Evaluation of Satellite-Derived Estimates of Lake Ice Cover Timing on Svalbard using *in situ* Data

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ABSTRACT

Arctic lakes are sensitive indicators of climate change. In recent decades satellites have greatly increased the capability of monitoring lake ice timing, especially in remote areas. However, satellite observations of lake ice in the Arctic are not often ground-truthed with *in situ* measurements and direct observations, due to the remoteness of much of the region. In this study of Lake Linné, one of the largest lakes on Svalbard, Norway in the North Atlantic region, we use continuously monitored lake water temperature and automated photographs from ground-based cameras to evaluate the ability of satellite platforms to capture lake ice timing and duration. Visible and near infrared surface reflectance data from the Moderate Resolution Imaging Spectroradiometer (MODIS) were used to observe the seasonal change in reflectance of Lake Linné from fall 2003 - spring 2018, and to determine summer ice-off (also called break-up end (BUE)). Microwave backscatter data from Sentinel-1 were similarly used to determine BUE and fall freeze-up (also called freeze-up start (FUS)) from fall 2014 - spring 2018. These estimates were directly compared to twice-daily photographs of the lake, as well as inferred ice cover from lake water temperatures. The analysis indicates that satellite-based ice timing estimates for Lake Linné compare favorably with *in situ* data during the study period. Additionally, the data show that lake ice duration has decreased significantly from 2003 - 2018 in this part of Svalbard, with little change in summer break-up but a trend toward much later fall freeze-up.

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