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New ideas for Earth-relevant space applications

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

Deliverable: D6.2

Gridded product of SMAP sigma-0 and uncertainties

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1 Document details

1.1 Overview of the document

This document is a demonstration of the gridded SMAP radar backscatter data set.

1.2 Document Information

WP Number	WP6
WP Title	Mapping of thin ice thickness
Deliverable	D6.2 – Gridded product of SMAP sigma-0 and uncertainties
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1.3 Document history

Version	Date	Comments & Status	Author
V1.0	07/06/2016	First version	Amelie Tetzlaff
V1.1	10/06/2016	Figures changed to dB, 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
ALOS	Advanced Land Observing Satellite
EASE grid	Equal-Area Scalable Earth grid
HH	Horizontal polarization
HV	Cross-polarization
JAXA	Japanese Aerospace Exploration Agency
PALSAR	Phased Array type L-band Synthetic Aperture Radar
SAR	Synthetic Aperture Radar
SMAP	Soil Moisture Active Passive satellite
VV	Vertical polarization

2 SMAP radar data

2.1 Instrument description

NASA's Soil Moisture Active Passive (SMAP) satellite carries both an L-band radiometer (see deliverable D6.4) and radar. The instrument consists of a conical-scanning antenna (SMAP Handbook) that maps out a swath width of 1000 km and provides daily coverage of the polar regions.

The radar measures at a frequency of 1.27 GHz and an incidence angle of 40° and provides dual co- and cross-polarized measurements. A resolution of about 3 km is obtained for the radar measurements by utilizing synthetic aperture radar (SAR) processing.

2.2 Data availability

SMAP radar data are only available from 13 April 2015 to 7 July 2015. Unfortunately, the radar failed irrevocably in July 2015.

3 Gridded product

The data used for the gridded product are based on the SMAP Level 3 Freeze/Thaw State Radar product (L3_FT_A version 3, Dunbar et al. 2016). The data are provided on a polar EASE-grid 2.0 with a grid size of 3 km (Brodzik et al. 2012, see also deliverable D6.4).

A demonstration of the gridded product 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_2/SMAP_sigma0_20150415.nc

The product has the following specifications:

- The data are provided on a north-polar EASE-grid 2.0 with a grid size of 3 km and a bounding latitude of 50° N.
- The array size of the fields is 2914x2914 grid cells.
- The file size is about 460 Mb.

An overview of the variables in the file is given in Table 3.1. The file contains radar backscatter values (σ_0) for horizontal (HH), vertical (VV) and cross-polarisations (HV), as well as their relative uncertainties.

Values for ascending and descending orbits are provided as separate fields. It is evident from Fig. 3.1 that there are substantial differences of backscatter values from the two different orbits. These differences are most pronounced over land areas. In addition, data from the descending orbit generally shows larger data gaps.

The relative uncertainties are the radar relative measurement errors based on radar measurement precision, relative calibration errors and radio frequency interference contributions (SMAP L2 & L3 Active ATBD), which are provided in the L3 Freeze/Thaw State product.

Table 3.1 Variable names and description.

Variable name	**Variable description**
time	Time since 1 January 2010

lat	Latitude in °
lon	Longitude in °
sigma0_HH_asc	Radar backscatter at horizontal polarization in ascending orbit
sigma0_HH_desc	Radar backscatter at horizontal polarization in descending orbit
kp_HH_asc	Relative uncertainty of radar backscatter at horizontal polarization in ascending orbit
kp_HH_desc	Relative uncertainty of radar backscatter at horizontal polarization in descending orbit
sigma0_VV_asc	Radar backscatter at vertical polarization in ascending orbit
sigma0_VV_desc	Radar backscatter at vertical polarization in descending orbit
kp_VV_asc	Relative uncertainty of radar backscatter at vertical polarization in ascending orbit
kp_VV_desc	Relative uncertainty of radar backscatter at vertical polarization in descending orbit
sigma0_HV_asc	Radar backscatter at cross-polarization in ascending orbit
sigma0_HV_desc	Radar backscatter at cross-polarization in descending orbit
kp_HV_asc	Relative uncertainty of radar backscatter at cross-polarization in ascending orbit
kp_HV_desc	Relative uncertainty of radar backscatter at cross-polarization in descending orbit

