Starlab Space

WP4.6: Processing of ENVISAT RA for Snow Depth

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LOTUS
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Cryosat - Siral Results

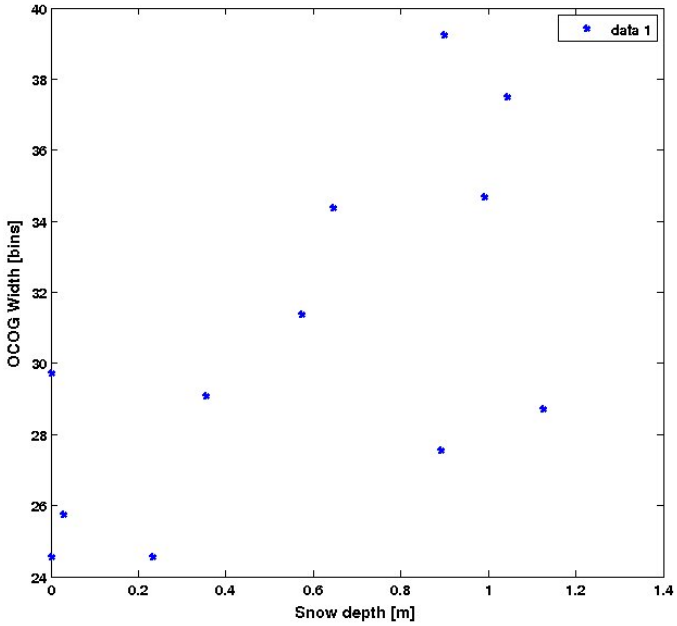
- **The analysis started with a preprocessing phase, where data were collected and calibrated in order to obtain power watts values.**

- **The OCOG retrtacker has been implemented and run over the selected points. Data statistic of the mean power, and OCOG parameters was for each month of the analysed period has been done.**

- **The waveform total power, OCOG amplitude/area, do not show any trend or relationship with changes in the snow depth.**

- **A correlation equal to 0.64 between the snow depth and the OCOG width parameter was found over Area 2, for years 2011 and 2012.**

Correlation between OCOC width and snow Depth equal to 0.64



Objectives

- To analyse **repeat pass** ENVISAT RA-2 data for snow depth retrieval.

- To identify constraints and propose remedial solutions.

