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Cloud screening and melt water detection over melting sea ice using AATSR/SLSTR

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With the onset of melt in the Arctic Ocean, the fraction of melt water on sea ice, the melt pond fraction, increases. The consequences are: the reduced albedo of sea ice, increased transmittance of sea ice and affected heat balance of the system with more heat passing through the ice into the ocean, which facilitates further melting. The onset of melt, duration of melt season and melt pond fraction are good indicators of the climate state of the Arctic and its change. In the absence of reliable sea ice thickness retrievals in summer, melt pond fraction retrieval from satellite is in demand as input for GCM as an indicator of melt state of the sea ice. The retrieval of melt pond fraction with a moderate resolution radiometer as AATSR is, however, a non-trivial task due to a variety of subpixel surface types with very different optical properties, which give non-unique combinations if mixed. In this work this has been solved by employing additional information on the surface and air temperature of the pixel.

In the current work, a concept of melt pond detection on sea ice is presented. The basis of the retrieval is the sensitivity of AATSR reflectance channels 550nm and 860nm to the amount of melt water on sea ice. The retrieval features extensive usage of a database of in situ surface albedo spectra. A tree of decisions is employed to select the feasible family of in situ spectra for the retrieval, depending on the melt stage of the surface. Reanalysis air temperature at the surface and brightness temperature measured by the satellite sensor are analyzed in order to evaluate the melting status of the surface. Case studies for FYI and MYI show plausible retrieved melt pond fractions, characteristic for both of the ice types. The developed retrieval can be used to process the historical AATSR (2002-2012) dataset, as well as for the SLSTR sensor onboard the future Sentinel-3 mission (scheduled for launch in 2015), to keep the continuity and obtain longer time sequence of the product.

Cloud detection over melting sea ice is a non-trivial problem as well. The sensitivity of AATSR 3.7 micron band to atmospheric reflectance is used to screen out clouds over melting sea ice.