

Annual Report for Research Centers and Institutes
Reporting Period 2002 and 2003
(April to April)

Centre for Earth Observation Science (CEOS)

Level 1 Centre
Faculty of Environment, University of Manitoba

Prepared by:

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Executive Summary

The Centre for Earth Observation Science (CEOS) was established in 1994 with a mandate to research, preserve and communicate knowledge of earth system processes using the technologies of Earth Observation Science.

This document is the Annual report for the period April 2002 to April 2003, which represents the previous fiscal year of operation.

CEOS educates and trains young scientists at the undergraduate and graduate levels in the field of Earth Observation Science. CEOS core courses consist of Physical Geography courses focusing on Earth System Science; Human Geography courses linking humans to the environment; and specialized techniques courses relating to the technologies used in Earth Observation Science.

The basis of CEOS is research partnerships, leveraging resources and providing a research umbrella under which members conduct multi-disciplinary collaborative research projects. Future research activities will continue to build on the research strengths of CEOS members and partners. Areas of application include climate change, particularly in the Arctic, agriculture, forestry, freshwater and geomatics. CEOS anticipates being an integral part of the new Faculty of the Environment, and looks forward to working closely with other units in the development of this Faculty

Personnel

Faculty

Internal

Barber, D.G., Professor of Environment and Geography (50 percent)
Baydack, R., Associate Professor Environment and Geography (10 percent)
Campbell, M., Assistant Professor Recreation Studies (5 percent)
Gardner, J. Professor of Environment and Geography (5 percent)
Hanesiak, J. Assistant Professor of Environment and Geography (25 percent)
Iacozza, J. Lecturer in Environment and Geography (20 percent)
Kenkel, N, Professor of Botany (10 percent)
Papakyriakou, T, Assistant Professor of Environment and Geography (25 percent)

External

Yackel, J. Professor of Geography University of Calgary (25 percent)

Post Doctorial Fellows

Walker, David (100 percent) (Supervisor: Drs. Barber and Baydack)
Fortier, Martin (100 percent) until August 2002 (Supervisor: Dr. Barber)

Research Associates

Support Staff

Fast, Doug, Cartographic support (10 percent)
Mossdrop, David R., Operations Manager of CEOS. (50 percent)
Roberecki, Aggie, Administrative support for CEOS, (50 percent)

Scientific Programmer

Chan, Wayne, Programmer (100 percent)

Students (Ph.D. Masters and honours)

The following students were supported (financially and/or logistically) over the reporting period, April 2002 to April 2003.

Name	Years Supervised	Degree (date)	Research Topic	Advisor
Butler, J	2002-2004	MA	Modeling Severe weather in the Prairies.	Hanesiak
Chen, Z.	2003-2005	MA	Climatology of the Canadian Prairies	Papakyriakou
Cooley, P.	1996-2001 (continuing)	Ph.D. (2004)	Development of a GIS based biodiversity atlas for Lake Malawi, Africa.	Barber
Galley, R.	2002-2004	MA	Climate Change in the Arctic	Barber
Geldsetzer, T.	2002-2006	PhD	Polarimetric Microwave Remote Sensing of Snow Covered Sea Ice	Yackel
Hochheim, K.	1995-2000 (continuing)	Ph.D. (2003)	Microwave and optical remote sensing of agricultural surfaces.	Barber
Hwang, P	2002-2006	PhD	Sea-ice microwave scattering	Barber
Kirk, R	2001-2002 (continuing)	MA (2004)	Melt ponds on sea ice	Barber
McCullough, G.	1998-2002 (continuing)	Ph.D. (2004)	River Sediment loading studies in Lake Malawi.	Barber
Mundy, C.J.	2001-2004	Ph.D. (2004)	Biological implications of snow thickness distributions on sea ice.	Barber
Owens, O.	2003-2005	MA	Polar Marine Environments	Papakyriakou
Saczuk, E.	1999-2002 (continuing)	PhD (2003)	Mass Wasting in the Himalaya	Gardner
Scharien, R.	2001-2004	MSc	Geophysical and microwave remote sensing investigations of melt ponded first-year Arctic sea ice	Yackel
Silvestrie, G.	1996-2001 (continuing)	PhD (2001)	Decision making of the Elderly	Smith
Smid, B	2000-2004	PhD (2004)	Using Recreational Habitat Suitability Indices (rHSI) to better manage the recreational potential of boreal ecosites	Campbell
Vasudevan, A.	2001-2003	MNRN	Incorporating Ecosite-level biodiversity values in forest management and decision support	Baydack
Wiseman, G.	2001-2003	MA (2003)	Mapping boreal ecosites and enhancing forest GIS inventories with remotely sensed data and evidential reasoning.	Barber.

Activities and Research Projects

Selected activities are highlighted below:

Proposal Development:

The Agassiz Centre – a Canada Foundation for Innovation (CFI) institutional innovation fund application (2002-onwards)

Dr. Barber will lead a multidisciplinary proposal to the CFI institutional innovation fund competition for a \$20M infrastructure to support the science of water interactions in the lithosphere, biosphere, and atmosphere within the province of Manitoba. Science to be supported by this infrastructure will focus attention on the role of freshwater flux variability as a function of global climate change. The centre will, if successful, be a major centre within the new Faculty of Environment.

