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Automatic estimation of lake ice cover and lake surface temperature using ENVISAT MERIS and AATSR

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Lake ice plays an important role in the understanding of the processes of cold region freshwater. On northern latitudes lakes form a major part of atmospheric and hydrologic systems, and a proper understanding of the water and energy budget of lakes is necessary to be able to forecast weather, climate and river flows. We will here present two algorithms for automatic estimation of lake ice cover and lake surface temperature using optical and thermal data, well suited for evaluating large time series of data.

The method for estimating the lake surface temperature (LST) from measurements of thermal radiation is based on the well-known algorithm developed by Key (1997). We make use of the thermal (11μm and 12 μm) bands of the Advanced Along Track Scanning Radiometer (AATSR) sensor on board ENVISAT. AATSR consists of two identical sensors, one pointing towards nadir and one pointing slightly forward. Both sensors are used for temperature retrieval.

For estimating lake ice cover (LIC) we make use of the Medium Resolution Imaging Spectrometer (MERIS) sensor, also carried by ENVISAT. The method for estimating the lake ice cover is based on linear spectral unmixing, allowing estimation of endmember contribution at sub-pixel resolution. Open water, snow and ice all have distinct spectra, which makes them well suited for spectral unmixing methods. The ice cover within a pixel is based on the estimated presence of ice and snow on the lake surface.

Both algorithms are integrated in a common software framework, with geo-correction, mosaicking and mask generation. Simultaneous AATSR images are used for cloud detection for both products. Since the spectral unmixing algorithm is sensitive to spectral variation, atmospheric correction is applied to the MERIS data. For this purpose we use the SMAC processor in the BEAM software.

Both algorithms are compared to in situ point measurements. Additionally, visual interpretation of MERIS image data is done for further evaluation of the LIC product. Result show to be promising for the winter period. During the melting season, however, the algorithm for LIC returns more ambiguous results, as ice and snow tend to be covered with water.

We will present the methods used and the current state of the algorithms. We will also present some results from a time series of data and discuss the results.