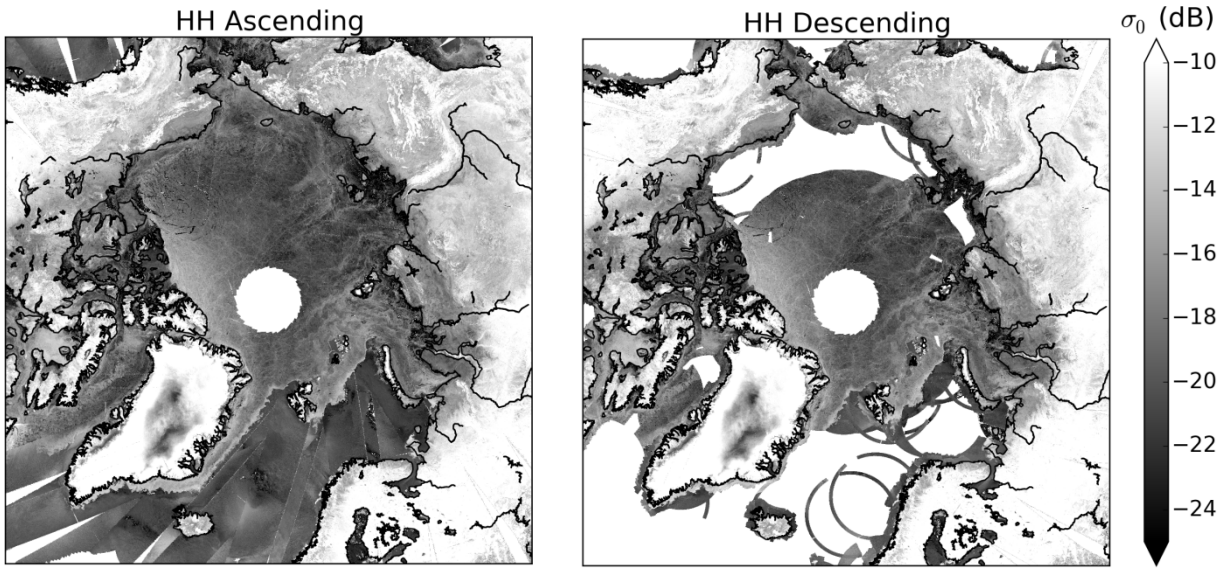

Figure 3.1 SMAP radar backscatter (σ_0) at horizontal polarization in ascending (left) and descending (right) orbits on 15 April 2015.

4 Outlook – Additional L-band data from ALOS-2 PALSAR-2

Within the SPICES project SMAP radar data were supposed to be used to characterize the sub-scale variability of ice thickness and/or ice concentration within a SMAP radiometer pixel. Since only about 3 months of SMAP radar data are available – from which only about 3 weeks are not affected by surface melting – the data can only be used for case studies and not to improve the operational ice thickness retrieval. Nevertheless, case studies will be useful to evaluate the potential of L-band radar measurements for improving the sea ice thickness retrieval, which is essential for the planning of future satellite missions.

To obtain additional data for the case studies we applied for L-band radar data from the ALOS-2 PALSAR-2 (Advanced Land Observing Satellite, Phased Array type L-band Synthetic Aperture Radar) instrument from the Japanese Aerospace Exploration Agency (JAXA). We will be able to use more than 100 scenes in ScanSAR mode with a swath width of 350 km and a resolution of 100 m. Thus, we can also conduct case studies during the freeze-up period.

5 References

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