ArcticNet – a Networks of Centres of Excellence proposal. (2002 – 2009)

Dr. Barber is one of four principals in the NCE application to create a network of Centres of Excellence in the theme of polar marine science. (The ArcticNET NCE was funded in July, 2003 at a level of \$45M.) He will lead one of four themes entitled “Land-Ocean Interactions in Sub-Arctic Hudson Bay: Managing the Largest Canadian Watershed in a New Climate”. This theme will see a major field experiment in Hudson Bay using the new Canadian Research Icebreaker as a platform for social, medical, physical and marine ecosystem studies of the Hudson Bay and associated inputs of freshwater. Dr. Barber will also participate in each of the other three themes and contribute to the overall management of the NCE through his membership on the Scientific Steering Committee.

On-going Projects:

The Canadian Arctic Shelf Exchange Study (CASES)
2001 - 2006

CASES was accepted as an NSERC national network award. Part of the CASES project will examine the relationship between the observed reduction in sea ice extent and volume with aspects of the marine ecosystem. This climate change study focuses on the mechanisms which couple physical and biological processes and will entail a year long field experiment in the Beaufort Sea and Amundsen Gulf in Arctic Canada. The team is led by L. Fortier (University of Laval). Dr. Barber was selected as a steering committee member and currently leads a subgroup on coupled physical/biological processes. Dr. Barber's subgroup will examine thermophysical controls on subice primary production and develop remote sensing and modelling tools for the estimate of the sensitivity of primary production to climate variability and change. His subgroup consists of 7 PI's from Canada, USA, UK, Japan, and Poland. He currently has a post-doc who has applied

to NSERC to come to the lab (from Laval) for a two-year period to work on this program. The final CASES proposal has a budget in excess of \$9.9M.

A Canadian Research Icebreaker – A program funded by the Canada Foundation for Innovation ‘International Fund’.

(2002 – 2017)

Dr. Barber is a principal investigator in the CFI application to purchase and retrofit a Canadian Coast Guard Ship as a research platform for polar science. This application was funded at a level of \$27.7M. These funds have been used to retrofit the structure of the ship and to purchase in excess of \$8M in scientific equipment which is integrated into the ship infrastructure. The ship will form the basis for a new polar science platform in which Canadians would lead International investigators in multidisciplinary polar science. His lab leads the sea ice components of this program and we are responsible for sea ice and meteorological infrastructure of the ship.

CONVECTION: Greenland Sea Convection mechanisms and Their Climatic Implications 2000-2005

CONVECTION is a collaborative research program to be performed in the Greenland Sea by a consortium of 11 institutes from 8 countries within the European Union and Dr. Barber’s lab in Canada. CONVECTION aims to assess open-ocean deep water production in the Greenland Sea by a combination of operational remote sensing, modelling and field measurements. This program seeks to understand the physics underlying convection and how this process links with global climatic factors. The field measurements comprise work in two winter and three summer cruises. Dr. Barber’s lab will work closely with partners at the Scott Polar Research Institute (Cambridge University, UK) and the Danish Meteorological Institute (Copenhagen) on the integration of Radarsat and surface energy balance measurements within CONVECTION. This project has been funded to a level of \$2M+ Euro-dollars.

Canada Research Chair ‘Arctic System Science’

(2002-2009)

Dr. Barber was selected as a Tier 2 CRC chair to work on aspects of polar marine science. His scientific program examines aspects of atmospheric and oceanic forcing of sea ice dynamic and thermodynamic processes under the auspices of global climate change. The program also examines aspects of physical and biological coupling in the marine ecosystem through such programs as CASES, NOW and ArcticNet.

C-ICE

The Collaborative Interdisciplinary Cryospheric Experiment (*C-ICE*) is a multi-year field experiment that integrates many individual projects, each with autonomous goals and objectives. The science conducted has directly evolved from research relating to one of four general themes: i. sea ice energy balance; ii. numerical modeling of atmospheric processes; iii. remote sensing of snow covered sea ice; and iv. ecosystem studies.

i. Sea Ice Microclimate: The energy balance over sea ice is understood only in a very rudimentary fashion. Due to the high contrast between the ocean and atmosphere, the

intervening spatial pattern of the sea ice leads to dramatic fluctuations in energy transfer. The seasonal nature of radiative contributions further enhances the complexity of the system.

ii. *Numerical Modelling of Atmospheric Processes*: Scale is the primary focus of these studies, linking surface observations to numerical models of the atmosphere operating at regional to hemispheric scales. The objective is to provide estimates of the geophysical and/or energy parameters required by numerical models. Input variables are inverted from remote sensing data of the surface and are used for both initialization and verification.

These baseline prerequisites are essential to monitoring marine cryospheric change. This issue forms a link with themes i., iii. and iv.

iii. *Remote Sensing of Snow Covered Sea Ice*: Energy will interact with the snow covered sea ice as a function of the physical characteristics. The basic premise of this work is that if both the state and seasonal evolution of the sea ice and snow microstructure are known, the interaction mechanisms at any wavelength of energy can be estimated. This leads to the idea that transfer functions must exist whereby interactions at one frequency may be used to estimate the interactions of energy at another frequency.

iv. *Ecosystem Studies*: The marine cryosphere provides habitat for a wide diversity of marine and avian species. The ramifications of change and variability must be coupled with adaptation responses of these biota since the biophysical processes are an integrator of the hydrospheric and atmospheric components of the system.

