

# Cold-Region Estuaries Workshop

*Hudson Bay – Baie d'Utson*

Ocean system

Marcel Babin & Matthew Asplin

# Scope

- Marine waters
- Large scale (Hudson Bay)
- Physical oceanography & biogeochemistry
- (nearly) No biology
- No climate
- No detail

What we know

# Physical oceanography - knowledge

- Bathymetry – how well?
- Large-scale water mass distribution (T, S)
- General circulation, transport
- Input-output in the Hudson Strait
- Teleconnection (EP/NP and AO) are documented
  
- Large-scale sea ice dynamics & Existence and location of polynyas
- Dissipation of tidal energy and the role of sea ice
- Impact of sea ice on vertical mixing
  
- River discharge for each river
- Plume behavior
- Freshwater budget for the HB & Residence times
- Distribution of river discharge to the bay and how it circulates within the HB

# Physical oceanography - models

- We have 3-D models to estimate large-scale water mass distribution, currents and sea-ice
- We have estuary 3-D models
- We are able to track the trajectory of freshwater from each individual river in the HB

# Physical oceanography - data

- We have limited time-series from a number of moorings
- Distributed stations with CTD and other physical measurements over decades of data collection

# Biogeochemical stocks & fluxes - Knowledge

- A good idea about inputs from rivers of particulate and dissolved organic carbon
- Some idea about inputs from rivers of nutrient (N is limiting)
- Large-scale distribution of nutrients in the HB, and how they are distributed by currents
- HB is mostly oligotrophic, PP is low
- HB contains a large amount of CDOM, which absorbs a large fraction of light
- We have a preliminary budget for terrigenous and marine organic carbon in the HB
- HB is a weak sink for CO<sub>2</sub> compared with other Arctic seas. Coastal waters are supersaturated in CO<sub>2</sub>

# Biogeochemical stocks & fluxes - Models

- 1? coupled 3D models



# Biogeochemical stocks & fluxes - Data

- Distributed stations with all kinds of measurements

What we do not know  
What we need to know

# Physical oceanography

- Small-scale circulation
- Vertical mixing
- The reasons for the current late freeze-up
- What will be the impact of tides when there will be less sea ice?
- Vertical distribution of tidal currents and their impact of vertical mixing

# Physical oceanography - models

- Small-scale
- Interface between coastal and offshore models
- Modeling the long-term impact of new and existing industrial activities on inputs to HB
- Several improvements to models:
  - Coastal erosion
  - Sea ice dynamics around islands
  - Polynya dynamics
  - Deep water formation
  - Coastal upwelling
  - Contribution of eddies to tracer transport
  - The effect of steep bathymetric features
  - Wave-ice interactions

# Physical oceanography - data

- No annual cycles
- Deficient hydrometric network and access to some data
- Coverage of James Bay

## Biogeochemical stocks & fluxes - Knowledge

- Spring phytoplankton bloom
- Indirect N supply pathways (degradation, photo-oxidation)
- Dense water formation on the west shelf
- Fate of C components from watersheds/rivers of origin, through estuaries and into HB marine system

# Biogeochemical stocks & fluxes - Data

- Limited observational record to assess the C cycle (budgets, forecasts, sensitivity to environmental change)
- Late-winter nutrient conditions offshore
- Annual cycle of DIN and DON deliveries by rivers?
- PP across SCM layers
- Validated ocean color remote sensing data

# Biogeochemical stocks & fluxes - Models

- Validated models