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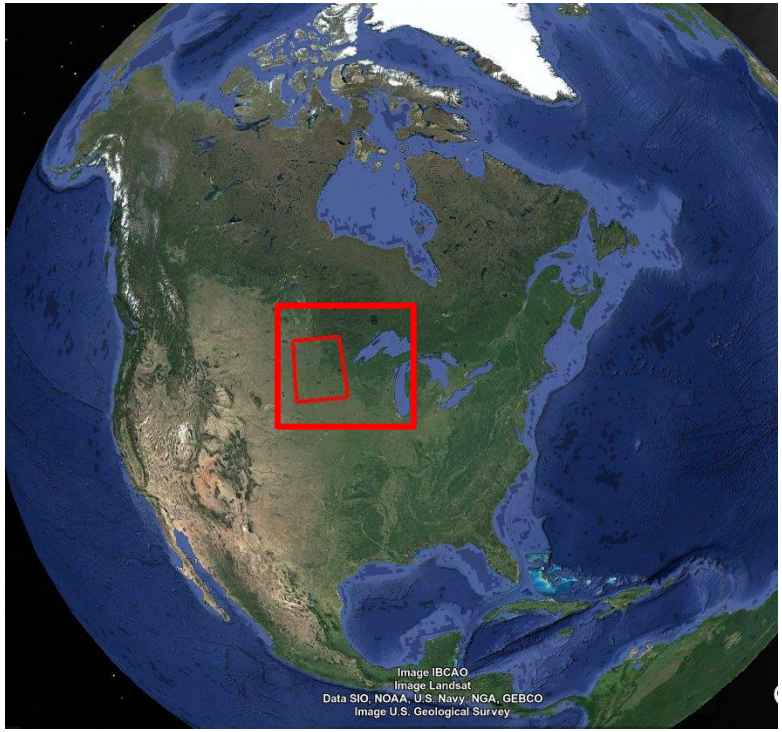
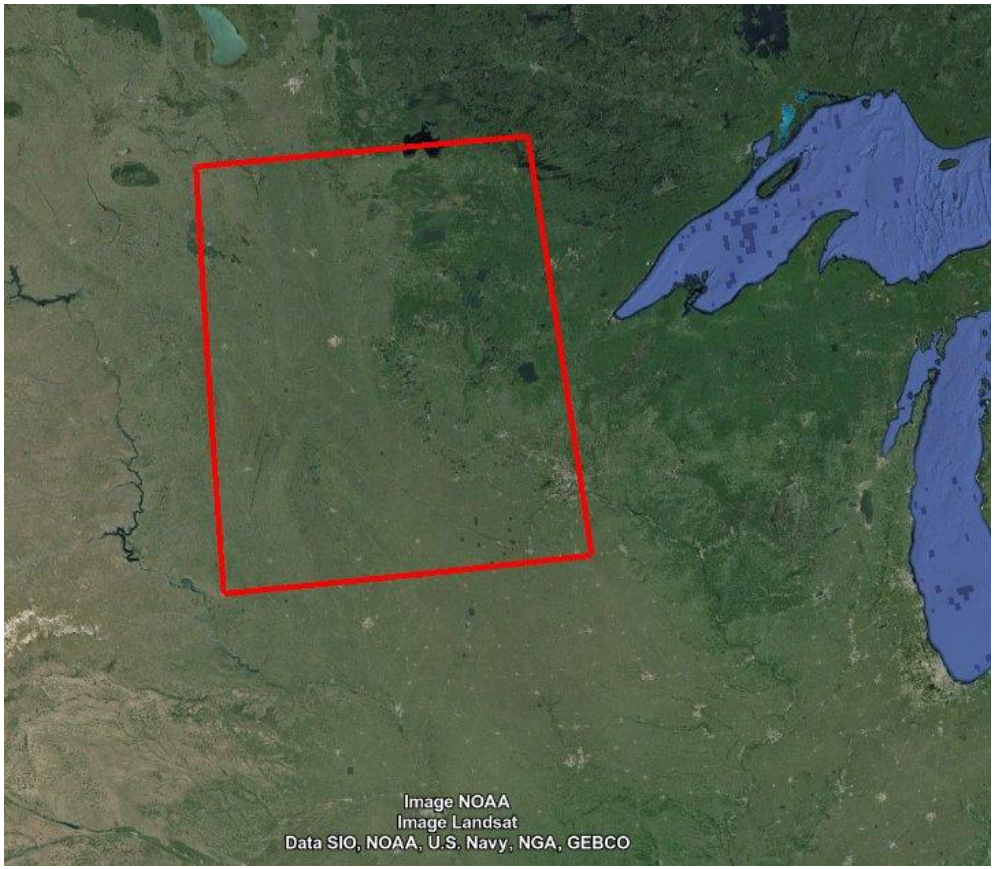
Data-set Description

