islands and Kamchatka indicate phase propagation at the speeds of all three first trench-wave modes. Lag-correlation computations reveal the predominance of the fundamental mode while cross-spectral studies clearly reveal propagation at the lower phase speeds of the next two higher modes. Off Peru the gravest mode can also be identified in the phase spectrum computed from three years of daily sea-level values, measured at stations in the extreme north and south of Peru. Similar computations using these stations and a station from central Peru showed no definite propagation which might be explained by the disturbance of the trench wave guide by the Nazca Ridge.

THIRTEENTH ANNUAL GENERAL MEETING
CANADIAN METEOROLOGICAL AND OCEANOGRAPHIC SOCIETY

UNIVERSITY OF VICTORIA
30 MAY 1979

AGENDA

1. Minutes of the Annual General Meeting, 31 May 1978

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
   f) Ad Hoc Committee for the Review and Evaluation of the Report on Meteorological Consulting Standards in Canada

4. Annual Reports from Local Centres

5. Budget for 1980

6. Motions from Council

7. Locations of Future Congresses

8. Other Business

9. Report of Nominating Committee

10. Installation of Officers for 1979-80

TREIZIÉME ASSEMBLÉE GÉNÉRALE ANNUELLE DE LA SOCIÉTÉ CANADIENNE DE MÉTÉOROLOGIE ET D'OCÉANOGRAPHIE

UNIVERSITÉ DE VICTORIA
LE 30 MAI 1979

ORDRE DU JOUR

1. Procès-verbal de l'assemblée générale annuelle, le 31 mai 1978

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 d'information publique
   e) Comité scientifique
   f) Comité ad hoc chargé de la révision et de l'évaluation du rapport sur les standards de la consultation météorologique au Canada

4. Rapports annuels des centres locaux

5. Budget 1980

6. Propositions du conseil d'administration

7. Emplacement des congrès à venir

8. Divers

9. Rapport du comité de mise en candidature

10. Investiture des membres du bureau d'administration pour 1979-80

Canadian Meteorological and Oceanographic Society

La Société Canadienne de Météorologie et d'Océanographie

MINUTES OF THE TWELFTH ANNUAL GENERAL MEETING HELD ON JUNE 1, 1978 AT THE NATURAL SCIENCES CENTRE, U.W.O., LONDON, ONTARIO.

The meeting was chaired by Ken Harry, President of the Society. There were 80 members and several guests present.

The introductory remarks by the Chairman included some minor modifications and additions to the order of business as published.

MSC Agenda be adopted.

1. Minutes of the 11th Annual General Meeting

MSC Minutes approved with spelling corrections

P. 3 (3d) D. Leahey

P. 6, para 3, line 4 undesirable

made.

2. Annual Reports from the Executive

2(a) President's Report (KFH)

The formal report appears on p. 39 of the Congress issue.

The President concentrated his remarks on the status of the request to O.A.S. for a grant, the desirability of some mobility for officers of the Society if business is to be conducted effectively and the avenue that the Development Fund offers for the internal generation of funds.

MSC Adopt and approve.

2(b) Treasurer (DGS)

The Treasurer spoke to the printed report (p. 44-47, Congress issue), pointed out small errors (p. 44 - footnote references, p. 45 typo. item totals), noted that all items are on the budgetary targets and that a small surplus is likely. Accepted in discussion that p. 47 entries were actually a budget projection.

MSC Report accepted as amended.

3. Annual Reports from Committees

3(a) Editorial Committee (TRO)

The Chairman reviewed the developments and changes made in the Journal content, format and in editorial board membership over the past year,

noted the healthy log of material on hand and the value of committee meetings to the discussion of ongoing policy.

Problems related to the range of appeal of a learned journal were discussed and the use of other vehicles to reach non-specialists were considered. The development of the Journal was praised by all.

MSC Report adopted.

3(b) Newsletter (KFH for MH)

The editor's report was read by the Chairman (copy appended) and comments were made on the recent changes in per-issue costs. The increasing value of Newsletter as a communications medium was noted with approval.

MSC Report adopted.

3(c) Awards Committee

3(d) Citations Committee

The Chairman reviewed the procedural changes, i.e. release of names and presentations at the Annual Luncheon, taken to enhance the stature of the Awards. The Committee chairmen and members were thanked for their work.

MSC Adopt.

3(e) Public Information Committee (JLK)

The Chairman prefaced his remarks with a review of the Committee role within the Society before speaking to the printed report (p. 53, Congress issue). Problems of formulating Policy statements and the narrow line between the mandates of the P.I. Committee and of the Scientific Committee in some areas were noted in discussion.

MSC Adopt.

3(f) Scientific Committee (JM)

The Chairman reported on discussions and views concerning the function and mandate of the Committee, outlined the nature of the topics discussed the previous day (Scientific Committee meeting #2, 77-78) and focussed on the status of the Weather Modification Brief following Council #3 and on the formation of a sub-committee on Weathership Papa composed of West Coast members.

There was agreement that the role of the Committee, with respect to Oceanography, be given greater formal recognition, perhaps via a sub-committee.

MSC Adopt.

3(g) Ad Hoc Committee on Meteorological Consulting Standards (DIMc)

The President reported on the status of the report. He pointed out that Council #3 accepted the report for early study by a mode to be determined.

Dr. McIntyre then gave a full and lively presentation of the Committee work. He emphasized that the report did not examine all implications of a Certification programme but that it does give a firm lead for discussion.

Reservations concerning a certification programme were expressed in detail and with fervour during discussion. The President invited early, detailed comments from all concerned members and expressed gratitude for the work done by the Committee.

4. Annual Reports from the Local Centres

With the exception of those from Montreal, Toronto and Halifax, reports published in the Congress issue (pp. 56-67) were briefly amplified by Centre representatives.

MSC Reports adopted as published and given.

5. Budget for 1979 (DGS)

Reported that the over-entry of $6,000 for grants means that some compensatory though not critical restraint in expenditures will be needed.

MSC Adopt
MSC Reappoint W. Koch as Auditor
MSC Fee structure of the Society remain unchanged in 1978

6. Motions from Council - NONE

7. Location of Future Congresses

The Chairman reported that the Chairman of the Toronto Centre has been informed concerning the previous commitments by the Society to a joint AGU/CGU/CAP/CMOS meeting, mid-May 1980 in Toronto.

MSC Toronto motion of acceptance deferred to Council.

8. Other Business

8(a) Freedom of Information Resolution

WHEREAS the Canadian Meteorological and Oceanographic Society affirms that a well-informed public is an essential factor in the development of an environmental ethic and in the solution of environmental problems; and

WHEREAS there is a need to establish the legal right of the public to receive, upon request, information concerning public business, subject to certain clearly and specifically defined exemptions, with any refusal to provide the requested information subject to independent judicial review;

NOW THEREFORE BE IT RESOLVED THAT the Canadian Meteorological and Oceanographic Society advocate the enactment of Freedom of Information legislation at the federal and provincial levels (April 26, 1978).

The mover (HK) outlined the rational and history of the resolution, related to the earlier (Federal) Bill C22 to the 1977 Government Green Paper.

Several members pointed to the general nature of the resolution and to potential problems concerning demands on data and excessive expense.

MSC 20:5 31 present.

8(b) Toronto Centre Resolution

Given that the CMOS, at the national executive level, makes awards available to the organizers of the Canada Wide Science Fairs; and that some centres participate in regional science fairs; and that the CMOS is one of the largest repositories for meteorological and oceanographic knowledge in Canada:

Be It Resolved that the CMOS national executive develop and print certificates of achievement suitable for presentation at science fairs and furthermore, that they encourage all centres to become involved with regional science fairs, as they are an excellent means of increasing public awareness of meteorology and oceanography.

Brief discussion indicated that all favoured the idea.

MSC Adopt.

9. Report of Nominating Committee

The Chairman read the report for T.A. Black (regrets), see pp. 48-49 Congress issue.

MSC Adopt.

10. Installation of Officers

The retiring President, Ken F. Harry thanked his Executive and complimented the Chairmen and members of Standing Committees and Ad Hoc Committees on their co-operation and work. The year had been enjoyable and he hoped that duties performed had been reasonably done! He looked forward to working as Past-President.

The new President, Ron Burling, recognized that he had a hard act to follow. He expressed pleasure that Oceanography has painlessly joined the Atmosphere and went on to thank his predecessor. He vowed to continue to enhance communications with members, to support the evolution of Newsletter, to increase the two-day discussion with Centres and to stimulate the input (to the Executive and Council) of information and concerns.

(Applause)

Adjourn 23.30

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

May 5, 1978.

Report on the C.M.O.S. Newsletter

The present editor replaced the former editor, Bill Creswick, with the publication of the October 1, 1977 newsletter. Bill Creswick retired as editor after approximately 5 years. His first issue as editor was September 14, 1973.

Beginning October 1, 1977 the C.M.O.S. Newsletter became a bi-monthly publication. Also with this issue the banner officially changed from C.M.S. to C.M.O.S. reflecting the constitutional change in our Society. As of the February 1978 issue, volume and serial numbers were appended. The February 1978 issue became Volume 6 No. 1.

The Newsletter now has a structural format. The format headings are:

President's Report
Editor's Comments
Letter to the Editor
News from your National Executive
News from your Centres
News and Notes
Announcements
Employment Opportunities

Typing of the Newsletter is done commercially at approximately $30 an issue. Printing and mailing is done by Toronto Press at roughly $250-$300 an issue.

The editor wishes to thank all those who have contributed to the Newsletter during the past year. Special recognition should go to all the Centre Presidents who have been extremely cooperative in sharing their time and news.

M. Horita
Editor
CMOS Newsletter.

PRESIDENT'S REPORT

1978 was an interesting, active and I believe, progressive year for the Society. As always, Council's paramount concern and all of its actions are aimed at increasing the usefulness of the Society to all of its members. An encouraging sign of expanding interest in the Society's affairs is requests from three areas about the possibility of forming new Chapters and of changing the status of one Chapter to that of a Centre; it is anticipated that actions in response to two of these requests will be possible before the 1979 Congress.

Of particular importance to the Society's well-being is the effectiveness of its publications. The first issue of Volume 16 of the Society's scientific journal *ATMOSPHERE-OCEAN* appeared in February in a new and expanded format and with several innovations. Under the present capable editorship of Tim Oke and built on the efforts of earlier editors, the journal has evolved as a publication which, with continued high standards of published material, augurs well for enhancement of the international scientific reputation of the Society. *Newsletter* too, now appears in an expanded form and with several innovations. Through the excellent work of Mert Horita, the editor, this publication has emerged as a vehicle for frequent (bi-monthly) dissemination of news to all members about activities and conerns of Council, the National Executive, Centres and Chapters, the Society's Committees and generally on items of interest to members including announcements and reports of scientific meetings. Of concern is the non-emergence of *Newsletter* as a forum for active debate, via letters to the Editor, on divergences of opinion about the Society's activities and affairs; most importantly, we await further ideas from the members about ways to enhance the usefulness of the Society to all members.

