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New ideas for Earth-relevant space applications

Space-borne observations for detecting and forecasting sea ice cover extremes

Deliverable: D6.1

Gridded product of SMOS and SMAP TB and uncertainties

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1 Document details

1.1 Overview of the document

This document is a demonstration of the gridded products of polarized brightness temperatures from SMOS and from SMAP at an incidence angle of 40°.

1.2 Document Information

WP Number	WP6
WP Title	Mapping of thin ice thickness
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1.3 Document history

Version	Date	Comments & Status	Author
V1.0	08/06/2016	First version	Amelie Tetzlaff
V1.1	10/06/2016	Correct headers	Amelie Tetzlaff

1.4 Reference Documents

- SPICES deliverable D6.4 – Report on SMOS and SMAP TB data quality and comparison

1.5 Acronyms

Acronym	Definition
EASE grid	Equal-Area Scalable Earth grid
ISEA grid	Icosahedral Snyder Equal Area grid
RMSE	Root Mean Squared Error
SMAP	Soil Moisture Active Passive satellite
SMOS	Soil Moisture and Ocean Salinity satellite
TB	Brightness temperature
TBH	TB at horizontal polarization
TBV	TB at vertical polarization
TOA	Top Of Atmosphere
TOI	Top Of Ionosphere

2 Introduction

We present data sets of polarized brightness temperatures (TBs) from the passive microwave sensors flying onboard the Soil Moisture and Ocean Salinity (SMOS) and the recently launched Soil Moisture Active Passive (SMAP) satellites. Both satellites measure at L-band at a frequency of 1.4 GHz.

While SMOS measures over a large range of incidence angles, SMAP only measures at a single incidence angle of 40°. Thus, the SMOS data is fitted to the SMAP incidence angle and both datasets are gridded to a polar EASE-grid 2.0 (Brodzik et al. 2012). For a detailed description of the SMOS and SMAP brightness temperature data and of the fitting and gridding procedures see deliverable D6.4.

3 Gridded datasets

A demonstration of the gridded products of SMOS and SMAP TBs for the Arctic that has been produced in the framework of the SPICES project can be found at the following ftp-server:

ftp://ftp-projects.zmaw.de/seaice/Projects/SPICES/D6_1/

The products have the following specifications:

- The data are provided on a north-polar EASE-grid 2.0 with a grid size of 12.5 km and a bounding latitude of 50° N.
- The array size of the fields is 700x700 grid cells.
- The file size is about 11 Mb.

An overview of the variables in the file is given in Table 3.1. The files contain brightness temperatures at vertical (TBV) and horizontal (TBH) polarizations at an incidence angle of 40° as well as their uncertainties.

Examples of TBVs from SMOS and SMAP and their uncertainties are shown in Fig. 3.1.

3.1 SMOS

The data used for the gridded SMOS TB product are based on the SMOS L1C brightness temperature data in version v620. The L1C product contains polarized multi-incidence angle TBs at the top of the ionosphere (TOI) geolocated in an ISEA grid with a grid size of 15 km. We apply a Faraday rotation correction using the given Faraday rotation angles to calculate TBs at the top of the atmosphere (TOA).

To obtain TBs at the SMAP incidence angle of 40°, all measured TBs during one day are collected at each grid point and a two-step regression is applied to fit separate functions to the TB components (Zhao et al. 2015). A detailed description of the fitting procedure is given in deliverable D6.4. The fitted TBs at 40° are then re-gridded to a polar EASE-grid 2.0 with a grid size of 12.5 km.

The uncertainty of the daily TB values is estimated from the root mean squared error (RMSE) of the measured values and the fitted curves.

3.2 SMAP

The data used for the gridded SMOS TB product are based on the SMAP L1B TB brightness temperature data in version 3 (Piepmeier et al. 2016). The L1B product contains swath data of time-ordered geolocated brightness temperatures as well as various correction terms (e.g. for extra-terrestrial radiation sources and atmospheric effects). To get a matching dataset to the SMOS TOA TBs we produce SMAP TBs at the top of the atmosphere that are only corrected for Faraday rotation and not for other radiation sources that impact the measured brightness temperatures.

All polarized TB values of one day are collected and gridded to a polar EASE-grid 2.0 with a grid size of 12.5 km using an inverse distance weighting gridding scheme with a search radius of 25 km (for details see deliverable D6.4).

A widely used method to estimate the uncertainty of averaged data x_i is the standard error, which is the sample standard deviation divided by the square root of the sample size *n*:

$$\frac{\sqrt{\frac{1}{n}\sum_{i=1}^{n}(x_i - \bar{x})^2}}{\sqrt{n}}.$$

For a weighted average, however, the calculation of the standard error is not trivial and there is no widely accepted definition. Therefore – as a rough estimate of the standard error – we divide the weighted sample standard deviation by an effective sample size n_{eff}. The effective sample size is estimated as the number of weights that cumulatively sum up to more than 80% of the total weights.

