

LIST OF STUDIES IN PROGRESS

1. PROPERTIES OF SNOW AND ICE

- 80-1 PROPERTIES OF SNOW--S.C. Colbeck U.S. Army Cold Regions Research and Engineering Laboratory, Hanover, NH.

Objectives: Investigate the mechanical properties of wet snow; investigate the grain structure and grain growth in snow; make water measurements and investigate water flow in snow; review articles books and conference proceedings.

Recent Reports: (1) Colbeck, S.C. (1979). "Sintering and Compaction of Wet Snow", Phil Mag. Vol. 39, No. 1, pp. 13-32.

(2) Colbeck, S.C., K.A. Shaw and G. Lemieux (1978). "Compression of Wet Snow, CRREL Report 78-10.

(3) Colbeck, S.C. (1979). "Grain Clusters in Wet Snow". J. Colloid and Interface Sci. Vol. 72, No. 3, pp. 371-84.

(4) Colbeck, S.C. "Snow Metamorphism Due to Radius of Curvature". J. Glaciology in press.

(5) Colbeck, S.C. (1978). "Difficulties of Measuring Water Saturation and Porosity of Snow". J. Glaciology. Vol. 20, No. 82, pp. 189-201.

(6) Colbeck, S.C. (1979). "Water Flow Through Heterogeneous Snow". J. Cold Regions Sci. and Tech. Vol. 1, No. 1, pp. 37-45.

- 80-2 THE ROLE OF THE SNOWPACK IN THE NUTRIENT BUDGET OF A SUBARCTIC ECOSYSTEM--Michael English, Department of Geography McGill University, Montréal, Québec.

Objectives: To study the interaction of melt water from the snowpack and underlying vegetation - To quantitatively define nutrient interaction between the snowpack - Vegetation/litter layer and soil - To determine the behaviour of this meltwater once it enters the lake system; does it flush out of the system or is it incorporated within the aquatic system - The study is currently in progress.

Recent Reports: Reports to the Arctic Institute of North America and to the Centre for Northern Studies and Research at McGill University, the funding agencies of this research.

- 80-3 SHORTWAVE RADIATION INVESTIGATIONS FOR GLACIATED BASINS--D.S. Munro, Department of Geography, University of Toronto, Toronto, Ontario.

Objectives: A model for the distribution of net shortwave radiation in a glaciated basin has been completed. The findings have been submitted in a report to the Snow and Ice Division, National Hydrology Research Institute, Environment Canada. Further work is contemplated with Dr. G.J. Young of the Snow and Ice Division.

Recent reports: Munro, D.S. (1979), "Shortwave Radiation Investigations for Glaciated Basins". Final Report to the Snow and Ice Division, National Hydrology Research Institute, Environment Canada, Ottawa, Ontario, 71 pp.

- 80-4 METEOROLOGICAL INFORMATION IN SKIFIELD PLANNING-- Terry D. Prowse, I.F. Owens, Department of Geography, University of Canterbury, New Zealand.

Objectives: Assessment of Meteorological information in ski-field planning and management. Feasibility studies were conducted for a proposed ski-field and research is continuing on establishing relationships between meteorological parameters, snow properties and avalanche occurrence in the Canterbury High Country, N. N.Z.

Recent reports: I.F. Owens & T.D. Prowse, (1980) (in press). "Meteorological Information in Skifield Planning". New Zealand Meteorological Symposium, 1979. Wellington, New Zealand.

80-5 THE AVALANCHE HAZARD IN NEW ZEALAND--Terry D. Prowse, G. McGregor, I.F. Owens, Department of Geography, University of Canterbury, Christchurch, New Zealand.

Objectives: To chronicle avalanche fatalities and the meteorological conditions which caused the avalanche releases. Work on the historical aspects has been concluded.

Recent Reports: McGregor, G., Prowse, T.D., Owens, I.F. (in preparation). "Avalanche Release in New Zealand - A Historical Perspective".

80-6 AVALANCHE ENGINEERING--P.A. Schaerer, Division of Building Research, National Research Council of Canada, Ottawa, Ontario.

Objectives: To determine the characteristics of snow avalanches in motion, the amount of snow moved by avalanches, and the feasibility of measures for avalanche protection. Impact pressures and seismic signals of avalanches were recorded at Rogers Pass. Analysis showed the impact pressures to be greater than previously assumed.

Recent reports: (1) Schaerer, P.A. Avalanche design criteria for Denny Creek Bridge. Submitted for publication in Ac International, American Concrete Institute.

(2) Schaerer, P.A., and Salway, A.A. Seismic and impact pressure monitoring of flowing avalanches. To be published in Journal of Glaciology.

80-7 GLACIER HYDROLOGY; ROCKY MOUNTAINS, ALBERTA/BRITISH COLUMBIA--G.J. Young, National Hydrology Research Institute, Snow and Ice Division, Environment Canada, Ottawa.

Objectives: An understanding of hydrological processes in glacier covered watersheds. An extension of the I.H.D. combined heat, ice and water balance studies in glacier basins.

Recent reports: (1) Young, G.J. (1978). The impact of floods from glacier-dammed lakes, Yukon, Canada. Paper presented at the International Symposium on the Computation and Prediction of Runoff from Glaciers and Glacierized Areas, Tbilisi, Georgian S.S.R. 3-11, September 1978.

