High Arctic hydrological, landscape and ecosystem responses to climate change

Summary

Project Leader(s)

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Water is crucial for northern communities and ecosystems and plays a vital role, in conjunction with climate and permafrost, in the morphology and stability of arctic landscapes. To determine the impacts of climate change on freshwater quality and availability in the High Arctic, we created a watershed and landscape ecosystem observatory. The research is conducted primarily at the Cape Bounty Arctic Watershed Observatory (CBAWO) on Melville Island, near the Nunavut/NWT border, with additional work at Polar Bear Pass on Bathurst Island. Research will investigate how climate change will affect rivers, permafrost, soils, vegetation, greenhouse gas emissions and the release of contaminants into High Arctic rivers, lakes and ponds. Our integrated watershed network will provide an unprecedented understanding of the sensitivity and anticipated future effects of climate change to the High Arctic water, permafrost and ecosystem. By closely integrating related water and ecosystem process studies, this project will identify key environmental and societal vulnerabilities. Our goal is to develop impact models to assess linkages between anticipated environmental change and possible adaptations by communities and government agencies (clean water supply and ecological integrity) and industry (resource extraction, infrastructure protection).

People

Network Investigators

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Campbell Scientific
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Garfield Weston Foundation
Government of Canada Program for International Polar Year
Indian and Northern Affairs Canada - Northern Scientific Training Program

IPY Federal Program Office
Natural Resources Canada - Polar Continental Shelf Project
Northern Scientific Training Program
NSERC Undergraduate Summer Research Award
NSERC-Discovery grants
Queen's University

Publications

Articles Published in Refereed Publications

Beylich, A.A., Lamoureux, S.F. and Decaulne, A., 2010, Developing quantitative frameworks for studies on sedimentary fluxes and budgets in changing cold environments, Polish Polar Research, , Accepted

Beylich, A.A., Lamoureux, S.F., Decaulne, A., Dixon, J.C., Orwin, J.F., Otto, J-C., Overeem, I., Saemundsson, Þ., Warburton, J., and Zwolinski, Z., 2010, , 2010. Sedimentary fluxes and budgets in changing cold environments: the global IAG/AIG sediment budgets in cold environments (SEDIBUD) programme, Geografiska Annaler, v. 92, 151-153, Published

Chutko, K.J., Lamoureux, S.F., 2009, Identification of coherent links between interannual sedimentary structures and daily meteorological observations in Arctic proglacial lacustrine varves: potentials and limitations, Canadian Journal of Earth Sciences, v.45, 1-13, Published

Chutko, K.J., Lamoureux, S.F., 2009, Estimating melt season characteristics at a plateau ice cap: model sensitivity between fixed and variable vertical lapse rates, International Journal of Climatology, v.29, 259-268, Published

Chutko, K.J., Lamoureux, S.F., 2009, Biolaminated sedimentation in a High Arctic freshwater lake, Sedimentology, 10.1111/j.1365-3091.2009.01049, 1, Published

Cockburn, J.M.H. and Lamoureux, S.F., 2008, Hydroclimate Controls over Seasonal Sediment Yield in Two Adjuacent High Arctic Watersheds, Hydrological Processes, v.22, 2013-2027, Published

Cockburn, J.M.H., and Lamoureux, S.F, 2008, Inflow and Lake Controls on Short-term mass Accumulation and Sedimentary Particle Size in a High Arctic Lake: Implications for Interpreting Varved Lacustrine Sedimentary Records, Journal of Paleolimnology, v.40, no.3, 923-942, Published

Derksen, C., and Treitz, P., 2010, Special Issue – International Polar Year, Canadian Journal of Remote Sensing 36, Supplement 1, 222, Published

Dugan H., Lamoureux S.F., Lafrenière, M. J., and Lewis, T., 2010, The impact of permafrost disturbances and sediment loading on the limnological characteristics of two high arctic lakes., Permafrost and Periglacial Processes (submitted), , Submitted

Dugan, H., Lamoureux, S.F., Lafreniere, M.J., Lewis, T., 2009, Major Hydrological and Sediment Yield Response to Summer Rainfall in a Small High Arctic Watershed, Hydrological Processes, 1, Published

Dugan, H.A. and Lamoureux, S.F, 2010, The chemical evolution of a hypersaline coastal lake in the High Arctic., Limnology and Oceanography, 56(2), 495-507, Published

Kirk, J.L., Muir, D.C.M., Antoniades, D., Douglas, M.S.V., Evans, M.S., Jackson, T.A., Kling, H., Lamoureux, S.F., Lim, D.S.S., Pienitz, R., Smol, J.P., Stewart, K., Wang, X., and Yang, F., 2010, Climate change and mercury accumulation in Canadian High and Subarctic Lakes, Environmental Science and Technology, , Accepted