The Program:

The *C-ICE* field program provides the surface data required to develop an understanding of the process linkages operating in an environment typical of fast ice conditions in the Canadian Arctic Archipelago. A modelling component within *C-ICE* operates in conjunction with the field activities, although the modelling aspects will assume greater importance as the existing field data are analyzed. The principal objective of this subgroup is to integrate the field data within numerical models of the primary processes operating in our area of interest, for the purpose of 'scaling up' observations to more regional scales.

Agencies participating in *C-ICE'2002* include: Centre for Earth Observation Science (University of Manitoba) (lead agency); University of Calgary; Canadian Ice Service, Polar Continental Shelf Project and Energy, Mines and Resources Canada, Environment Canada; Canada Centre for Remote Sensing; Atmospheric Environment Service, Downsview, Ontario; National Research Council, Ottawa, Ontario; the Winnipeg Climate Centre and Transport Canada.

The duration of this year's field program was 11 weeks, extending from day 120 (April 30) to day 194 (July 13). The base camp was established on Truro Island (75°14.686'N, 97°09.207'W). The camp was located approximately 80 km NW of Resolute, Nunavut.

This location allowed easy access to the various sites on the first-year sea ice in McDougall Sound. Various physical measurements were made on the sea ice, less than 5 km from the location of base camp

Northern Scientific Training Program fundees for CICE 2002 were:

CJ Mundy - 1st year PhD student - funded \$3500
John Iacozza- 1st year PhD student - funded \$3500
Ryan Galley - 1st year Masters - funded \$3500
Philip Hwang - 1st year PhD student - funded \$3300

Development of an Ecosite-based Decision Support System for Sustainable Forest Management (continuing, application for funding into 2004)

This is a three year project fund as a CFS/NSERC/SSHRC Forest Research Partnerships Program.

Objectives

To develop an integrated ecosite level classification and sustainable forest management decision support system that incorporates conservation of biological diversity, nature-based outdoor recreation/tourism, and conservation of spiritual, cultural and aesthetic resources. The broad objectives of the project are to:

1. Develop a GIS database identifying ecosites for Manitoba.
2. Apply the ecosite classification to forest management in Manitoba.
3. Develop and apply a model for biodiversity conservation using ecosites.
4. Identify and correlate recreation/ tourism experiences based on ecosites.
5. Develop a decision support system for sustainable forest management linked to the ecosite classification.
6. Develop a mechanism to facilitate communication of our results to all partners.

Research achievements and progress:

- Continued support for serving project information on the web with the addition of an on-line version of the Field Sampling Manual and revisions of material (<http://www.umanitoba.ca/geography/ecosite>).
- Continued application of the preliminary key, ecosite descriptors and primary data collection at 120 sites established in the Province (stratified by Terrestrial Ecozones).
- Development of an aerial photographic key to the Ecosites.
- Development of a stratified model to be used in generating a rHSI for boreal canoeists.
- Field sampling along three boreal rivers (in addition to the existing river database) that totaled more than 570 kilometers of river routes and 351 river sites/features that were visited/verified.

- Field sampling and telemetry collection along key recreational trails in the Province that included 233 kilometers of summer use trails visited and mapped.
- Incorporation of time-series Landsat ETM+ within the project GIS database layers. Initial workflow has been completed on augmenting the existing inventory with biophysical attributes derived from the remotely sensed imagery.
- Initiated an aboriginal traditional knowledge component as a test application of the Ecosite classification

Lake Winnipeg Research Consortium (LWRC)

CEOS is a founding member of the Lake Winnipeg Research Consortium. This organization facilitates multi-disciplinary science, coordinates public and private research, and promotes information-sharing. This past summer was the third field season for this group and CEOS actively collected field data for ~30 days on the Lake and obtained remote sensing data for the entire field season of the group. CEOS also provided a portable GPS data collection system for use in vessel tracking on Lake Winnipeg and use one of CEOSs' spectral radiometers to collect reflectance data during the lake cruise.

CEOS has received funding for and is conducting a project on Chlorophyll Mapping using MODIS/MERIS imagery over Lake Winnipeg. This has been Year II of a four-year project designed to test and refine algorithms for use in mapping chlorophyll concentrations in Case 2 waters in Lake Winnipeg using NASA's Terra MODIS and the European Envisat MERIS satellite data in Chlorophyll-a and sediment concentration in Lake Winnipeg will be mapped over three open water seasons for the determination of lakewide primary productivity and carbon sequestration.

