BaySys Newsletter

Issue 3 - Summer 2018

Project Update

Year 3 of the BaySys project is coming to an end. NSERC progress reporting is upon us, and Teams are hard at work processing and analysing samples and data acquired during this summer's fieldwork, all with the aim of providing a scientific basis to separate climate change effects from those of regulation of freshwater on physical, biological and biogeochemical conditions in Hudson Bay. Read more about the project here: http://umanitoba.ca/faculties/environment/departments/ceos/research/BaySys.html

Meetings

Integrated Observational/Modeling Meeting was held at Manitoba Hydro on September 18th 2018
Research Advisory Committee Meeting will be held on October 26th 2018
BaySys All-Hands Workshop and Science Steering Committee Meeting will be held in conjunction from November 15th to 16th 2018.

Outreach and Knowledge Exchange

The Chesterfield Inlet Community Visit was held on June 7th 2018 on board the *CCGS* Amundsen
The Churchill Community Visit was held on July 3rd on board the *CCGS* Amundsen
Knowledge Exchange Workshop was held in Churchill from July 2nd - 3rd 2018.

Recent Publications

Barber, D.G., Babb, D.G., et al. (2018) "Increasing Mobility of High Arctic Sea Ice Increases Marine Hazards Off the East Coast of Newfoundland", *Geophysical Research Letters*.

Déry, S.J., T.A. Stadnyk, M. MacDonald, K. Koenig, C. Guay (accepted). Flow regulation transcends daily natural variation in Hudson Bay's two largest rivers. Hydrol. Process. HP-18-0109.

Find previous BaySys Newsletters here: http://umanitoba.ca/faculties/environment/departments/ceos/research/1455.html

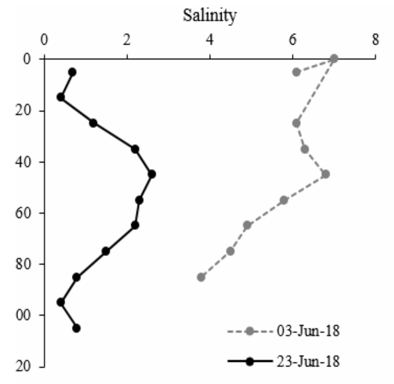
Field Program Updates

Leg 1 of the 2018 Amundsen cruise was successful. Many of our objectives for the cruise and BaySys project were achieved, baring a few locations in the bay in which were not able to access due to ice and weather conditions. Overall, data collection and sampling went well, including all on board and remote based (i.e., helicopter; zodiac; barge; and on-ice) operations.

The cruise provided immense value to the BaySys project. It allowed for large-scale data collection throughout a partial ice-covered Hudson Bay that would otherwise have been impossible via most other modes of fieldwork (i.e., land and ice-camps; small vessel sampling; pedestrian survey and data collection). The data collected throughout Hudson Bay ensures that we have comparative results to past fieldwork, as well as provides physical inputs for the BaySys modeling teams. In addition, community visits provided those on board with important experience in science communication and involvement with local communities, including elders, officials, and youth. The impressive amount of samples and data collection over six weeks, and the results that will derive from their analysis ultimately help BaySys teams achieve their goals and provide insight towards answering the overall project objectives to separate climate change effects from those of hydroelectric regulation of freshwater on physical, biological and biogeochemical conditions in Hudson Bay.

Team 1

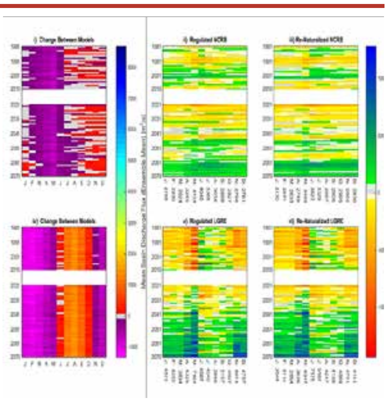
A specific aim of Team 1 on board the Amundsen was to characterize the physical properties of the ice cover and provide context on the ice conditions for other BaySys teams. Using a variety of field techniques from direct in situ physical measurements, to remote sensing instruments and autonomous platforms that remained on the ice, we collected temperature and salinity data, measured its thickness, assessed its roughness, quantified its aerial concentration and the floe size distribution, monitored its radiometric signatures to compare to satellite observations, and tracked its drift through varying currents. Overall the sea ice was relatively warm and near isothermal at every site sampled. The salinity varied from values typical of first year sea ice (5 – 7) to values indicative of freshwater ice (0 – 1).



