Detection of melt ponds on sea ice in the Chukchi Sea in summer season using TerraSAR-X dual-polarization data

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As a prevalent phenomenon in the Arctic winter season, melt ponds have a significant influence on climate change by absorbing incoming solar radiation and changing the melting rate of sea ice. Detection of melt ponds can help us better understand the interaction between sea ice and climate. In this study, melt pond classification models were developed using the TerraSAR-X dual-polarization data and two machine learning methods including decision trees (DT) and random forest (RF). Reference data of melt ponds, sea ice, and open water were extracted from the airborne SAR images with spatial resolution of 0.6 m through visual interpretation. A total of 8 polarimetric parameters such as HH and VV backscattering coefficients, co-polarization ratio, co-polarization phase difference, co-polarization correlation coefficient, alpha angle, entropy, and anisotropy from the TerraSAR-X dual-polarization data were used as input variables in the models. Due to the similarity of the polarimetric signature between melt ponds and open water, two spatial texture metrics such as average and standard deviation of the polarimetric parameters were also used as input variables. The use of the texture features in the DT and RF models showed better performances for detection of melt ponds. The HH and VV backscattering coefficients and their average were considered as the most contributing variables to the classification in both models. Furthermore, the comparison of melt pond fraction and sea ice concentration for the RF-derived melt pond and reference maps showed a root mean square deviation of 2.4% and 7.0%, respectively. This result indicates that high-resolution dual-polarization SAR data can be utilized for the accurate monitoring of melt pond fraction at a local scale.