The Canadian Cryospheric Systems Experiment (CRYSYS)

1989 - Present

CRYSYS is a Canadian led international project initiated by the Meteorological Survey of Canada (B. Goodison, PI). The CRYSYS project examines aspects of the cryosphere (portions of the planet system containing frozen water) relative to climate variability and change. The objective is to develop the capabilities to monitor pertinent geophysical variables of the cryosphere using remote sensing and to utilize these data in modeling cryospheric processes. CRYSYS is a foreign interdisciplinary project within the NASA Earth Science Enterprise program and is funded by MSC, NASA, and NSERC. CEOS is making available on-line (through the CCIN website as well as the CEOS website) a subset of the C-ICE data archive for use by the general science community.

Academic Contributions

Primary Publications

- Ingram, G., J. Bacle, D. Barber, Y. Gratton, H. Melling. Physical Processes in the North Water Polynya. *Deep Sea Research*. In press (Jan'02).
- Cooley, P. and D.G. Barber. Remote Sensing of the Coastal Zone of Tropical Lakes using Synthetic Aperture Radar and Optical Data. *International Association of Great Lakes Research*. In Press (June'02).
- Hunter, F., Donald, D., F. Hunter, B. Johnson, W Hyde, J. Hanesiak, M. Kellerhals, R. Hopkinson and B. Oegema, 2002: The Vanguard torrential storm (Meteorology and Hydrology). *Can. Water Resour. J.*, 27, No. 2, 213-227.
- Barber, D.G. and J. Iacozza. Historical analysis of sea ice conditions in M'Clintock Channel and Gulf of Boothia, Nunavut; Implications for Ringed Seal and Polar Bear Habitat. *Arctic*. In Press (April'03).
- DeAbreu, R.A., J. Yackel, D. Barber and M. Arnett. Operational Satellite Sensing of Arctic First Year Sea Ice Melt. *Canadian Journal of Remote Sensing*. In Press (Jan'03)
- Barber, D., J. Iacozza, and A. Walker. On the Estimation of Snow Water Equivalent (SWE) using microwave Radiometry over First-Year Sea Ice. *Hydrological Processes*. In Press (Sept'02).
- Cooley, P. and D.G. Barber. Remote Sensing of the Coastal Zone of Tropical Lakes using Synthetic Aperture Radar and Optical Data. *International Association of Great Lakes Research*. In Press (June'02).
- Ingram, G., J. Bacle, D. Barber, Y. Gratton, H. Melling. An Overview of Physical Processes in the North Water. *Deep Sea Research II*. 49(22-23): 4893-4906
- Hanesiak, J.M., S. Lobban and R.L. Raddatz, 2003: Local initiation of deep convection on the Canadian Prairie Provinces. *Boundary Layer Met.* (in press)
- Barber, D.G. and J.M. Hanesiak, 2003: Meteorological forcing of sea ice concentrations in the Southern Beaufort Sea over the period 1978-2001. *J. Geophys. Res.* (accepted)
- Hunter, F., Donald, D., F. Hunter, B. Johnson, W Hyde, J. Hanesiak, M. Kellerhals, R. Hopkinson and B. Oegema, 2002: The Vanguard torrential storm (Meteorology and Hydrology). *Can. Water Resour. J.*, 27, No. 2, 213-227.
- Yackel, J.J , 2003. Observations of snow and first-year sea ice thickness using a small EM induction device. Oral Presentation. 8th Annual Environment Canada – CRYospheric SYStem (CRYSYS) Meeting, Montreal, QC. March 23-25, 2003
- A. Rees and Yackel, J.J , 2003. Application of passive and active microwave data for determining snow cover properties in the Chinook belt of Alberta. Oral Presentation. 8th Annual Environment Canada – CRYospheric SYStem (CRYSYS) Meeting, Montreal, QC. March 23-25, 2003
- S.E. Howell and Yackel, J.J , 2003. A vessel transit analysis of sea ice in the Western Arctic, 1969-2002: implications for ship navigation. Poster presentation. 8th Annual Environment Canada – CRYospheric SYStem (CRYSYS) Meeting, Montreal, QC. March 23-25, 2003

- Yackel, J.J , 2003. On the utility of diurnal measurements of snow covered first-year sea ice microwave scattering for estimating surface and climate state variables. Oral Presentation. 37th Annual Canadian Meteorological and Oceanographic Society (CMOS) meeting. Ottawa, Ontario, June 25-27, 2003.
- R. Scharien and Yackel, J.J , 2003. An approach for quantifying melt ponded first-year sea ice surface roughness: implications for microwave scattering. Poster presentation. 8th Annual Environment Canada – CRYospheric SYStem (CRYSYS) Meeting, Montreal, QC. March 23-25, 2003.
- Yackel, J.J , 2002. CRYSYS snow cover monitoring research at the University of Calgary. 7th Annual Environment Canada – CRYospheric SYStem (CRYSYS) Meeting., Victoria, B.C., March 24-26, 2002
- Yackel, J.J. and D. G. Barber. 2002. Towards Validation of a Snow Water Equivalence Algorithm over landfast first-year sea ice using RADARSAT-1. Oral Presentation. IEEE Geosciences and Remote Sensing Symposium and 24th Canadian Symposium on Remote Sensing, Toronto, Ontario, June 24-28, 2002.
- R. Scharien and Yackel, J.J . On the relationship between wind speed, sea ice melt pond morphology and SAR scattering. Poster Presentation. IEEE Geosciences and Remote Sensing Symposium and 24th Canadian Symposium on Remote Sensing. Toronto, Ontario, June 24-28, 2002.
- Rees and Yackel, J.J , 2002. Evaluating the Synergistic use of SMM/I and ERS-2 SAR for Snow Water Equivalent (SWE) and Snow Covered Area (SCA) Estimations. IEEE Geosciences and Remote Sensing Symposium and 24th Canadian Symposium on Remote Sensing. Toronto, Ontario, June 24-28, 2002.