Lafreniere, M. and Lamoureux, S, 2008, Seasonal Dynamics of Dissolved Nitrogen Exports from two High Arctic Watersheds, Melville Island, Canada, Hydrological Research, v.39, no.4, 324-335, Published

Lamoureux, S.F. and Lafreniere, M.J., 2009, Fluvial Impact of Extensive Active Layer Detachments, Cape Bounty, Melville Island, Canada, Arctic, Antarctic and Alpine Research, v.41, no.1, 59–68, Published

Lewis, T and Lamoureux, S.F., 2010, Twenty-first century discharge and sediment yield predictions in a small high arctic watershed, Global and Planetary Change, in press, Accepted

Lewis, T and Lamoureux, S.F., 2010, Twenty-first century discharge and sediment yield predictions in a small high Arctic watershed, Global and Planetary Change, 27-41, Published

McDonald, D.M., Lamoureux, S.F., 2009, Hydroclimatic and channel snowpack controls over suspended sediment and grain size transport in a High Arctic catchment, Earth Surface Processes and Landforms, v.34, 424-436, Published

McDonald, D.M., Lamoureux, S.F. and Warburton, J., 2010, Assessment of a time-integrated fluvial suspended sediment sampler in a High Arctic setting, Geografiska Annaler, v. 92, 225-235, Published

Muir, E.C.G, Wang, X., Yang, F., Nguyen, N., Jacskon, T.A., Evans, M.S., Douglas, M., Kock, G., Lamoureux, S., Pienitz, R., Smol, J., Vincent, W.F., Dastoor, A.P., 2009, Spatial Trends and Historical Deposition of Mercury in Eastern and Northern Canada Inferred from Lake Sediment Cores, Environmental Science & Technology, 1, Submitted

Orwin, J.F., Lamoureux, S.F., Warburton, J., and Beylich, A.A., 2010, A framework for characterizing sediment flux from cold environments, Geografiska Annaler, 92, 155-176, Published

Pautler, B.G., Austin, J., Otto, A., Stewart, K., Lamoureux, S.F. and Simpson, M.J., 2010, Biomarker assessment of organic matter sources and degradation in Canadian High Arctic littoral sediments, Biogeochemistry, v. 100, 75-87, Published

Pautler, B.G., Simpson, A.J., McNally, D.J., Lamoureux, S.F. And Simpson, M.J., 2010, Arctic permafrost active layer detachments stimulate microbial activity and degradation of soil organic matter, Environmental Science and Technology, Accepted, Accepted

Pautler, B.G., Simpson, A.J., McNally, D.J., Lamoureux, S.F. And Simpson, M.J., 2010, 2010, Arctic permafrost active layer detachments stimulate microbial activity and degradation of soil organic matter, Environmental Science & Technology, v. 44, 4076–4082, Published

Stewart, K.A. and Lamoureux, S.F., 2010, Seasonal hydrochemical conditions and limnological response in adjacent High Arctic lakes: Cape Bounty, Melville Island, Nunavut., Arctic, , Accepted

Tomkins, J.D., Lamoureux, S.F., Antoniades, D. and Vincent, W.F., 2010, Autumn snowfall and hydroclimatic variability during the past millennium inferred from the varved sediments of meromictic Lake A, northern Ellesmere Island, Canada., Quaternary Research, v. 74, 188-198, Published

Tomkins, J.D., Lamoureux, S.F., Antoniades, D., Vincent, W.F., 2009, Sedimentary pellets as an ice cover proxy in a High Arctic ice-covered lake, Journal of Paleolimnology, 1, Accepted

Wall, J., Collingwood, A., and Treitz, P., 2010, Monitoring surface moisture state in the Canadian High Arctic using synthetic aperture radar (SAR)., Canadian Journal of Remote Sensing, v. 36, supplement 1, S124 - S134, Published

Other Refereed Contributions

Dugan, H.A., Lamoureux, S.F., Lewis, T. and Lafreniere, M.J.., 2010, The impact of permafrost disturbances and sediment loading on the seasonal mixing of two High Arctic lakes, Canadian Geophisycal Union Annual Meeting, Ottawa, May 31-June 4, 1, Published

