

High Arctic hydrological, landscape and ecosystem responses to climate change

Summary

Project Leaders

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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 and the Apex River, Baffin 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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Partners

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Campbell Scientific
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Garfield Weston Foundation
Government of Canada Program for International Polar Year

IPY Federal Program Office
Natural Resources Canada - Polar Continental Shelf Project
Natural Sciences and Engineering Research Council of Canada - Discovery Frontiers
Natural Sciences and Engineering Research Council of Canada - Discovery grants
Natural Sciences and Engineering Research Council of Canada - Research Tools and Instruments
Natural Sciences and Engineering Research Council of Canada - Undergraduate Summer Research Award
Northern Scientific Training Program
Polar Continental Shelf Program
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Publications

Articles Published in Refereed Publications

Abnizova, A., Miller, E., Young, K.L. and Shakil, S., 2012, Seasonal Variability in Hydrological and Physico-chemical Characteristics of Small Water Bodies Across Polar Bear Pass, a High Arctic Wetland, Bathurst Island, Nunavut, Canada., Arctic, Antarctica and Alpine Research, , Submitted

Abnizova, A., Miller, E.A., Young K.L., and Shakil S., 2014, Hydrological and physico-chemical variability of small ponds across a High Arctic wetland during thaw seasons., Hydrological Sciences Journal, , Accepted

Abnizova, A., Young, K. and Boike, J., 2012, Snowmelt Hydrology and Carbon Dynamics in Wetland Ponds at Polar Bear Pass, Bathurst Island, Nunavut., Ecosystems, , Submitted

Abnizova, A., Young, K. L., and Lafrenière, M.J., 2014, Pond hydrology and dissolved carbon dynamics at Polar Bear Pass wetland, Bathurst Island, Nunavut, Ecohydrology, v.7 no.1, 73-90, Published

Abnizova, A., Young, K., and Lafrenière, M.J., 2011, Pond hydrology and dissolved carbon dynamics at Polar Bear Pass wetland, Bathurst Island, Nunavut, Ecohydrology, , Submitted

Abnizova, A., Young, K., and Lafrenière, M.J., 2012, Pond Hydrology and Dissolved Carbon Dynamics at Polar Bear Pass wetland, Bathurst Island, Nunavut, Ecohydrology, , Accepted

Abnizova, A., Young, K., and Lafrenière, M.J., 2013, Pond Hydrology and Dissolved Carbon Dynamics at Polar Bear Pass wetland, Bathurst Island, Nunavut, Ecohydrology, doi:10.1002/eco.1323, 2012, Published

Assini, J. and Young, K.L., 2011, Snowcover and snowmelt of an extensive High Arctic wetland: spatial and temporal seasonal patterns., Hydrological Sciences Journal, , Accepted

Assini, J. and Young, K.L., 2012, Snowcover and Snowmelt of an Extensive High Arctic Wetland: Spatial and Temporal Seasonal Patterns., Hydrological Sciences Journal, v.4, 738-755, Published

Atkinson, D. and Treitz, P., 2013, Modeling Biophysical Variables across an Arctic Latitudinal Gradient using High Spatial Resolution Remote Sensing data, Arctic, Antarctic and Alpine Research, v.45, no. 2, 161-178, Published

Atkinson, D.M. and Treitz, P.M., 2012, Modelling Biophysical Variables across an Arctic Latitudinal Gradient using High Spatial Resolution Remote Sensing Data, Arctic, Antarctic and Alpine Research, , Submitted

Atkinson, D.M. and Treitz, P.M., 2012, Arctic Ecological Classifications Derived from Vegetation Community and Satellite Spectral Data, Remote Sensing, v.4, no.12, 3948-3971, Published

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Beamish, A., Neil, A., Wagner, I., Scott, N., 2013, Impacts of active layer detachments on carbon exchange in a High Arctic ecosystem, Cape Bounty, Nunavut, Canada, Polar Biology, , Submitted