Test Area

Northern Great plans

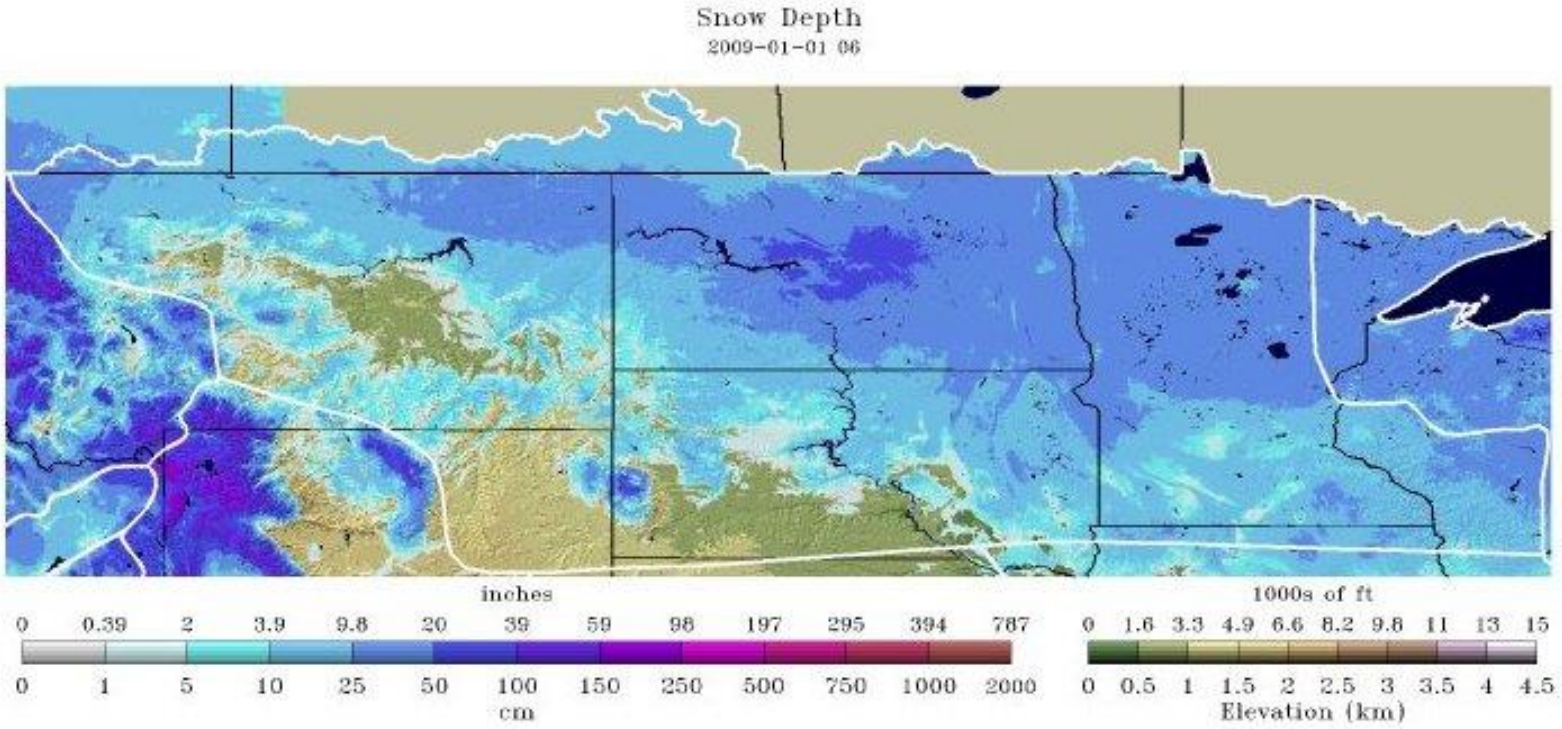




Data-set Description

Ground Truth data

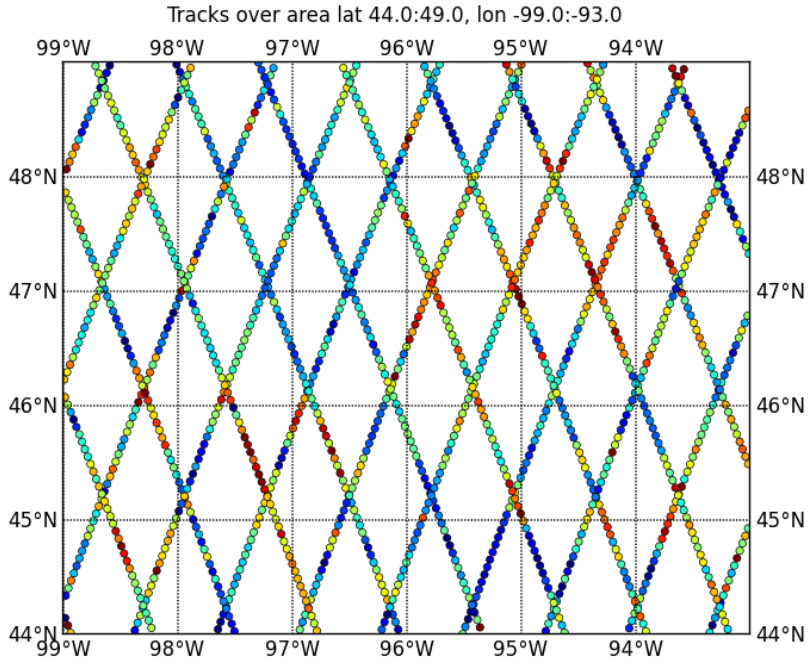
Over the areas chosen for the analysis of the ENVISAT RA data are available snow cover and depth maps provided by the U.S. “National Operational Hydrologic Remote Sensing Center”. **The maps are generated using a multi-layer, physically based snow model operated at 1 km² spatial resolution and hourly temporal