(2) Young, G.J. (1978). Streamflow formation in a glacierized watershed in the Rocky Mountains, Canada. Paper presented at the International Symposium on the Computation and Prediction of Runoff from Glaciers and Glacierized Areas, Tbilisi, Georgian S.S.R. 3-11, September 1978.

(3) Young, G.J., Glynn, J.E., Reid, I.A. & Sherstone, D.A., (1978). Mapping the Athabasca Glacier, Alberta, Canada, by orthophotography and by conventional methods. Paper presented at the International Symposium of New Technology for mapping. International Society for Photogrammetry, Commission IV. Ottawa, 2-6 October 1978, pp. 643-659.

(4) Collins, D.N. and Young, G.J. (1979). Hydrochemical Separation of Components of Discharge in Alpine Catchments. Proceedings of the 47th Western Snow Conference, pp. 1-9.

(5) Power, J.M. and Young, G.J., (1979). Application of the U.B.C. Watershed Model to Peyto Glacier Basin. Canadian Hydrology Symposium, Vancouver, Canada, May 1979, pp. 217-228.

(6) Collins, D.N. and Young, G.J. Separation of Runoff Components in Glacierized Alpine Watersheds by Hydrochemical Analysis. Canadian Hydrology Symposium, Vancouver, Canada, May 1979, pp. 570-581.

(7) Power, J.M. and Young, G.J., (1979). Application of an operational hydrologic forecasting model to a glacierized research basin. Third Northern Research Basin Symposium Workshop, 11-15 June 1979, Quebec City, Quebec, 20 p.

(8) Young, G.J. and Ommanney, C.S.L., (1979). Recent glacier studies in Canada. Submitted for inclusion in Canada Water Year Book 1979. 19 p.

80-8 RUNOFF PRECESSES AND REGIMES IN SMALL, HIGH ARCTIC BASINS, NORTHWEST DEVON ISLAND. --M.K. Woo and P. Marsh, Department of Geography, McMaster University, Ontario.

Objectives: The overall objective is to study the runoff generating processes in glacierized and non-glacierized, permafrost areas, to enable a numerical prediction of streamflow regimes in small basins of the Arctic Islands. Field work was carried out near Eidsbotn Fiord on Devon Island during the summer of 1979. Further field work is planned for the summer of 1980.

## 2. PRECIPITATION AND ACCUMULATION

80-9 SNOW AND ICE COVER CONDITIONS AND ASSOCIATED WINTER CLIMATIC REGIMES--Michael A. Bilello. U.S. Army Cold Regions Research and Engineering Lab.

Objectives: Provide a description of seasonal snow and ice cover conditions in Arctic and Subarctic regions, and establish techniques to predict these conditions using climatic and meteorological information. Analogs and maps to depict various aspects of the winter environment throughout North America, Europe, and Asia have been and are being developed.

Recent reports: (1) Bilello, M.A. (1978). "Ice decay patterns on a lake, a river, and a coastal bay in Canada." Paper presented at the 26th Annual Meeting of the Canadian Association of Geographers at the University of Regina, Saskatchewan, Canada.

(2) Bilello, M.A. (1978). "Decay patterns of land-fast sea ice in Canada and Alaska." Paper presented at the ICSI/AIDJEX Symposium on Sea Ice Processes and Models, at the University of Washington, Seattle.

(3) Bilello, M.A. (1978). "Sea-ice temperature curves for Slidre Fiord, Canada." Paper presented at the 27th Annual Meeting of the Canadian Association of Geographers at the University of Western Ontario, Canada.

(4) Slaughter, C. and Bilello, M.A. (1978). "Subarctic watershed research in the Soviet Union." Paper was published in the Arctic Bulletin, Vol. 2, No. 13.

(5) Bilello, M.A. and Bates, R.E. (1978). "Climatic survey at CRREL in association with the land treatment project." CRREL Special Report 78-21.

(6) Bilello, M.A. and Appel, G.C. (1978). "Analysis of the mid-winter temperature regime and snow occurrence in Germany." CRREL Research Report 78-21.

(7) Bilello, M.A. (1979). "Relationships between January Temperatures and the winter regime in East and West Germany." Paper published in the first issue of the new Elsevier Scientific Publication: Cold Regions Research and Technology.

(8) Bilello, M.A. (1979). "Notes and Quotes from snow and ice observers in Alaska." Paper published in the Proceedings of the 1979 Annual Meeting of the Western Snow Conference.

(9) Bilello, M.A. (1979). "Changes in surface temperature with elevation in winter." Paper presented at the 28th Annual Meeting of the Canadian Association of Geographers at the University of Victoria, B.C., Canada.

(10) Bilello, M.A. (1979). "Review of surface ice conditions in Arctic and Subarctic regions." CRREL Internal Report prepared for the U.S. Geological Service.

(11) Bilello, M.A. (1979). "A review of snow conditions and winter climate near Burlington and Underhill, Vermont." CRREL Internal Report in preparation for the "Snow I" field program.

(12) Bilello, M.A. (In Press). "Maximum thickness and subsequent decay of lake, river, and fast sea ice in Canada and Alaska." CRREL Research Report, 80-6.

80-10 NASHWAAK EXPERIMENTAL WATERSHED PROJECT-HYDROMETEOROLOGICAL STUDIES--R.B.B. Dickison and D.A. Daugharty, University of New-Brunswick, Fredericton, N.B.

Objectives: To evaluate the effects of forest clearcutting on water balance, stream regional, energy balance and snow cover, on a small watershed in central New-Brunswick. Calibration period 1971-78; treatment carried out in 1978-79.