As evident from their reports the Society's Committees were particularly active in 1978. Several Committee recommendations culminated in action by Council. First, the recommendation on "Freedom of Information", which was passed at the Annual General Meeting in London, was sent to the Prime Minister, and copies were forwarded to the Premiers of all Provinces and to Leaders of all Opposition Parties; this action was initiated by Herb Kruger and taken via the Standing Committee on Public Information (SCPI) to the Annual General Meeting. Next a comprehensive report from a sub-committee of the Scientific Committee (SC) about Weather Modification in Canada was forwarded to an interdepartmental review committee on this matter. A second letter to the Prime Minister was sent in August deploring the impending termination before April 1979, of Ocean Weather Station "Papa"; more than 100 copies were distributed to MP's and MLA's, as well as to the Secretary of the Treasury Board, the two Ministers of the Department of Fisheries and Environment and their Deputy and Assistant Deputy Ministers, to administrators of AES and OAS, and to the media. The "Papa" letter resulted from joint action by the Subcommittee of the SC on OWS "Papa", the SCPI and Council; as is by now well-known this culminated in a delay of the termination of the weather station. Following the announcements in September and October of severe cuts of several kinds in AES further letters protesting some aspects were sent to the Minister of Environment Canada with copies to his Deputies and to administrators in AES; also other correspondence was exchanged and meetings held with members of AES.

Jointly with its committees, Council is continuing its considerations of the relative effects of different kinds of cutbacks in AES and is planning a further protest to be directed at the Federal Cabinet and Treasury Board early in 1979. The protest will be based partly on the special nature of AES as providing a service which is part of the fabric of daily life for all Canadians, on the high benefit to cost ratio of the service to agriculture, forestry, transportation, etc., on the unfair burden thrust on AES as the sole agency responsible for additional funds ensuing from the delay in termination of OWS "Papa", while simultaneously working to identify, develop, prove and implement alternative systems at substantial cost, and on the cuts in the Department of Fisheries and Environment which are apparently disproportionately allocated to the Environment Branch of the Department; each of these has many implications which we believe are not perceived by the Cabinet. Special thanks are due to John Knox, Chairman of the SCPI and of the "Papa" subcommittee, to John Maybank, Chairman of the Scientific Committee and to many others for their help in initiating and effecting these actions.

During Congress in 1978, the Ad Hoc Committee on Meteorological Consulting Standards in Canada presented an extensive report and 43 recommendations to Council and the membership. This Committee was dissolved in July and a new Ad Hoc Committee for Review and Evaluation of the Report was formed with Randy Angle as Chairman; it has acted energetically in distributing a questionnaire which has elicited widespread and varied opinions from members. A clear message so far is that precipitate action by the Society is not desired; a clearer perspective of desirable actions will be reached before Congress 1979.

Early in 1978, Ken Harry, who was then President proposed that Awards and Citations be announced at the Awards Luncheon and not in earlier publications as in the past. This more interesting practice started with the Luncheon during the London Congress at which we were pleased also to have AES participate by the presentation of the prestigious Patterson Medal. The organizing committee, chaired by Bob Lowe, is to be congratulated on running the successful Congress in London. It is noteworthy among many activities of the Council, that our Vice-President, John Powell, has re-opened a rather neglected line of communication with the membership by engaging in vigourous communication with the Chairmen of Centres and Correspondents of Chapters. He is also preparing a report and will make recommendations on the possibility of having special interest groups in the Society; this is a matter of considerable consequence.

Once again the Society is indebted to AES for their invaluable financial aid in 1978 and for sponsoring the excellent Speaker's Tour (in early 1979) by Alistair Fraser, who entertained the Membership from St John's (the site of a potential Chapter), to Victoria.

Financial operations in 1978 ended with a deficit of about $4,200 mainly because some costs of printing, distribution and commissions rose unexpectedly. Besides the proposal to AES for a subvention for 1979, Tim Oke has applied to the Natural Sciences and Engineering Research Council for a Scientific Publication Grant to support the publication of *ATMOSPHERE-OCEAN*. We are hopeful that total granting from all agencies will total $26,000 for 1979. If this hope is realized, the Society would be able to provide urgently needed support for attendance at meetings of the Committees – a policy for which an increased allocation was made in 1978; more generally, we could enhance present operations and find new ways to benefit Meteorology and Oceanography in Canada and to interest all involved, in whatever way, in these disciplines.

R.W. Burling
President

RAPPORT DU PRÉSIDENT

L'année 1978 a été une année intéressante, riche en activités, et durant laquelle je crois que notre Société a fait des progrès. Comme toujours, le Bureau d'Administration s'est préoccupé avant tout d'accroître les avantages procurés par la Société à ses membres et a orienté tous ses gestes en ce sens. On notera comme signe encourageant, d'un intérêt accru aux affaires de notre Société, les demandes qui ont été faites de la part de trois régions quant à la possibilité de former de nouveaux chapitres et de la part d'un chapitre de se transformer en centre. Il devrait être possible de faire suite à deux de ces demandes avant le congrès de 1979.

L'efficacité de ses publications est d'une grande importance à la bonne marche de la Société. Le premier numéro du seizième volume du journal scientifique de la Société, *ATMOSPHERE-OCEAN*, est apparu en février sous un format nouveau et agrandi. Sous la direction de Tim Oke, et à la suite des efforts de ses prédécesseurs à la rédaction, ce journal est devenu une publication aux standards élevés qui contribue à l'affermissement de la réputation scientifique internationale de notre Société. Notre *Bulletin de Nouvelles* paraît aussi sous une forme nouvelle et agrandie. A la suite de l'excellent travail de son rédacteur, Mert Horita, cette publication est devenue un véhicule pour la dissémination rapide (tous les deux mois) de nouvelles sur les travaux et délibérations du Conseil de la Société, du Bureau d'Administration, des centres et chapitres, des comités de la Société et de tout autres items d'intérêt général, y compris les annonces ou rapports de réunions scientifiques. Nous déplorons toutefois que le *Bulletin de Nouvelles* ne serve pas encore de forum où devrait s'engager, par lettres à la rédaction, un débat vigoureux entre divers points de vue et opinions sur les affaires de la Société. Nous espérons particulièrement recevoir des membres de la Société toute suggestion sur les façons d'améliorer ou d'ajouter aux services que leur procure la Société.

Comme on peut le constater par les rapports qu'ils ont soumis, les comités de la Société ont été très actifs en 1978. Plusieurs recommandations émanant des comités ont mené à des décisions du Bureau d'Administration. Citons d'abord la recommandation sur le "Droit à l'Information", adoptée à l'assemblée générale annuelle de London, qui a été transmise au premier ministre du Canada et des copies de laquelle ont aussi été envoyées aux premiers ministres de toutes les provinces, ainsi qu'aux chefs des partis d'opposition. L'initiative de cette recommandation a été prise par Herb Kruger et présentée, par l'intermédiaire du Comité Permanent d'Information Publique (CPIP) à l'assemblée générale annuelle. Notons ensuite le rapport compréhensif sur la Modification du temps au Canada, rédigé par un sous-comité du Comité Scientifique et présenté à un comité interministériel fédéral chargé d'examiner ce sujet. En août, une seconde lettre fut envoyée au premier ministre, déplorant la cessation prochaine (avant avril 1979) des activités de la station météorologique océanique "Papa"; plus de cent copies de cette lettre furent distribuées aux députés fédéraux et provinciaux, ainsi qu'au Secrétaire du Conseil du Trésor, aux deux ministres du ministère des Pêches et de l'Environnement, à leurs sous-ministres et sous-ministres-adjoints, aux administrateurs du Service de l'Environnement atmosphérique et des Sciences de la Mer, et enfin à la presse. C'est une initiative conjointe du Comité Scientifique, sous-comité "Papa", du CPIP et du Conseil de la Société qui a donné naissance à cette lettre au premier ministre qui, on le sait, a retardé l'échéance de la suspension des activités de "Papa". Pour faire suite aux déclarations faites en septembre et en octobre selon lesquelles le Service de l'Environnement atmosphérique subirait diverses réductions budgétaires, d'autres lettres, exposant les objections de la Société à quelques-unes de ces mesures furent envoyées au Ministre de l'Environnement, à ses sous-ministres et aux administrateurs du Service de l'Environnement atmosphérique (SEA). Avec l'appui de ses comités, le Conseil de la Société continue à se pencher sur l'examen des conséquences des réductions dans le budget du SEA et se prépare à communiquer ses protestations au Cabinet Fédéral et au Secrétaire du Conseil du Trésor au début de 1979. Cette contestation sera basée d'abord en partie sur le rôle tout particulier joué par le SEA, qui dispense un service intégré à la vie quotidienne de tous les Canadiens; en second lieu, elle s'appuiera sur la valeur des services rendus par la SEA à l'agriculture, à l'industrie forestière, au transport, etc. . .; troisièmement, nous signalerons l'injustice du fardeau imposé au SEA en tant qu'organisme responsable de défrayer à la fois le coût des activités de la station "Papa" et celui de l'identification, de la préparation et de la mise en service des systèmes

qui remplaceront "Papa"; enfin, nous attirerons l'attention sur le fait que les réductions budgétaires du ministère des Pêches et de l'Environnement soient imposées de façon apparamment disproportionnée au secteur environnement de ce ministère. Chacun des points énumérés ci-haut est lourd de conséquences qui, selon nous, n'ont pas été clairement perçues par le Cabinet. Nous tenons à remercier John Knox, président du CPIP et de son sous-comité "Papa", et John Maybank, président du Comité Scientifique, ainsi que tous les autres qui ont participé à la préparation et à la formulation de ces démarches.

Au cours du congrès de 1978, le comité ad-hoc sur les Standards de Consultation Météorologique au Canada présenta au Conseil et aux membres de la Société un volumineux rapport ainsi que 43 recommandations. Ce comité fut dissous en juillet et un nouveau comité, chargé de la révision et de l'évaluation de ce rapport fut créé, sous la présidence de Randy Angle; ce comité s'est vigoureusement mis à la tâche en distribuant un questionnaire qui a réussi à recueiller les opinions souvent divergentes de plusieurs membres de la Société. Un message se dégage clairement de ce sondage: on ne souhaite pour le moment pas de gestes précipités de la part de la Société. Une perspective plus claire des mesures à prendre devrait émerger avant le congrès de 1979.

Au début de 1978, Ken Harry, alors président de la Société, proposa que les récompenses et citations soient annoncées au cours d'un déjeuner d'occasion, au lieu d'être publiées d'avance comme auparavant. Cette suggestion fut pour la première fois mise en pratique au congrès de London, au cours d'un déjeuner où le Service de l'Environnement atmosphérique nous fit aussi l'honneur de présenter leur prestigieuse Médaille Patterson. Le comité d'organisation du congrès de London, dirigé par Bob Lowe, mérite toutes nos félicitations! Notons aussi, parmi les nombreuses activités du Conseil de la Société, que notre vice-président, John Powell, a ré-ouvert une voie de communications quelque peu négligée en amorçant un dialogue vigoureux avec les présidents des centres et des chapitres de la Société. Il prépare aussi un rapport où il présentera ses recommandations sur la possibilité d'organiser des groupes d'intérêt specialisé au sein de la Société; c'est là une question de grande importance.

Notre Société remercie encore une fois le Service de l'Environnement atmosphérique pour son inestimable aide financière et pour son parrainage de la tournée de conférences, données cette année (1979) par Alistair Fraser, qui a bien intéressé la Société de St-Jean (où un nouveau chapitre est en voie de formation) à Victoria.

Les affaires financières de 1978 se sont soldées par un déficit d'à peu près $4,200, attribuable surtout à une hausse inattendue des frais d'imprimerie , de distribution et des commissions.

Parallèlement à notre demande de subvention au SEA pour 1979, Tim Oke a soumis au Conseil de Recherches en Sciences Naturelles et en Génie une demande de Subvention à la Publication pour aider à publier *ATMOSPHERE-OCEAN*. Nous espérons recevoir de la part de tous ces organismes des subventions au total de $26,000. Si cet espoir se réalise, la Société pourra enfin fournir aux membres des divers comités une aide qui leur permettra d'assister aux réunions de ces comités – une décision selon laquelle des fonds supplémentaires avaient déjà été mis de côté en 1978; d'une façon plus générale, nous pourrons rehausser le niveau des activités actuelles de la Société, découvrir des méthodes nouvelles, profitables, à la Météorologie et à l'Océanographie au Canada et attirer vers nous tous ceux qui s'intéressent d'un façon ou d'une autre à ces disciplines.