resolution**. The model is run assimilating all operationally available ground, airborne, and satellite observations of snow water equivalent, snow depth, and snow cover.



Data-set Description

RA-2 Data

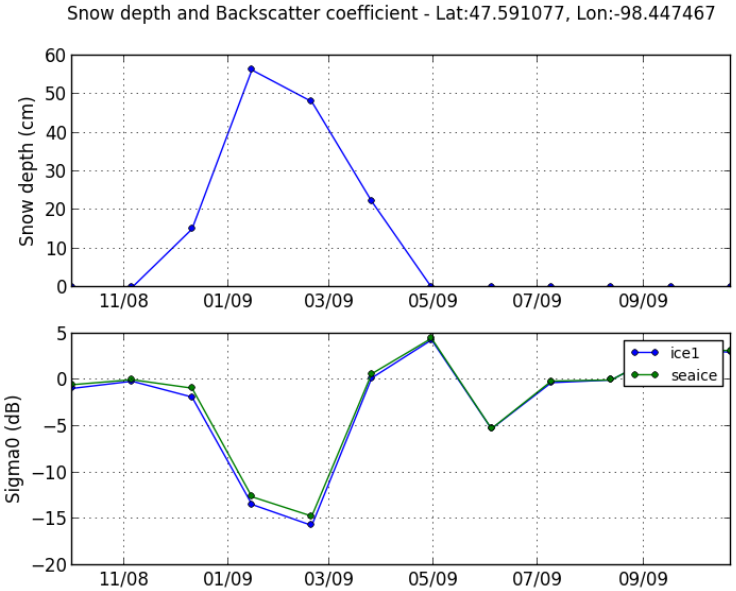
Over the areas of interest have been found RA-2 data covering the period between **January 2005 and December 2009.**
The data analyzed are of L2 GDR type.
About **16500 measurements** have been selected over the area of study