Recent reports: Dickison, R.B.B., (1979). "Use of a Square Grid System for Modelling Snow Cover Distribution". Presented at the IHP Third Northern Research Basin Symposium Workshop. Quebec 11-15 June 1979.

80-11 SPECIAL CHARACTERISTICS OF LAKE SNOWCOVER--Terry D. Prowse, Department of Geography, University of Canterbury, Christchurch, New Zealand, W.P. Adams, Department of Geography, Trent University, Peterborough, Ontario, Canada.

Objectives: To assess the special characteristics of lake snowcover (eg depth, density, water equivalent, stratigraphy) especially as they differ from land snowcover, work has been concluded.

Recent reports: Adams, W.P. and Prowse, T.D., (1978). Observations on special characteristics of lake snowcover. In: Proc. Eastern Snow Conference 1978, p. 117-128.

80-12 SPATIAL DISTRIBUTION OF SNOWFALL AND SNOW COVER--R.M. Thompstone, P.J. Pilon, S. Bouchard, Power Operations, Quebec, Alcan Smelters and Chemicals Ltd., Arvida, Quebec, Canada.

Objectives: Improve knowledge of spatial distribution of snowfall and snow cover for use in runoff forecasting for the operational management of Alcan's multi-reservoir hydroelectric system.

Recent reports: (1) Thompstone, R.M., and P.J. Pilon (1979). "Square grid spatial interpolation of snow cover for a hydrometeorological information system". Proceedings, Thirty-sixth annual meeting of the Eastern Snow Conference.

(2) Thompstone, R.M., A. Poiré and A. Vallée (1978). "Computer-based hydro-meteorological information system for managing a multi-reservoir water resources system". Proceedings, CSCE Specialty Conference on Computer Applications in Hydrotechnical and Municipal Engineering. Canadian Society for Civil Engineering. pp. 118-137.

(3) Thompstone, R.M., A. Poiré and A. Vallée. "A hydrometeorological information system for water resources management". To appear in INFOR - Canadian Journal of Operational Research and Information Processing.

(4) Thompstone, R.M., and R. Bergeron. "Spatial averaging of daily meteorological data - practical results from a hydrometeorological information "system". To be presented at the Fourth Atlantic Region CSCE Hydrotechnical Conference, St. John's, Newfoundland, June 4-5, 1980. Copies will be available from the authors.

- 80-13 EVALUATION OF SNOW COURSE DATA IN THE SAINT JOHN BASIN--N.B.A. Trivett, S.E. Waterman, Hydrometeorology Division, Atmospheric Environment Service, Downsview, Ontario.
- Objectives: To evaluate the snow course network with respect to cover type and to develop objective techniques to calculate areal averages of snow water equivalent for each subbasin from snow course data. Currently evaluating objective techniques.
3. SNOWPACK MEASUREMENT
- 80-14 SNOWFALL AND SNOWCOVER IN EAST CENTRAL ONTARIO--W.P. Adams, Trent University, Peterborough, Ontario.
- Objectives: Studies of the performance of Canadian and Soviet snow gauges and study of the evolution of snow cover on land and on lakes.
- Recent reports: (1) Adams, W.P. (with T.D. Prowse) Observations on special characteristics of lake Snowcover, Proc. Eastern Snow Conf., 35, 1978, pp. 117-128.
- (2) Adams, W.P. (with T.D. Prowse) The Climatological Record for Peterborough, Occasional Paper No. 6, Department of Geography, Trent University, 1978, 240 p.
- 80-15 SNOW AND ICE SURVEY - ELIZABETH LAKE BASIN--Douglas R. Barr, McGill Subarctic Research Station, Schefferville, Québec, Canada.
- Objectives: Conducted intensive (600 point) snow and ice survey of Elizabeth Lake Basin, Labrador (5 km SW of Schefferville) in Late February, 1979, (in conjunction with Trent University, Ontario).
- Recent reports: Adams, W.P. and D.R. Barr, (1979), Vegetation - snow relationships in Labrador. Proc. Eastern Snow Conference, 36, pp. 1-25.
- 80-16 SCHEFFERVILLE REGION SNOW SURVEYS--Douglas R. Barr, McGill Subarctic Research Station, Schefferville, Québec, Canada.
- Objectives: Winter 1978/1979, maintained two outlying 10 point snowcourses (approximately once per month January-May) at Greenbush and Kivivic (north of Schefferville).
- 80-17 SCHEFFERVILLE SNOW SURVEYS--Douglas R. Barr, McGill Subarctic Research Station, Schefferville, Québec, Canada.
- Objectives: Winter 1978/1979 maintained (October-June) weekly program along 10 point snowcourse and monitored snow stratigraphy at one site (in conjunction with Trent University, Ontario). This was the 20th year of McGill's snowcourse measurements in this area.
- 80-18 EXPERIENCE DANS L'AUTOMATISATION DES MESURES NIVOMETRIQUES A LA STATION DE DUCHESNAY--André Fréchette, Service de la Météorologie, Québec.
- Objectives: Evaluer le fonctionnement de différents capteurs nivométriques.
- 80-19 SNOWFALL MEASUREMENT IN CANADA--B.E. Goodison, Atmospheric Environment Service, Downsview, Ontario.
- Objectives: Field investigations in different regions of Canada are used to assess the accuracy and comparability of Canadian methods of snowfall measurement and the influence of trace amounts, retention losses and blowing snow on Nipher gauge measurements at selected stations. Field assessment of Nipher type shields for F & P and Universal gauges has been initiated at selected stations. An experiment to measure fresh snowfall water equivalent using the type-D rain gauge

was initiated in all regions.

