Implementation of an unstructured-grid Great Lakes Ice-circulation Model (GLIM) for Great Lakes Earth System Model (GLESM)

An unstructured-grid Great Lakes Ice-circulation Model (GLIM) was implemented in the all five Great Lakes within the Great Lakes watershed. The ~5-km resolution for open water and finer (~200m) resolution were used to resolve narrow river channels, islands, and archipelagos. The model was spun up for ten years and the seasonal cycle was investigated. Available historical measurements were used to validate the model. Furthermore, the seasonal cycles for ice concentration, thickness, velocity, and other variables are well reproduced. Satellite measurements of ice cover were used to validate the GLIM. The seasonal cycle for lake surface temperature is well reproduced in comparison to the satellite measurements. Additional sensitivity experiments further confirm the important impacts of ice cover on lake water temperature and water level variations. Some important physical phenomena such as lake seiches, Poncare waves are revealed. Further theoretical studies and in situ measurements are required to explain these important processes in the Great Lakes in addition to climate change impacts. This unstructured-grid GLIM is designed for a backbone model coupled to regional atmospheric model, aquatic ecosystem model, and hydrological model for the future regional GLESM.