R.W. Burling
Président

TREASURER'S REPORT

In contrast to the stable financial environment of 1977, the transactions of the Society increased substantially in 1978. Extraordinary items, such as page charges for Volume 16, No. 1 (First International Workshop on Hailfall Measurements) of *ATMOSPHERE-OCEAN*, the development of the new format for *ATMOSPHERE-OCEAN*, reprinting of the By-Laws and Constitution, increased mailing charges and other factors contributed to substantial increases in revenues and expenditures.

Despite a $6,000 decrease in budgeted grant revenue, the net 1978 loss was held to $4,145.33 or within $1,145.33 of the original projection (equivalent to 2% of total expenditures). This loss does not consider the retroactive Federal and Provincial tax rebates on the publication of the *Newsletter* for previous years (which will be reflected in next year's revenue).

During 1978 and early 1979 the final transactions to convert all assets to the new name of the Society were completed.

As previously indicated, successful applications were made for rebates of Federal and Provincial (Ontario) Sales Taxes on the *Newsletter*. The rebate will be retroactive for 2 years Federally and 3 years Provincially. In addition, the Editor of *ATMOSPHERE-OCEAN* initiated a request for additional grants to assist in the publication of *ATMOSPHERE-OCEAN* and co-operative legal action to obtain relief from a new postal classification for *ATMOSPHERE-OCEAN*.

During 1978, advertising was introduced as a source of revenue for the *Newsletter*. If the advertising revenue can be substantially increased, this will allow for and encourage a significantly expanded *Newsletter*.

The INCOME for 1978 indicates items entered into the accounts during that year. The dues and subscriptions cover the period from October 1, 1977 to September 30, 1978. Charges for *ATMOSPHERE-OCEAN* include four regular issues to Volume 16, No. 3. The 1978 Congress Issue cost is included under other charges (Account 206) and under *ATMOSPHERE-OCEAN* for 1977.

The STATEMENT OF FINANCIAL POSITION, detailing the Society's assets and liabilities, shows a decrease in the Society's assets equivalent to the 1978 loss of $4,145.33 over the 1977 year-end balance.

APPENDIX I presents the balance of each account on December 31, 1978. Account numbers have been structured to separate income (100's), expenses (200's), assets (300's) and liabilities (400's).

Budget for 1979-80

Budget statements for 1979 and 1980 indicate estimates of revenue and expenditures consistent with previous experience and planned CMOS programmes. Income from dues and subscriptions reflect the rates approved at the 1977 Annual General Meeting.

The budget under Operations and the Scientific Committee are intended to allow for Executive, Scientific and Editorial Committee travel and communications costs at a time when employees are less able to indirectly subsidize the Society's operations as they often did in the past.

P. Sagert
Treasurer

RAPPORT DU TRÉSORIER

En contraste avec les conditions financières stables de 1977, les transactions de la Société ont augmenté substantiellement en 1978. Des items extraordinaires, tels que les frais de publication chargés au premier numéro du volume 16 d'*ATMOSPHERE-OCEAN* (Premier Atelier International sur la Mesure de la Grêle), le développement du nouveau format d'*ATMOSPHERE-OCEAN*, la ré-impression des Règlements et de la Constitution, la hausse des frais postaux et d'autres facteurs ont contribué à l'augmentation des revenus et des dépenses.

Malgré une diminution de $6,000 aux subventions prévues au budget, le déficit net n'a pas dépassé $4,145.33, soit à $1,145.33 près, le montant prévu originalement (qui équivaut à 2% des dépenses totales). Cette perte ne tient pas compte des remboursements rétroactifs de taxes fédérales et provinciales relatifs à la publication du *Bulletin de Nouvelles* au cours des dernières années (ces remboursements apparaîtront comme revenus l'an prochain).

Au cours de 1978 et au début de 1979, les dernières transactions visant à convertir tous les biens de la Société sous son nouveau nom ont été complétées.

Tel que mentionné ci-haut, la demande faite par la Société de remboursements de taxes de vente fédérale et provinciale (Ontario) sur les déboursements associés au *Bulletin de Nouvelles* a été approuvée. Ces remboursements se feront de façon rétroactive pour les deux dernières années au niveau fédéral, et pour les trois dernières au niveau provincial. De plus, le rédacteur-en-chef d'*ATMOSPHERE-OCEAN* a soumis une demande de subventions supplémentaires pour aider à la publication de ce journal; des démarches juridiques ont aussi été amorcées afin d'annuler l'effet d'une reclassification postale d'*ATMOSPHERE-OCEAN*.

A partir de 1978, la publicité a été admise comme source de revenus au *Bulletin de Nouvelles*. Une augmentation substantielle de cette source de revenus permettrait une expansion considérable du *Bulletin de Nouvelles*.

Le REVENU pour 1978 comprend toutes les sommes inscrites aux comptes au cours de cette année. Les cotisations et souscriptions couvrent la période du 1er octobre 1977 au 30 septembre 1978. Les coûts de la revue *ATMOSPHERE-OCEAN* incluent quatre numéros réguliers jusqu'au troisième numéro du volume 16. Les coûts du numéro du congrès sont portés sous l'item divers (Compte 206) et au compte *ATMOSPHERE-OCEAN* 1977.

Le BILAN décrit l'actif et le passif de la Société; il indique une baisse nette de l'actif par rapport au solde de l'année 1977 égale au déficit de $4,145.33 encouru en 1978.

En APPENDICE I, on trouve le solde de chaque compte pour l'année se terminant le 31 décembre 1978. Les numéros de comptes ont été réorganisés pour séparer les revenus (comptes 100 . . .), des depenses (200 . . .), l'actif (300 . . .) du passif (400 . . .).

Budget de 1979-80

Les sommes portées au budget pour 1979 et 1980 sont des estimations basées sur l'expérience des années précédentes et sur les programmes projetés par la SCMO. Les revenus provenant des cotisations et des souscriptions réflètent les taux approuvés par la Société à l'Assemblée Générale Annuelle de 1977.

Les sommes prévues aux dépenses sous les rubriques Opérations et Comité Scientifique couvriront les frais de déplacement des membres du Bureau d'Administration, du Comité Scientifique et du Comité de rédaction, ainsi que les frais de communication; il est devenu nécessaire de pourvoir à ces dépenses depuis que les employés (du gouvernement et des universités. . .) ne peuvent plus qu'avec difficulté couvrir indirectement les frais de la Société, comme il l'ont souvent fait dans le passé.

P. Sagert
le trésorier

CANADIAN METEOROLOGICAL AND OCEANOGRAPHIC SOCIETY/
LA SOCIÉTÉ CANADIENNE DE MÉTÉOROLOGIE ET D'OCÉANOGRAPHIE
INCOME STATEMENT/ÉTAT DU REVENU
FOR THE FISCAL YEAR ENDED 31 DECEMBER, 1978/
POUR L'EXERCICE FINANCIER TERMINÉ LE 31 DÉCEMBRE, 1978

INCOME/REVENU	1978	1977
Dues and Subscriptions/Cotisations et souscriptions[1]	$22,561.86	$18,452.21
AES Grant/Subvention SEA	16,000.00	16,000.00
Congress Revenue/Revenu du Congrès	505.77	2,826.60
Others/Autres[2]	10,545.26	1,531.13
	$49,612.89	$38,810.24
EXPENDITURES/DÉPENSES		
ATMOSPHERE-OCEAN[3]	$32,118.91	$23,234.54
Newsletter/Bulletin de Nouvelles	2,399.05	1,805.74
Other Printing Services/Autres frais d'imprimerie[4]	4,408.89	253.84
U of T Press (Commissions)	4,495.78	3,142.51
Centre Expenses/Depenses des centres	2,849.00	2,838.00
Operations/Opérations[5]	5,797.87	2,056.55
Scientific Committee/Comité scientifique	1,188.72	1,308.74
Congress Expenses/Dépenses du Congrès	500.00	1,000.00
Information Services/Services d'information	0.00	165.39
	$53,758.22	$35,805.31
NET GAIN/REVENU NET	($4,145.33)	$ 3,004.93

1 Accounts/Comptes no. 101, 102
2 Accounts/Comptes no. 105, 106, 107, 108
3 Accounts/Comptes no. 201, 207
4 Accounts/Comptes no. 203, 204, 206
5 Accounts/Comptes no. 211, 212, 213, 214, 215, 216, 217, 218, 219, 220

CANADIAN METEOROLOGICAL AND OCEANOGRAPHIC SOCIETY/
LA SOCIÉTÉ CANADIENNE DE MÉTÉOROLOGIE ET D'OCÉANOGRAPHIE
STATEMENT OF FINANCIAL POSITION/BILAN
31 DECEMBER 1978/31 DÉCEMBRE 1978

ASSETS/ACTIF

CURRENT ASSETS/DISPONIBILITÉS

Cash/Caisse (Royal Bank/Banque Royale)	$ 875.20
Short Term Deposit/Dépôt à court terme	6,000.00
Development Fund/Fonds de développement	4,150.00
Development Fund Interest/Intérêt du fonds de développement	1,343.50
Hornstein Fund/Fonds Hornstein	1,000.00
Hornstein Fund Interest/Intérêt du fonds Hornstein	231.77
Canada Savings Bonds I/Obligations d'épargnes du Canada I	950.00
Canada Savings Bonds II (Coupons)/ Obligations d'épargnes du Canada II (Coupons)	1,059.25
Bell Canada Shares/Parts de Bell Canada	781.50
Accounts Receivable/Comptes à recevoir	2,345.00
	$18,736.22

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

CURRENT LIABILITIES/EXIGIBILITÉS

Accounts payable/Comptes à payer	$ 6,140.59

SOCIETY'S EQUITY/AVOIR DE LA SOCIÉTÉ

Society's Equity (31 December 1977)/ Avoir de la Société (31 décembre 1977)	$16,740.96
Increase from operations/Augmentation due aux opérations	(4,145.33)
Society's Equity (31 December 1978)/ Avoir de la Société (31 décembre 1978)	12,595.63
TOTAL LIABILITIES AND SOCIETY'S EQUITY/ TOTAL DU PASSIF ET DE L'AVOIR DE LA SOCIÉTÉ	$18,736.22

APPENDIX I/APPENDICE I

CANADIAN METEOROLOGICAL AND OCEANOGRAPHIC SOCIETY/ LA SOCIÉTÉ CANADIENNE DE MÉTÉOROLOGIE ET D'OCÉANOGRAPHIE BALANCE OF EACH ACCOUNT/SOLDE DE CHAQUE COMPTE FOR THE YEAR ENDED 31 DECEMBER 1978/ POUR L'ANNÉE TÉRMINÉE LE 31 DÉCEMBRE 1978