Recent reports: (1) Goodison, B.E., (1978). Accuracy of Canadian Snow Gauge Measurements. Journal of Applied Meteorology, Vol. 17, No. 10, pp. 1542-1548.

(2) Goodison, B.E. and D.J. McKay, (1978). Canadian Snowfall Measurements: Some Implications for the Collection and Analysis of Data From Remote Stations. Proceedings, Western Snow Conference, 45th Annual Meeting, April 18-20, 1978. Otter Rock, Oregon, 48-57.

(3) Goodison, B.E., (1978). Canadian Snow Gauge Measurements: Accuracy, Implications, Alternatives, Needs. Proceedings, Seventh Symposium on Applied Prairie Hydrology, Water Studies Institute, Saskatoon, May 9-11, 1978 pp. 7-15.

(4) Goodison, B.E., (1978). Comparability of Snowfall and Snow Cover in a Southern Ontario Basin. Proceedings, Modelling of Snow Cover Runoff, CRREL, Hanover, New Hampshire, September 26-29, 1978, 34-43.

80-20 SNOW MEASUREMENT PROGRAM--B.E. Goodison, Atmospheric Environment Service, Downsview, Ontario.

Objectives: As a member of the Western Snow Conference Working Group on Snow Sampler Metrication, the committee (P. Farnes, N. Peterson, R.P. Richards) has designed, tested and analyzed the results of metric snow samplers for North America, both large (ESC-50) and small (WSC-10) diameters. Recommendations on new designs are being prepared and a final report is being prepared for the ESC/WSC meeting in 1982.

Recent reports: Goodison, B.E., (1978). Accuracy of Snow Samplers for Measuring Shallow Snowpacks: An Update. Proceedings, Eastern Snow Conference, 35th Annual Meeting, Hanover, New Hampshire.

#### 4. SNOWMELT

80-21 SNOW MELTING IN THE INTERFACIAL ENERGY BUDGET--David Miller, Department of Geological Sciences, University of Wisconsin-Milwaukee, Milwaukee, Wisconsin.

Objectives: Have just finished a three-year program on the interface study noted above, and the result, "Energy at the surface of the Earth" has gone into production for a late-1980 publication date. Chapter 14 deals with snow-melting.

Recent reports: "Water at the surface of the Earth", published by Academic Press, deals with snowfall in chapter 6 (and especially snowfall interception), and with snow cover in chapter 7.

80-22 APPLICATION OF SATELLITE SNOWMELT MODELS IN THE SOUTH ISLAND HIGH COUNTRY--Terry D. Prowse, I.F. Owens, Department of Geography, University of Canterbury, Christchurch, New Zealand.

Objectives: To assess the applicability of satellite snowmelt models in New Zealand. Field testing of the models is still in progress.

Recent Reports: I.F. Owens & T.D. Prowse, (1979). Progress report on application of satellite snowmelt models in the South Island High Country. Report submitted to department of Scientific & Industrial Research, New Zealand.

80-23 SNOWMELT INFILTRATION AND RUNOFF--Anthony Wankiewicz, National Hydrology Research Institute, Environment Canada, Ottawa, Ontario,

Objectives: To provide an improved understanding of (a) transmission of liquid water within the snowpack, at or along the snow/soil interface and within the saturated and unsaturated zones, (b) the influence of these phenomena on the generation of snow cover runoff.

Recent reports: Wankiewicz, (1979). A review of water movement in snow. Proceedings of the workshop on modeling of snow cover runoff, 26-28 Sept. 1978, Hanover, N.H., pp. 222-252.

5. STREAMFLOW

- 80-24 HUBBARD BROOK ECOSYSTEM STUDY--Robert S. Pierce, U.S. Forest Service, Northeastern Forest Experiment Station, Durham, N.H.

Objectives: Chemistry of winter precipitation and streamflow are being monitored routinely on several small (about 20 ha) watersheds in hardwood forest. Snow and frost are monitored at 4 snow courses. There is no active snow or ice research.

- 80-25 REAL-TIME DAILY HYDROLOGICAL FORECASTING--R.M. Thompstone, P.J. Pilon, S. Bouchard, Power Operations, Alcan Smelters and Chemicals Ltd.

Objectives: Provide daily hydrological forecasts for use in the operational management of Alcan's multi-reservoir hydroelectric system.

Recent reports: Only internal documentation has been prepared to date.

- 80-26 HYDROLOGIC RISK AND RELIABILITY IN THE OPERATION OF A MULTI-RESERVOIR WATER RESOURCES SYSTEM SUBJECT TO SNOW-MELT RUNOFF--R.M. Thompstone, Power Operations, Quebec, Alcan Smelters and Chemicals Ltd, Arvida, Quebec, Canada.

Objectives: Improved measures of risk and reliability for use in the operational management of Alcan's multi-reservoir hydroelectric system.

Recent reports: (1) Thompstone, R.M., and A. Poiré (1979). "Risk analysis for reservoir operations during spring inflow". Proceedings, CSCE Fourth National Hydro-technical Conference. Canadian Society for Civil Engineering, pp. 151-165.

(2) Thompstone, R.M., D.K. Sen and R. Divi (1979). "Hydrologic modelling and optimization techniques for operating multi-reservoir water resources systems". Proceedings, CSCE Fourth National Hydrotechnical Conference. Canadian Society for Civil Engineering. pp. 132-150.

