Improving Lake Ice Simulations in Canada based on Lake Size

ALEXIS ROBINSON[1] AND LAURA C. BROWN[1]

ABSTRACT

Lake coverage in Canada is estimated to be between 15-40% depending on location and many experience some form of ice cover throughout the year. Research shows that lake ice duration is shortening in response to a warming climate. Lake ice models are an important tool that can be used to study spatial and temporal changes to lake ice regimes under a changing climate. The Canadian Lake Ice Model (CLIMo) is a well-tested one-dimensional thermodynamic freshwater ice model that has been used to successfully simulate Arctic and sub-Arctic lake ice cover. Research from central Ontario, Canada, shows that adjusting the albedo parameterization in CLIMo (CLIMo-Temperate) results in a better representation of temperate region lake ice cover. This study uses CLIMo and CLIMo-Temperate to simulate lake ice-on and ice-off dates for 174 lakes across Canada that have historical ice records available. Model inputs include meteorological data obtained from Environment and Climate Change Canada with simulations validated using the historical ice records in the Canadian Ice Database and the Global Lake and River Ice Phenology Database. Results for small (< 1 km^2) have a mean absolute error (MAE) of 2 to 9 days. For medium (1-100 km^2) and large sized lakes (> 100 km^2) the MAE ranges from 3 to 37 days for ice-off. The results show a satisfactory agreement between field measurements and modeled dates for lakes < 1 km^2, however, there is substantial variation in ice-off dates for lakes > 1 km^2. The findings show the importance of accounting for lake size and provide a basis to derive a lake size adjustment factor. This size factor will improve the accuracy of one-dimensional lake ice models, which will lead to improvements for global and regional climate models, numerical weather forecasting, and future climate projections.

[1] Department of Geography, Geomatics and Environment, University of Toronto Mississauga, Missasauga, ON, Canada