Beamish, A., Neil, A., Wagner, I., Scott, N., 2014, Impacts of active layer detachments on carbon exchange in a High Arctic ecosystem, Cape Bounty, Nunavut, Canada, Polar Biology, 37, 1459-1468, Published

Beylich, A.A., Lamoureux, S.F. and Decaulne, A., 2011, Developing quantitative frameworks for studies on sedimentary fluxes and budgets in changing cold environments, Polish Polar Research, v. 30, no. 1, 5-8, Published

Bonnaventure, P. and Lamoureux, S.F., 2012, The Active Layer: A Conceptual Review of Monitoring, Modelling Techniques and Changes in a Warming Climate, Progress in Physical Geography, , Accepted

Bonnaventure, P.B., Lamoureux, S.F. and Favaro, E.A., 2014, Over winter channel bed temperature regimes generated by contrasting snow accumulation in a High Arctic river, Permafrost and Periglacial Processes, , Submitted

Bonnaventure, P.P. and Lamoureux, S.F., 2013, Autumn heat loss dominates in High Arctic lakes transitioning to a longer ice-free period, Limnology and Oceanography, , Submitted

Collingwood, A., Treitz, P. and Charbonneau, F., 2014, Surface Roughness Estimation from Radarsat-2 Data in a High Arctic Environment, International Journal of Applied Earth Observation and Geoinformation, v.27, 70-80, Published

Collingwood, A., Treitz, P., and Charbonneau, F., 2014, Surface Roughness Estimation from Radarsat-2 Data in a High Arctic Environment, International Journal of Applied Earth Observation and Geoinformation, v.27, 70-80, Published

Collingwood, A., Treitz, P., Charbonneau, F. and Atkinson, D., 2014, Artificial Neural Network Modeling of High Arctic Phytomass using Synthetic Aperture Radar, Remote Sensing, , Submitted

Collingwood, A., Treitz, P., Charbonneau, F. and Atkinson, D., 2014, Artificial Neural Network Modeling of High Arctic Phytomass Using Synthetic Aperture Radar and Multispectral Data, Remote Sensing, v.6, 2134-2153, Published

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Dugan, H.A, Lamoureux, S.F., Lewis, T. and Lafreniere, M.J., 2012, The impact of permafrost disturbances and sediment loading on the limnological characteristics of two high arctic lakes, Permafrost and Periglacial Processes, v. 23, no. 2, 119-126, Published

Dugan, H.A. and Lamoureux, S.F., 2011, The chemical evolution of a hypersaline coastal lake in the High Arctic, Limnology and Oceanography, 56: 495-507, 13, Published

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Dugan, H.A., Gleeson, T., Lamoureux, S.F. and Novakowski, K., 2012, Tracing groundwater discharge in a High Arctic lake using radon-222, Environmental Earth Sciences v. 66, no. 5, 1385-1392, Published

Lamoureux, S.F., Lafrenière, M.J., 2014, Seasonal fluxes and age of particulate organic carbon exported from Arctic catchments impacted by localized permafrost slope disturbances, Environmental Research Letters v 9, 45002, Published

Lamoureux, S.F., Lafrenière, M.J., Favaro, E., 2013, Sediment erosion impact and recovery following localized slope disturbances, Geophysical Research Letters, , Submitted

Lamoureux, S.F., Lafrenière, M.J., Favaro, E., 2014, Erosion dynamics following localized permafrost slope disturbances, Geophysical Research Letters v 41, 10.1002/2014GL060677, Accepted

Lapointe, F., Francus, P., Lamoureux, S.F., Said, M. and Cuven, S., 2012, 1750 years of large rainfall events inferred from particle size at East Lake, Cape Bounty, Melville Island, Canada., Journal of Paleolimnology, v. 48, 159-173, Published

Lewis, T., Lafrenière, M.J., Lamoureux, S.F., 2011, The impact of permafrost disturbances and climate on runoff chemistry of two High Arctic rivers, Hydrological Processes, Published Online October 2011, DOI: 10.1002/hyp.8335, Published