(3) Thompstone, R.M. (1978). "Recherche opérationnelle et gestion de ressources hydrauliques". Presented to "Société canadienne pour la recherche opérationnelle - Section Québec". Available from the author.

- 80-27 USE OF SNOW SURVEY MEASUREMENTS IN FORECASTING THE VOLUME OF THE SPRING FRESHET. --R.M. Thompstone, P.J. Pilon, S. Bouchard, Power Operations, Quebec, Alcan Smelters and Chemicals Ltd, Arvida, Québec, Canada.

Objectives: Improve hydrologic forecasts for use in the operational management of Alcan's multi-reservoir hydroelectric system.

Recent reports:(1)Thompstone, R.M., A. Poiré and P.J. Pilon (1979). "Frequency analysis and forecasting spring inflow events for water resources management". Proceedings, Canadian Hydrology Symposium: 79, Cold Climate Hydrology. National Research Council of Canada, Associate Committee on Hydrology. pp. 252-261.

(2) Thompstone, R.M. (1978). "Frequency analysis and forecasting of spring runoff volumes - a case study". Presented at Stochastic Modelling of River Flows, an advanced specialized seminar sponsored by the National Research Council of Canada Associate Committee on Hydrology. Available from the author.

(3) Thompstone, R.M., and R. Bergeron. "Prévision hydrologique interactive dans un système d'information hydrométéorologique". To be presented at the Second Quebec Region CSCE Hydrotechnical Conference, Sherbrooke, Quebec, May 22-23, 1980. Copies will be available from the authors.

80-28 SPRING FLOOD FORECASTING USING TRANSFER FUNCTION - NOISE MODELLING--W.E. Watt and M.J. Nozdryn-Plotnicki, Queen's University, Kingston, Ontario.

Objectives: Adaptation of a new approach to forecasting spring floods which makes use of a "proper" combination of the input hydrometeorological data and the known discharge in the river. Results are encouraging and reports being prepared.

6. LAKE AND RIVER ICE

80-29 STUDY OF THE WINTER COVER OF LAKES AND ITS BIOLOGICAL IMPLICATIONS-- W.P. Adams and D.C. Lasenby, Trent University.

Objectives: Study of the major components of the ice and snowcover of lakes in Ontario and in Northern Quebec-Labrador with particular reference to the roles of these components in such things as the lake oxygen and light regimes, nutrient loading and other aspects of cryo-chemistry.

Recent reports: (1) Adams, W.P. (with M.C. English and D.C. Lasenby) Snow and ice in the phosphorus budget of a lake in south central Ontario, Water Research, 13, 1978, pp. 213-215.

(2) Adams, W.P. (with M.C. English and D.C. Lasenby) Snow and ice on lakes, Chapter in book on snow, edited by D.M. Gray, sponsored by NRC Committee on Snow and Ice (in press).

(3) Adams, W.P. (with D.R. Barr) Vegetation-snow relationships in Labrador, Proc. Eastern Snow Conf., 36, 1979, pp. 1-25.

(4) Adams, W.P. (with D.R. Barr, J.R. Glew, K.J. Hurford and M.W. Stillman) Lake ice density in the environment - practical approaches to measurement and calculation, Ecology Bulletin, Department of Biology, Trent University, 4 (1), 1979, pp. 15-24.

(5) Adams, W.P. (with N.T. Roulet) Illustration of the roles of snow in the evolution of the winter cover of a lake, Arctic, 1980 (in press).

80-30 THEORETICAL STUDY OF ICE SUPPRESSION POSSIBILITIES--George O. Ashton, U.S.A. CRREL, Hanover, NH.

Objectives: Construct a simulation model for ice suppression resulting from discharge of warm water into rivers. Construct a simulation model of point source bubbler systems to melt ice.

Recent reports: (1) CRREL Report 79-30 Suppression of River Ice by Thermal Effluents.

(2) CRREL Report 79-12 Point source Bubbler Systems to Suppress Ice.

80-31 ICE SURVEYS - SCHEFFERVILLE--Douglas R. Barr, McGill Subarctic Research Station, Schefferville, Québec, Canada.

Objectives: Maintained weekly ice surveys (snow, ice) on Knob Lake (3 sites) and Maryjo (1 site)(data submitted to A.E.S.). Sporadic snow and ice data for other lakes also available.

80-32 GENERAL ASSISTANCE - SNOW AND ICE STUDIES--Douglas R. Barr, McGill Subarctic Research Station, Shefferville, Québec, Canada.

Objectives: The Station provides back-up for a major year-round Limnology Project conducted by Dr. F. Rigler, Biology Department, McGill University and a variety of snow studies including, for example, the study of ground temperatures/snowpack relationships being conducted by the University of Montreal.