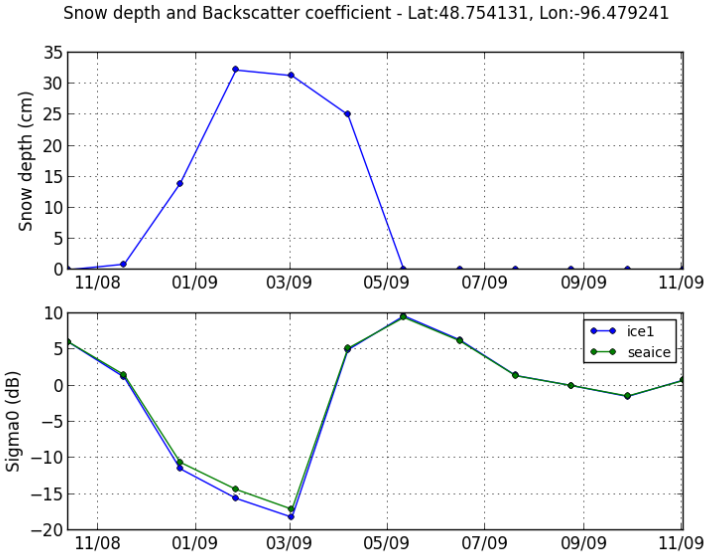


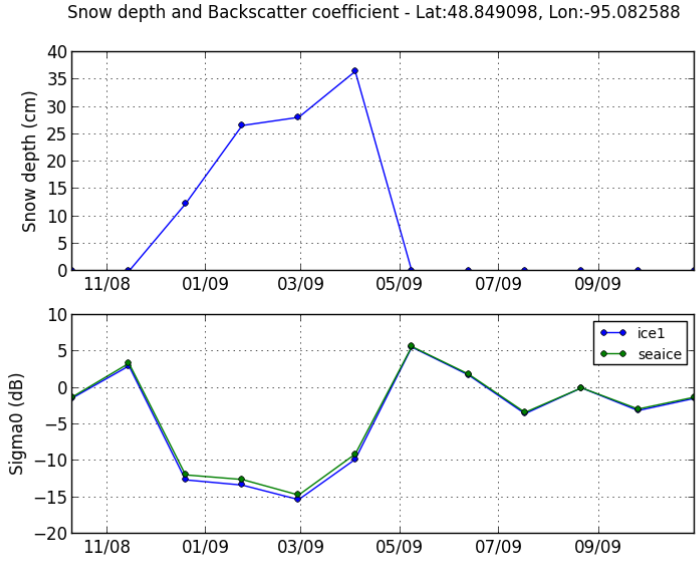
ENVISAT RA-2 measurements over the area of interest for one cycle (33 days).