N[1]		1978	1977
101	U of T Press *dues and subscriptions/ Cotisations et souscriptions)	$22,426.86	$17,712.51
102	Sustaining Members/Membres de soutien	135.00	740.00
103	AES Grant/Subvention SEA	16,000.00	16,000.00
104	Congress revenue/Revenu du Congrès	505.77[2]	2,826.60
105	Interest earned/Revenus des intérêts	1,806.27	1,415.75
106	Divident income/Revenu des dividendes	50.04	47.88
107	Advertising revenue/Revenus de publicité	125.00[3]	0.00
108	Other revenue/Revenus divers	8,563.95[4]	67.50
201	U of T Press (*ATMOSPHERE-OCEAN*)	32,086.95[5]	22,224.54
202	U of T Press (*Newsletter/Bulletin de Nouvelles*)	2,399.05	1,805.74
203	U of T Press (Labels, letterheads/ Etiquette, En-tête de lettres)	148.17	116.76
204	U of T Press (Citation)	0.00	103.06
205	U of T Press (Commissions)	4,495.78[6]	3,142.51
206	U of T Press (Other/Divers)	4,260.72[7]	34.02
207	*ATMOSPHERE-OCEAN* (Technical editing/ Rédaction technique)	31.99[8]	1,010.00
208	Scientific committee/Comité scientifique	1,188.72	1,308.74
209	Congress expenses/Dépenses du congrès	500.00	1,000.00
210	Centre expenses/Dépenses des Centres	2,849.00	2,838.00
211	Travel expenses/Dépenses de voyages	3,853.70	902.53
212	Prizes, gifts expenses/Dépenses - prix, dons	315.00	419.96
213	Service expenses/Dépenses frais de services	34.37	0.00
214	Office expenses/Dépenses de bureau	688.55	8.24
215	Communications expenses/ Dépenses de communications	767.60	605.82
216	Interest expenses/Dépenses Intérêts	0.00	0.00
217	Exchange expenses/Dépenses frais de change	0.00	0.00
218	Auditor expenses/Dépenses du vérificateur	100.00	100.00
219	Translation expenses/Dépenses de traduction	0.00	20.00
220	Information services/Services d'information	38.27	0.00
221	Information services/Services d'information	0.00	165.39
301	Cash/Caisse (Royal Bank/Banque Royale)	875.20	1,607.27
302	Short-term Deposit/Dépôt à court terme	6,000.00	10,000.00
303	Development Fund/Fonds de développement	4,150.00	4,150.00
304	Development Fund Interest/ Intérêt du fonds de développement	1,343.50[9]	747.70
305	Hornstein Fund/Fonds Hornstein	1,000.00	1,000.00
306	Hornstein Fund Interest/Intérêt du fonds Hornstein	231.77	247.36
307	Canada Savings Bonds I/ Obligations d'épargnes du Canada I	950.00	950.00
308	Canada Savings Bonds II (Coupons)/ Obligations d'épargnes du Canada II (Coupons)	1,059.25[10]	672.13
309	Bell Canada shares/Parts de Bell Canada	781.50[11]	643.50[12]
310	Accounts receivable/Comptes à recevoir	2,345.00	2,000.00
401	Accounts payable/Comptes à payer	6,140.59	5,277.00
402	Society's equity/Avoir de la Société	12,595.63	16,740.96

CANADIAN METEOROLOGICAL AND OCEANOGRAPHIC SOCIETY/
LA SOCIÉTÉ CANADIENNE DE MÉTÉOROLOGIE ET D'OCÉANOGRAPHIE
INCOME STATEMENT BUDGET/
BUDGET DE L'ÉTAT DU REVENU

INCOME/REVENU	1979	1980
Dues and subscriptions/Cotisations et souscriptions	$23,000	$24,000
Sustaining Members/Membres de soutien	500	500
AES Grants/Subventions du SEA	16,000	16,000
Other Grants/Autres subventions	10,000	12,000
Congress revenue/Revenu du Congrès	500	1,000
Development Fund/Fonds de développement	500	500
Other/Autre	3,000	3,000
	$53,500	$57,000
EXPENDITURES/DÉPENSES		
ATMOSPHERE-OCEAN	$31,900	$33,500
Newsletter/Bulletin de Nouvelles	2,800	3,200
U of T Press (Commissions)	4,700	4,800
Centre Expenses/Dépenses des Centres	3,000	3,300
Operations/Opérations	4,600	5,200
Scientific Committee/Comité scientifique	5,000	5,000
Congress Expenses/Dépenses du Congrès	500	1,000
Information Services/Services d'information	1,000	1,000
	$53,500	$57,000
NET GAIN (LOSS)/REVENU (PERTE) NETTE	–	–

Notes:

1 – Account Number
2 – This figure represents a return of $5.77 plus a $500.00 advance from the London Congress. Congress Revenue actually totalled $9,371.00.
3 – *CMOS Newsletter* advertisements.
4 – Revenue from page charges and extra copies of papers totalled $5,669.00. Sales of *ATMOSPHERE-OCEAN* ($2,000.00) are also included.
5 – Includes additional costs of *ATMOSPHERE-OCEAN*, Volume 16, No. 1 for which $5,669.00 was reimbursed.
6 – Includes subscription charges for 1,075 members at $3.00 each for 1978 and $1,270.78 charges for 1977.
7 – Includes printing costs for Congress Issue, By-laws, Constitution and offprints.
8 – Technical Editing charges for 1977 and 1978 (*ATMOSPHERE-OCEAN* Vol. 15, No. 3 to Vol. 16, No. 4 and the Congress Issue) will be based upon a policy of Council formulated early in 1979.
9 – Represents interest and deposit in Royal Bank account.
10 – Includes "bonus" interest.
11 – Value of shares as of 31 December 1978.
12 – Value of shares as of 31 December 1977.

AUDITOR'S REPORT

I have examined the Statement of Financial Position of the Canadian Meteorological and Oceanographic Society as of 31 December 1978, 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 and Oceanographic Society at 31 December 1978, 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.

Wayne R. Koch, RIA

RAPPORT DU VÉRIFICATEUR

J'ai examiné le bilan de la Société canadienne de météorologie et d'océanographie au 31 décembre 1978 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 1978 et les résultats de ses activités en 1978, conformément aux principes comptables généralement acceptés tels qu'appliqués d'une façon compatible avec celle de l'an passé.

Wayne R. Koch, RIA

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

The Nominating Committee (D. Leahey, Chairman; D. Bauer; C. Garrett; R.W. Longley; G. McKay) is unanimous in nominating the following persons to the 1979 CMOS Executive. All nominees have expressed their willingness to serve in the indicated positions. The nominations have been made with the understanding that the CMOS Executive will shift from Vancouver to Edmonton in 1979.

C'est à l'unanimité que le comité de mise en candidature (D. Leahey, Président; D. Bauer; C. Garrett; R.W. Longley; G. McKay) soumet la liste suivante de candidats au bureau d'administration pour 1979. Tous les candidats ont consenti à occuper le poste indiqué. Les mises en candidature ont tenu compte du déménagement prévu du bureau d'administration de la Société de Vancouver à Edmonton en 1979.

President/Président

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Vice President/Vice-Président	Dr John Maybank Saskatchewan Research Council 30 Campus Drive Saskatoon, Saskatchewan S7N 0X1 Tel: (306) 343-8251
Corresponding Secretary/ Secrétaire correspondant	Dave B. Fraser Officer in Charge Arctic Weather Centre Atmospheric Environment Service 6325-103rd Street Edmonton, Alberta T6H 5H6 Tel: (403) 437-1540
Treasurer/Trésorier	Mr Randy Angle Division of Pollution Control Alberta Department of Environment Oxford Place Building 106th Street Edmonton, Alberta T5K 2J6 Tel: (403) 427-5893
Recording Secretary/ Secrétaire d'assemblée	Mr James H. Renick Atmospheric Sciences Division Alberta Research Council Campus Tower 8625-112th Street Edmonton, Alberta T6G 1K8
Councillors-at-large/Conseillers	Dr Alec Chisholm Atmospheric Environment Service 4905 Dufferin Street Downsview, Ontario M3H 5T4
	Dr Gaston Paulin Service de la Météorologie 194 Avenue St-Sacrement Québec, P.Q. G1N 4J5
	Dr Brian Petrie Bedford Institute of Oceanography Dartmouth, Nova Scotia B2Y 4A2

D. Leahey
Chairman/Président

EDITORIAL COMMITTEE REPORT

1978 was the first year for our journal in its new format. In general it has been a good year. *ATMOSPHERE-OCEAN* seems to have been well received and we look forward to continued steady development.

The rate of submissions of papers remained commensurate with that of previous years but in our opinion the quality of the average article increased. One departure was the publication of the refereed proceedings of the First International Workshop on Hailfall Measurements. The authors of that issue paid voluntary page charges thereby subsidizing the publication. Given this financial stimulus and the economies of the new journal format it was possible to produce a greatly expanded number of pages in Volume 16. Council authorized expenditures equivalent to a page limit of 80 pages/issue. This limit was later increased to 88 with provision for further review. At the end of 1978 a backlog of papers sufficient to fill two issues existed.

The second class mailing privileges enjoyed by the journal, and worth approximately $1,000 to the Society, were removed by the Post Office. Under the co-ordination of the University of Toronto Press we, and three other journals similarly affected, have instituted legal action to seek restitution of the privileges. P. Merilees is to be thanked for acting on behalf of the Society in the discussions.

The list of complimentary subscriptions has been reviewed with a view to rationalizing their distribution and cutting unnecessary costs. Plans are also underway to solicit new subscriptions especially from oceanographic institutions and individuals, and to exchange subscriber lists with established journals in the fields of meteorology and oceanography.

Potentially the most important development relates to discussions initiated by the Editor with the Natural Sciences and Engineering Research Council (NSERC). A case was made to support a request for NSERC funds to aid the publication of *ATMOSPHERE-OCEAN*. NSERC agreed to consider such a request under their Scientific Publication Grant programme and the Editor has submitted a formal application for 1979.

In summary, 1978 has been a significant year for our journal. It has seen growth and change in combination with attention to the financial under-pinnings of the operations. We have been helped in these endeavours by many members of the Society and the University of Toronto Press and by the scientific referees who form the essence of any successful journal. To all of these we extend our sincere thanks.

T.R. Oke, Editor
ATMOSPHERE-OCEAN

RAPPORT DU COMITÉ DE RÉDACTION

L'année 1978 a été la première durant laquelle notre journal a paru sous son nouveau format. En général, cette année a été assez heureuse: *ATMOSPHERE-OCEAN* a été bien reçu, et nous pouvons nous attendre à ce que le journal continue à se développer.

Le nombre de travaux soumis au journal est resté semblable à celui reçu au cours des années précédentes, mais la qualité moyenne des articles semble s'être améliorée. Une nouveauté certaine a été la publication des procès-verbaux (dûment révisés) du Premier Atelier International sur la Mesure de la Grêle. Les auteurs de ce numéro ont contribué au frais de publication par des contributions volontaires. Cet apport financier ainsi que les économies réalisées par l'adoption du nouveau format ont permis de publier un nombre de pages beaucoup plus grand au volume 16. Le Conseil autorisa d'abord un niveau de dépenses équivalent à 80 pages par numéro. Cette limite fut ensuite portée à 88 pages, avec possibilité de révisions ultérieures. A la fin de 1978 il restait une réserve de travaux non-publiés suffisante pour remplir deux numéros.

Les privilèges de courrier de deuxième classe dont jouissait le journal, représentant une économie d'environ $1,000 sur le tarif régulier, ont été abolis par la Poste canadienne. Sous la coordination des Presses de l'Université de Toronto, nous avons, en compagnie de trois autres

journaux touchés par le même règlement, entrepris des démarches juridiques visant au retour de ces privilèges. Nous remercions P. Merilees, qui s'est fait le porte-parole de la Société dans ces discussions.

La liste des abonnements gratuits a été passée en revue, pour en rationaliser la distribution et éliminer les frais superflus. Nous nous préparons aussi à solliciter de nouveaux abonnements chez les océanographes et les instituts océanographiques, ainsi qu'à échanger notre liste d'abonnés avec des journaux météorologiques et océanographiques déjà solidement établis.

