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DETECTION OF MELT PONDS ON ARCTIC SEA ICE FROM TERRASAR-X DUAL-POLARIMETRIC DATA

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Melt ponds on Arctic sea ice have been considered as a controlling factor of sea ice extent and surface albedo in the Arctic Ocean. The area of melt ponds has been used as a primary parameter in global climate models, and weather forecast and prediction models of polar regions. In summer season, melt ponds on sea ice dramatically increase in a short period, which facilitates rapid sea ice retreat. Therefore, it is very important to monitor melt ponds on sea ice, especially during summer season. As the melt ponds have radar scattering properties distinctive from sea ice and open water, synthetic aperture radar (SAR) can be used as a powerful tool to detect melt ponds on sea ice. Particularly, polarimetric SAR data can be very useful for mapping of melt ponds because they provide various scattering properties depending on surface types. In this study, we used TerraSAR-X dual-polarimetric SAR data (HH and VV-pol) acquired in Stripmap mode and high-resolution (30 cm) airborne SAR images (HH-pol) over Chukchi Sea obtained on 12 August 2011. Various polarimteric parameters, such as backscattering coefficient, polarization ratio, correlation, homogeneity, and entropy for melt pond, sea ice and open water were extracted from the TerraSAR-X dual-polarimetric data by referencing the airborne SAR images. The parameters were used as input layers to machine learning approaches that classified surface types into melt pond, sea ice and open water from the entire TerraSAR-X image. Validation of the melt pond map derived from the machine learning approaches was performed by using a separate validation dataset. Results showed that the machine learning approaches employing dual-polarimetric parameters provided a very accurate map of melt ponds with high spatial resolution and outperformed typical classification methods based on the features extracted from single-polarized SAR data. A new algorithm for retrieving melt pond fraction is being developed through synergistic use of the polarimetric SAR data and optical images such as MODIS and Landsat 8 OLI, which enables more precise retrieval of melt ponds on sea ice in the Arctic Ocean than the approaches based on single data sources.