Ice Concentration Based on C-Band HH-polarized SAR Data

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Ice concentration is defined as the proportion of the ice covered area over a given area. High-resolution ice concentration are required for navigation, validating ice models and data assimilation. The currently available operational ice concentration products are based on microwave radiometer data and their resolution is several kilometers. For example University of Bremen delivers operational (global) ice concentration products based on AMSR-E data using an algorithm called the ASI algorithm [1]. However, data from SAR instruments cover large sea and ocean areas with much higher precision than that of the radiometer data, and they are not very efficiently utilized in e.g. measuring of ice concentration yet.

In this presentation a sea ice concentration algorithm based on C-band HH-channel SAR data is presented. The algorithm is based on autocorrelation distributions within SAR segments. It has been shown that autocorrelation can be used to distinguish between open water and sea ice at C-band with good accuracy [2, 3] in cold ice conditions. To estimate segmentwise ice concentration we compute the distribution of the autocorrelation feature for each segment, then we decompose the distributions into several distributions which can be interpreted to represent different ice types and open water. Based on this decomposition we can estimate the proportions of open water and ice within each segment, i.e ice concentration. The decomposition is performed using the EM algorithm [4].

The algorithm results for a set of Radarsat-2 SAR images over the Baltic Sea are shown, and these results are also compared with the ice concentration of the operational FMI ice charts and the Baltic Sea ASI algorithm results.

The algorithm works rather well for large SAR segments, but for small segments there can occur larger estimation errors. This is due to the fact that a statistical algorithm requires a certain amount of data to perform reliably. It also is obvious, based on the definition of ice concentration, that concentration is dependent on the resolution (scale). At very high resolution the concentration is always either one (ice) or zero (water). Taking into account these restrictions, we can say that our algorithm clearly improves the spatial resolution of ice concentration estimation based on radiometer data. Even though our algorithm can not capture the concentration of all the small SAR segments, the locations of segment boundaries are accurate.

References

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