

Annual Report for Research Centers and Institutes Reporting Period 2000 and 2001

Centre for Earth Observation Science (CEOS)

Level 1 Centre of the Faculty of Arts
Department of Geography, University of Manitoba

Prepared by:

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Personnel

Faculty

Internal

Barber, D.G., Professor of Geography (50 percent)
Bullock, P. Assistant Professor of Soils Science (10 percent)
Gardner, J. Professor of Geography (5 percent)
Kenkel, N, Professor of Botany (10 percent)
Papakyriakou, T, Assistant Professor of Geography (15 percent)
Stene.L, Associate Professor of Geography (10 percent)
Smith, G. Professor of Geography (10 percent)

External

Yackel, J. Professor of Geography University of Calgary (15 percent: Jan to Apr)

John Yackel was hired to the Assistant Professor level at the University of Calgary in July of 2000. He was the first Master's of Geographic Information Systems (MGIS) appointment. John is involved in teaching the remote sensing core course for this program, and also has undergraduate (Introductory Statistics) and graduate supervision responsibilities. John remains active in sea ice research and is an annual participant of the Collaborative-Interdisciplinary Cryospheric Experiment (C-ICE) in the Canadian High Arctic. He is currently a co-investigator on national and international climate change related projects that utilize microwave remote sensing as the primary data set for examining Arctic sea ice and terrestrial snow cover processes. His appointment at the University of Calgary provided him with a Faculty of Social Sciences Start-Up Grant. He subsequently was successful in obtaining both NSERC Operating and Equipment Grants to investigate Arctic sea ice processes using microwave remote sensing. John successfully defended his Ph.D. dissertation in February 2001. Subsequently he was successful on an April 2001 research grant application to MSC CRYSYS for a project dealing with the synergism of ERS-2 SAR and DMPS SSM/I data for Chinook affected SWE and SCA detection in Southern Alberta.

CEOS related activities

Dr. Yackel participated in the C-ICE'00 Field Experiment in June of 2000. His fieldwork concentrated on the collection of sea ice mechanical strength data onboard the CCG ship Louis St. Laurent during mid-June. This data is being analyzed by the Canadian Hydraulics Centre, the Canadian Ice Service and the University of Calgary. John subsequently attended C-ICE'01 field planning meetings in October 2000 and March 2001.

Research Associates

Iacozza, J. full time appointment to CEOS

Mundy, C.J. full time appointment to CEOS (July 2000 to July 2001)

Visiting Scholars/Researchers

Barbosa, M., PhD – Brazil (GlobeSAR)

Campbell, M., PHD – University of Manitoba Department of Recreation Studies

Support Staff

Mossdrop, David R., Operations Manager of CEOS. (50 percent)

Roberecki, Aggie, Administrative support for CEOS, (50 percent)

Students (Ph.D. Masters and honours)

The following students were supported (financially and/or logistically) over the reporting period, April 2000 to April 2001.

Name	Years Supervised	Degree (date)	Research Topic	Advisor
Cooley, P.	1996-2001	Ph.D. (2001)	Development of a GIS based biodiversity atlas for Lake Malawi, Africa.	Barber
Hanesiak, J	1996-2001	Ph.D. (2001)	Integration of remote sensing data within numerical models of ocean-sea ice-atmosphere processes.	Barber
Harouche, I.	1999-2001	MA (2001)	Sea Ice Remote Sensing	Barber
Hempel, R.	1998-2000	MA (2002)	Forrest Management in Indonesia	Barber
Hochheim, K.	1995-2000	Ph.D. (2002)	Microwave and optical remote sensing of agricultural surfaces.	Barber
McCullough, G.	1998-2002	Ph.D. (2002)	River Sediment loading studies in Lake Malawi.	Barber
Mkanda, F.	1997-2002	Ph.D. (2002)	Soil erosion modeling within a geographical information system.	Barber
Mundy, C.J.	2001-2004	Ph.D. (2004)	Biological implications of snow thickness distributions on sea ice.	Barber
Pegado, A	1997-2000	MA (2000)	Effects of sedimentation of Fish Diversity in Lake Malawi, Africa.	Barber
Quiring, S.	1999-2001	MA (2001)	Prairie climate change study	Papakyriak
Saczuk, E.	1999-2002	PhD (2002)	Mass Wasting in the Himalaya	Gardner
Scharien, R	2000	Honours	Intercomparison of SSM/I and Radarsat derived ice types and concentrations.	Barber
Silvestrie, G.	1996-2001	PhD (2001)	Decision making of the Elderly	Smith
Thorgillson, W.	1998-2000	MA (2000)	Precision Agriculture	Barber
Vander Kruys, J.	1999-2001	MA (2001)	Cryosphere-climate interactions	Barber
Walker, D.	1995-2001	PhD (2001)	Riding Mountain National Park study	Kenkel
Yackel, J.	1995-2000	Ph.D. (2000)	Estimation of ice breaker navigability based on the time series microwave scattering coefficient (σ°).	Barber

Thesis completed

Mundy, C.J., Ecological implications of snow thickness distributions on sea ice.