Papers in review

- Baggaley, D.G. and J.M. Hanesiak, 2003: An empirical blowing snow forecast technique for the Canadian Arctic and Prairie Provinces, Weather & Forecasting

Technical Papers

Hanesiak, J.M., E. Carriere and T. Fisisco
 Climatology of adverse weather events in the Canadian Arctic
 CEOS-tech-2003-2, Geography Department
 Faculty of Environment, University of Manitoba
 Winnipeg, MB, R3C 2N2.

Barber, D.G., J.M. Hanesiak, W. Chan and C. Blouw
 An overview of the Ocean-Sea ice-Atmosphere (OSA) system in the CASES study region over the period 1978 to 2001
 Centre for Earth Observation Science Technical report # CEOS-Tech-2003-1
 Faculty of Environment, University of Manitoba
 Winnipeg, MB. Canada. R3C 2N2

Workshops/Meetings/Presentations/Conferences Papers

Hanesiak, J.M. and S. Lobban, 2002

Pilot Study of the Role of Land Surface Forcing On Prairie Convection Initiation, Internal Report, Available at the Atmospheric & Hydrological Sciences Division (AHSD) Prairie & Northern Region, Meteorological Service of Canada
Winnipeg, Manitoba, pp. 17.

McCullough, G.K. March, 2003. The Temperature of Lake Winnipeg. Preliminary Report on Development of a Thermal Model. Paper presented at the Annual Science Meeting of the Lake Winnipeg Research Consortium, Winnipeg, 28 March, 2003.

Kling, H.J., M.P. Stainton, G.K. McCullough, A.G. Salki, and L.L. Hendzel. 2002. Changing phytoplankton in FLake Winnipeg: a result of eutrophication/impoundment, climate change or exotic species. 45th Conference on Great Lakes Research, Winnipeg, 2-6 June, 2002.

McCullough, G.K. 2002. Flow and sediment transport in Lake Malawi near the mouth of the Linthipe River described using optical backscatter and acoustic Doppler current profile data. 45th Conference on Great Lakes Research, Winnipeg, 2-6 June, 2002.

McCullough, G.K., D.G. Barber, M. Stainton and H.J. Kling. 2002. Relationships between AVHRR and MODIS reflectance data and in-situ chlorophyll concentrations in a large turbid lake, Lake Winnipeg. 45th Conference on Great Lakes Research, Winnipeg, 2-6 June, 2002.

McCullough, G.K., P.M. Cooley and K. Hocheim. 2002. 16 year retrospective analysis of suspended sediment patterns in Lake Winnipeg using NOAA AVHRR imagery. 45th Conference on Great Lakes Research, Winnipeg, 2-6 June, 2002.

Stainton, M.P., G.K. McCullough and G.J. Brunskill. 2002. Changes in the source and fate of carbon, nitrogen and phosphorous in a large turbid lake/reservoir, Lake Winnipeg. 45th Conference on Great Lakes Research, Winnipeg, 2-6 June, 2002.

Stainton, M.P and G.K. McCullough. Effect of climate change on nitrogen and phosphorous loading to Lake Winnipeg. 2002. 45th Conference on Great Lakes Research, Winnipeg, 2-6 June, 2002.

McCullough, G.K. March, 2003. Chlorophyll Mapping using MODIS/MERIS imagery over Case 2 Waters, Lake Winnipeg Annual Report 2002/03. Report to the Canadian Space Agency on Research funded under a Canadian Space Plan Proposal to the Earth and Environment Applications Program, 2002/03 to 2004/05.

Invited speaker, Barber, D.G., Sea Ice and the North Water Polynya. Chapman Conference on Arctic Oceanography. Montreal, PQ. Aug'02.

Invited speaker, Barber, D.G., Sea Ice and Climate Processes. Canadian Meteorological and Oceanographic Society (CMOS) Annual Congress, Rimouski, PQ. May'02.

Hanesiak J.M. (Oral Presentation), Local Initiation of Deep Convection on the Canadian Prairie Provinces, 37th annual CMOS Conference, Ottawa, Ontario, June 2-5, 2003

Hanesiak J.M. (Oral Presentation), Utility of a Blowing Snow Model for Operational Forecasts on the Canadian Prairies and Arctic, 37th annual CMOS Conference, Ottawa, Ontario, June 2-5, 2003

Hanesiak J.M. (Co-author), Arctic Polynyas and Climate Change Experiences from the NOW and CASES research networks, 37th annual CMOS Conference, Ottawa, Ontario, June 2-5, 2003

Hanesiak J.M. (Co-author), Modeling surface exchange and heat transfer for the shallow snow cover at SHEBA, Seventh Conference on Polar Meteorology and Oceanography and Joint Symposium on High Latitude Climate Variations (AMS), 12-16 May 2003, Hyannis, Massachusetts, USA

