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Sea ice type dynamics in the Arctic based on Sentinel-1 Data

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Sea ice observation from satellites has been carried out for more than four decades and is one of the most important applications of EO data in operational monitoring as well as in climate change studies. Several sensors and retrieval methods have been developed and successfully utilized to measure sea ice area, concentration, drift, type, thickness, etc [e.g. Breivik et al., 2009]. Today operational sea ice monitoring and analysis is fully dependent on use of satellite data. However, new and improved satellite systems, such as multi-polarisation Synthetic Apperture Radar (SAR), require further studies to develop more advanced and automated sea ice monitoring methods. In addition, the unprecedented volume of data available from recently launched Sentinel missions provides both challenges and opportunities for studying sea ice dynamics.

In this study we investigate sea ice type dynamics in the Fram strait based on Sentinel-1 A, B SAR data. Series of images for the winter season are classified into 4 ice types (young ice, first year ice, multiyear ice and leads) using the new algorithm developed by us for sea ice classification, which is based on segmentation, GLCM calculation, Haralick texture feature extraction, unsupervised and supervised classifications and Support Vector Machine (SVM) [Zakhvatkina et al., 2016; Korosov et al., 2016]. This algorithm is further improved by applying thermal and scalloping noise removal [Park et al. 2016]. Sea ice drift is retrieved from the same series of Sentinel-1 images using the newly developed algorithm based on combination of feature tracking and pattern matching [Mukenhuber et al., 2016].

Time series of these two products (sea ice type and sea ice drift) are combined in order to study sea ice deformation processes at small scales. Zones of sea ice convergence and divergence identified from sea ice drift are compared with ridges and leads identified from texture features. That allows more specific interpretation of SAR imagery and more accurate automatic classification.

In addition, the map of four ice types calculated using the texture features from one SAR image is propagated forward using the sea ice drift vectors. The propagated ice type is compared with ice type derived from the next image. The comparison identifies changes in ice type which occurred during drift and allows to reduce uncertainties in sea ice type calculation.