Hudson Bay System Study (BaySys) Quarterly Newsletter

Issue 2 - Winter/Spring 2018

The past winter term has been busy for BaySys teams. David Landry joined us in January 2018 as the new BaySys coordinator. The Science Steering Committee and Research Advisory Council meetings were held on February 2nd 2018.

Upcoming Meetings and Reports

There will be an interactive workshop in the fall of 2018 for all team members to discuss how to incorporate data from Team 2/6 into each teams assessment of impacts from climate change vs regulation.
The SSC and RAC meeting will be in fall 2018.
The Hudson Bay IRIS is in production and will be published in fall 2018.

Outreach and Knowledge Exchange

Arctic Science Day at Fort Whyte as a success on March 8, 2018. For further information see: https://www.fortwhyte.org/arctic-science-day-2018-recap/

The Knowledge Exchange Workshop will occur on July 3 in Churchill on board the CCGS *Amundsen*.

Recent Publications

Barber, D.G., Babb, D.G., Ehn, J.K., Chan, W., Matthes, L., Dalman, L.A., Campbell, Y., Harasyn, M.L., Firoozy, N., Theriault, N., Lukovich, J.V., Zagon, T., Papakyriakou, T., Capelle, D.W., Forest, A., and Gariepy, A. (2018) "Increasing Mobility of High Arctic Sea Ice Increases Marine Hazards Off the East Coast of Newfoundland", *Geophysical Research Letters*, DOI: 10.1002/2017GL076587.

For more publications: http://umanitoba.ca/faculties/environment/departments/ceos/research/1418.html

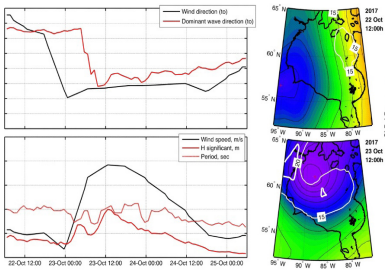
Field Program Updates

Spring 2018 - The 2018 Amundsen field program preperation is underway. Vital equipement and instruments were shipped to Québec City, where they will await loading onto the research vessel. Meanwhile, BaySys teams continue to plan accordingly and prepare for the long hual from Québec City, through Hudson Bay, and ending in Churchill MB. The bay-wide survey will include numerours scientifc station stops along icy straits, open waters, and coastal river systems.

Full pallets awaiting departure from CEOS

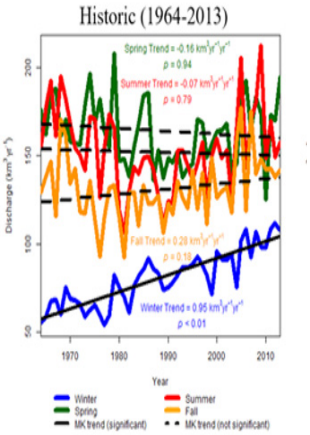
Team 1

Began analysis of year-long records from AN01, NE03 and NE02 moorings deployed in October 2016. The upward-looking Acoustic Doppler Current Profilers are one of the most important components of those moorings measuring current speed, direction and wind wave characteristics. One of the most severe storms occurred in late October 2017 with a wind speed exceeding 20 m/s. This storm resulted in significant increase of wave heights at AN01 from 3 to 10 m during several hours according to directional wave spectra processing. Such a strong increase could considerably modify the vertical stratification and resulted in enhanced vertical mixing of surface fresh layer with underlying saline waters. The further analysis implies to investigate the wave mixing statistics and its seasonal modification due to the presence of sea ice.



