EVALUATION OF ICE MODELS IN LARGE LAKES USING 3-D COUPLED HYDRODYNAMIC-ICE MODELS

IMPROVING SIMULATIONS OF ICE FORMATION & MOVEMENT ON LAKES

Current understanding of ice formation, ice movement and lake physical processes is limited by the fact that ice models were developed and validated for ocean applications. Researchers are improving lake ice modelling capabilities which will ultimately enable us to better understand the implications of lake ice on bio-geochemical processes including the growth of Harmful Algal Blooms (HABs).

This project will lay the ground work for future investigations of the implications of winter phytoplankton blooms on late summer harmful algal blooms by coupling (and improving on) a hydrodynamic-ice model with a biogeochemical model.

Improve existing ice models

This project will result in recommendations for improving ice models by:

1. Identifying the strengths and weaknesses of two ice models coupled to same hydrodynamic core in the context of large, partially ice-covered lakes:
   - Hydrodynamic core: MITgcm
   - Ice models: MITgcm ice model and CICE
2. Comparing predictions of the two ice models with satellite observations.

The project initially focuses on Lakes Erie and Ontario because of their different ice cover patterns, a consequence of their different depths.

Improve understanding of how ice cover affects lake physical processes

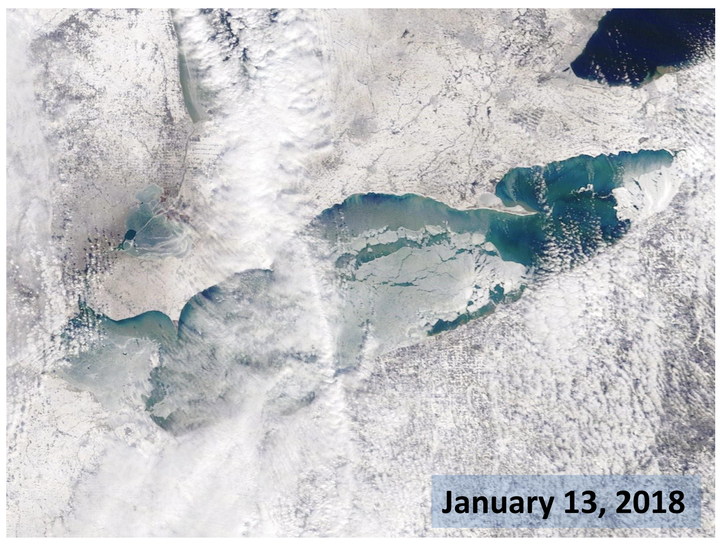
This project will improve parametrizations of physical processes for use in lake-scale simulations.

- Little is currently known about how physical processes (e.g., wind driven mixing, air-water heat exchanged, convection) are modified in partially ice-covered lakes.
- This project will conduct high resolution investigations in small idealized domains to better understand these processes in lakes.

Develop improved frazil ice model

The new model will improve our capability to model ice:

- Ice that grows on a surface ice-layer and frazil ice in the water column does not affect air-lake heat exchange in the same way.
- Frazil ice ultimately consolidates on the surface of the ice sheet or on the bottom of the lake.
- Frazil ice encapsulates silt and phytoplankton thereby incorporating it into the ice sheet that forms on the surface of the water column.



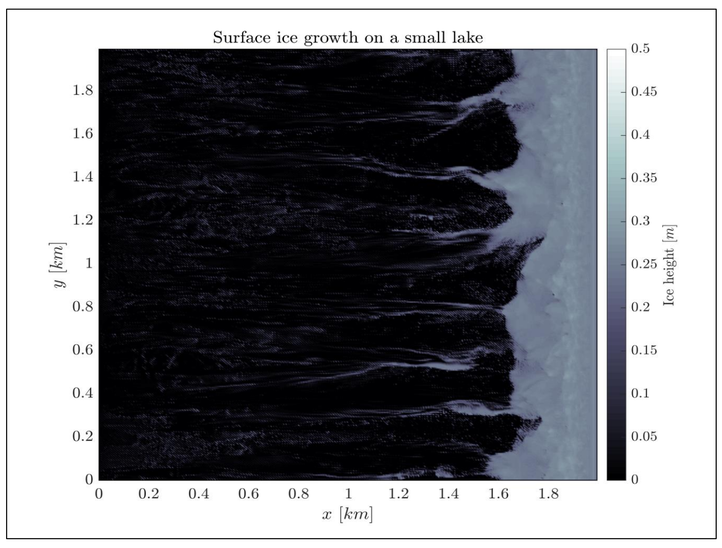


Image 1 & 2: Modis images Lake Erie showing growth and movement of ice on Lake Erie
Image 3: Numerical simulation of the MITgcm model

UNIVERSITY OF WATERLOO | the water INSTITUTE
GWF
CANADA FIRST RESEARCH EXCELLENCE FUND