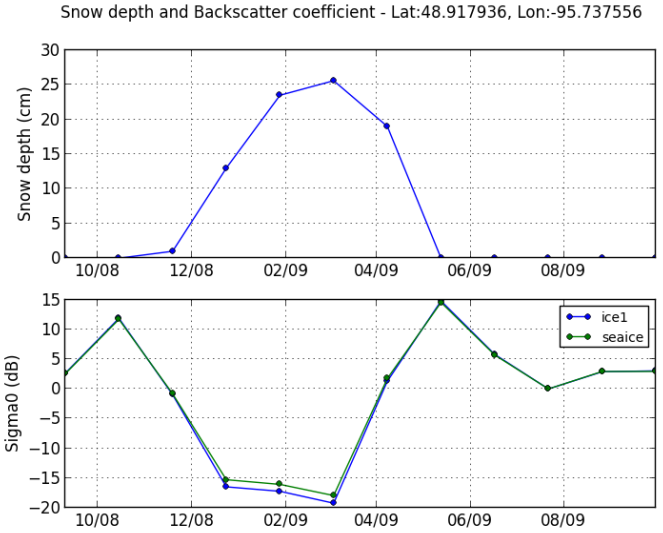
Data Analysis

Repeat pass backscattering evolution









Snow Backscattering

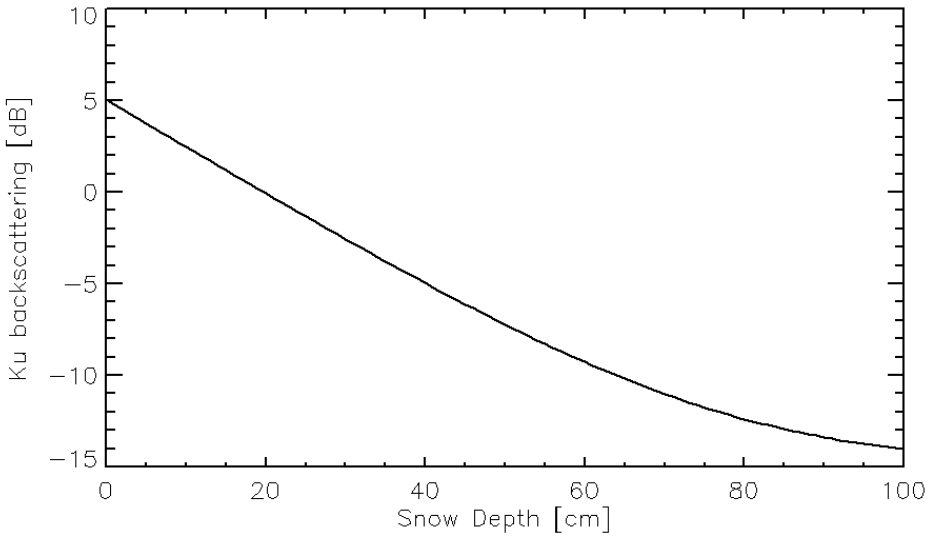
At normal incidence angle, back scattering from snow covered area can be modelled as the sum of **reflection from snow surface** , **volume scattering**, **and two-way attenuation** of the ground return signal [Papa et al., 2002].

Over the area of study the snow depth never exceed 2 m, thus volume scattering contribution can be neglected, if compared to the other contributions.

$$\sigma_{tot} = 10 \log \left(\sigma_{ground} exp^{-2ke*d} + \sigma_{surf}\right)$$

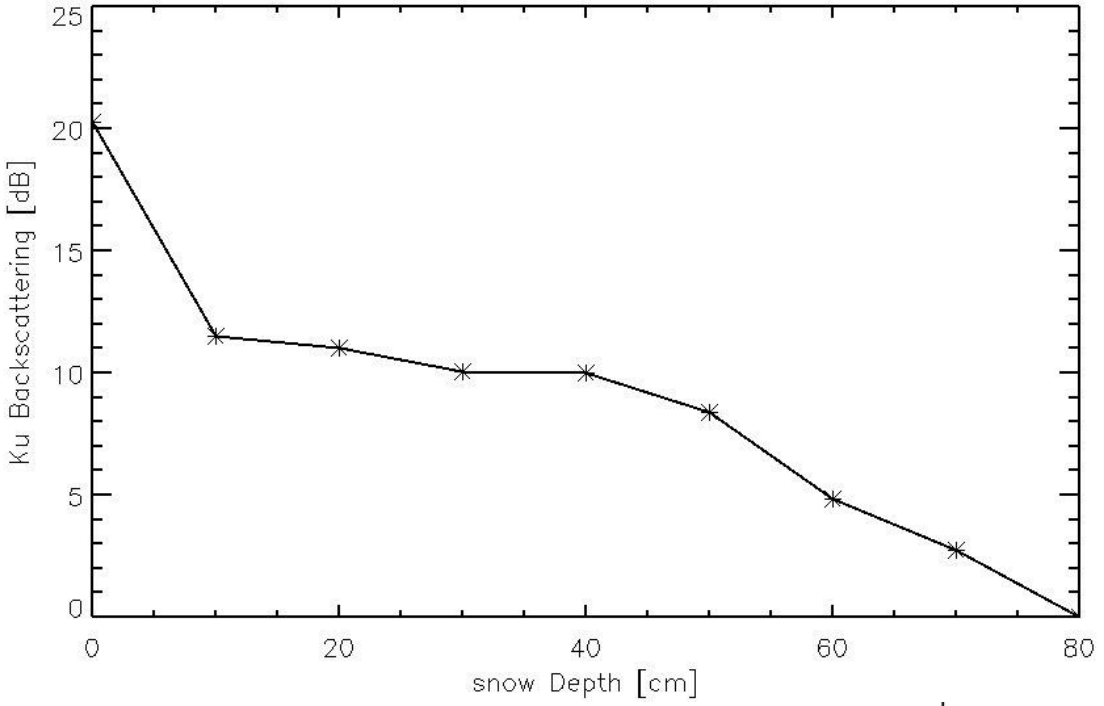
Where:

- *ke* is the extinction coefficient [1/m]
- *d* is the snow depth [m]

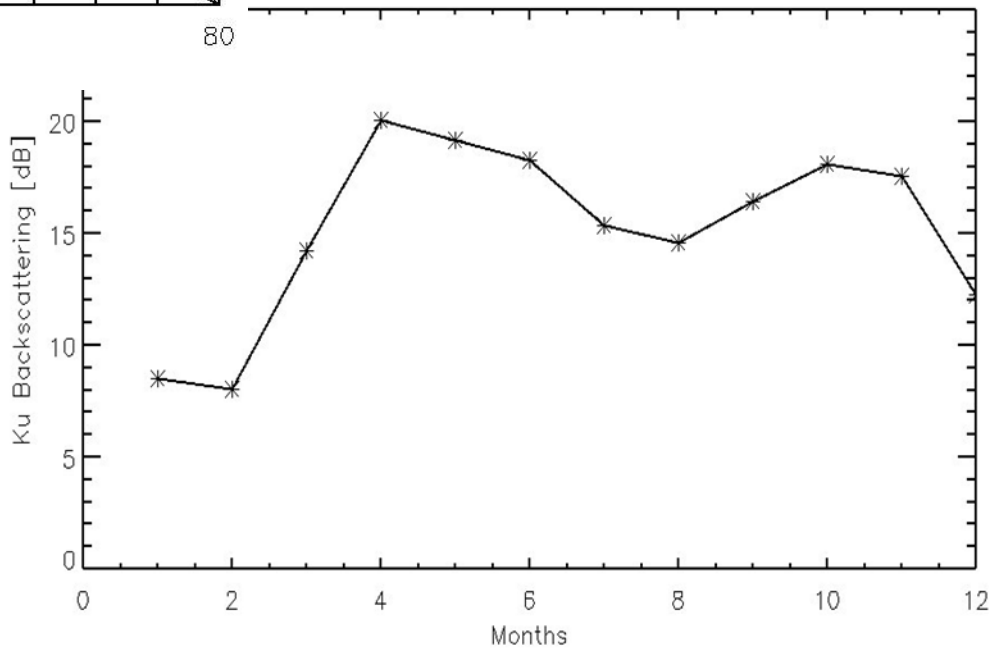


F. Papa, N.M. Mognard, E.D. josberger, F. remy, " *Estimating Terrestrial Snow Depth With the Topex Poseidon Altimeter and Radiometer*", IEEE Trans. Geoscience ad Remote Sensing. Vol 40, no 10, 2022