Louiseize, N.L. and Lafrenière, M.J., 2014, Active layer slope disturbances affect magnitude and composition of dissolved nitrogen export from High Arctic headwater catchments, Journal of Hydrology, , Submitted

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Maher, A., Treitz, P. and Ferguson, M., 2012, Can Landsat data detect variations in snow cover within habitats of arctic ungulates?, Wildlife Biology, v.18, 1-13, Published

Miller, E.A., and Young, K.L., 2014, Evaluation of the presence of streambed vegetation on storage and runoff in hillslope streams in a High Arctic environment, Ecohydrology, , Submitted

Muster, S., Langer, M., Abnizova, A., and Young, K.L., 2014, Spatio-temporal sensitivity of MODIS land surface temperatures indicates high potential for large-scale land cover change detection in Arctic permafrost landscapes, Remote Sensing of Environment, , Submitted

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Ojala, A.E.K., Francus, P., Zolitschka, B., Behl, R., Besonen, M. and Lamoureux, S.F., 2012, The fidelity of sediment varve chronologies – a review, Quaternary Science Reviews, v. 43, 45-60, Published

Rudy, A.C.A., Lamoureux, S.F., Treitz, P. and Collingwood, A., 2012, Identifying permafrost slope disturbance using multi-temporal optical satellite images and change detection techniques, Cold Regions Science and Technology, doi:10.1016/j.coldregions.2012.12.008, Published

Stewart, K.A. and Lamoureux, S.F., 2011, Connections between river runoff and limnological conditions in adjacent High Arctic lakes: Cape Bounty, Melville Island, Nunavut., Arctic, v. 64, no. 2, 137-268, Published

Stewart, K.A., Lamoureux, S.F., 2011, Seasonal and microhabitat influences on diatom assemblages and their representation in sediment traps and surface sediments from adjacent High Arctic lakes: Cape Bounty, Melville Island, Nunavut., Hydrobiologia, , Accepted