Hanesiak J.M. (Co-author), Meteorological forcing of sea ice variability in the Southern Beaufort Sea, Seventh Conference on Polar Meteorology and Oceanography and Joint Symposium on High Latitude Climate Variations (AMS), 12-16 May 2003, Hyannis, Massachusetts, USA

Hanesiak J.M. (Co-author), Spectral radiative transfer through high Arctic clouds and their theoretical effects on under-ice primary production, Gordon Research Conference on Polar and Marine Science, Ventura, CA, March 16-23, 2003

Hanesiak J.M. (Co-author), Oceanic and Atmospheric Controls on the formation and dissolution of the North Open Water (NOW) Polynya Ice Bridge, Chapman Conference on High Latitude Ocean Processes, Montreal, QC, August 23-26, 2002

Hanesiak J.M. (Oral Presentation), Preliminary Meteorological Look At An Extreme Precipitation Event In The High Arctic, 36th annual CMOS Conference, Rimouski, Quebec, May 22-25, 2002.

Hanesiak J.M. (Oral Presentation), Sea-Ice Simulations Using a Coupled One-Dimensional Thermodynamic Snow Sea-Ice Model, 36th annual CMOS Conference, Rimouski, Quebec, May 22-25, 2002.

Hanesiak J.M. (Co-author), Wind Speed and Blowing Snow for the Canadian Prairie and Arctic, 36th annual CMOS Conference, Rimouski, Quebec, May 22-25, 2002.

Hanesiak J.M. (Co-author), Ramifications of Interannual Variation of the Springtime Climate on the Energy Budget of Sea Ice in the Canadian Arctic Archipelago, 36th annual CMOS Conference, Rimouski, Quebec, May 22-25, 2002.

Hanesiak J.M. (Co-author), Physical and Biological Impacts of Early Spring Melt on the First-Year Ice Environment of the Canadian Arctic Archipelago, 36th annual CMOS Conference, Rimouski, Quebec, May 22-25, 2002.

Funding Sources

Research Support held by CEOS Principle investigators

The following research grants (dollars and/or value-in-kind) were obtained or held within the reporting period.

Principal Investigator	Grant Description	Amount
Barber, D.G.	Meteorological Services of Canada. Research Grant to examine the role of clouds in microwave emission over sea ice.	
Barber, D.G.	Meteorological Services of Canada. Research Grant to link microwave remote sensing to a one-dimensional thermodynamic model of snow covered sea ice.	
Barber, D.G.	University of Manitoba Research Support Grant to prepare an application for a Networks of Centre's of Excellence in Arctic System Science.	
Barber, D.G.,	Canadian Arctic Shelf Exchange Study (CASES; L. Fortier/Laval/PI). An NSERC network grant for \$10M over 5 years; Dr. Barber's portion in cash is over and above access to ship time.	
Barber, D.G.,	Canadian Arctic Shelf Exchange Study (CASES; L. Fortier/Laval/PI). Shiptime allocation for subgroup-2 which Dr. Barber lead which is calculated as 57 berths for 42 days each at \$600 per day.	
Barber, D.G.	C-ICE'02 - Polar Continental Shelf Project, Energy Mines and Resources. This is a grant of in-kind support for helicopter, twin otter and snow machine rental; room and board; field equipment and logistical field support.	
Barber, D.G.,	A Canadian Research Icebreaker (L. Fortier, Laval/PI). A CFI international fund award totally 27.5M\$ over four years. Dr. Barber's portion of this grant is 1.14M\$ in direct capital equipment that Dr. Barber's lab purchased and will maintain	
Barber, D.G.,	A Canadian Research Icebreaker (L. Fortier, Laval/PI). A CFI international fund award totally 27.5M\$ over four years. Dr. Barber's portion of this grant is about 3.2M\$ in support in kind for ship time and access to the infrastructure for Dr. Barber's research group	
Barber, D.G.	Northern Studies Training Program to support the C-ICE'02 experiment	
Barber, D.G.	CRYSYS support from Meteorological Service of Canada for modeling snow on sea ice	
Barber, D.G.	University of Manitoba Research Support Grant to prepare an application for a Networks of Centre's of Excellence in Arctic	