Table 3.1 Variable names and description.

Variable name	**Variable description**
time	Time since 1 January 2010
lat	Latitude in °
lon	Longitude in °
Tbv	Brightness temperatures at vertical polarization at an incidence angle of 40°
Tbh	Brightness temperatures at horizontal polarization at an incidence angle of 40°
Tbv_uncertainty	TBV uncertainty SMOS: RMSE between measured TBVs and the fitted curve SMAP: Estimated standard error of TBV
Tbh_uncertainty	TBH uncertainty SMOS: RMSE between measured TBHs and the fitted curve SMAP: Estimated standard error of TBH

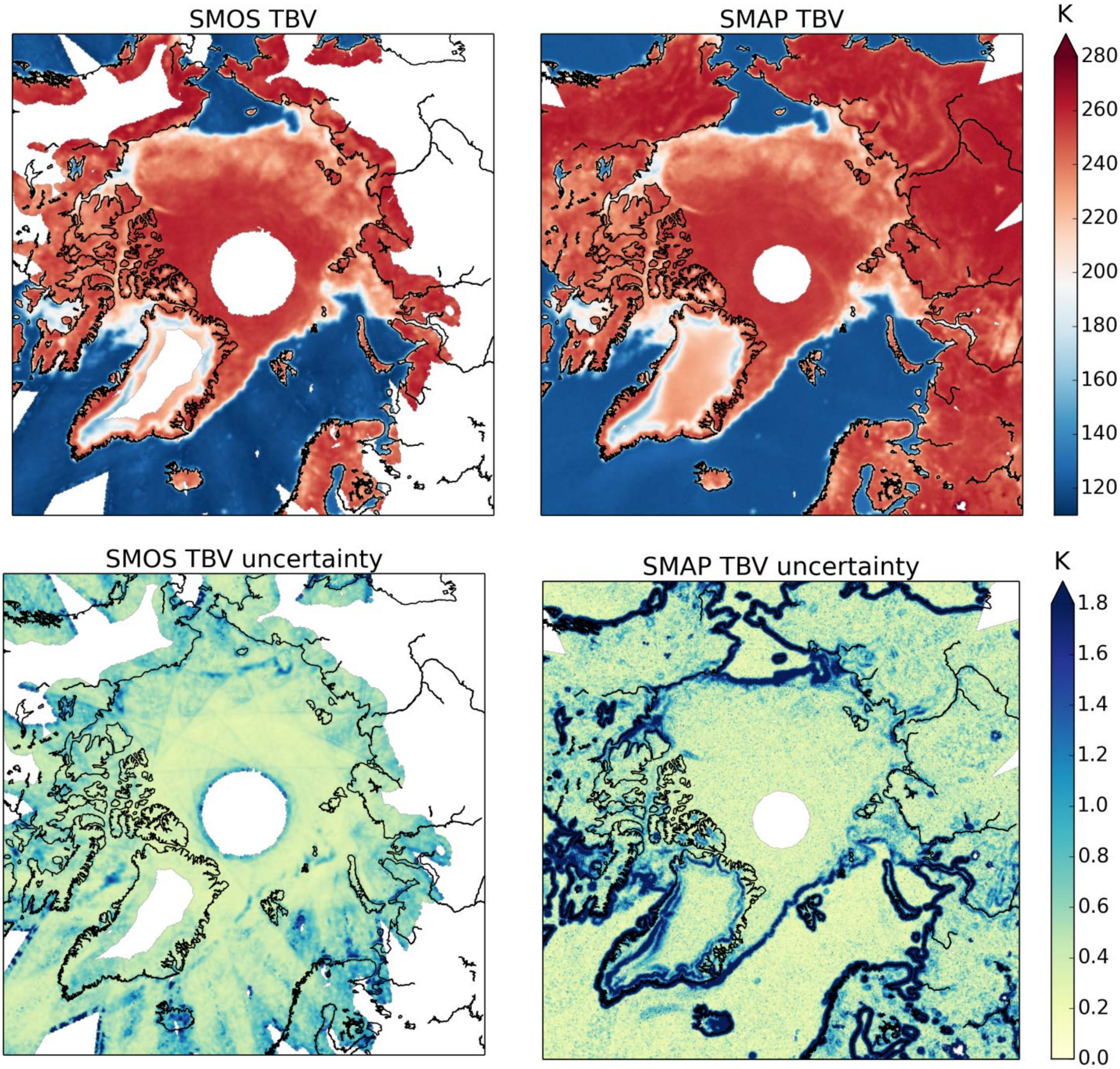

Figure 3.1 Brightness temperatures (upper) at vertical polarization from SMOS (left column) and SMAP (right column) and uncertainties (lower) on 5 November 2015.

4 References

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