Data Analysis

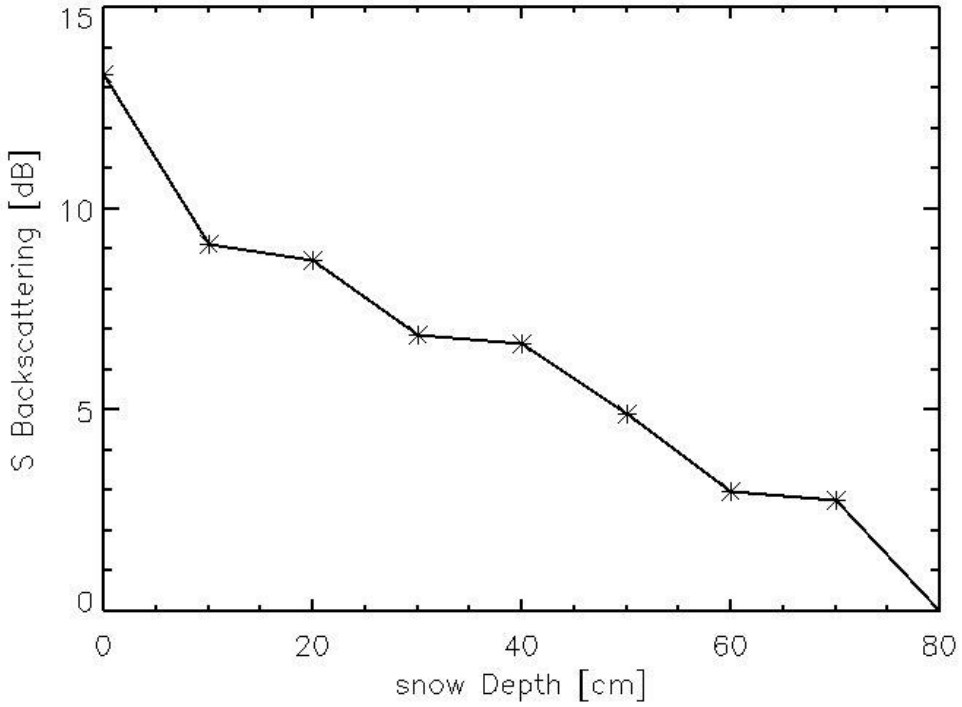


Mean backscattering vs time

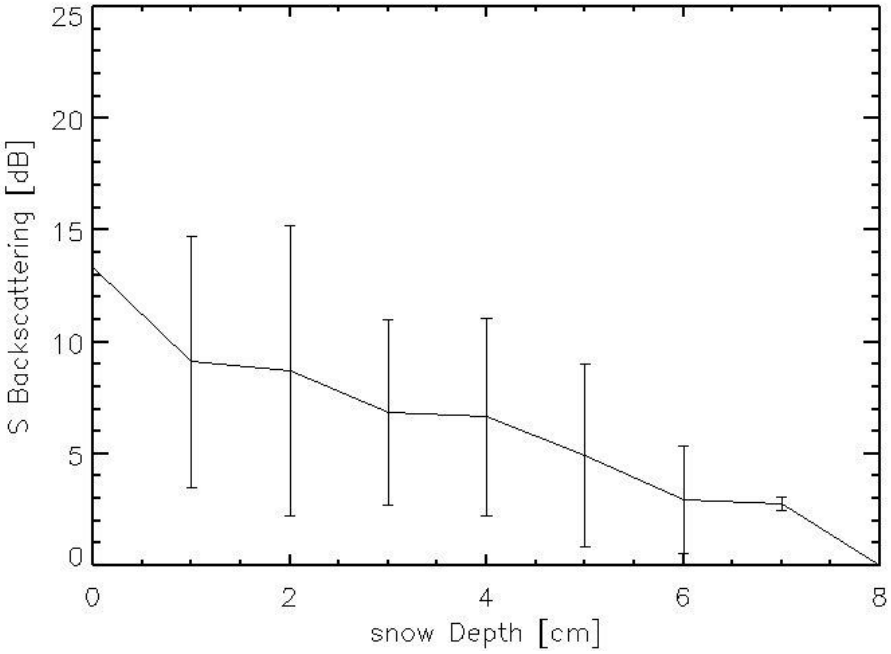


Data Analysis

Mean backscattering



Backscattering std dev.



Conclusions & Next Steps

- **Analysis of ENVISAT RA-2 data clearly shows a trend with snow depth, which agrees with models.**

- **However low resolution of the sensor introduce noise in the backscattering leading to high variability of the measured sigma naught.**

- **We believe this could be different in the case of Sentinel-3, as in this case the satellite will have a higher resolution, that could potentially allow a better filtering of the data.**

Thanks for Your Attention

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