Kirk, J.L., Muir, D., Tunks, C., Alpi, L., Lawson, G., Iqaluk, D., Iqaluk, B., St. Louis, V., Lehnherr, I., Lamoureux, S., Stewart, K., and Lewis, T., 2010, The transfer of terrestrial mercury to Arctic freshwater Arctic ecosystems at Cape Bounty, Melville Island, Nunavut., SETAC North America, Portland, Oregon, United States, November 8th-12th, 2010, 155, Published

Lamoureux, S.F. and Lewis, T., 2010, The environmental signal contained in nonglacial Arctic varves: lessons from seven years of intensive lake and watershed process research., PAGES Varve Working Group workshop, Tallinn, Estonia, April 7-9., 1, Published

Lamoureux, S.F., Lafrenière, M.J., Fletcher, J.H., Paulter, B.G., Simpson, A.J. and Simpson, M.J., 2010, Carbon mobilization and utilization due to localized permafrost disturbance in High Arctic watersheds., IPY Early Results Workshop, Canadian IPY program, Ottawa, February 16-18., 1, Published

Myklebust, M. Lafleur,P., Humphreys, E., Poissant, L., St. Louis, V.L., Papakyioakou, T., Barker, J.D., and Swystun, K., 2010, Spatial variability of net ecosystem exchange of CO2 in the Canadian Arctic tundra., IPY, Oslo Science Conference, June 8-12, 2010., 1, Published

Scott, N.A., Wagner, J., Gregory, F., Humphreys, E., Lafleur, P., Lafreniere, M., Lamoureux, S., Lewis, T. and Treitz, P., 2010, Quantifying the watershed-scale carbon balance of high-Arctic ecosystems at Cape bounty, Melville Island, Nunavut., IPY Scientists Meeting, Edmonton, Alberta. November 2010, 1, Published

Non-Refereed Contributions

Atkinson, D.M., and Treitz, P.M., 2008, Estimating CO2 flux measurements from the integration of high spatial resolution remotely sensed data and biophysical variables, 2008 ArcticNet Annual Conference Proceedings, 44-45, Published

Bassutti, A. and Lamoureux S., 2010, Quantifying Arctic lake underflows using a novel underflow sediment trap, Proceedings of ArcticNet Annual Scientific Meeting, Ottawa, Ontario, Dec 14-17th, 2010, 94, Published

Beamish, A., Wagner, I., and Scott, N.A., 2010, Disturbance-induced carbon fluxes in High Arctic Ecosystems., Annual ArcticNet Science Meeting, Ottawa, ON. Dec. 2010, 95, Published

Bosquet, L., Lamoureux, S.F., Henry, G., 2008, Climate Change and Recent Permafrost Disturbance Impacts on High Arctic Tundra Vegetation, 2008 ArcticNet Annual Conference Proceedings, 191, Published

Cassidy, A. and Lamoureux, S., 2010, The impact of historical permafrost disruption on tundra vegetation, Proceedings of ArcticNet Annual Scientific Meeting, Ottawa, Ontario, Dec 14-17th, 2010, 108, Published

Collingwood, A., Treitz, P., and Charbonneau, F., 2010, Surface roughness modeling with SAR data in a High Arctic environment, Proceedings of the ArcticNet Annual Scientific Meeting, December14 - 17, 2010. Ottawa, Ontario., 111, Published

Croft, A. and Young, K.L., 2010, Link between benthic macroinvertebrate diversity and the hydrology of High Arctic ponds. Invited Paper, CMOS-CGU Joint Congress, Ottawa, Ontario, May 31-June 4, 2010, 1, Published

Dugan, H., Lewis, T., Lamoureux, S., Lafreniere, M.J., 2008, Investigating the Formation of High Conductivity Bottom Water in a Freshwater High Arcitc Lake, 2008 ArcticNet Annual Conference Proceedings, 212, Published

Fletcher, J., Lafreniere, M., Lamoureux, S., 2008, The Influence of Recent Active Layer Disturbances on Fluvial Sediment Fluxes in Paired Canadian High Arctic Watersheds, 2008 ArcticNet Annual Conference Proceedings, 218, Published

Gregory, F.M., Scott, N.A., Treitz, P.M., Atkinson, D.M., 2008, Seasonal Variation in Net Carbon Exchange in three High Arctic Vegetation Communities, 2008 ArcticNet Annual Conference Proceedings, 1, Published

Gregory, F.M., Treitz, P.M., and Scott, N.A., 2009, Carbon Dioxide Flux and NDVI by Vegetation Community in the Canadian High Arctic, 2009 AGU Fall Meeting, San Francisco, CA, 1, Published

Gregory, F.M.,Treitz, P.M., and Scott, N.A., 2009, Source or Sink? Monitoring Growing Season Carbon Exchange and NDVI at Cape Bounty, Nunavut, 2009 ArcticNet Annual Conference Proceedings, 43-44, Published