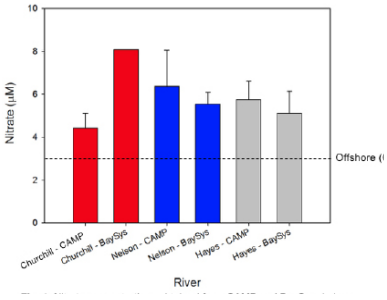
Team 2

Analyses of historical runoff trends entering Hudson Bay show increasing runoff in recent decades (1990-2010), with the most significant increases occurring to winter discharge. Discharge projections into Hudson Bay are also characterized from 2021-2070 using the HYPE hydrological model. Nineteen simulations from the CMIP5 climate modeling experiment and two representative concentration pathways (RCPs, 4.5 and 8.5) are used to force the hydrological model and derive various runoff scenarios. Annual runoff over the majority of the HBDB is projected to increase, with the greatest increases projected for Québec and on Baffin Island. Projected increases in discharge are greatest furthest north, into Foxe Basin, Ungava Bay and Hudson Strait, exceeding >10% above historical annual means as a result of increasing precipitation. Little change in annual runoff is projected to occur across the Canadian prairies, consistent with increasing precipitation and temperature that is offset by increasing evapotranspiration.



Team 3

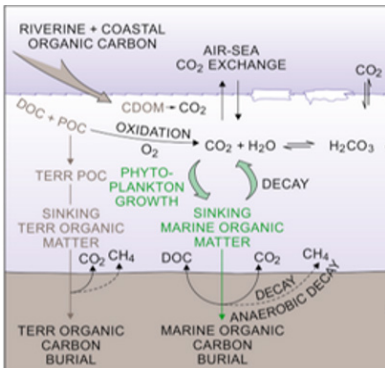
Thus far, Team 3 found no indication that regulated rivers (Nelson) are different from unregulated ones (Hayes). Nitrate concentrations are higher in rivers than offshore waters, especially during winter, which sets the stage for a sizable spring bloom in nearshore waters. Moreover, DNA analyses showed that the Great Whale River is characterized by microbes tolerant to changing coastal estuarine conditions. Benthic surveys showed no difference among epibenthic communities in the Hudson Bay complex except between James Bay-South and Central-James Bay. Satellite observations showed a high spatial-temporal and interannual variability of ice-edge. Fish species assemblages vary in different parts of the bay with Arctic species mostly found in the northern and eastern regions and in Hudson strait.



Nitrate concentrations obtained from CAMP and BaySys during winter/spring were compared between regulated and unregulated rivers.

Team 4

Team 4 has been working hard on integrating several research groups' efforts into a single, 'big-picture' assessment of how carbon flows through the Hudson Bay system to develop the first complete carbon-budget for the bay. The budget incorporates published and unpublished measurements of organic and inorganic carbon from rivers, sediments, surface and deep waters, and air-sea exchange, as well as modeling studies. Important outcomes from this study are a better understanding on the connection between inorganic and organic carbon cycles, shedding light on how river delivery of terrestrial carbon contributes to ocean acidification and *CO2* uptake/release by the bay. These relationships have given insight into the impact of changing river load on the coastal and basin carbon system of the bay, but importantly also have identified where data are needed to better our ability to predict the impact of change on of carbon.

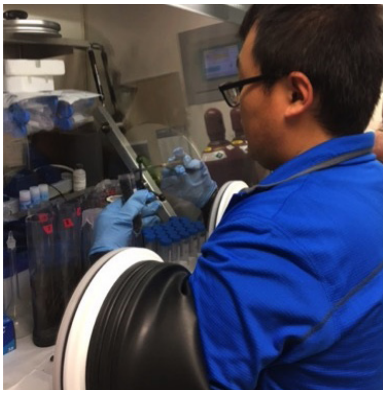


Simplified carbon budget for Hudson Bay, showing sources, sinks, and internal carbon transformations.

Team 5

While most members are busy preparing for the upcoming bay-wide expedition, we are seeing the transition from lab-based analysis to data interpretation of the samples collected in earlier field campaigns. Two of our fantastic MSc students are shaping their theses: Tassia Stainton is tracing the sources and transport of particulate matter in the Nelson River watershed. She has been using historical data and samples collected during our field campaigns in Northern Manitoba to determine the sources of particulate matter to Hudson Bay delivered by the Nelson River. James Singer is using historical records of mercury from sediment cores collected in Northern Manitoba water bodies to determine how changes to the watershed, such as flooding and climate change, influence bioaccumulating methylmercury production.