Non-Refereed Contributions

- Abnizova, A. and Young, K.L., 2011, Seasonal hydrology and DOC dynamics at an extensive low-gradient wetland, Polar Bear Pass, Nunavut, Canada., Canadian Geophysical Union (CGU), AGM, Banff, May 14-17, Abstract, 1, Published
- Abnizova, A. and Young, K.L., 2012, Snowmelt Hydrology and Carbon Dynamics in Wetland Ponds at Polar Bear Pass, Bathurst Island, Nunavut, Canada., International Polar Year Meeting, Montreal, April 22-27, 2012, abstract, Published
- Abnizova, A., Young, K.L. and Lafreniere, M.J., 2013, Hydrologic Connectivity and Dissolved Carbon Fluxes in Low-Gradient High Arctic Wetlands, Polar Bear Pass, Bathurst Island, Canada., 19th International Northern Research Basins Symposium and Workshop, Southcentral Alaska, August 11-17, 2013, 3-14, Published
- Abnizova, A., Young, K.L. and Shakil, S., 2012, Seasonal Variability in Hydrological and Physicochemical Characteristics of Small Water Bodies Across Polar Bear Pass, a High Arctic Wetland, Bathurst Island, Nunavut, Canada., American Geophysical Union AGM, San Francisco, Dec. 3-7, 2012, abstract, Published
- Atkinson, D.M. and Treitz, P., 2011, Estimation of Arctic Tundra Biophysical Variables from IKONOS Multispectral Data, Canadian Association of Geographers Annual General Meeting, Calgary, Alberta, May 30 – June 4 2011, 1, Published
- Beamish, A., and Scott, N., 2011, Disturbance-induced carbon fluxes in High Arctic Ecosystems, Inquiry at Queen's Undergraduate Research Conference, Queen's University, Kingston, ON., March 2011, Published
- Beamish, A., Neil, A., Wagner, I., and Scott, N.A., 2011, Impacts of active layer detachments on carbon exchange in a high-Arctic ecosystem, Cape Bounty, Nunavut, Canada., American Geophysical Union Meeting, San Francisco, CA., Dec. 2011, Published
- Beamish, A., Neil, A., Wagner, I., and Scott, N.A., 2012, Impacts of active layer detachments on carbon exchange in a high-Arctic ecosystem, Cape Bounty, Nunavut, Canada, IPY 2012 from Knowledge to Action Conference, April 22-29, 2012, Montreal (Oral Presentation), , Accepted
- Beamish, A., Scott, N.A., 2011, Disturbance-induced carbon fluxes in High Arctic Ecosystems, GEOTOP Conference, UQAM, Montreal, Canada., March 2011, Published
- Blaser, A.B., Scott, N.A. and Treitz, P., 2014, Seasonal Dynamics of Ecosystem Carbon Exchange for a Wet Sedge Vegetation Community, Melville Island, NU, Arctic Change 2014, Ottawa, ON. December 8-12, 2014, Poster Presentation, Published
- Bonnaventure, P.P. and Lamoureux, S.F., 2012, Complex Thermal Storage and Mixing of High Arctic Lakes Transitioning to Seasonal Ice Cover and a Longer Ice-free Period, Proceedings of ArcticNet Annual Scientific Meeting 2012, Vancouver, BC, Dec 10-14 (Oral Presentation), 37, Published
- Bonnaventure, P.P. and Lamoureux, S.F., 2012, Thermal storage and mixing of High Arctic lakes transitioning to seasonal ice cover and a longer ice-free period, IPY 2012 from Knowledge to Action Conference, April 22-29, 2012, Montreal (poster), 165, Published
- Bonnaventure, P.P., Lamoureux, S.F., 2013, Examining the Effect of Seasonal vs. Perennial Sea Ice Cover on Air and Ground Temperatures in Two Coastal High Arctic Areas of Melville Island., ArcticNet 2013 Annual Scientific Meeting, Halifax, Dec 9-12, 2013, 1, Published
- Buckley, E.C., Buckley, J.R, Scott, N.A., and Treitz, P., 2014, Estimating Soil Moisture in the Polar Semi-desert, International Geoscience and Remote Sensing Symposium, Quebec City, QC. July 14, 2014, Poster Presentation, Published

Favaro, E.A., Lamoureux, S.F., 2013, Downstream Patterns of Suspended Sediment Transport in a High Arctic River, ArcticNet 2013 Annual Scientific Meeting, Halifax, Dec 9-12, 2013, 76, Published

Favaro, E.A., Lamoureux, S.F., 2014, Downstream Patterns of Suspended Sediment Transport in a High Arctic River, Canadian Geophysical Union, Student Conference, Toronto, Jan. 17-18, , Accepted

Gregory, F., Treitz, P., Scott, N.A., 2012, Using IKONOS-derived NDVI to study vegetation dynamics in the Canadian High Arctic, Annual CSRS meeting, Sherbrooke, QC. June 2012, , Accepted

Holloway, J., Rudy, A.C.A., Lamoureux, S.F. and Treitz, P., 2014, Modeling Landscape Susceptibility to Permafrost Disturbances Reveals Differential Patterns related to Subsurface Water Pressurization, Arctic Change 2014, Ottawa, ON. December 8-12, 2014, Poster Presentation, Published

Holloway, J.E., Lamoureux, S.F., Montross, S., Lafrenière, M., 2013, Mud ejections: characterizing subsurface flow pathways from the deep active layer to the surface in the Canadian High Arctic, ArcticNet 2013 Annual Scientific Meeting, Halifax, Dec 9-12, 2013, 152, Published

Holloway, J.E., Lamoureux, S.F., Montross, S.N. and Lafrenière, M.J., 2012, Mud Ejections: characterizing emerging subsurface flow pathways from the deep active layer to the surface in the Canadian High Arctic, Proceedings of ArcticNet Annual Scientific Meeting 2012, Vancouver, BC, Dec 10-14 (poster), 139, Published