- 80-33 THERMAL REGIMES AS DISTURBED BY MAN--Roy E. Bates and George D. Ashton, USA CRREL, Hanover, N.H.
- Objectives: The objective of this study is to determine the influence of ice covers on the disposition of added heat to water bodies. Work has started on a summary of thermal structures, Ice conditions and meteorological conditions on Lake Champlain.
- Recent reports: (1) USA CRREL Report 79-26 by Roy E. Bates and Mary Lynn Brown "Lake Champlain ice formation and ice free dates and predictions from meteorological indicators".
- (2) USA CRREL Report 80-2 by Roy E. Bates "Winter thermal structure, ice conditions and climate of Lake Champlain."
- 80-34 FUNDAMENTAL MECHANICS OF ICE JAMS--Darryl Calkins and Roy Bates, USA CRREL, Hanover, N.H.
- Objectives: Verification of current theories relating to ice jam initiation as they predict ice thickness, water levels and discharge for shallow streams. Field data has been collected on ice jam thickness, water levels and the usual meteorological condition. Field data will be used to calibrate physical models of this river.
- Recent reports: USA CRREL Report "Analysis of Ice Jams and their meteorological indicators for three winters (1976-78)" by Roy E. Bates and Mary Lynn Brown.
- 80-35 ICE MANAGEMENT IN LAC ST. PIERRE, QUEBEC--J.V. Danys, Transport Canada, Canadian Coast Guard, Marine Aids Division, Ottawa.
- Objectives: To study and control the behaviour of ice in the St. Lawrence Seaway. Further work in progress.
- Recent reports: Obtainable from Canadian Journal of Civil Engineering.
- 80-36 RESEARCH ON FRESH WATER ICE--Bernard Michel, Université Laval, Département de Génie civil, Québec.
- Objectives: The following projects are underway: frazil ice studies; mechanical properties of fresh water ice; ice impact on structures; internal stresses in lake ice; ice and micro-climate.
- Recent reports: (1) Michel, B. (1978) - "A mechanical model of creep of polycrystalline ice", Revue canadienne de géotechnique, Vol. 15, No. 2, pp 155-170.
- (2) Michel, B. (1978) - "The strength of polycrystalline ice" Revue canadienne de génie civil, Vol. 5, No. 3, pp. 285-300.
- (3) Michel, B. (1978) - "Ice accumulation at freeze-up and break-up" Proc. IAHR Symposium on Ice Problems, Lulea, Sweden, Part 2, pp. 301-317.
- (4) Michel, B. (1978) - "Ice Mechanics" Les Presses de l'Université Laval, Québec 499 p.
- (5) Gagnon, Louis, M.Sc. (1978) - "Le fluage de plaques circulaires de glace S<sub>2</sub>" Thèse de maîtrise présentée au Département de Génie civil, Université Laval.
- (6) Isnard, Jean-Loup, M.Sc. (1978) - "Contribution à l'étude expérimentale de l'indentation des plaques de glace" Thèse de maîtrise présentée au Département de Génie civil, Université Laval.

Michel, B.; Purves, W. and Soucy, A. (1979) - "Ice effects on oceanographic conditions in Rupert Bay" Proc. POAC 79, Vol. 1, pp. 515-31.

Robert, S. (1979) - "Note sur la conception d'appareils pour mesurer la contrainte dans la glace" Rapport GCT-79-03, Département de Génie civil, Université Laval, 37 p.

Paradis, M. (1979) - "Analyse mathématique de l'équation différentielle de fluage de la glace" Rapport CGT-79-06, 68 p. Département de Génie civil, Université Laval.

Michel, B. (1979) - "Computation of backwater curves under ice covers" Rapport GCS-79-03, 24 p. Département de Génie civil, Université Laval.

Robert, Sylvain, M.Sc. (1979) - "Contribution à l'étude de la nucléation du frazil" Thèse de maîtrise présentée au département de Génie civil de l'Université Laval.

- 80-37 WINTER COVER ON TEMPERATURE LAKES--Terry D. Prowse, Department of Geography, University of Canterbury, Christchurch, New Zealand, W.P. Adams, Department of Geography, Trent University, Peterborough, Ontario, Canada.

Objectives: To assess both the temporal and spatial variation of snow, white ice and black ice on temperate lakes. Work has been concluded.

Recent reports: (1) Prowse, T.D. 1978, Winter Cover on Temperate Lakes (unpublished M.Sc. thesis, Trent Univ. Canada) 284 p.

(2) Prowse, T.D. & Adams, W.P., The Evolution and Magnitude of Spatial Patterns in the Winter Cover of Temperate Lakes (in preparation).

- 80-38 THE RELATIONSHIP BETWEEN WINTER LAKE COVER, RADIATION RECEIPTS AND THE OXYGEN DEFICIT IN TEMPERATE LAKES--T.D. Prowse, Dept. of Geography, R.L. Stephenson, Dept. of Zoology, University of Canterbury, Christchurch, New Zealand.

Objectives: To assess the role of snow, white and black ice on controlling winter lacustrine radiation receipts and their impact on the winter oxygen deficit.

Recent reports: Prowse, T.D. & R.L. Stephenson (in preparation)  
The Relationship between Winter Lake Cover, Radiation Receipts and the Oxygen Deficit in Temperate Lakes.

THE ESTIMATION OF LIGHT TRANSMISSION THROUGH A MULTI-LAYERED SNOW AND ICE LAKE COVER IN SUBARCTIC QUEBEC--Nigel T. Roulet (Grad. Student) Dr. W.P. Adams (Advisor) Dept. of Geog., Trent University, Peterborough, Ontario.

Objectives: The basic objective of this work is to provide a simple model for the transmission of light through snow and ice covers of a lake, using gross measurements of these parameters. It is hoped that through this work the spatial significance of the lake cover as a 'filter' of light will be recognised - we are now in the final data collection stage of the research.

- 80-40 LIARD RIVER SPRING FLOOD - ICE JAM STUDY--David A. Sherstone: Snow & Ice Div., National Hydrology Research Institute, Environment Canada, Ottawa.