Principal Investigator	Grant Description	Amount
Barber, D.G.	System Science. Canada Research Chair (Tier II). Five year grant to support operations of the chair	
Barber, D.G.	Canada Foundation for Innovation. Chair infrastructure award	
Barber, D.G.	Western Economic Diversification and the University of Manitoba. Support to develop a CFI Institutional Innovation Fund proposal for the Agassiz Centre	
Barber, D.G.	Northern Studies Training Program to support C-ICE and CASES 2003 experiments	
Barber, D.G.	Snow Water Equivalent (SWE) estimation and biological linkages. CRYSYS support for ongoing arctic system science program	
Barber, D.G.	Polar Continental Shelf Project (PCSP) logistics support for my Resolute Bay and CASES field experiments in 2003 for twin otter, helicopter and field logistics.	
Barber, D.G.	European Space Agency (ESA) access to ENVISAT data in support of CASES. 275 ASAR scenes Sept 03 to Sept 04.	
Barber, D.G.	Canadian Space Agency. SubIce primary production estimates from Radarsat (with C. Michel, DFO, FWI).	
Barber, D.G.	Canadian Space Agency. Optical Properties of Lake Winnipeg. (with G. McCullough)	
Baydack, R.	Three year grant from the Canadian Forest Service, NSERC and SHRC tri-council to develop an ecological forest classification system in Manitoba (with Dr's Barber and Campbell)	
Hanesiak, J.M.	2002: NSERC Program: Equipment Grants Tethersonde Meteorological Tower (TMT) for Atmosphere-Sea Ice Coupling Studies	
Hanesiak, J.M.	2002-2006(Feb.) NSERC Program: Research Grants (individual) Atmosphere-Sea Ice Coupling	
Hanesiak, J.M.	2002: Atmospheric & Hydrological Sciences Division (Prairie Section) Pilot Study of the Role of Land Surface Forcing On Prairie Convection Initiation	
Hanesiak, J.M.	2002: New Opportunities Fund Canada Foundation for Innovation (CFI) Ground-based remote sensing for atmosphere-surface climate interactions in the Canadian Arctic	
Hanesiak, J.M. Co-Investigator	2003: Project Grant Canadian Foundation for Climate and Atmospheric Sciences (CFCAS) Drifting and Blowing Snow: Measurements and Modelling	
Hanesiak, J.M.	2003: Research Grant Atmospheric & Hydrological Sciences Division (Prairie Section)	

Principal Investigator	Grant Description	Amount
Hanesiak, J.M.	High Temporal Resolution Atmospheric Boundary Layer Characteristics During the 2003 Southern Manitoba Convective Season: Linkages to Synoptic Forcing and Crop Phenology 2003: Atmospheric & Hydrological Sciences Division (Prairie Section) Canadian Arctic Shelf Exchange Study (CASES)	
Papakyriakou Pennock (U. Sask. PI)	NSERC/BIOCAP 2003-2005- Landscape-Scale Measurement of Process-Level Nitrous Oxide Measurements.	
Papakyriakou Taylor (York, University)	CFCAS 2003-2005– Blowing Snow: Measurement and Modeling	
Papakyriakou	2003 NSTP funds for 1 Master’s Student for Arctic Research	
Papakyriakou Lobb (UofM, PI)	Research Grant (Ducks Unlimited). 2003 Landscape-Scale greenhouse gas monitoring – Prairie Wetlands and Agrosystems	
Papakyriakou, T	2002-2006(Feb.) NSERC Program: Research Grants (individual) Relationship between complex snow surfaces and the atmosphere-surface-subsurface exchange of energy and mass	
Papakyriakou, T	2002 (Feb.) NSERC Program: Equipment Grants Relationship between complex snow surfaces and the atmosphere-surface-subsurface exchange of energy and mass	
Papakyriakou	Discovery Grant, NSERC2001-2004	
Yackel, J.C.	2002-2006(Feb.) NSERC Program: Research Grants (individual) Use of microwave remote sensing for estimating the thermodynamic and ablation state of Arctic sea ice	
Yackel, J.C.	Environment Canada Research Grant (CRYSYS)	
Yackel, J.C.	2002 (Feb.) NSERC Program: Equipment Grants Use of microwave remote sensing for estimating the thermodynamic and ablation state of Arctic sea ice: equipment.	
Yackel, J.C.	NSERC Operating Grant	

Future budgetary requirements:

CEOS received an annual operating grant from the Faculty of Arts. The Department of Environment and Geography and CEOS also collaborate on providing teaching and research facilities within the Department. Currently CEOS maintains one undergraduate computer laboratory, and two graduate research computer labs.

Most of the CEOS research support money is used to provide student stipends and purchase field equipment. The operating grant is used for day-to-day operational expenses; software licensing/upgrading, publication costs, equipment repair/upgrading/replacement/purchase and consumables. The yearly operating grant (formerly from the Faculty of Arts as a special unit allocation) will need to be established as baseline funding within the new Faculty of the Environment. The new baseline funding should include salaries. This will provide year-to-year stability that will enable CEOS to grow and expand in the broad research areas of the Arctic, Agriculture, Forestry, Freshwater and Geomatics Technologies. To accommodate a larger number of active researchers participating within CEOS in the up-coming year the operating budget will need to be increased if the current level of research and related activities is to be maintained. CEOS will experience an increase in the number of researchers when it becomes a Faculty wide center (2004). The active researchers that are expected to join and operate under the CEOS research umbrella are; Drs. R Baydack (in Dr. Baydack's case increase involvement), S. McLachlan, F. Wang and N. Hunter. CEOS will need an accompanying increase in support staff with the operations manager, administrative assistant become full-time, and additional technical support, beyond the meteorological technician that the Faculty of Environment has currently put in place. CEOS will require another field equipment technician and a full-time computer technician.

