

# Freshwater-Marine Coupling in the Hudson Bay IRIS

## Summary

### Project Leaders

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Climate models predict warming in the Hudson Bay watershed that may alter the amount and timing of runoff and hence, of the load of suspended solids, dissolved organic matter and other major nutrients, and heat delivered to the Bay. In the Churchill and Nelson estuaries, such changes will be superimposed on earlier changes in the hydrological regime; diversion of Churchill River flows into the Nelson River and a shift of a third of total discharge from summer to winter. Our study of transfer pathways through river estuaries into Hudson Bay will improve our understanding of the effects of these changes. The overarching objective of this project is to describe the impact of freshwater quality and quantity on marine processes within Hudson Bay. In particular we are interested in understanding the principal processes which couple the freshwater and marine systems in Hudson Bay and to examine the cumulative impacts of climate change and hydroelectric development on Hudson Bay. Our key industry partner (Manitoba Hydro) will use this information to examine aspects of environmental impacts due to development of dams along the Nelson River, including the planned development of Conawapa Generating Station. More specifically our team will determine the fluxes, pathways and fate of suspended solids and dissolved organic matter transferred through the Churchill and Nelson estuaries during the open water season when mixing in the estuary is determined by wind-driven waves, tides and fluvial and marine currents, and under ice, when mixing is determined by tides and fluvial and marine currents alone. We will also investigate the relative significance of fluvial loading and littoral resuspension to concentrations of suspended solids in the estuaries and Hudson Bay and to study the effect of suspended solids and dissolved organic matter on radiative transfer in the estuary and nearby Hudson Bay. This team will also investigate historical effects of climate on Hudson Bay by interpretation of data stored in bottom sediments within our three supersites - the estuaries of the Nelson and Churchill Rivers, and of the Grande Rivière de la Baleine - and also in sediments deposited at the Bay-wide scale.

## People

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## Partners

Canadian Coast Guard  
 Canadian Space Agency  
 Churchill Gateway Development Corporation  
 Environment Canada  
 European Space Agency  
 Fisheries and Oceans Canada - Bedford Institute of Oceanography  
 Manitoba Hydro  
 Manitoba Innovation Fund  
 Memorial University of Newfoundland  
 Natural Resources Canada - Environmental Studies Research Fund (ESRF)  
 OmniTRAX  
 Ouranos  
 Polar Continental Shelf Program  
 Province of Manitoba  
 Transport Canada  
 University of Manitoba  
 World Wildlife Fund Canada

## Publications

### Articles Published in Refereed Publications

Barber, D.G, G. McCullough, D. Babb, A.S Komarov, L.M Candlish, J.V. Lukovich, M. Asplin, S. Prinsenberg, I. Dmitrenko, and S. Rysgaard., 2014, Climate Change and Ice Hazards in the Beaufort Sea, *Elementa*, , Accepted

Bouchat, A., L.B. Tremblay, 2014, Energy dissipation in viscous-plastic sea-ice models, *Journal of Geophysical Research: Oceans*, n/a, Accepted

Braune, Birgit M., Anthony J. Gaston, Kyle H. Elliott, Jennifer F. Provencher, Kerry J. Woo, Magaly Chambellant, Steven H. Ferguson, and Robert J. Letcher, 2013, Organohalogen Contaminants and Total Mercury in Forage Fish Preyed upon by Thick-Billed Murres in Northern Hudson Bay, *Marine Pollution Bulletin*, na, Published

Brown, T. M., Kuzyk, Z. Z. A., Stow, J. P., Burgess, N. M., Solomon, S. M., Sheldon, T. A., and Reimer, K. J., 2013, Effects-based marine ecological risk assessment at a polychlorinated biphenyl-contaminated site in Saglek, Labrador, Canada., *Environmental Toxicology and Chemistry*, v.32, no.2, 453-467, Published

Brunelle, C. B., Larouche, P., and Gosselin, M., 2012, Variability of phytoplankton light absorption in Canadian Arctic seas., *Journal of Geophysical Research: Oceans*, v.117, no.C8, C00G17, Published