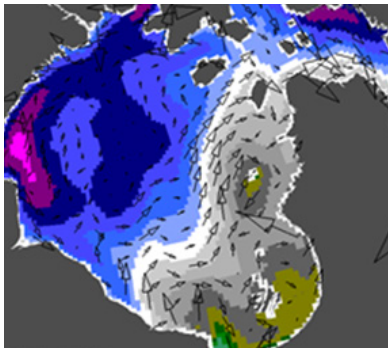
The results of these students' work provide the rest of our team with a first view of how organic matter and mercury are linked in riverine sources to Hudson Bay and will guide our planned work during the upcoming bay-wide expedition.



Jiang Liu, PhD student, processing samples collected from Northern Manitoba water bodies for sulfide analysis (J. Singer)

Team 6

Preliminary results from T6 modelling was presented at the Arctic Change conference in Quebec City in December 2017. This presentation reaffirmed our teams' objectives. Initial analysis focussed on evaluation the NEMO model simulations within the Hudson Bay over the recent years (2002-2017). One interesting result coming out of this process was the finding that significant freshwater input into south-east Hudson Bay leads to an increase in steric and sea surface height in this region in summer, driving a localized seasonal anti-cyclonic cell, compared to the regular basin wide cyclonic circulation (see figure). Observational evidence for this feature can be seen in geostrophic velocities calculated from AVISO satellite data.



Stories from BaySys - Team 4 - Dave Capelle

David Capelle during a field campaign in February 2017 near Churchill, MB. (photo credit: Laura Dalman).

Our research aims to improve our understanding on the Hudson Bay carbon cycle during spring, and the fate of terrestrial carbon that reaches Hudson Bay.

I recently addressed the lack of winter measurements during a winter field campaign on the southwestern shore of Hudson Bay in 2017. However, spring is an extremely important time of year when several key processes occur. I plan to survey the carbon system across a range of Hudson Bay environments during the spring 2018 research cruise, from rivers and estuaries to offshore regions, from open water to ice-covered, and from surface waters to the sediments. I will measure everything from dissolved and particulate forms of carbon in water and ice. On top of these discrete measurements, incubation experiments will be used to estimate the rates of organic carbon remineralization by microbes in each of these regions.

Our research is helping hydroelectric companies (e.g. Manitoba Hydro) better understand their impact on Hudson Bay, and local communities who may be impacted by climate change and ocean acidification.

Stories from BaySys - Team Central - David Landry

David Landry conducting a GPR survey during the 2015 field campaign on southern Baffin Island, NU. (photo credit: Brooke Milne).

As the new BaySys coordinator, I am excited to bring my research background in Arctic anthropological archaeology to this project. Over the past seven years, I have studied Palaeo-Inuit technology, landscapes and communities on southern Baffin Island, specifically, focusing on providing new insight into Dorset (ca. 2,500 - 1,100 BP) mobility, transport, and resource-use throughout time.

In 2013, with a small field crews of 4 reseachers, we spent several days surveying inland southern Baffin Island in search of potential toolstone quarry sites, and with a bit of luck, we came across an extensive Paleo-Inuit quarry along the Hone river, just south of Amadjuak Lake. In the following years of my PhD tenure, I was able to examine and analyze data collected through several geophysical and terrestrial remote sensing surveys at this site among others in the inland region. Ultimately, my research produced four publications and allowed me to more accurately reconstruct Paleo-Inuit mobility and technological organization on southern Baffin Island. In addition, the use of non-invasive survey methods proved useful in developing a novel methodology for the investigation of these types of archaeological sites.

Looking forward, I am eager to contribute my skillset and knowledge of the Arctic and its people to the BaySys project and beyond. Glad to be a part of the team!

Partners