Le développement qui s'avérera peut-être le plus important se rapporte aux discussions amorcées par le rédacteur-en-chef avec le Conseil de Recherches en Sciences Naturelles et en Génie (CRSNG). Un dossier a été préparé pour appuyer une demande de fonds auprès du CRSNG pour assister financièrement à la publication d'*ATMOSPHERE-OCEAN*. Le CRSNG s'est dit prêt à recevoir cette demande sous son Programme de Subventions aux Publications; le rédacteur-en-chef a déjà soumis une demande officielle pour 1979.

En somme, l'année 1978 a été importante pour notre journal; sa croissance et les modifications apportées à son format ont toutefois été accompagnées d'un souci d'en assurer solidement les assises financières. Nous avons reçu l'aide de plusieurs membres de la Société, des Presses de l'Université de Toronto, et de tous les hommes de science qui ont prêté leur expertise au système de jury scientifique essentiel au succès d'un journal scientifique. A tous, nous adressons nos plus sincères remerciements.

T.R. Oke, Rédacteur-en-chef
ATMOSPHERE-OCEAN

CMOS NEWSLETTER REPORT

The past year has been the first complete year that the *CMOS Newsletter* has been published in its bi-monthly format. During this period the significant changes to the *Newsletter* have been the recognition and acceptance of employment advertisements, commercial advertisements and a directory of Sustaining Members. A nominal fee schedule was passed by the Executive and came into effect with the June 1978 issue. To-date five employment advertisements have been placed with a cost recovery of $175. A small format change to the *CMOS Newsletter* heading was made at the request of the Treasurer to include a reference that the *Newsletter* was published bi-monthly. The change was made to facilitate recognition by the "tax-man" for tax deduction purposes. Another significant change to the *Newsletter* was the addition of Simon Kevan's column entitled the CMOS Unabashed Dictionary.

Since the present editor took responsibility for the *Newsletter* in 1977, the size of the issues has been steadily increasing from 9 pages in October 1977 to 25 in February 1979.

With the immanent change in location of the CMOS Executive from the Vancouver area to Edmonton it is recommended that a new editor be found in Edmonton.

The editor wishes to acknowledge the support of all those who contributed to the *Newsletter* and especially the Centre chairmen whose bi-monthly reports were published.

M. Horita, Editor
CMOS Newsletter

RAPPORT DU RÉDACTEUR DU "BULLETIN DE NOUVELLES"

L'année qui vient de s'écouler a été la première durant laquelle le *Bulletin de Nouvelles* a été publié sous son nouveau format bimensuel. Durant cette période, les modifications les plus importantes ont été la décision d'accepter les annonces d'emploi et les réclames commerciales, ainsi que la publication d'une liste des Membres de Soutien de la Société. Un barême de tarifs a été approuvé par le Bureau d'Administation et est entré en vigueur avec le numéro de juin 1978. Jusqu'ici, cinq annonces d'emploi ont été publiées, pour un retour de $175. Une modification

mineure à l'en-tête du *Bulletin de Nouvelles* a été effectuée à la demande du trésorier de la Société; il s'agit simplement d'une mention de la bimensualité de la publication. Ce changement facilitera les relations avec le fisc au niveau des déductions. Notons aussi une addition intéressante au *Bulletin de Nouvelles:* la rubrique de Simon Kevan intitulée "Dictionnaire facétieux de la SCMO".

Depuis l'entrée en fonction du rédacteur actuel, en 1977, le nombre de pages d'un numéro du *Bulletin de Nouvelles* est passé graduellement de 9 en octobre 1977 à 25 en février 1979.

Etant donné le déménagement prochain du Bureau d'Administration de la Société de Vancouver à Edmonton, nous suggérons qu'un remplaçant à la rédaction du *Bulletin de Nouvelles* soit aussi trouvé dans cette ville.

Le rédacteur du *Bulletin* exprime sa reconnaissance à tous ceux qui lui sont venus en aide, spécialement les présidents des Centres qui lui ont fait parvenir leurs rapports bimensuels.

M. Horita
Rédacteur du *Bulletin de Nouvelles*

AWARDS COMMITTEE REPORT/RAPPORT DU COMITÉ DES RÉCOMPENSES

The Committee (composed of C. East, H.M. Fraser, P. LeBlond – Chairman, T.S. Murty and E.R. Reinelt) reviewed the nominations submitted and recommended Awards to Council.

Le Comité (composé de C. East, H.M. Fraser, P. LeBlond – Président, T.S. Murty et E.R. Reinelt) a étudié les nominations qui ont été soumises et a recommandé au Conseil la présentation des récompenses.

CITATIONS COMMITTEE REPORT/RAPPORT DU COMITÉ DES CITATIONS

The Committee (composed of N. Cutler, K. Denman – Chairman, G. Paulin, P. Sagert and H. Sandstrom) reviewed the submitted nominations and recommended Awards to Council.

Le Comité (composé de N. Cutler, K. Denman – Président, G. Paulin, P. Sagert et H. Sandstrom) a étudié les nominations qui ont été soumises et a recommandé au Conseil la présentation des citations.

LIST OF PREVIOUS RECIPIENTS OF SOCIETY AWARDS/ LAURÉATS DES ANNÉES PRÉCÉDENTES

President's Prize/Prix du président

1967 A. Robert
1968 A.W. Brewer
1969 G.T. Csanady
1970 R.E. Munn
1971 M. Kwizak and A. Robert
1972 T.R. Oke
1973 A.J. Chisholm and Marianne English
1974 Gordon A. McBean
1975 Not awarded
1976 W.F.J. Evans
1977 P.E. Merilees

Dr Andrew Thomson Prize in Applied Meteorology/
Prix du Dr Andrew Thomson en météorologie appliquée

1967 A. Davenport
1968 D. Davies
1969 M.K. Thomas
1970 N. Yacowar
1971 J.S. Marshall
1972 P.W. Summers
1973 H.P. Wilson
1974 Roger Daley
1975 Gordon A. McKay
1976 S. Orvig and E.A. Vowinckel
1977 J.I. McPherson

Graduate Student Prize/Prix aux étudiants gradués

1967 S. Woronko
1968 Not awarded
1969 T. Warn
1970 N.A. McFarlane
1971 R.S. Schemenauer
1972 L. Ettinger
1973 V.S. Chung
1974 Geoffrey Strong
1975 Helen Warn
1976 H. Melling
1977 M. Beland
L.W. Diehl

Rube Hornstein Prize in Operational Meteorology/
Prix de météorologie opérationelle Rube Hornstein

1975 Waldimar L. Gutzman
1976 S.V.A. Gordon
1977 K. Lee

Citations

1973 John A. Livingston
Pierre Dansereau
P.D. McTaggart-Cowan
1974 Barbara Frum, Alan Maitland, Harry Browne and Staff, CBC "As It Happens"
Alberta Environmental Conservation Authority
Lydia Dotto (Globe and Mail Science reporter)
1975 Tony Le Sauteur
1976 Conseil Québecois de l'environnement
Douglas H. Pimlott
1977 Directors of the ARK, New Alchemy Institute, P.E.I.

LIST OF AES/CMOS LECTURE TOUR SPEAKERS/
CONFÉRENCIERS EN TOURNÉE, SOUS L'ÉGIDE DE LA SCMO ET DU SEA

1969 K.M. King
1970 T.R. Oke
1971 F.K. Hare
1972 M.B. Danard
1973 W.R. Frisken
1974 A.G. Davenport
1975 P.E. Merilees
1976 J. Maybank
1977 D.A. Huntley
1978 D.S. Davison

LIST OF SUSTAINING MEMBERS OF THE SOCIETY/
MEMBRES DE SOUTIEN DE LA SOCIÉTÉ

Air Canada
Alberta Weather Modification Board
Airflow Developments (Canada) Ltd
Beak Consultants Ltd
Bendix-Aviation Electric
Bristol Aerospace Ltd
Dobrocky Seatech Ltd
Hermes Electronics Ltd
McLaren Atlantic Ltd
MacDonald, Dettweiler and Associates Ltd
P.E. Merilees
Neil Sargent

LIST OF PRESIDENTS OF THE SOCIETY/ LES PRÉSIDENTS DE LA SOCIÉTÉ

1961	R.H. Douglas	1971	C.M. Penner	1975	P.E. Merilees
1962-4	B.W. Boville	1972	G.A. McKay	1976	J.E. Hay
1964-6	R.E. Munn	1973	W.F. Hitschfeld	1977	K.F. Harry
1966-9	M.K. Thomas	1974	A. Robert	1978	R.W. Burling
1970	D.N. McMullen				

REPORT FROM THE SCIENTIFIC COMMITTEE

The Scientific Committee membership included:

Dr J.R. Maybank (Chairman) Saskatchewan Research Council
Mr H.M. Fraser (Secretary) Atmospheric Environment Service, Winnipeg
Prof. R.R. Rogers, McGill University
Dr W.R. Peltier, University of Toronto
Dr M. Kwizak, Atmospheric Environment Service, Downsview
Dr A. Fraser, Pennsylvania State University
Dr G.T. Needler, Institut Océanographique de Bedford
Dr P. Hamblin, Canada Centre for Inland Waters
Prof. T. Oke, University of British Columbia
Dr C. Gautier, INRS, Université du Québec à Rimouski
Mr P. Denison, Acres Consulting Services Limited, Niagara Falls.

The Committee met in London May 30 and again in Toronto November 9 to consider various problems of concern to the CMOS and to make suitable recommendations to the Executive Committee.

A sub-committee under Dr. Maybank completed its brief on "Weather Modification: Policy and Regulations; Considerations for Canada" and after finalization and acceptance by the Committee this was forwarded to the Council at the time of the 1978 Congress.

The Committee were concerned with the availability of funds for atmospheric research both because of government restraints and because of the reorganization of the funding mechanisms of the National Research Council. As a result it was recommended to the CMOS Council that the society seek the establishment of a separate Granting Committee on Atmospheric Science within the new Natural Sciences and Engineering Research Council.

The sub-committee previously established under Mr J. Knox to study Ocean Weather Ship P proved valuable, since the exigencies of that situation resulted in their reporting directly to the Council as well as to the Committee. The Committee maintained an active consideration of the problem and forwarded recommendations in three areas: continued monitoring of the Weather Ship situation; development of the public awareness role of the CMOS; and more consideration by the government about the effect of cut-backs on continuing meteorological programmes.

The report on "Meteorological Consulting Standards Canada" was discussed in depth. To provide further clarification for the Committee and for the CMOS a working group was established under Mr P. Denison to obtain further information from industry.

The next meeting of the Committee will be held in Victoria, May 29, 1979.

H.M. Fraser
Secretary

RAPPORT DU COMITÉ SCIENTIFIQUE

Les membres du Comité Scientifique sont:

Dr J.R. Maybank (Président), Saskatchewan Research Council
M. H.M. Fraser (Secrétaire), Service de l'Environnement atmosphérique, Winnipeg
Prof. R.R. Rogers, Université McGill
Dr W.R. Peltier, Université de Toronto
Dr M. Kwizak, Service de l'Environnement atmosphérique, Downsview
Dr A. Fraser, Pennsylvania State University
Dr G.T. Needler, Institut Océanographique de Bedford
Dr P. Hamblin, Centre Canadien pour les Eaux Intérieures
Prof. T. Oke, Université de Colombie-Britannique
Dr C. Gautier, INRS, Université du Québec à Rimouski
M.P. Denison, Acres Consulting Services Limited, Niagara Falls

Le comité a siégé à London le 30 mai et à Toronto le 9 novembre pour délibérer sur divers problèmes intéressant la SCMO et préparer ses recommandations au Bureau d'Administration.