Pogson, L., Tremblay, L.B., Lavoie, D., Michel, C. and Vancoppenolle, M., 2011, Development and validation of a one-dimensional snow-ice-algae model against observations in Resolute Passage, Canadian Archipelago', *Journal of Geophysical Research*, v. 116, C04010, doi:10.1029/2010JC006119, Submitted

Schmidt, G. A., Annan, J. D., Bartlein, P. J., Cook, B. I., Guilford, E., Hargreaves, J. C., Harrison, S. P., Kageyama, M., LeGrande, A. N., Konecky, B., Lovejoy, S., Mann, M. E., Masson-Delmotte, V., Risi, C., Thompson, D., Timmermann, A., Tremblay, L.-B., and Yiou, P., 2014, Using palaeo-climate comparisons to constrain future projections in CMIP5, *Clim. Past*, 221-250, Published

Sirven, J., L.B. Tremblay, 2015, Analytical study of an isotropic viscoplastic sea ice model in idealized configurations, *Journal of Physical Oceanography*, 331-354, Published

Sirven, J., Tremblay, B., 2012, Analytical study of an isotropic visco-plastic sea-ice model in idealized configurations, *Journal of Physical Oceanography*, , Submitted

St-Laurent, P., Straneo, F., & Barber, D. G., 2012, A conceptual model of an Arctic sea., *Journal of Geophysical Research: Oceans*, v.117, no.C6, C007652, Published

St-Laurent, P., Straneo, F., Dumais, J.-F., and Barber, D.G., 2011, What is the fate of the river waters of Hudson Bay?, *Journal of Marine Systems*, v. 88(3), 352-361, Published

Wang, R., McCullough, G. K., Gunn, G. G., Hochheim, K. P., Dorostkar, A., Sydor, K., and Barber, D. G., 2012, An observational study of ice effects on Nelson River estuarine variability, Hudson Bay, Canada, *Continental Shelf Research*, v.47, 68-77, Published

Wang, R., McCullough, G.K., Gunn, G., Hochheim, K.P., Dorostkar, A., Sydor, K., Barber, D.G., 2012, An observational study of ice effects on Nelson River estuarine variability, Hudson Bay, Canada, *Coastal Shelf Re.*, , Submitted

Watt, C. A., M. P. Heide-Jørgensen, and S. H. Ferguson., 2013, How Adaptable Are Narwhal? A Comparison of Foraging Patterns among the World's Three Narwhal Populations, *Ecosphere*, na, Published

Wu, Y., Tang, C., & Hannah, C., 2012, The circulation of eastern Canadian seas, *Progress in Oceanography*, v.106, 28-48, Published

Young, B. G., and S. H. Ferguson., 2013, Seasons of the Ringed Seal: Pelagic Open-Water Hyperphagy, Benthic Feeding over Winter and Spring Fasting during Molt., *Wildlife Research*, 52-60, Published

**Other Refereed Contributions**

Rudels, B, Anderson, D., Eriksson, P., Fahrbach, E., Jakobsson, M., Jones, E.P., Melling, H., Prinsenber, S., Schauer, Yao, T., 2012, "Observations in the Ocean" in "ACSYS Achievements - Ocean Arctic Climate Change - The ACSYS Decade and Beyond", *Atmospheric and Oceanographic Sciences Library*, v.43, 117-198, Published

**Non-Refereed Contributions**

Blanken, H., L.B. Tremblay, S. Gaskin, A. Slavin, 2014, Arctic oil spills: a risk assessment of transport in sea ice and ocean surface waters from current exploration sites, E-proceeding of the 36th IAHR World Congress, na, Published

Eastwood, A., Kuzyk, Z., Heath, J., Petrusevich, V., Ehns, J., Dmitrenko, I., Gueguen, C. and Barber, D.G., 2014, Oceanographic Conditions under the Landfast Sea Ice in Southeast Hudson Bay, *ArcticNet Annual Meeting 2014 - Arctic Change*, 1, Published