Holloway, J.E., Lamoureux, S.F., Montross, S.N., Lafreniere, M.J., 2014, Mud Boils: Characterizing Subsurface Flow Pathways from the Deep Active Layer to the Surface in the Canadian High Arctic, Canadian Geophysical Union, Student Conference, Toronto, Jan. 17-18, , Accepted

Holloway, J.E., Lamoureux, S.F., Montross, S.N., Lafreniere, M.J., 2014, Mud Boils: Characterizing Subsurface Flow Pathways from the Deep Active Layer to the Surface in the Canadian High Arctic, Canadian Geophysical Union, Student Conference, Toronto, Jan. 17-18, 10, Published

Humphreys, E and Lafleur, P., 2012, Contrasting responses of high and low Arctic tundra CO₂ exchange to variations in temperature and moisture, IPY 2012 Meeting, April 22-27, 2012, Montreal, QC., (oral presentation), Published

Kirk, J. L., Lehnherr, I., St. Louis, V. L., Muir, D., Lamoureux, S., Gleason, A., Lewis, T., K. Stewart, K, Iqaluk, D., 2011, The transfer of terrestrial mercury to freshwater lakes of the Canadian high Arctic., 10th International Conference on Mercury as a Global Pollutant, Halifax, , Accepted

Kirk, J.L, Muir, D., Antoniades, D., Douglas, M., Evans, M., Jackson, T., Kling, H., Lamoureux, S., Stewart, K., Lim, D., Pienitz, R., Smol, J., Wang, X., Yang, F., 2011, Response to comment on climate change and mercury accumulation in Canadian high and subarctic lakes, Environmental Science and Technology, v. 45, 6705-6706, Published

Kirk, J.L., Lehnherr, I., Muir, D., Gleason, A., St Louis, V., Lamoureux, S.F., Lafrenière, M.L. and Stewart, K., 2012, The transfer of terrestrial mercury to freshwater aquatic ecosystems at Cape Bounty, Melville Island, Nunavut, Proceedings of ArcticNet Annual Scientific Meeting 2012, Vancouver, BC, Dec 10-14 (poster), 140, Published

Kjikjerkovska, E., Lamoureux, S., Lafrenière, M., Shirley, J., 2013, Thirty years of hydrological and water source changes in the Apex River, Iqaluit, Baffin Island, ArcticNet 2013 Annual Scientific Meeting, Halifax, Dec 9-12, 2013, 157, Published

Lafrenière, M. J, S. F. Lamoureux, and H. Munro, 2012, Impact of Warming and Permafrost disturbance on solute and nutrient export in High Arctic watersheds, IPY 2012 from Knowledge to Action Conference, April 22-29, 2012, Montreal, (Oral Presentation), Published

Lafrenière, M.J, Louiseize, NL, Lamoureux S.F. and Hastings, M., 2014, Permafrost Disturbance Impacts on Dissolved Ion Loads and Nitrogen Dynamics, American Geophysical Union (AGU) Fall Meeting, San Francisco, CA, Dec 15-19th, GC11F-07(Invited-oral), Published

Rudy, A.C.A., Lamoureux, S.F. and Treitz, P., 2012, Satellite change detection techniques and object-based analysis to identify permafrost slope disturbances at Cape Bounty, Melville Island, Nunavut, Proceedings of ArcticNet Annual Scientific Meeting 2012, Vancouver, BC, Dec 10-14 (Oral Presentation), 93-94, Published

Rudy, A.C.A., Lamoureux, S.F. and Treitz, P., 2012, Mapping high arctic permafrost disturbances using multi-temporal aerial photographs and satellite imagery, Melville Island, Nunavut, IPY 2012 from Knowledge to Action Conference, April 22-29, 2012, Montreal (poster), 187, Published