Un sous-comité dirigé par Dr Maybank a complété un rapport sur "Les Modifications du temps: Politique et Réglementation: Considérations canadiennes"; après une révision finale et adoption par le Comité Scientifique, ce rapport a été soumis au Conseil au congrès de 1978.

Le comité s'est préoccupé de la disponibilité de fonds consacrés à la recherche en sciences de l'atmosphère à la suite à la fois des réductions budgetaires et de la réorganisation du Conseil National de Recherches. Il a été recommandé au Conseil de la SCMO de s'efforcer de faire instituer un Comité de Subventions spécialement dédié aux Sciences atmosphériques au sein du Conseil National de Recherches.

Le sous-comité déjà créé sous la direction de John Knox et chargé d'étudier le statut de la Station Météorologique P a rendu de grands services en rendant son rapport à ce Comité aussi bien qu'au Conseil de la Société. Le Comité Scientifique a continué à se préoccuper activement de ce problème et a recommandé une surveillance continue du statut de la station P, un développement du rôle que doit jouer la SCMO auprès de l'opinion publique, et enfin qu'une plus grande attention soit portée par le gouvernement à l'influence des réductions budgétaires sur les programmes météorologiques en cours.

Le rapport sur les Standards de la Consultation Météorologique au Canada a été étudié en profondeur. Un groupe de travail dirigé par M. P. Denison a été formé afin de clarifier d'avantage la situation et d'obtenir des informations supplémentaires du secteur industriel.

La prochaine séance du Comité aura lieu à Victoria, le 29 mai 1979.

Le secrétaire
H.M. Fraser

REPORT FROM THE STANDING COMMITTEE ON PUBLIC INFORMATION

1. The Standing Committee, chaired by John Knox, Department of Geography, UBC comprise the following members:

   Liaison (AES) – H.B. Kruger, AES, Downsview, Ontario
   Toronto Centre – Dr A.J. Chisholm, AES, Downsview, Ontario
   Vancouver Centre – Garry Schaefer, AES, Vancouver, British Columbia
   Quebec Centre – Dr M.G. Ferland, Quebec
   Winnipeg Centre – H.M. Fraser, AES, Manitoba
   Halifax Centre – A.D. Gates, AES, Nova Scotia
   Regina Centre – R.J. O'Brien, AES, Regina, Saskatchewan
   Montreal Centre – A. Ouellet, AES, Quebec
   Ottawa Centre – D.W. Boyd, Ottawa, Ontario
   Alberta Centre – H.P. Wilson, Edmonton, Alberta
   Liaison (NOSA) – Dr G.K. Sato, NOSA, DFE, Ottawa

2. During the Summer of 1978, the Chairman was primarily engaged in the work of a Sub-committee, (J.L. Knox, K.F. Harry, M. Miyake, S. Pond) struck by Dr John Maybank, for the purpose of preparing a CMOS statement concerning Ocean Weather Station P. H.B. Kruger was most helpful in providing background information.

   The sudden announcement in early August 1978 of the Government's decision to withdraw the weather ships by April 1979, (2 years earlier than anticipated), required a quick and vigourous response from CMOS. Consequently the Chairman SCPI, spent a great deal of time working directly with the CMOS President preparing and disseminating statements of the Society's opposition to the premature termination of Station P.

3. Normal activities of the SCPI have therefore been curtailed. It is hoped that arrangements can be made at the forthcoming Congress in Victoria to meet with members of the Committee or their Centre representatives.

J.L. Knox
Chairman

RAPPORT DU COMITÉ PERMANENT D'INFORMATION PUBLIQUE

1. Ce comité permanent, présidé par John Knox, du département de géographie de l'Université de Colombie-Britannique, est formé des personnes suivantes:

   Liaison avec le SEA – H.B. Kruger, SEA, Downsview, Ontario
   Centre de Toronto – Dr A.J. Chisholm, SEA, Downsview, Ontario
   Centre de Vancouver – Garry Schaefer, SEA, Vancouver, Colombie-Britannique
   Centre de Québec – Dr M.G. Ferland, Québec
   Centre de Winnipeg – H.M. Fraser, SEA, Manitoba
   Centre d'Halifax – A.D. Gates, SEA, Nouvelle-Écosse
   Centre de Régina – R.J. O'Brien, SEA, Régina, Saskatchewan
   Centre de Montréal – A. Ouellet, SEA, Québec
   Centre d'Ottawa – D.W. Boyd, Ottawa, Ontario
   Centre d'Alberta – H.P. Wilson, Edmonton, Alberta
   Liaison avec AON – Dr G.K. Sato, AON, Pêches et Environnement, Ottawa

   (SEA – Service de l'Environnement atmosphérique; AON – Affaires Océanoscientifiques Nationales)

2. Durant l'été 1978, le président a surtout participé aux travaux d'un sous-comité (J.L. Knox, K.F. Harry, M. Miyake et S. Pond) organisé par John Maybank pour préparer une prise de position de la SCMO sur la station météorologique océanique P. Les informations fournies par H.B. Kruger ont été précieuses au travail du comité.

   L'annonce soudaine, au début d'août 1978, de la décision du gouvernement de retirer les navires météorologiques dès avril 1979 (soit deux ans plus tôt que prévu) exigea une réaction rapide et vigoureuse de la part de la SCMO. Le président du Comité Permanent d'Information Publique travailla donc longuement et étroitement avec le président de la SCMO à préparer et distribuer une prise de position exprimant l'opposition de la Société à ce qu'il soit mis fin prématurément à la station P.

3. Les activités normales du Comité Permanent d'Information Publique ont donc un peu souffert. Nous espérons qu'il sera possible au cours du prochain congrès, à Victoria, de rencontrer les membres du comité ou du moins leurs représentants des divers centres.

J.L. Knox
Président

REPORT OF THE AC HOC COMMITTEE FOR THE REVIEW AND EVALUATION OF THE REPORT ON METEOROLOGICAL CONSULTING STANDARDS IN CANADA

Due to the large number and far reaching consequences of the recommendations contained in the 112-page Report of the Ad Hoc Committee on Meteorological Consulting Standards in Canada, a second Ad Hoc Committee was formed in August 1978 to co-ordinate the review and evaluation of the recommendations by the membership of the Society. The Review and Evaluation Committee consisted of: R.P. Angle (Chairman), CMOS Councillor-at-large; J. Dionne, CMOS Councillor-at-large; A.D.J. O'Neill, AES representative; D.P. McIntyre, liaison with Ad Hoc Committee on Meteorological Consulting Standards in Canada. Early in the autumn, J. Dionne submitted his resignation because his many university commitments did not allow enough time to act on the committee. The third Councillor-at-large, G. McBean, then joined the committee.

The Review and Evaluation Committee perceived its task as:

1. Facilitating discussion of the issues at the Centres
2. Obtaining feedback from those most affected by the proposed actions
3. Consolidating all responses in order to arrive at the best course of action for the CMOS

The committee prepared and distributed to the Centres an information package consisting of the executive summary, a condensation of the recommendations and some guidelines for discussion. A request for written responses was placed in the *Newsletter* and responses were solicited directly from a number of people in industry, government, and universities. Later the entire information package was published in the *Newsletter* and Committee members became active in promoting discussion at their respective Centres. An interim report was presented at the February Council Meeting and the final report of the Committee's findings will be completed by May 1979.

R.P. Angle
Chairman

RAPPORT DU COMITÉ AD HOC CHARGÉ DE LA RÉVISION ET DE L'ÉVALUATION DU RAPPORT SUR LES STANDARDS DE LA CONSULTATION MÉTÉOROLOGIQUE AU CANADA

Etant donné le nombre et l'importance des recommandations présentées au sein des 112 pages du Rapport du comité ad hoc sur les Standards de la Consultation Météorologique au Canada, un autre comité ad hoc a été mis sur pied en août 1978 pour coordonner la revue et l'évaluation de ces recommandations par les membres de la Société. Ce comité a été formé de R.P. Angle (Président), Conseiller de la Société; J. Dionne, Conseiller de la Société; A.D.J. O'Neill, réprésentant le SEA, et D.P. McIntyre, assurant la liaison avec l'ex-comité ad hoc sur les Standards de la Consultation Météorologique au Canada. Au début de l'automne, J. Dionne donna sa démission, ses charges universitaires lui laissant trop peu de temps à consacrer aux travaux du comité. Un troisième conseiller de la SCMO, G. McBean, le remplaça au comité.

Le comité de revue et d'évaluation perçoit sa fonction comme suit:

1. Faciliter les débats au niveau des Centres
2. Recueiller les commentaires des membres de la Société les plus susceptibles d'être affectés par les mesures qui ont été proposées
3. D'extraire de ces commentaires un plan d'action optimal pour la SCMO

Le comité a préparé et distribué à tous les Centres un bulletin d'information contenant un résumé du Rapport sur la Consultation Météorologique, de ses recommandations, sous forme abrégée, et de quelques suggestions pouvant servir d'aide à la discussion. Des réponses écrites ont été sollicitées à la fois par l'intermédiaire du *Bulletin de Nouvelles* de la SCMO et en écrivant directement à un certain nombre de personnes des secteurs industriel, gouvernemental et

académique. Le bulletin d'information distribué aux centres a ensuite été publié au long dans le *Bulletin de Nouvelles* et les membres du comité se sont efforcés de stimuler les discussions au niveau de leurs Centres respectifs. Un rapport intérimaire a été presenté au Conseil de la SCMO à sa réunion de février; un rapport final des conclusions du comité sera prêt pour mai 1979.

R.P. Angle
Président

REPORTS FROM LOCAL CENTRES

B.C. CENTRE

Executive 1978-79

Chairman	J. Knox	Dept. of Geography, UBC
Vice-Chairman	P. Crean	Inst. of Oceanography, UBC
Secretary-Treasurer	V. Puss	Pacific Weather Centre, AES
Program Director	N. Boston	Beak Consultants Ltd, Vancouver
Project Coordinator	P. Morin	Pacific Weather Centre, AES
Past Chairman	P. LeBlond	Inst. of Oceanography, UBC

Two more video cassettes were purchased to produce duplicates of our videotape – "A Forecaster's Day". Details of copyright for the background music will be cleared up before widespread distribution of this production is to begin. Among other projects, two oceanographic posters were produced for display on the ferries sailing between the mainland and Vancouver Island.

The fall general meeting was held at the Faculty Club of the University of British Columbia. Viewing of the videotape as well as election of the new executive took place at this meeting. In addition, the report: Meteorological Consulting in Canada, was discussed in some detail. The perennial plea for ideas from the members regarding uses for the annual subvention was heard once more. It was decided to look into the possibility of producing film loops of GOES-type satellite images for training or local research purposes.

It was reported that the members of the Vancouver Island Chapter had the planning for the 1979 Victoria Congress well in hand. Shortly thereafter, the gathering retired to the bar where further informal discussions took place.

The following speakers presented lectures during the year:

25 Jan.	K. Bryan	"Coupled Ocean-Atmosphere Circulation Models"
2 Mar.	T. Murty	"Tsunamis"
14 Mar.	D. Davison	"Atmospheric Turbulence and Dispersion"
1 Nov.	B. Fitzharris	"Climatic Questions Arising from Hydroelectric Developments in New Zealand"
29 Nov.	W. Large	"The JASIN Experiment"

Financial Statement 1978

Income

Cash on hand December 31, 1977	$ 594.50
Bank Interest	7.11
Victoria Conference Grant	500.00
Annual Subvention from National Executive	336.00
	$1,437.61

Expenses

Postage and Meeting Expenses	$ 107.18
Purchase of Blank Video Cassettes	86.24
Video Player Rental	50.00
Posters for British Columbia Ferries	86.84
Victoria Conference Grant	500.00
	$ 830.26
Credit Balance as of December 31, 1978	$ 607.35

V. Puss
Secretary-Treasurer

VICTORIA CHAPTER

The operations of the Chapter have been temporarily suspended because many of the members are occupied in the arrangements for the Thirteenth Congress.

