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Effect of geometric roughness on the sea ice emissivity at low-frequency microwave channels

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We made an attempt to retrieve the roughness effect on the sea ice emissivity at instantaneous pixel-level brightness temperatures measured from AMSR (Advanced Microwave Scanning Radiometer) 10.65 – 36.5 GHz channels. The algorithm is based on a two-dimensional roughness parameterization (referred to as a roughness index) with an assumption that the surface emissivity follows Fresnel reflection theory but with modification by surface facet orientations.
Validating the algorithm, we used aircraft PSR (Polarimetric Scanning Radiometer) measured brightness temperatures (Stroeve et al., 2006), which have the same frequency and viewing geometry as for AMSR-E. Roughness index retrieved from PSR-measured brightness temperatures was compared against collocated in-situ roughness measurements given in an rms height. It is shown that PSR retrieved roughness index is linearly correlated with the field-measured rms height; correlation coefficients are 0.88 for 18.7 GHz and 0.94 for 36.5 GHz. Such close relationship further suggest that AMSR-estimated sea ice roughness index can be related to the physical surface roughness.
Also retrieved was the effective incident angle which can be defined as a viewing zenith angle relative to the mean rough facets. It is noted that the geographical distribution of retrieved effective incident angle is similar to the roughness index, i.e. larger deviation from 55 degree for higher frequency. It is thought that the effective incident angle can help to produce a better sea ice concentration and snow depth above the sea ice because the orientation of the rough facets strongly affects the PR (polarization ratio) and GR (gradient ratio) which are basis of those products. In this presentation, relationships between roughness index/effective incident angle and PR/GR are also discussed.