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Evaluation and Assimilation of Remotely-Sensed Lake Surface Temperature in the HIRLAM Weather Forecasting System

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Lakes are an important feature in the regional climate and play an important role in the surface radiation balance, heat and water vapor exchanges with the atmosphere. Therefore, understanding lake-atmosphere interactions allow for better climate modeling and weather forecasting. With the increasing spatial resolution of numerical weather prediction (NWP) models and regional climate models (RCMs), it has become necessary to improve the representation of lake-climate interactions to better describe the energy exchange between the atmosphere and the earth's surface. Obtaining spatially detailed *in situ* observations of Lake Surface Temperature (LST) and ice cover is challenging, especially for large and deep lakes. Over the past two decades, the number of *in situ* observation sites of lake ice has decreased dramatically in many northern countries. The network of *in situ* observation sites has plummeted at a time when there is an increase demand of lake ice observations by the modeling community. Moreover, the number of sites where LST is measured is even more limited than that of ice observation sites. Development of lake models as parameterization schemes in NWP makes it possible to support the sharp reduction in observational practices; however, they could have errors especially during freeze-up/break-up periods. Remote sensing provides data with a spatial coverage that *in situ* measurements or lake schemes currently incorporated into NWP models do not capture.

In this study, satellite-derived LST products from the MODerate resolution Imaging Spectroradiometer (MODIS) aboard NASA's Earth Observing System Terra and Aqua satellite platforms, and the Advanced Along Track Scanning Radiometer (AATSR) aboard ESA's ENVISAT satellite, which acquired data until April 2012, are evaluated against *in situ* measurements of 27 Finnish lakes during the open water period. Results show a good agreement between daily averaged satellite observations and *in situ* measurements with mean bias error (MBE) of -0.68 and -1.03 for MODIS and AATSR, respectively. This strong level of agreement lead to applying validated MODIS observations into the HIgh Resolution Limited Area Model (HIRLAM) weather forecasting system to improve weather forecasting analysis by assimilating satellite observations, *in situ*, and lake model of LST. Applying the MODIS observations into HIRLAM resulted in a more realistic lake analysis outcome which can be considered as an initial step towards improving future weather forecasts.