Rudy, A.C.A., Lamoureux, S.F., Treitz, P., 2013, Permafrost Disturbance Susceptibility Mapping Using Key Physiographic Controls and Geospatial Modelling in the Canadian High Arctic., ArcticNet 2013 Annual Scientific Meeting, Halifax, Dec 9-12, 2013, , Accepted

Rudy, A.C.A., Lamoureux, S.F., Treitz, P. and Van Ewijk, K., 2014, Universal Permafrost Disturbance Susceptibility Modelling for a Region in the Canadian High Arctic, Arctic Change 2014, Ottawa, ON. December 8-12, 2014, Oral Presentation, Published

Rudy, A.C.A., Lamoureux, S.F., Treitz, P., Van Ewijk, K. and Bonnaventure, P., 2014, Modelling Permafrost Disturbance Susceptibility across the Canadian High Arctic, 4th European Conference on Permafrost. 18-21 June 2014, Evora, Portugal, Oral Presentation, Published

Scott, N., Wagner, I., Gregory, F., Buckley, E., Beamish, A., Treitz, P., 2013, Factors regulating net greenhouse gas exchange across high-Arctic landscapes at Cape Bounty, Melville Island, Nunavut: interaction of vegetation distribution and environmental controls., ArcticNet Annual General Meeting, Halifax, NS Dec. 2013., 1, Published

Scott, N.A., Buckley, E., Yue, J., Humphreys, E., Lafleur, P., 2012, Spatial and temporal patterns of net ecosystem exchange of carbon dioxide and ecosystem respiration at the Cape Bounty Arctic Watershed Observatory, Melville Island, Nunavut., Proceedings of ArcticNet Annual Scientific Meeting 2012, Vancouver, BC, Dec 10-14 (Oral Presentation),,, , Accepted

Scott, N.A., Wagner, I., Gregory, F., Humphreys, E., Lafleur, P., Lafreniere, M., Lamoureux, S., Treitz, P., 2012, Contribution of terrestrial and fluvial processes to the net carbon balance of intact and disturbed small high Arctic watersheds at Cape Bounty, Melville Island, Nunavut, IPY 2012 from Knowledge to Action Conference, April 22-29, 2012, Montreal (poster, , Accepted

St. Louis, V.L., Lehnherr, I., Lamoureux, S.F., Graydon, J.A., Barker, J.D., Emmerton, C. and Kirk, J.L., 2012, Net ecosystem exchange of carbon dioxide and methane from lakes and wetlands in the Canadian High Arctic, IPY 2012 from Knowledge to Action Conference, April 22-29, 2012, Montreal, (Oral Presentation), Published

St.Louis, V., Muir, D., Lehnherr, I., St-Pierre, K., Schiff, S., Venkiteswaran, J., Talbot, C., Emmerton, C., Kosolofski, H., Stern, D., and Akeeagok, S., 2013, Quantifying contaminant loadings, water quality and climate change impacts on Canada's largest high Arctic lake (Lake Hazen), Northern Contaminants Program Results Workshop, Ottawa, September 2013, 0, Published

St.Pierre, K.A., St.Louis, V.L., Lehnherr, I., Muir, D., Szostek, L., Kirk, J.L., Talbot, C., 2014, Mercury Dynamics in the Rapidly Changing Lake Hazen Watershed (Quttinirpaaq National Park, Nunavut, Canada),. Arctic Change 2014 Conference, Ottawa, 1, Published

Wagner, I., Beamish, A., Cassidy, A., Treitz, P., and Scott, N., 2011, Relationships among phenology, NDVI, and CO2 exchange in three high-Arctic plant communities., Poster presented at the 32nd Canadian Symposium on Remote Sensing, Sherbrooke, Quebec, Canada June 13-16, 2011, June 2011, Published

Wagner, I., Gregory, F., Fisher, E., Neil, A., Scott, N.A., 2012, Greenhouse gas exchange from three high-Arctic vegetation types along a soil moisture gradient at Cape Bounty, Melville Island, Nunavut, IPY 2012 from Knowledge to Action Conference, April 22-29, 2012, Montreal (poster),, , Accepted

