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Satellite Remote Sensingof Melt Ponds and Albedoin the Arctic

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A wide variety of surface types are present in the Arctic: Ocean, ice, snow and melt ponds cover the surface featuring a strong heterogeneity. Due to the differences in their albedo the composition of these surface types strongly impacts the radiative feedback and hence the energy budget which is crucial in climate models. During the summer period the variability is particularly high because the increased temperatures lead to melt pond formation. The seasonal development of melt ponds features fast and local changes in fraction of surface types and thus in albedo. To study the ice-albedo feedback and its impact on the Arctic climate, large scale and regular information on these characteristics are necessary. This can be facilitated by the use of satellite remote sensing.
In 2016, the Sentinel-3 mission was launched providing full coverage of the Arctic on a daily basis aside from cloud coverage limitations. The devices these satellites carry include the Ocean and Land Colour Instrument (OLCI) and the Sea and Land Surface Temperature Radiometer (SLSTR). Together these two instruments measure 30 spectral bands at wavelengths between 400 nm and 12 µm. We present the available melt pond fraction and surface albedo products retrieved from the optical Setinel-3 satellite data with the Melt Pond Detector (MPD) algorithm developed by Zege and others. However, these measurements cannot resolve surface type heterogeneity beyond the spatial resolution of 1.2 km and require additional information to enable spectral unmixing of these surface types at a sub-pixel scale. To investigate the performance and enable improvements of the established retrieval, higher resolution satellite imagery is used. The Sentinel-2 twin satellites were launched in 2015 and 2017 and provide spectral measurements in the optical and near-infrared range at a resolution of 10 m whereas the temporal and spatial coverage is limited. A classification algorithm developed by Wang et al. is applied to obtain melt pond fractions of this increased accuracy for the years 2018 to 2021. Here, we present the melt pond fraction for selected Sentinel-2 scenes and their correspondence with the allocated MPD results. These show good agreement for landfast ice areas with distinct melt ponds, while in general drift and resolution issues are likely to be responsible for discrepancies. For the period of June and July 2020, the available and cloud free scenes along the MOSAiC (Multidisciplinary drifting Observatory for the Study of Arctic Climate) drift track are evaluated. This observation indicates a melt onset on the MOSAiC floe mid of June, roughly one week prior to the vicinity.