Compelling reasons for the continued support of CEOS (from a presentation Dr. Barber made in October 2003 to the VP Research, Dean and Associate Dean of the Faculty of Environment)

1. CEOS is profitable.
2. CEOS has the track record and reputation needed for leadership.
3. Graduates are VERY employable
4. CEOS has the reputation but NOT the people, space or financial resources
5. CEOS plays a major role in the new Canadian Research Icebreaker project (15 year program)
6. CEOS will host theme 3 of ArcticNet (October 2003 start). CEOS faculty and students also participate in each of the other 3 themes of ArcticNet with faculty members Papakyriakou and Hanesiak taking lead roles in themes 3 and 4.
7. CEOS is the host organization for the Canada Research Chair held by D. Barber and as such has been identified as a vehicle by which the U of M supports this chair.
8. Faculty of Environment needs strong research programs; CEOS can provide a framework for management of integrated 'Environmental Earth Science' research.

Events and Activities that bring focus to CEOS:

1. Faculty of Environment will focus on the integration of NSERC, SSHRC and CIHR research.
2. Environmental Earth Systems research requires a different approach
3. DFO chair, UFA in Environmental science
4. Agassiz Centre proposal
5. Lake Winnipeg project
6. Potential Indonesian CIDA project
7. CFCAS prairie drought project

Infrastructure

Research Space:

As a bare minimum the space currently utilized by CEOS, namely Room 104Isbister (~600 square feet) must be provide for in any physical move of CEOS to another location; the Wallace building for example.

Presently room 104 Isbister is the only workshop/laboratory/storage space available to CEOS and is being used to house the CASES/CICE projects, funded by a Canadian Research Chair to Dr. Barber, an NSERC network grant to D. Barber, and NSERC operating grants to Drs. Barber, Hanesiak and Papakyriakou. This room is being used a both a storage room to house over \$3 M of equipment and as a workroom to build, test and repair equipment. At present, this room is totally inadequate in its function; work is being carried out in the hall after classes have concluded for the day. The current problem is greatly exacerbated by the fact that a new Network of Centres of Excellence is expected to triple the requirements of this small space. The NCE is called ArcticNet and is lead at the University of Manitoba by Dr. Barber. This space is also the only storage and field deployment lab available for other projects being run through the Centre for Earth Observation Science (e.g., Indonesian project, agriculture project, ecosite forestry project) thus the space must be increased, partitioned into electronics and field preparation components.

What is required is separate space to house and repair field equipment and analyze field samples. In terms of storage, heated and non-heated storage rooms are required. The heated storage will be used to store and service electronic loggers, meteorological equipment, electromagnetic instruments, etc. It must have a secure entrance, allowing access by technicians and graduate students. The non-heated storage space will house large pieces of field equipment such as boats, snow machines, trailers, etc. (area of 10,000 ft² minimum). It must be able to allow access for large motorized devices, thus includes a large door with high ceiling space. The lab space needs to have benches, fume hoods, electrical outlets, sinks and a temperature controlled cold room (good to -20C). The area for this lab should be at least 2500 square feet in order to accommodate the requirements.

In addition to the space requirements, it is not feasible that the students/faculty be disjoined from this space. It is not practical for the work/storage space to be in a separate building from the faculty members and students, due to the large reliance on the space for research purposes. Any consideration of moving room 104, should therefore include moving faculty and student space as well. Presently, the office space being occupied by faculty linked to room 104 is 537 ft² (four offices). These three physical geography faculty members are supporting 21 students (including a post-doc).

Research Equipment:

CEOS considers remote sensing, geographic information systems, image analysis systems, global positioning systems, computer modeling and analytical methods as an integrated set of 'Geomatics' tools.

- Computer Hardware/software resources: no new significant hardware was acquired during this reporting period
 1. CEOS has a network computer facility with modern industry standard software; and
 2. Through the University of Manitoba CEOS is part of a GIS consortium, which has entered into a province-wide licensing agreement with ERSI to provide industry standard GIS software to students regardless of which institute they are attending.
 3. A NSERC equipment grant by Dr. Barber purchased a SUN Ultra 60 server that is used within his research program and by others within CEOS to develop models and collect meteorological data.

- Field equipment: only large new equipment will be listed below, a complete list of research equipment totaling nearly \$3 million dollars can be found in the capital asset management system of the University of Manitoba
 1. MR series FT-SpectroRadiometer
 2. PA1 Doppler Sodar
 3. Sea-Bird Electronics 19 plus SeaCat Profiler
 4. Bombardier Trax and Skandic Tundra with trailer
 5. Paraglider
 6. gas (CO2) flux towers
 7. Solar panel power array
 8. WVR-1100 Portable Water Vapour Radiometer
 9. air/ice boat

Data:

- MOUs between CEOS and the Province of Manitoba (Land Information Branch), NASA, CSA, NASDA, and ESA for access rights to data - with the qualification that these data must be used for research.
- The University of Manitoba Libraries has entered into a licensing agreement with Linnet Geomatics to make the Land Information Navigator data available on campus. CEOS is the repository of one of four University held sets of these data.

Web Address

To be kept up-to-date with the variety of CEOS activities and to be informed of upcoming events, check our World Wide Web page regularly.

www.umanitoba.ca/ceos

www.umanitoba.ca/environment/envirogeog

www.umanitoba.ca/environment

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