ALBERTA CENTRE

Executive: to May 1978		*from June to December 1978*
Dr R.G. Humphries	Chairman	Mr L. Wojtiw
Mr L. Wojtiw	Vice-Chairman	Mr R.P. Angle
Mr G. Lunn	Secretary-Treasurer	Mr A.S. Mann
Dr B.L. Barge	Past Chairman	Dr R.G. Humphries
Dr D.S. Davison	Calgary Representative	Dr D.S. Davison

Meetings – Edmonton:

31 Jan.	Terry Rachuk	"Solar and Wind Energy Research Project"
28 Feb.	Dr D.S. Davison (AES/CMOS Speaker)	"Atmospheric Turbulence and Dispersion"
20 Mar.	Don Storr	"A Comparison of Snowmelt Rates Calculated by the U.S. Corps of Engineers Model with a Measured Rate on a Snow Pillow at Marmot Creek"
27 Apr.	B. Janz A.S. Mann	"Review of the Alberta Oil Sands Environmental Research Program and Climatology of the AOSERP Study Area"
19 Oct.	Geoff Strong	"Forecasting for Alberta Hail Project Operations"
16 Nov.	R.P. Angle (Moderator) Dr D.S. Davison D.B. Fraser S.M. Checkwitch	Panel Discussion on Meteorological Standards for Consultants

Meetings – Calgary:

3 Feb.	Dr B.W. Boville	"Man's Impact on the Earth's Climate"
16 Feb.	J.H. Renick	"Present Status of Weather Modification"
4 Apr.	Laurie Davidson	"An Overview of the Physical Climate of the Canadian Arctic"

Financial Statement 1978

Balance (brought forward from 31 December, 1977)		$1,058.25
Income		
1978-79 Subvention	$308.00	
Interest	12.96	
Total	$320.96	
Expenses		
Stamps, Coffee, etc.	$347.36	
Regional Science Fair	50.00	
Cheques	4.29	
Total	$401.65	
Balance 31 December, 1978		$977.56

A.S. Mann
Secretary-Treasurer

REGINA CENTRE

The first activity scheduled for October was to be a joint meeting with the Saskatoon chapter. Prior to the meeting, the closure of the Regina Weather Office was announced. Quite predictably, morale collapsed and activities came to a halt.

There were two achievements worth mentioning. A high school in Fort Qu'Appelle sent a letter to the Weather Office requesting reference material for their science library. We responded with a copy of *Climate Canada* by Hare and Thomas. The one function held by the Regina Centre was a dinner meeting on January 31, with guest speaker Dr Alistair Fraser.

This is the final report from CMOS Regina.

Final Financial Statement – January 1978-February 1979

Balance Forward			$702.26
1978	*Debits*	*Credits*	
April 14 – Dinner Meeting	$ 33.45		
April 29 – Interest		$ 9.95	
October 31 – Interest		10.27	
November 7 – Branch Allotment		163.00	
		$183.22	
1979			
January 23 – Wiley & Sons	12.82		
January 31 – Dinner Meeting	115.93		
February 2 – Projector Rental	21.00		
	$183.20		
Net Credit	$ 0.02		
Balance (Returned to National Treasurer)			$702.28

D.A. Bernachi
Chairman

SASKATOON CHAPTER

The first meeting of the year was held on February 28. After a short business meeting members and guests enjoyed the CMOS Speaker's Tour Lecture given by Dr Douglas Davison.

Dr J. Pakiam, Department of Georgraphy, University of Singapore, spoke to chapter members and guests. His topic was "Radar Observations of Thunderstorms."

Announcement of the proposed cutbacks in forecasting staff at the Regina Weather Office raised questions about the Center-Chapter relationship. A short meeting was held with the chairman and one other member of the Regina center in late October. It was decided that any decision would have to be deferred until the status of the Regina Weather Office was certain.

In November five members of the Saskatoon Chapter participated in a meeting of the Saskatchewan Intercouncil Committee on Agricultural Meteorology. The main topic of the meeting was the effect of the closure of the Regina Forecast Office on agriculture in Saskatchewan.

On December 15 John Maybank and John Bergsteinsson of the Saskatchewan Research Council presented the provincial government with a report on "The Provision of Weather Service in Saskatchewan." The Saskatchewan Research Council had been contracted by the province to study the effects of the proposed staff reductions in Regina on weather services in Saskatchewan and to make recommendations regarding present and future needs for weather services.

Plans for 1979 include the Speaker's Tour in early February and a proposed weather radar symposium in early March. Due to the uncertainty of the status of the Regina Weather Office, election of officers was delayed until the March 1979 meeting.

D.J. Bauer
Corresponding Secretary

WINNIPEG CENTRE

Summary of meetings during 1978:

19 Jan.	A. Warkentin Manitoba Water Resources	"Floods and Flood Forecasting"
1 Mar.	Dr Douglas S. Davison INTERA Environmental Consultants Ltd, Calgary	"Atmospheric Turbulence and Dispersion"
2 May	George Pratt District Director Plant Products Agriculture Canada	"Operations of the Plant Products Division"
12 Oct.	Ernie Robertson Biomass Energy Institute	"Biological Energy Sources"
23 Nov.	Dr John Benci Canadian Wheat Board	"The Wheat Board's Use of Weather Information in its Planning and Operations"

Displays and awards:

On March 23 and 25 a meteorological display was held in the Garden City shopping mall. This display consisted of various weather instruments, charts, pictures and slides, and an operating teletype and facsimile machine receiving weather data. One or two meteorologists were on hand at all times to answer questions.

We again awarded trophies and cash prizes for the best meteorological displays at the Manitoba Schools Science Symposium at the University of Winnipeg on May 5, 6, and 7, 1978.

The Prairie Award was given to Messrs R. Raddatz and K. Fluto for their paper on "A Statistical Aid to Thunderstorm Forecasting." This award is given for the best paper on operational meteorology in the Central Region.

Miscellaneous:

A slide projector was purchased for use at meetings and displays.

Financial Statement 1978

Cash on hand as of January 1, 1978		$1,144.61
Receipts		
Subvention cheque	$ 263.00	
Dinner meeting January 19, 1978	161.00	
Dinner meeting March 1, 1978	85.00	
Dinner meeting May 2, 1978	30.85	
Dinner meeting October 12, 1978	217.00	
Dinner meeting November 23, 1978	147.00	
Donation for Prairie Award	100.00	
Interest	20.22	
Total	$1,024.07	$1,024.07
		$2,168.68
Expenditures		
Dinner meeting January 19, 1978	$ 221.90	
Dinner meeting March 1, 1978	170.79	
Dinner meeting May 2, 1978	40.41	
Dinner meeting October 12, 1978	292.45	
Dinner meeting November 23, 1978	150.54	
Refreshments for annual meeting May 16, 1978	19.22	
Slide projector	230.97	
Science Symposium Awards	100.00	
Postage stamps	14.00	
Prairie Award	50.26	
Credit Union Service Charges	1.39	
WMO display (Miscellaneous)	5.37	
Account book	1.16	
Total	$1,298.46	$1,298.46
Balance		$ 870.22
Cash on hand as of January 1, 1979		$ 870.22

P.G. Murray
Secretary-Treasurer

TORONTO CENTRE

Executive of the Centre for 1978-79:

Chairman	M.D. Hewson
Secretary	F. Conway
Treasurer	D. Phillips
Programme Chairman	O.J. Koren

List of Speakers during 1978:

25 Jan.	Dr G.K. Rodgers	"Research at Canada Centre for Inland Waters"
2 Mar.	Dr D. Davidson AES/CMOS Tour Speaker	"Atmospheric Turbulence and Air Quality"
5 Apr.	Dr C.O. Hines	"Short-Term Sun-Weather Correlations"
17 May	Dr Don Gilman	"Long Range Prediction in the U.S.A."
18 Oct.	M.J. Newark	"Tornadoes, Waterspouts, and Funnel Clouds in Canada"
15 Nov.	D. Devall	"The T.V. Weatherman . . . A Link"

1978 was a fairly successful year for the Toronto Centre, and a full programme is already underway for 1979. The Chairman, who will resign as of February 1, has been transferred to Newfoundland by his employer, and as a result the duties of the chairman for the balance of his term will be shared by the other three members of the local executive.

M.D. Hewson
Chairman

Financial Statement 1978

Income	
Bank interest	$ 9.97
Wine & Cheese – ticket sales	169.50
Subsidy	431.00
Total	$610.47
Expenditures	
Printing and office supplies	$114.26
Typing	14.00
Postage	74.04
Refreshments for meetings	21.60
Cost for Wine & Cheese meeting	150.15
Gilman's visit expenses	253.50
Bank service charges	0.50
Total	$628.05
Bank balance as of January 1, 1978	$556.46
Income for 1978	610.47
Expenditures for 1978	628.05
BALANCE as of December 31, 1978	$538.88

D.J. Phillips
Treasurer

OTTAWA CENTRE

The 1978-79 executive decided on a theme *International Aspects of Meteorology and Oceanography* for the speaker meetings of the 1978-79 season. A number of senior meteorologists from various countries, who were in Ottawa to attend a NATO meeting, were on hand to hear Dr Horst Leese, of the Federal Republic of Germany present the first talk on this theme.

The Ottawa Centre was active in the "Ottawa Regional Science Fair" again in 1978. Two girls from Immaculata High School shared the $40 prize and received trophies for the best meteorological/oceanographic entry. This was the second year in a row that girls from this school have won this prize.

The list of Speakers for 1978:

18 Jan.	L.B. Machattie Forest Fire Research Institute DOE	"Applications of Local Meteorology (with examples from Forestry)"
13 Feb.	Dr A.E. Collin Assistant Deputy Minister, AES	"Arctic Ocean Science"
9 Mar.	Dr D.S. Davison INTERA Environmental Consultants Ltd Calgary, Alberta	"Overview of the Relations Between Turbulence and Dispersion"
3 May	Warren Forrester Canadian Hydrographic Service	"Investigation of the Meteorological, Tidal and other Influences on the Flow Through Little Current Channel on Lake Huron"
28 Sept.	Dr Horst Leese Chief, Geophysical Branch Ministry of Defence Bonn, FRG	"Meteorological and Oceanographic Services and Problems in the Federal Republic of Germany"
26 Oct.	Dr J.B. Harrington Forest Fire Research Institute, DOE	"International Forest Meteorology"
29 Nov.	G.R. Yungblut Resources Management and Conservation Branch DEMR	"Weather and Offshore Drilling"

Financial Statement 1978

Bank balance, 1 January 1978	$744.78	
Petty cash on hand, 1 January 1978	46.84	
Total cash on hand	$791.62	$ 791.62
Income		
Interest	$ 7.94	
CMOS Subvention	285.00	
Meetings, sale of coffee	16.70	
Total	$309.64	$ 309.64
		$1,101.26

Expenses

Postage	$ 81.93	
Science Fair (prizes, engraving)	76.77	
Speakers' expenses and dinner meeting	67.85	
Other meeting expenses	23.79	
Total	$250.34	$ 250.34
Difference		$ 850.92
Bank balance, 31 December 1978	$840.70	
Petty cash on hand, 31 December 1978	10.22	
Total cash on hand	$850.92	

R.B. Saunders
Secretary-Treasurer

CENTRE DE MONTRÉAL

Les membres de l'exécutif du Centre local sont:

Président	H. Allard	Service de l'Environnement atmosphérique
Secrétaire	G. Desautels	Service de l'Environnement atmosphérique
Trésorier	J.G. Cantin	Service de l'Environnement atmosphérique
Président sortant	C. East	Centre de recherches en sciences de l'environnement – Université du Québec à Montréal

La liste des réunions tenues en 1978 est:

15 fév.	Jean Louis Bisson Hydro Québec	"La prévision du ruissellement naturel"
8 mars	Dr D. Davison Intera Environmental Consultants Ltd	"Atmospheric turbulence and dispersion"
21 mars	Dr T.N. Krishnamurty Florida State University	GATE Films
19 avril	Dr Peter Yau McGill University	"Numerical simulation of convective clouds in 3 dimensions"
24 oct.	Dr Peter Schuepp	"La recherche en agrométéorologie au Collège Macdonald et propos connexes"
13 déc.	Dr Conrad East Université du Québec à Montréal	"L'ozone à Montréal: Sources locales ou lointaines?"

