

2024 NORTHEAST AQUATIC BIOLOGISTS CONFERENCE

ESTIMATING 40-YEAR DAILY LAKE ICE COVER UNDER THE CLIMATE CHANGE FOR NORTHERN TEMPERATE LAKES

North temperate lakes have experienced extensive loss of lake ice cover over the past century. These observed losses have been partially based on studies that used ground observations over multiple decades; however, these observations lack widespread spatial coverage and fail to capture lake ice dynamics in unmonitored lakes. Satellite remote sensing, such as Landsat, can provide worldwide lake ice observations in 30 meter resolution from 1984 to present, but it faces challenges related to temporal variability due to long revisiting periods (16 days) and cloud cover. To address these challenges, we developed a lake ice model based on a deep learning algorithm (Long Short Term Memory, LSTM) to simulate daily continuous lake ice cover changes for northern temperate lakes. The model was trained and validated on the lake ice cover data on over 33,000 lakes worldwide retrieved from the satellite images of Landsat 5 (1984–2012), Landsat 7 (1999–2003), and Harmonized Landsat 8 & 9 and Sentinel-2 (HLS, 2013–present). Our model uses meteorological data from the ERA5-Land global reanalysis data set (1950–present) and static attributes (e.g, water storage) from Hydrolakes, so users will be able to retrieve daily lake ice cover dynamics since 1950 for over 980,000 lakes in the northern temperate zone. Trend analysis of lake ice cover variables (e.g., ice on date, ice off date, percent ice cover) over the last 40+ years can indicate how recent changes in climate have affected ice cover dynamics. We anticipate that the model will provide valuable insights for lake ice management in the context of future global warming.

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