Pegado, A., Effects of sedimentation of Fish Diversity in Lake Malawi, Africa. MA 2000.

Quiring, S., Prairie climate change study

Yackel, J., Estimation of ice breaker navigability based on the time series microwave scattering coefficient (σ°).

Activities and Research Projects

Selected activities are highlighted below:

Proposal Development:

On-going Projects:

CASES 2000 – 2006

The Canadian Arctic Shelf Exchange Study (CASES) is being proposed as an NSERC National Network. Scientifically we propose to 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 processes which drive these relationships and will entail a year-long field experiment in the Beaufort Sea and Amundsen Gulf in Northern Canada. Conditionally funded by NSERC

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.

Due to atmospheric attenuation of incident visible wavelength radiation during the spring, micro-wavelengths are more appropriate for monitoring the metamorphic state of the snow covered ice surface than are visible wavelengths.

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 *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'2000* include: Centre for Earth Observation Science (University of Manitoba) (lead agency); 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.

International Field Work Indonesia Project Summary

The Indonesia project has completed gathering data in the field with a second expedition lead by CIFOR staff. Initial data collection focused on the spectrum of land cover types available, which has now been supplemented by an in-depth study of early succession stages of vegetation re-growth. With this additional data, analysis is underway to investigate the threshold of detecting cleared areas as they re-grow. Findings to date have been presented at the Canadian Association of Geographers Prairie Region held in Devil's Lake, North Dakota.

Malawi Project Summary

During 2001, Francis X. Mkanda, native of Malawi, Africa, successfully completed his Ph.D. thesis. Two remaining PhD students in the Lake Malawi Biodiversity Conservation Project at CEOS are Greg McCullough and Paul Cooley. They are in the last year of their studies, and publishing papers in support of their degrees.

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 second field season for this group and CEOS actively collected field data for 10 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.

Nsnet

The Northern Studies network (Nsnet) is an interdisciplinary research group established at the University of Manitoba under the direction of the operations manager of CEOS.

International Associate for Great Lakes Research (IAGLR)

CEOS on behalf of the University of Manitoba and LWRC submitted a letter of intent to host the 2002 annual conference. The letter was accepted and planning has begun. The conference is expected to attract ~400 international fresh water scientists.

Completed Projects:

The project 'Measuring tundra productivity and vegetation structure from cloud-free weather satellite (geocomp-n) data' has completed the first field season in TUKTUK NOGATE National Park. This project is a research partnership between the Parks Canada Service Agency and the University of Manitoba. The aim of the present partnership between Parks Canada and CEOS is to improve the interpretation of the GEOCOMP-n satellite data that Parks Canada is currently using as a monitoring tool in its northern parks.

Academic Contributions

Primary Publications

Publications:

- Barber, D.G., J. Hanesiak, W. Chan and J. Piwowar. 2001. Spatial and temporal patterns of sea ice/atmosphere processes within the NOW Polynya between 1978 and 1996. *Atmosphere-Ocean*. 39(3):343-359.
- Barber, D.G., J. Yackel and J. Hanesiak. 2000. Perspectives on Sea Ice, RadarSat-1, and Arctic Climate Processes. *Canadian Journal of Remote Sensing*. 27(1):51-61.
- Barber, D., R.Marsden, P. Minnett, G. Ingram and L. Fortier. 2001. Physical Processes Within the North Water (NOW) Polynya. *Atmosphere-Ocean*. 39(3):163-166.
- Barber, D.G., E. Sazuk, and P. Richard. 2001. Examination of beluga-habitat relationships through the use of Telemetry and GIS. *Arctic*. 54(3) :305-316
- Barber, D., J. Iacozza, and A. Walker. On the Estimation of Snow Water Equivalent (SWE) Using Microwave Radiometry over First-Year Sea Ice. *Remote Sensing of Environment*. In Review (May'00).
- Barber, D.G., J. Yackel and J. Hanesiak. 2001. Sea Ice, RadarSat-1, and Arctic Climate Change. A review and update. ADRO special issue, *Canadian Journal of Remote Sensing*. 27, 53-63.
- Fortier, L. M. Fortier, M. Fukuchi, D. Barber, Y. Gratton, L. Legendre, T. Odate and B. Hargrave. 2001. The International North Water Polynya Study (NOW): A progress report. *Memoirs of the national Institute of Polar Research, Special Issue 54(343-348)*. National Institute of Polar Research, Tokyo.
- Hanesiak, J. J. Yackel and D. Barber. 2001. Effect of Melt Ponds on First-Year Sea Ice Ablation-Integration of RADARSAT-1 and Thermodynamic Modeling. *Canadian Journal of Remote Sensing*. 27(5):1-10.43.
- Hanesiak, J.M, D. G., Barber, R. De Abreu and J.J. Yackel. 2001. Local and regional albedo. Observations of arctic first-year sea ice during melt ponding. *Journal of Geophysical Research-Oceans*. 106(C1):1005-1016.
- Hanesiak, J.M., D.G. Barber T.N. Papakyriakou and, P.J. *Minnett*. 2001. Parameterization Schemes of Incident Radiation in the North Water Polynya. *Atmosphere-Ocean NOW special issue*. 39(3):223-238
- Harouche, I. and D.G. Barber. Seasonal Characterization of Microwave Emissions Over Snow-Covered First-Year Sea Ice. *Hydrological Processes*, **15**, 3571-3583
- Hochheim, K.P. and D. G. Barber. The Seasonal Backscattering of Agricultural Crops as Observed by RADARSAT-1. Part 1. Wheat. *International Journal of Remote Sensing*. In review (Oct'00).
- Hochheim, K.P. and D. G. Barber. The Seasonal Backscattering of Agricultural Crops as Observed by RADARSAT-1. Part 2. Canola. *International Journal of Remote Sensing*. In review (Oct'00).