Objectives: (1) Study of locations, frequency and severity of river ice jams during spring break-up. (2) Study of processes responsible for ice jam creation and destruction and resultant channel bank and bed modification by ice action. (3) sediment production by ice during break-up.

Recent reports: (1979) Progress report currently completed and awaiting printing. 1980 final report due Dec. 1980.

80-41 DEFORMATION AND FAILURE OF FRESH-WATER ICE--N.K. Sinha, Division of Building Research, National Research Council of Canada, Ottawa.

Objectives: To investigate the rheological and mechanical properties of river and lake ice. Further investigations have been carried out on the rate sensitivity of compressive strength of S-2 ice. A numerical method of predicting strain history from stress history has been developed.

Recent reports: (1) Sinha, N.K. Rate sensitivity of compressive strength of columnar-grained ice. Prepared for presentation at 1979 Spring Meeting, Society of Experimental Stress Analysis, San Francisco, 20-25 May, 1979.

(2) Sinha, N.K., and Frederking, R. Effect of test system stiffness on strength of ice. Proc. POAC '79, Fifth Int. Conf. on Port and Ocean Engineering under Arctic Conditions, Aug. 13-18, 1979, Vol. 1, pp. 708-717.

80-42 ICE COVER BREAK-UP ON A SMALL HIGH ARCTIC LAKE--M.K. Woo & R. Heron, Department of Geography, McMaster University, Hamilton, Ontario.

Objectives: The objective of this project is to obtain an understanding of, and to model, the break-up processes of the ice cover of a typical small lake in the High Arctic. Field work was carried out near Resolute Bay, N.W.T. during the summer of 1979. A further field season is planned for the summer of 1980.

## 7. HIGHWAYS AND BUILDINGS

80-43 HYDROLOGIC STUDIES, MACKENZIE DELTA REGION, N.W.T.--J.C. Anderson; A.W. Gell, Snow & Ice Division, Environment Canada, Ottawa.

Objectives: - provide hydrologic information (snow cover; summer rainfall; runoff; river ice conditions; icings) relevant to the design and construction of northern highways; - determine mean water balance component magnitudes in tundra and taiga environments.

Recent reports: J.C. Anderson (1979) "Hydrologic Studies in the Mackenzie Delta Region, N.W.T., 1978." Report for the Northern Roads Environmental Working Group, Indian and Northern Affairs, Ottawa. 48 p. appendices (internal report).

80-44 ICE ENGINEERING--R. Frederking, Division of Building Research, National Research Council of Canada, Ottawa.

Objectives: To establish the criteria required for the design of structures subject to forces due to river, lake or sea ice, and for the assessment of the load carrying capacity of ice covers. The ice behaviour around the dock at Nanisivik, N.W.T., has been studied and a qualitative model of ice behaviour formulated.

Recent reports: (1) Frederking, R. Laboratory tests on downdrag loads developed by floating ice covers on vertical piles. Proceedings POAC '79, The Fifth Int. Conf. on Port and Ocean Engineering under Arctic Conditions, Aug. 13-18, Trondheim, pp. 1097-1110.

(2) Frederking, R. Ice action on Nanisivik Wharf, Strathcona Sound, N.W.T., Winter 1979-80. Submitted to Can. J. Civil Eng.

80-45 SNOW LOADS ON ROOFS IN CANADA--D.A. Taylor, National Research Council Canada, Division of Building Research, Ottawa.

Objectives: In general, to provide information for the improvement of the Commentary on Snow Loads in the National Building Code of Canada and to help designers with snow load problems. In particular (1) to collect data on the density of snow on roofs across Canada in order that depth measurements can be reliably converted to loads; (2) to survey snow loads on flat and multi-level flat roofs and on drifts

where the roofs change levels; (3) to study the effect of slope and roof texture on the accumulation of snow on sloping roofs; (4) to collect data for improvement of the unbalanced snow distributions used for the design of cylindrical arch-shaped roofs; (5) to survey snow on arena-type roofs in Canada; (6) to study snow loads on mobile homes and; (7) to prepare general papers to assist designers and the construction industry with roof snow load problems.

Recent reports: (1) D.A. Taylor (1979). A Survey of Snow Loads on the Roofs of Arena-type Buildings in Canada, Canadian Journal of Civil Engineering, Vol. 6, No. 1, pp 85-96; also available as National Research Council of Canada Paper No. NRCC 17278, Ottawa, Ontario.

(2) D.A. Taylor (1980). Roof Snow Loads in Canada, Canadian Journal of Civil Engineering, Vol. 7, No. 1, pp 1-18.

(3) D.A. Taylor. Snow Loads for the Design of Cylindrical Curved Roofs in Canada: 1953-1980. Submitted to the Canadian Journal of Civil Engineering.

(4) D.A. Taylor and W.R. Schriever. An Investigation of Unbalanced Snow Distributions for the Design of Arch-shaped Roofs in Canada, submitted to the Canadian Journal of Civil Engineering.

(5) D.A. Taylor. A study of Snow Density on Roofs in Canada, in preparation.

## 8. SOIL AND WATER FROST

80-46 PREDICTION DU GEL SAISONNIER DANS LE TERRITOIRE DE LA BAIE JAMES--Bhawan Singh et James T. Gray, Université de Montréal, Département de Géographie, Montréal.

Objectives: To be able to predict the depth and duration of seasonal frost from measurable components of the radiation and energy balances.