Gilles Desautels
Secrétaire

Etat des revenus et des dépenses – exercice terminé le 31 décembre 1978

Revenus

Intérêts bancaires	$ 11.14
Recettes	22.13
Subvention SCMO	332.00
Total	$365.27

Dépenses

Frais de bureaux (timbres et enveloppes)	$ 60.57
Rafraîchissements	37.50
Frais de représentation (conférenciers)	108.95
Divers	3.40
Total	$210.42
Excédent des revenus sur les dépenses	$154.85

Bilan au 31 décembre 1978

Actif à court terme	
En caisse	$583.86
	$583.86
Passif à court terme	Nil
Avoir du fonds	
Solde au début de l'exercice (01.01.1978)	$429.01
Excédent des revenus sur les dépenses	$154.85
Solde à la fin de l'exercice (31.12.1978)	$583.86

J.G. Cantin
Trésorier

CENTRE DE QUÉBEC

Président	Ghislain Jacques	
Vice-Président	Jean-Pierre Fortin	
Conseillers	Gaston Paulin	Justin Brouillette
	Gilles Tardif	Jacques Gariépy
	Raymond Poiré	
Secrétaire	Guy Bergeron	
Trésorier	Gaétan-D. Soucy	

Conférenciers pour 1978

18 jan.	Dr George Gallagher	"Simulation du climat à l'aide de modèles numériques et microclimat des cultures en serre"
17 fév.	Dr Benoît Jean	"Utilisations de l'énergie solaire"
7 mars	Dr Douglas S. Davison	"Atmospheric turbulence and air quality"
22 mars	Dr Gabriel Polisois	"Les impacts des activités énergétiques sur le climat"
20 oct.	Dr Camille Rousseau	"Qui n'a pas vu les Pays-Bas n'a pas vu l'Europe"
15 nov.	Dr René Verreault	"De nouveaux instruments pour les stations météorologiques nordiques"
13 déc.	Dr Yves Delage	"Le futur modèle canadien de prévisions météorologiques"

La Société de Météorologie de Québec remettait son prix annuel 1978 au Dr Charles Eugène Ouellet pour son importante contribution au domaine de l'agrométéorologie.

D'autre part, notre station météorologique mobile était prêtée à divers organismes s'intéressant ou voulant s'initier à la météorologie.

Le secrétaire
Guy Bergeron

Rapport du trésorier 1978

Actif	
Actif en caisse au début de l'exercice	$1,922.00
Cotisations des membres (48)	192.00
Octroi du MRN	500.00
Subvention de la SCMO	205.00
Intérêts	90.83
Remboursement pour timbres	4.42
Total	2,914.25
Capital social	5.00
Actif total	$2,919.25
Passif	
Frais de séjour et de déplacements des conférenciers	$ 349.52
Achat de timbres et matériel de bureau	70.24
Frais de secrétariat (dactylographie)	45.00
Frais pour assemblée générale et réunion d'ouverture	296.32
Frais relatifs à la situation météorologique mobile	40.76
Prix de la SMQ (plaque-écusson)	40.72
Total	842.56
Immobilisation du capital social	5.00
Passif total	$ 847.56
Excédent de l'actif sur le passif	$2,071.69

N.B.: De cet excédent, un montant de $1,206.14 est engagé pour l'achat d'instruments météorologiques destinés à la station météorologique mobile.

Le trésorier
Gaétan-D. Soucy

HALIFAX CENTRE

Chairman	Dr S.D. Smith	Bedford Institute of Oceanography
Secretary	Prof H.J. Thiébaux	Dalhousie University
Treasurer	Mr E.J.G. Guimond	Maritimes Weather Office

A major activity for the year was completion of work on meteorological information and instrument kits designed for use in the Nova Scotia School System, at the junior high school level. In addition to assembling the technical components, a teachers' guide has been prepared to explain the use of the materials. The kits contain simple meteorological instruments, visual aid material, and instructions for individual and class projects. It is expected that they will be distributed through the Nova Scotia Museum Information Centres throughout the Province.

The kits were reviewed in our November chapter meeting to which science teachers were invited. Their enthusiasm and suggestions were greatly appreciated.

1978 Meetings of CMOS Halifax Centre:

23 Jan.	F.W. Dobson	"A wave follower experiment in the Bahamas"
6 Mar.	D.S. Davison	"Atmospheric turbulence and dispersion"
19 Apr.	J.A.W. McCulloch	"A.E.S. Wave Climate Study" and "An overview of some of the results from the IFYGL lake meteorology program"

7 June	A.J. Hanson	"Coastal aquaculture in Southeast Asia"
18 Oct.	C.W. Snoek	"The potential of ocean waves as a renewable source of energy"
15 Nov.	R.W. Shaw and Becky Wall	"Demonstration of meteorological information and instrument kits being donated by CMOS Halifax Centre for use in the N.S. School system"
13 Dec.	M. Lodge	"Why the Institute of Man and Resources, P.E.I."

Activities Planned for 1979:

22 Jan.	Alistair Fraser	"A halo is an ice thing"
14 Feb.	Rube Hornstein	"The Winds of Change"

S.D. Smith
Chairman

Financial Statement 1978

Bank balance December 31, 1977		$1,499.86
Credits and Deposits:		
Receipts from Jan. 1978 Dinner Meeting, Bar, Tickets	$ 326.50	
Regular Allocation	326.00	
Extra Allocation	200.00	
Bank Interest	49.39	
Total	$ 901.89	901.89
Debits or Expenditures		
Money paid for EDUCATIONAL KITS in 1978	$1,734.97	
Cost of Dinner paid Royal Yacht Squadron, N.S.	363.40	
Mailing costs for Meeting notices	32.82	
Coffee and "donuts" served at Meetings	21.73	
Petty Cash fund (Treasurer)*	25.00	
Total	$2,177.92	2,177.92
Bank Balance at December 31, 1978		$ 223.83

Petty Cash Fund

Credit from Bank Account		$ 25.00
Expenditures		
Coffee and "donuts" Oct., Nov., and Dec. Meetings	$ 15.31	
Postage cost for special invitations to guest-speaker and education personnel	1.12	
Total	$ 16.43	16.43
Cash on hand		$ 8.57

*This Petty Cash Fund was instituted to obviate the need to "borrow" small amounts of money to provide mailing costs and other inexpensive services such as refreshments for regular meetings. (Receipts are kept.)

E.J.G. Guimond
Treasurer

ANNOUNCEMENTS

Fifth International Conference on Wind Engineering

The Fifth International Conference on Wind Engineering will be held at Colorado State University, Fort Collins, Colorado, July 8-14, 1979.

Sessions will be devoted to the following topics: Social and Economic Impact of Wind Storms; Wind Characteristics and Description; Local Wind Environment; Steady Wind Loads; Unsteady Wind Loading; Dynamic Response of Tall Buildings and Towers; Dynamic Response of Bridges and Roof Membranes; Physical and Mathematical Modelling; Wind Engineering Applications; Wind Engineering Practice.

For the complete conference programme and fuller details write to Dr J.E. Cermak, Chairman, 5th Int. Conf. on Wind Engineering, Colorado State Univ., Ft Collins, Colorado, USA 80523 (Tel:(303) 491-6696/6686).

Call for Papers – First National Heat Transfer Symposium – 1980

The First National Heat Transfer Symposium will be held in conjunction with the 30th Chemical Engineering Conference in Edmonton, October 19-22, 1980.

Four sessions are planned: (1) Two-phase Heat Transfer; (2) Heat and Mass Transfer in Biological Systems; (3) Heat Transfer Equipment in Hostile Environments; and (4) Fundamental Research in Heat Transfer. Contributions are solicited for session (2) in the areas of heat and mass exchange of: individual plants or plant parts, plant communities, animals, or humans. Submitted papers will be refereed and may be published in a special issue of the Canadian Journal of Chemical Engineering.

Abstracts of about 250 words should be sent to Prof. Earle A. Ripley, Plant Ecology Dept, University of Saskatchewan, Saskatoon, Sask. S7N 0W0 before August 1, 1979. Complete manuscripts, based on abstract acceptance, are due before November 1, 1979. Decisions on paper acceptance will be made and communicated to authors before February 1, 1980.

Canadian Meteorological and Oceanographic Society

La Société canadienne de météorologie et d'océanographie

The Canadian Meteorological and Oceanographic Society assumed its present constitution in 1977. The organization was first established in 1940 as the Canadian Branch of the Royal Meteorological Society, later becoming the Canadian Meteorological Society in 1967. The Society exists for the advancement of Meteorology and Oceanography (including Limnology) and membership is open to persons and organizations sharing these interests. There are nine Local Centres of the Society which hold meetings of interest to the membership. *ATMOSPHERE-OCEAN* is the scientific journal of the Society and is distributed free to all members. Each spring the Society convenes a National Congress.

Correspondence regarding Society affairs and membership should be directed to the Corresponding Secretary, Canadian Meteorological and Oceanographic Society, c/o Department of Geography, Simon Fraser University, Burnaby, B.C., V5A 1S6.

There are three types of membership – Member, Student Member and Sustaining Member. For 1979 the dues are $25.00, $5.00 and $60.00 (min.), respectively. The annual Institutional subscription rate for *ATMOSPHERE-OCEAN* is $25.00.

Correspondence relating 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 canadienne de météorologie et d'océanographie a adopté la présente constitution en 1977. La Division canadienne de la Société royale de météorologie a été fondée en 1940 et remplacée par la Société météorologique du Canada en 1967. Cette société existe pour le progrès de la météorologie et de l'océanographie (y compris la limnologie) et accueille comme membres toute personne ou organisation intéressée à ces sciences. Les neuf centres locaux de la société réunissent les membres pour des discussions et conférences. *ATMOSPHERE-OCEAN*, la revue scientifique de la société, est distribuée gratuitement à tous les membres. La société organise chaque printemps un Congrès national.

Toute correspondance concernant les activités de la Société et les souscriptions devrait être adressée au Secrétaire-correspondant, Société canadienne de météorologie de d'océanographie, Département de Géographie, L'Université Simon Fraser, Burnaby, B.C., V5A 1S6.

Il y a trois types de membres: Membre, Membre étudiant, et Mebre de soutien. La cotisation pour 1979 est de $25.00, $5.00 et $60.00 (min.) respectivement. Les institutions peuvent souscrire à *ATMOSPHERE-OCEAN* au coût de $25.00 par année.

La correspondance concernant 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.