- Iacoza, J. and D.G. Barber. Ablation patterns of snow cover over smooth first-year sea ice in the Canadian Arctic. *Hydrological Processes*. In press (Sept'01).
- Ingram, G., J. Bacle, D. Barber, Y. Gratton, H. Melling. Physical Processes in the North Water Polynya. *Deep Sea Research*. In review (May'01).
- Macey, S.M., Smith, G.C. and Watkins, J.F., "Aging and the Aged," In Gaile, G.L. and Willmott, C.J. (eds.), *Geography in America at the Dawn of the 21st Century*, New York: Oxford University Press, in press.
- Mundy, C.J., and D. G. Barber. 2001 On the Relationship Between Spatial Patterns of Sea Ice Type and the Mechanisms Which Create and Maintain the North Water (NOW) Polynya. *Atmosphere-Ocean*. 39(3):327-341.
- Mundy, C.J. and D.G. Barber. 2000. The North Water Polynya: Physical and Biological Aspects. In Oak et al (Eds). *Pushing the Margins: Native and Northern Studies*. Native Studies Press, University of Manitoba. 422 pp. (ISBN 0-9686138-1-0).
- Nghiem. S.V., D.K. Perovich, A.J. Gow, R. Kwok, D.G. Barber, J.C. Comiso. Observation of Sea Ice Surface Thermal States under Cloud Cover. *Journal of Geophysical Research (Oceans)*. In review (June'00).
- Smith, G.C., *Geographical Aspects of Intergenerational Exchange*, *Progress in Human Geography*. In Review.
- Wilson, K, D.G., Barber, and D. King. 2001. Validation and Production of RADARSAT-1 Derived Ice Motion Maps in the North Water Polynya (NOW), January-December 1998. *Atmosphere-Ocean*. 39(3):257-278.
- Wilson, K, D.G., Barber, and D. King. A Case Study in Tracking 1998 Spring Ice Dynamics in the Smith Sound, North Water Polynya Region using RADARSAT-1, *Annals of Glaciology*, International Glaciological Society. In Press (Oct'00)
- Yackel, J. and D.G. Barber and T.N. Papakyriakou. 2001. On the Estimation of Spring Melt in the North Water (NOW) using RADARSAT-1 SAR. . *Atmosphere-Ocean*. 39(3):195-208. Yackel, J. and D. G. Barber. 2000. Melt ponds on Sea Ice in the Canadian Arctic Archipelago. Part 2. On the use of RADARSAT-1 Synthetic Aperture Radar for Geophysical Inversion. *Journal of Geophysical Research-Oceans*. 105(C9):22,061-22,070.
- Yackel, J. and D.G. Barber. 2000. Arctic Climate Change. A Case of Mounting Evidence. In Oak et al (Eds). *Pushing the Margins: Native and Northern Studies*. Native Studies Press, University of Manitoba. 422 pp. (ISBN 0-9686138-1-0).
- Yackel, J., J. Hanesiak and D. G. Barber. 2000. Melt ponds on Sea Ice in the Canadian Arctic Archipelago. Part 1 – Variability in Morphology and Surface Radiation. *Journal of Geophysical Research-Oceans* 105(C9): 22,049-22,060.

Conference Papers

- Yackel, J.J., C.J. Mundy and D.G. Barber. 2001. On the Use of Remote Sensing and GIS for examining sea ice conditions in the North Water Polynya, Baffin Bay. *GIS 2001*. Vancouver, B.C., 19-22, February (interactive presentation given).

