Classification of Fram Strait Sea Ice by Synthetic Aperture Radar.

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Space-borne synthetic aperture radar (SAR) systems are essential for operational monitoring of sea ice in polar regions. Radar polarimetry is a powerfulniche within remote sensing, allowing investigations of various sea ice types' scattering properties. Full-polarimetric and compact polarimetry SARmeasurements may hence allow improved sea ice type characterization and discrimination capabilities aiding operational sea ice services. In this talk,we disseminate results from remote sensing measurements of sea ice collected under the Norwegian Young Sea Ice 2015 (N-ICE2015) field campaignthat took place January to June 2015 in the Fram Strait. In particular, we focus on multifrequency SAR studies, involving acquisitions from ALOS-2 (L-band), Radarsat-2 (C-band), and TerraSAR-X (X-band), and give some directions for future research. First, an analysis of full-polarimetric L-, C-, anddual-polarization (HH/VV) X-band SAR data recorded over lead ice revealed that by combining the scattering entropy and co-polarization ratio we cansuccessfully separate newly formed sea ice from open water and thicker sea ice within all three frequencies throughout the winter and spring season. Thepolarization difference exhibits less incidence angle dependency and shows to provide additional discrimination support. X- and L-band SAR actscomplementary to the more regular acquisitions in C-band in terms of characterizing the newly formed sea ice types and surface structure. Second, asemi-coherent backscatter model is used to interpret the space-borne SAR data acquisitions of the Fram Strait sea ice. Specifically, full-polarimetric L-,C-, dual-polarization (HH/VV) and full-polarimetric X-band SAR is compared to model output. Constrained to simultaneous in-situ observations fromthe campaign, the model is able to reproduce the backscatter from lead ice and ice floes well for the individual frequency bands. For open water leads,unexpectedly high backscatter values are observed in L-band compared to C-band. Possible explanations relating to the sea ice formation process arediscussed. Third, an automatic sea ice classification algorithm developed for near real-time services on full-polarimetric SAR measurements has beentested for X-, C-, and L-band data. Spatial and temporal coincident sea ice freeboard measurements of an airborne laser scanner as well as sea icethickness data were used to validate the classification results. It was found that the number of multipolarization SAR parameters could be reduced from18 to 9, for all three frequencies, whilst still maintaining the 96.9% sea ice classification accuracy. The set of parameters that were found most useful inL-band was slightly different compared to those for the other two frequencies. Next, exploring a supervised classification scheme, we which to includemore full-polarimetric ALOS-2 L-band SAR scenes from the N-ICE campaign. Our goal is to investigate which multipolarization SAR parameters thatare most useful for operational services, aiming at high accuracy sea ice classification under various environmental conditions and imaging geometries.