Salinity profiles for ice floes sampled in northern Hudson Bay (03-Jun-18) and southern Hudson Bay (23-Jun-18).

Team 2

Team 2 has most recently been working on analyses of future regulated streamflow relative to simulations (historic and future) running a "re-naturalized" HYPE model that removes all impacts of regulation. Results indicate that both climate change and regulation control freshwater exports to Hudson Bay, both recent past, present and into the future. Specifically, intra-annual variability is primarily driven by hydroelectric regulation, while inter-decadal (long-term) variability is controlled mainly by climate. Inter-annual variability of streamflow, however, is largely dictated by upstream storage capacity. These findings help us to understand the unique role each play on the timing and magnitude of past and future freshwater flux (Tefs et al., in preparation).



Anomaly in mean basin discharge (i, iv), and mean basin discharge for the Nelson-Churchill and La Grande Riviere Complex regulated (ii,v) and re-naturalized (iii,vi) model scenarios, respectively.

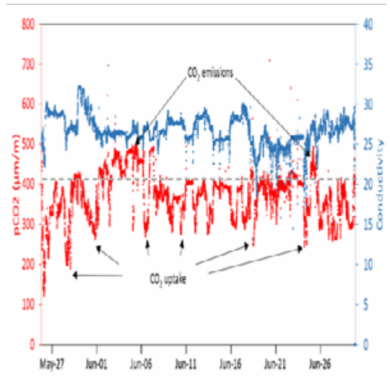
Team 3

One Team 3 fieldwork objective was the monitoring of key parameters for zooplankton and fish using various sampling devices and the EK60 echosounder. We aimed to compare species assemblages in different areas of the Hudson Bay system, understanding which fish species develop in estuaries and along the ice-edge during the spring-melt season, and to capture adult fish in Hudson Bay for the first time. Among 460 adult fish caught, several species found are new to our data set. We also captured arctic cod on the south coast of Hudson Bay, an area where we previously thought that arctic cod had stopped inhabiting. There were also some fish larvae specimen found at the mouth of the Nelson Estuary that have not yet been identified.

Relative abundance of fish larvae in the Nelson River Estuary

Team 4

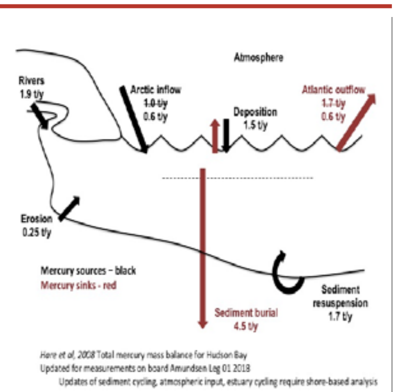
The biogeochemical cycling of carbon is continually changing within the Arctic Ocean as a consequence of climate change. Team 4 cruise objectives were to measure principle components of the carbon system across Hudson Bay, including those variables deemed most influential at moderating the transformation, transport and distribution of carbon. Central to the cruise objectives were to include in freshwater from the Bay's major rivers. Measurements were made within the water column, at the air-sea (or air-ice) interface, and in the atmosphere. The data are very preliminary and require additional processing before making reliable inferences, but it appears that the bay is overall under-saturated in pCO2, suggesting the bay is net autotrophic and a net sink for atmospheric CO2 during the spring.



The surface pCO2 concentration and salinity vs. time from the continuous underway system in the engine room.