Hincke, A.J.C., Scott, N.A., Atkinson, D.M., Treitz, P.M., 2008, The Influence of Vegetation Communities on Soil Carbon and Nitrogen Storage in Mid- and High-Arctic Ecosystems, 2008 ArcticNet Annual Conference Proceedings, 239, Published

Kathan, K. and Lamoureux, S., 2010, The use of XRF geochemical stratigraphy in interpreting sedimentary sources and processes for paleohydrological reconstruction within the Arctic fluvial-to-marine transition zone, Proceedings of ArcticNet Annual Scientific Meeting, Ottawa, Ontario, Dec 14-17th, 2010, 130, Published

Lafreniere, M.J. and Lamoureux, S.F., 2008, Impact of Climate Variability and Permafrost Landscape Disturbances on Runoff Generation and Solute Loads at Cape Bounty, Melville Island, 2006-2008, 2008 ArcticNet Annual Conference Proceedings, 108, Published

Lamoureux, S., and Lafreniere, M., 2010, The geomorphical and hydrological characteristics of permafrost slope disturbances in the western Canadian High Arctic., Proceedings of ArcticNet Annual Scientific Meeting, Ottawa, Ontario, Dec 14-17th, 2010, 133, Published

Laurin, E. and Lafreniere, M., 2008, The Influence of Increased Snow Accumulation on Runoff from High Arctic Headwater Catchments, 2008 ArcticNet Annual Conference Proceedings, 259, Published

Lewis, T. and Lamoureux, S.F., 2008, Predicting 21st Century Discharge and Sediment Flux in Small Unglaciated Arctic Rivers, 2008 ArcticNet Annual Conference Proceedings, 263, Published

Myklebust, M., Lafleur, P.M., Humphreys, E.R., Poissant, L., St. Louis, V.L., Papakyioakou, T., Barker, J.D. and Swystun, K., 2010, Spatial variability of net ecosystem exchange of CO2 in the Canadian Arctic tundra, IPY Oslo Science Conference, 100, Published

Rudy, A. and Lamoureux S., 2010, Landscape controls over permafrost slope disturbances, Sabine Peninsula, Melville Island, Nunavut, Proceedings of ArcticNet Annual Scientific Meeting, Ottawa, Ontario, Dec 14-17th, 2010, 157, Published

Scott, N., Wagner, I., Gregory, F., Humphries, E., Lafleur, P., Lafreniere, M., Lamoureux, S. Treitz, P., and Lewis, T., 2010, Quantifying the watershed-scale carbon balance of intact and disturbed High Arctic ecosystems at Cape Bounty, Melville Island, Nunavut, Proceedings of the ArcticNet Annual Scientific Meeting, December14 - 17, 2010. Ottawa, Ontario., 81, Published

Scott, N.A., 2010, Impacts of Land-use Change and Landscape Disturbance on the Carbon Cycle., “Thinking Ahead for a Strong Future” Conference to mark the 10th anniversary of the Canada Research Chair program, Toronto, ON. Nov. 2010., 1, Published

Veillette, M., Lamoureux, S., and Orwin, J.F., 2010, Sediment transport responses to permafrost disturbances in a Canadian High Arctic river, Cape Bounty, Nunavut, Proceedings of ArcticNet Annual Scientific Meeting, Ottawa, Ontario, Dec 14-17th, 2010, 165, Published

Wagner, I., Beamish, A. Cassidy, A. Treitz, P., and Scott, N., 2010, Relationships among phenology, NDVI, and CO2 exchange in three high-Arctic plant community types, Proceedings of the ArcticNet Annual Scientific Meeting, December 14-17, Ottawa, Canada, 167, Published

Wagner, I., Fisher, E., Neil, A., and Scott, N.A., 2010, Trace gas fluxes from three high-Arctic plant communities along a soil moisture gradient., IPY Scientists Meeting, Edmonton, Alberta. November 2010, 1, Published

Specialized Publications

Bosquet, L., 2010, The effects of observed and experimental climate change and permafrost disturbance on tundra vegetation in the western Canadian High Arctic, MSc Thesis, pp. 160, Published

Dugan, Hilary, 2010, Long term evolution and recent dynamics of High Arctic coastal basins, MSc Thesis, pp. 150, Published

Laurin, E., 2010, The Impacts of Experimental Snow Augmentation on Soil Thermal Regimes and Nutrient Fluxes from High Arctic Headwater Catchments, MSc Thesis, pp.148, Published