EGU21-13036
https://doi.org/10.5194/egusphere-egu21-13036
EGU General Assembly 2021
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Surface reflectivity in polar regions retrieved from TDS-1 mission data

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In current times of a changing global climate, a special interest is focused on the large-scale recording of sea ice. Among the existing remote sensing methods, bi-statically reflected signals of Global Navigation Satellite Systems (GNSS) could play an important role in fulfilling the task. Within this project, sensitivity of GNSS signal reflections to sea ice properties like its occurrence, sea ice thickness (SIT) and sea concentration (SIC) is evaluated. When getting older, sea ice tends go get thicker. Because of decreasing salinity, i.e. less permittivity, as well as relatively higher surface roughness of older ice, it can be assumed that reflected signal strength decreases with increasing SIT. The reflection data used were recorded in the years 2015 and 2016 by the TechDemoSat-1 (TDS-1) satellite over the Arctic and Antarctic. It includes a down-looking antenna for the reflected as well as an up-looking antenna dedicated to receive the direct signal. The raw data, provided by the manufacturer SSTL, were pre-processed by IEEC/ICE-CSIC to derive georeferenced signal power values. The reflectivity was estimated by comparing the power of the up- and down-looking links. The project focuses on the signal link budget to apply necessary corrections. For this reason, the receiver antenna gain as well as the Free-Space Path Loss (FSPL) were calculated and applied for reflectivity correction. Differences of nadir and zenith antenna FSPL and gain show influence of up to 6 dB and −9 dB to 9 dB respectively on the recorded signal strength. All retrieved reflectivity values are compared to model predictions based on Fresnel coefficients but also to available ancillary truth data of other remote sensing missions to identify possible patterns: SIT relations are investigated using Level-2 data of the Soil Moisture and Ocean Salinity (SMOS) satellite. The SIC comparison was done with an AMSR-2 product. The results show sensitivity of the reflectivity value to both SIT and SIC simultaneously, whereby the surface roughness is also likely to have an influence. This on-going study aims at the consolidation of retrieval

algorithms for sea-ice observation. The resolution of different ice types and the retrieval of SIT and SIC based on satellite data is a challenge for future work in this respect.