Team 5

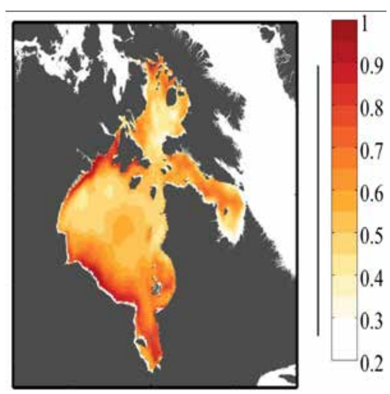
The Team 5 objective of the cruise was to build a mercury (total mercury and methylmercury) budget in Hudson Bay by seawater samples collected from the rosette, ice sampling, zodiac, barge and helicopter sampling for rivers and sediment core sampling. Selected water and ice samples will be analyzed for DOM characterization, which may assist in interpreting the fate of mercury in the Arctic. Incubation experiments were conducted using seawater samples from subsurface chlorophyll maximum, oxygen minimum and bottom, as well as in sediment cores to determine the net methylation capability in different Hudson Bay reservoirs to determine their impact on the mass budget of mercury.



Hare et al, 2008 Total mercury mass balance for Hudson Bay. Updated for measurements on board Amundsen Leg 01 2018

Team 6

We first welcome Dr. Frédéric Dupont (ECCC) as a new member of Team 6. Evaluation of the NEMO ice-ocean model in recent studies has demonstrated the ability of the ANHA configuration to provide a realistic representation of thermodynamic and dynamic processes in the Hudson Bay Complex. In an assessment of sea surface temperatures modeled using bulk flux parameterization, Shabnam JafariKhasragh has documented sensitivity of simulated SSTs to atmospheric forcing due to differences in longwave heat fluxes, and limited sensitivity to model resolution and discharge. Furthermore, Natasha Ridenour with Team 1 & 6 colleagues, has shown in an evaluation paper and freshwater budget analysis that freshwater circulation and in particular the magnitude and strength of freshwater fluxes are sensitive to river discharge forcing in the HBC.



Comparison of simulated SSTs with satellite data for August- September, 2002-2009, using the Willmott skill score. A value of one indicates agreement. Figure and analysis courtesy of Shabnam JafariKhasragh.

Stories from BaySys - Team 1 - Yanique Campbell

Surface Gravity Waves: From the Tropics to the Arctic

As a Jamaican who grew up in a small, coastal community, the ocean has always been a major part of my life. In a community heavily dependent on fishing, the sea is the primary means of survival. As such, my goal as a young intern stepping out into the world of research was to understand more about the ocean and how better predictions of ocean processes could be made. On board the Amundsen this year, my research played an important role in the BAYSYS project. The idea of waves being a part of the climate change problem has only in recent years gained notable attention as Arctic sea ice extents have been significantly decreasing. This decrease of ice increases the amount of space, known as fetch, that waves need in order to develop. I use a combination of wave buoys with accelerometers, GPS, wind sensors, and remote sensing for measuring wave characteristics, such as the heights and periods of the waves, as well as wind speed and direction.

Stories from BaySys - Team 5 - Ainsleigh Loria

Mercury in the Food Web: Sampling on Board the CCGS Amundsen

This is my third consecutive summer on board the *CCGS* Amundsen where I collect biological samples for contaminants analysis as part of the BaySys project. Zooplankton are an important component to the food web, and they consist mainly of small animals and immature stages of larger animals. The sampling process on board is straight forward. We have two main nets that we use to catch the zooplankton: the Tucker, which is dragged alongside the icebreaker while moving slowly, and the Monster, which is basically dunked straight down into the water and is then pulled back up towards the surface. Twist off bottles are positioned at the end of the net where the zooplankton are collected. I keep a Coleman water jug nearby into which I transfer the sample in order to keep them cool, then I bring it to the laboratory on-board the icebreaker. Next, I pour the sample into a large pan to sort the bugs one by one, and by species, using tweezers. They then go into labelled vials and are stored in the freezer until we bring them back to the university, where we conduct the mercury analysis.