The Influence of Arctic Climate Change on Local Marine Ecology

Projecting Oceanic Conditions and Biogeochemical Cycling under Future Climate Scenarios
- develop a high resolution ice-ocean-bgc model of the Arctic with tides
- project ocean acidification, nutrient stratification
- changes in phytoplankton and zooplankton abundance
- link physics and biology
- implications for higher trophic level species

Marine Protected Areas
- Tarium Niryutait
  - protected since 2010
  - size: 1740 km²
  - world’s largest summering stock of beluga whales

Canadian Model of Ocean Carbon (CMOC)

North American Arctic Model
- Nucleus for European Modelling of the Ocean model (NEMO v3.6) [1]
- LIM3 - Louvain-la-Neuve sea-ice model [2]
- 1/4° grid lat and lon, 46 levels
- CanOE [4] - the successor to the Canadian Model of Ocean Carbon (CMOC)

The Canadian Ocean Ecosystem Model [4]
- Modelling Ice-algae
  - results from NAA in NEMO3.4 with LIM2

Marine Protected Areas
- Anuialiks Shallow
  - protected since 2016
  - size: 2316 km²
  - world’s largest summering stock of beluga whales

Nested sub-domains
- AGRIF - Adaptive Grid Refinement in Fortran
- 2-way nest
- high resolution bathymetry
- 1/12° - 1/20° grid lat and lon

Kitikmeot Inuvialuit Settlement
- important regions of subsistence fishing and hunting for the Circumpolar People

Validation with Observations
- Ocean Networks Canada Community Observatory [6]
- The Canadian Rangers Ocean Watch (CROW) [8]
- Canadian High Arctic Research Station (CHARS)
- Joint Ocean Ice Studies (JOIS) [9] [10]
- Kitikmeot Sea Science Study (C3S)
- Beaufort Sea Regional Assessment [7]
- The Canada’s Three Oceans (C3O) Project

- associate marine fish communities and their habitats
- development of regional baselines

Project Scope
- develop a regional model of the Arctic with ice and tides
- adapt CanOE to NEMO 3.6 with LIM3
- improve on etopo1 bathymetry with available data for AGRIF
- make projections of nutrient distribution, ocean acidification and physical oceanic conditions for future climate change scenarios
- test ice algae in the updated model
- test the estimated thermal limits, the peak and pejus values of physiological performance for key Arctic marine food web species to quantify the impact of climate change multi-stressors at various life history stages and acclimation temperatures.

"The most important thing that we have is our land and waters [...] if we continue to ensure they are properly cared for - they will support us for many more generations to come." -Inuvialuit Elders

Figures:
1. June 1, 2008 temperature from a preliminary NEMO 3.6 run.
2. Inuvialuit settlement region.
3. Locations of the nests. etopo1 bathymetry is shown.
5. Ice pan-Arctic mean ice algal (IA) abundance.
6. Depth-integrated annual ice algal and under-ice primary production.
7. Year-round observation network.