- Yackel, J.J., D.G. Barber and T.N. Papakyriakou. 2000. On the estimation of sea ice ablation in the North Water polynya using RADARSAT-1. *The International Glaciological Society International Symposium on Sea Ice and its Interactions with the Ocean, Atmosphere and Biosphere*, University of Alaska Fairbanks, Fairbanks, Alaska, 19–23, June (oral presentation given).
- Yackel, J.J. 2001. Assessing historical records of Chinooks and their link to climate change. Ecological Monitoring and Assessment Network (EMAN) National Science Meeting. Calgary, Alberta, 2-5, May (oral presentation given).

Workshops/Meetings

Role of GIS and Remote Sensing in Climate Change Adaptation and Impacts, PARC
Funded

Funding Sources

CEOS receives an annual operating grant from the Faculty of Arts. The Department of Geography and CEOS also collaborate on providing teaching and research facilities within the Department. Currently we have one undergraduate lab, and two graduate research labs. The following research grants were obtained within the reporting period.

Principal Investigator	Grant Description
Barber, D.G.,	Fisheries and Oceans support for establishment of a Centre for Northern Studies at the University of Manitoba
Barber, D.G.,	Manitoba Conservation support for establishment of a Centre for Northern Studies at the University of Manitoba
Barber, D.G.,	Prepare and deliver a national workshop on the role of Earth Observations in climate change (PARC)
Barber, D.G.,	Supplemental funding for CRYSYS'99 funding
Barber, D.G.	NSERC Equipment Grant – This is an equipment grant to purchase a UNIX workstation for numerical modelling
Barber, D.G.	Meteorological Services of Canada. Research Grant to examine the role of clouds in microwave emission over sea ice and for linking microwave remote sensing to a one-dimensional thermodynamic model of snow covered sea ice.(CRYSYS)
Barber, D.G.	Support from the Department of Fisheries and Oceans for training of two graduate students (1 PhD and 1 masters) as part of the Lake Malawi Biodiversity Conservation Program
Barber, D.G.	Sea Ice/Climate Dynamics subgroup of the North Water Polynya Study (NOW). Research grant from NSERC for a National Network.
Barber, D.G.	Sea Ice/Climate Dynamics subgroup of the North Water Polynya Study (NOW). Research grant from NSERC for a National Network.

Principal Investigator	Grant Description
Barber, D.G.	Canadian Climate Centre, Atmospheric Environment Service. Research Grant to develop a technique for estimation SWE over snow covered sea ice.
Barber, D.G.	Canadian Climate Centre, Atmospheric Environment Service. Research Grant to investigate approaches available for linking remote sensing data within numerical climate process models
Barber, D.G.	Canadian Ice Services, Environment Canada, Support in Kind for the NOW polynya study
Barber, D.G.	Canadian Ice Services, Environment Canada, Research Grant to support the NOW polynya study
Barber, D.G.	Arctic Ice Regime Shipping System research project supported by Transport Canada and Canadian Ice Services
Barber, D.G.	National Ice Services, Washington, DC. Research Grant to support the NOW polynya study
Barber, D.G.	Arctic Ice Regime Shipping System research project supported by Canadian Ice Services
Barber, D.G.	Arctic Ice Regime Shipping System (Phase 2 and 3) research project supported by Transport Canada and Canadian Ice Services
Barber, D.G.	NSERC Operating Grant - This is a four year grant for general research support from the Natural Sciences and Engineering Research Council.
Barber, D.G.	NOW sea ice collaborative research with the Canadian Ice Services
Barber, D.G.	Globesar projects for collaborative research work in Argentina, Brazil and Peru. Funds are provided by CCRS for travel between labs, per diem support and collaboration on field research.
Barber, D.G.	Northern Studies Training Program to

Principal Investigator	Grant Description
	support the C-ICE'00 experiment
Smith, G.	SSHRC research grant (1998-2001). Effects of Local Environments upon the Adjustments of Movers to Senior Citizen Housing.
Barber, D.G.	Collaborative research grant from the Centre for International Forest Research (CIFOR) in Indonesia
Total	

The Centre has a reasonably good financial status. Most of the CEOS research support money is used to provide student stipends and purchase equipment. The operating grant from the Faculty of Arts will need to be increased in the near future if we are to maintain the current level of research and related activities.

Infrastructure

Research Facilities

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:
 1. CEOS has a state-of-the-art 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.
- Field equipment:
 1. two VIS/NIR spectrometers,
 2. Trimble differential GPS base station and rover units, and
 3. surface energy balance and cloud physics instrumentation (radiometers, psychrometers, ceilometers, and an all sky cameras)
 4. various loggers and climate measuring equipment
 5. digital still and video cameras
 6. two 7 section parcels
 7. Paraglider

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/geography

email addresses:

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