Recent reports: (1) CINEP special publication March, 1980.

(2) To be submitted to Journal Canadien de la Science de la Terre.

## 9. REMOTE SENSING

80-47 INVESTIGATION OF THE APPLICATION OF HCMM THERMAL DATA TO SNOW HYDROLOGY--James C. Barnes, Environment Research & Technology, Inc., Concord, Massachusetts.

Objectives: Determine utility of thermal infrared data from the Heat Capacity Mapping Mission (HCMM) Satellite for measuring snow surface temperatures.

Recent reports: report expected in 1980.

80-48 PREPARATION OF SATELLITE SNOW MAPPING AND RUNOFF PREDICTION HANDBOOK--James C. Barnes/C. James Bowley, Environmental Research and Technology, Inc., Concord, Massachusetts.

Objectives: Prepare Handbook as one of the final products of NASA Applications Systems Verification Test on Operational Applications of Satellite Snowcover Observations.

Recent reports: Handbook is currently in printing by NASA.

Paper: "The Evolution of Satellite Snow Mapping with Emphasis on the Use of Landsat in the Snow ASVT Study Areas" by J.C. Barnes and C.J. Bowley presented at NASA Workshop (April 1979) on Operational Applications of Satellite Snowcover Observations.

80-49 AIRBORNE GAMMA RADIATION SNOW SURVEY TECHNIQUES--Thomas R. Carroll and Eugene L. Peck, National Weather Service, Office of Hydrology, Minneapolis River Forecast Center, Minneapolis.

Objectives: Conduct research related to soil moisture and snow water equivalent calculation using natural terrestrial gamma radiation attenuation techniques. Establish optimum flight line network for operational airborne snow survey program.

Recent reports: Airborne Snow Survey using Natural Gamma Radiation.

- 80-50 REMOTE SENSING OF SNOW COVER: SURSAT SNOW EXPERIMENT--B.E. Goodison; S. Waterman; A. Wankiewicz; E. Langham; J. Metcalfe, Environment Canada.

Objectives: Overflights by a Convair 580 to obtain synthetic aperture radar and scatterometer data were done at intervals during the 1978-1979 winter. An extensive simultaneous ground based data collection program was carried out in March 1979 for one of the flights. Evaluation of the X and L band data continues, but X band gives more information on snowpack conditions than L band. A report is in preparation.

- 80-51 COMPUTER ENHANCED SNOW COVER ANALYSIS OF SATELLITE DATA--W.D. Hogg, A.J. Hanssen, S. Waterman, Hydrometeorology Division, Atmospheric Environment Service, Canada.

Objectives: Development of operational, semi-automated techniques for estimating snow cover extent on a sub-basin on grid square basis using polar orbiting meteorological satellite data. Operational maps of the Saint John Basin are being provided for the 1980 season.

Recent reports: Hogg, W.D. and A.J. Hanssen, "Computer Enhanced Snow Cover Analysis of Satellite Data". Proceedings Canadian Hydrology Symposium: 1979 pp. 414-423.

- 80-52 SNOW COVER ANALYSIS USING LANDSAT DIGITAL DATA--Carolyn J. Merry, Harlan L. McKim, U.S. Army Cold Regions Research and Engineering Laboratory, Hanover, NH.

Objectives: To map snow/cover vegetation categories from Landsat digital data for correlation to groundtruth data on water equivalent. These data serve as input to the SSARR (Streamflow Synthesis and Reservoir Regulation) model for predictions of spring runoff.

Recent reports: Merry, C.J. and H.L. McKim (1978) Computer processing of Landsat digital data and sensor interface development for use in New England reservoir management, Final Contract Report submitted to the Water Control Branch, New England Division and NASA, CRREL Special Report 78-6, 66 p.

- 80-53 MAPPING NEW ZEALAND AND ANTARCTIC SNOWPACK FROM LANDSAT--Terry D. Prowse, Dept. of Geography, University of Canterbury, Christchurch, New Zealand, I.L. Thomas, Physics and Engineering Laboratory, Dept. of Scientific and Industrial Research Lower Hutt, New Zealand, I.F. Owens, Dept. of Geography, University of Canterbury Christchurch, New Zealand.

Objectives: To classify snowcover and its areal extent with the use of landsat digital data, Work has been concluded.

Recent reports: I.L. Thomas, with T.D. Prowse and I.F. Owens, 1979. Mapping New Zealand and Antarctic Snowpack from Landsat. In: Proceedings of final workshop on operational applications of satellite snowcover observations. Sparks Nevada: 16-17 April 1979. Also as PEL report no. 643.

- 80-54 MODELLING OF SHORTWAVE RADIATION FOR SNOW COVERED TERRAIN -- S.E. Waterman, Hydrometeorology Division, Atmospheric Environment Service, Canada.

Objectives: Model spectral flux of diffuse and direct solar radiation incident on snow covered surfaces for various atmospheric and topographic conditions. Simulation of the response of various remote sensors to changing snowpack conditions and evaluation of multispectral remote sensing techniques for snowcover monitoring.

Recent reports: (1) Waterman, S.E. (in press) "Investigation of Multispectral Remote Sensing of Snow Cover using a Solar Radiation Model". Proc. of the 6th Canadian Symp. on Remote Sensing Halifax N.S. May 1980.

(2) Waterman, S.E. (in press) "Modelling of Shortwave Radiation for Snow Covered Terrain". Proc. 37th Eastern Snow Conf. Peterborough, Ontario, June 1980.