Geophysical Research Abstracts
Vol. 16, EGU2014-5814-4, 2014
EGU General Assembly 2014

Measuring Sea Ice Thickness with SMOS Radiometer

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The Arctic Ocean is under profound transformation. Observations and model predictions show dramatic decline in sea ice extent and volume.Measurements of ice thickness are considered as one of the Essential Climate Variables of the Global Climate Observing System (GCOS) program. Barring scattered and sporadic measurements obtained in situ by drilling crews, current ice thickness measurements are largely derived from space-borne altimetry, hence limited by its very technique to only thick sea ice (i.e. thicker than ∼1 m).

In November 2009, the European Space Agency's (ESA) launched the Soil Moisture and Ocean Salinity (SMOS), a satellite equipped with a microwave synthetic aperture radiometer working at 1.4 GHz for sea surface salinity and soil moisture (SM) observations. SMOS is also becoming a sensor of choice for estimate of thin sea ice, thus complementary to thick ice altimetry-based sensors.

We will present a new algorithm for ice thickness retrieval from SMOS brightness data. The method uses physical emissivity models and exploits the multi-angular capability of SMOS to mitigate errors. We use a three-layer radiative transfer model (air + sea ice + sea water) to compute the emissivity of the sea ice at L-band. The model uses the Fresnel reflection equations and the dielectric constants of each of the three media. This model assumes an infinite sea water layer, but a finite sea ice layer. To estimate ice thickness, we use an iterative inversion approach similar to the one used to retrieve sea surface salinity in the official SMOS production chain.