Use of high frequency radiometer and altimeter on board AMSU-B, AMSR-E and Altika/SARAL for observations of the Antarctic ice sheet surface.

Fifi I. Adodo[1]*, Ghislain Picard[2], Frédérique Rémy[1]

[1]LEGOS/CNRS, 14 av. E. Belin, 31400, Toulouse, France (*Corresponding author: fifi.adodo@legos.obs-mip.fr)

[2]LGGE, 54 Rue Molière , 38402, St Martin d'Heres Cedex, France

Introduction

Snow surface properties quickly evolved according to local weather conditions, therefore are climate change indicator. These snow surface properties such as grain size, density, accumulation rate etc... are very important for evaluation and monitoring of the impact of climate change on the polar ice sheet. The purpose of this study is to combine the microwave radiometers and altimeters data to retrieve and quantify the snowpack surface properties of the Antarctica Ice Sheet. In order to retrieve these snowpack properties, we explore the high frequency microwave radiometer variable (Tb) in combination with altimeter parameter (Backscatter coefficient) and models (DMRT-ML and EASI). We focus more particulary on the evolution of the snowpack at Dôme C and found that surface grains size is increasing.

Field of Study & Data

- Dôme C (longitude=-123,38° , latitude=-75,1° , altitude= 3200m).

Locate on the plateau of the Eastern part of Antarctica. Known as low accumulation rate and weak wind region, flat and literally smooth area.

- **Data**
- Radar Altimeter
- Passive microwave radiometer
- ✓ Data acquisition day and night and in all weather conditions
- ✓ Spatial and temporal coverage
- ✓ Provide informations both on the surface and subsurface of the snowpack

Sensors and characteristics	Frequency (GHz)	Temporal resolution	spatial resolution
AMSU-B	89 / 150	daily	25*25
AMSR-E	37 / 89	daily	25*25
ENVISAT	3.2 / 13.6	35 days	5*5
SARAL/AltiKa	35,75	35 days	5*5

DMRT-ML (Dense Media Radiative Transfert Multi-Layer)

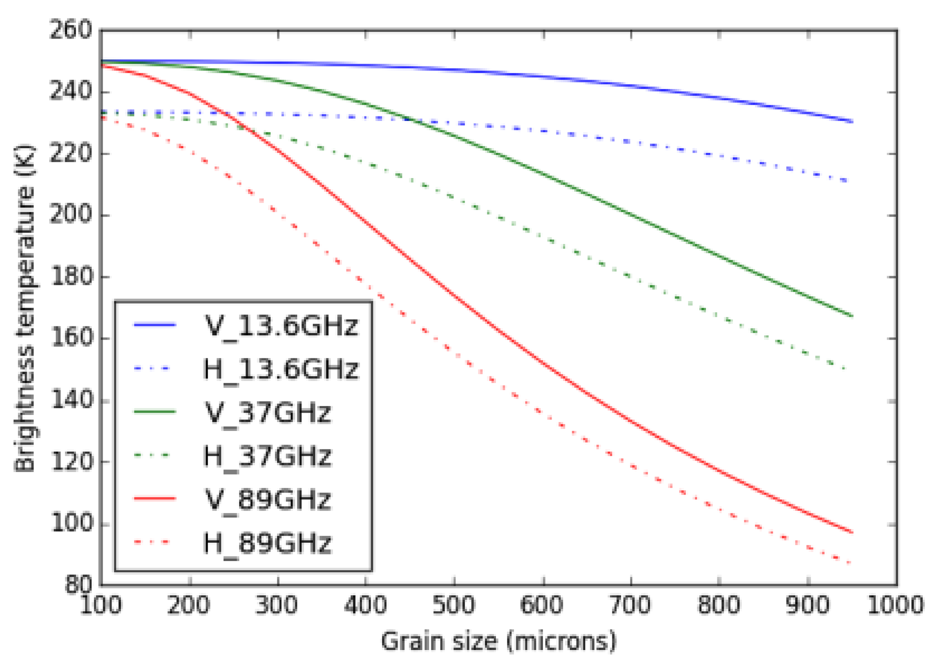


Figure 1: Brightness temperature simulation with DMRT-ML

Main Inputs:

r =0,5mm
ρ=350kg/m³
T= 250 K

EASI (Echo Altimeter Simulation on Ice and snow)

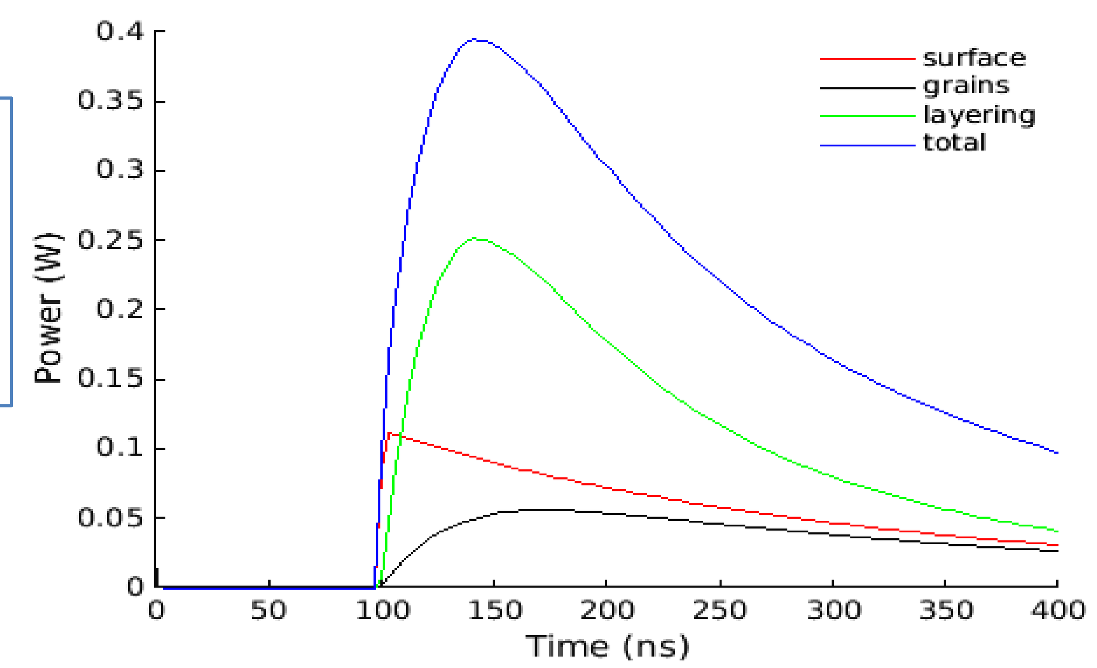


Figure 2: Altimeter waveform simulation with EASI

Results

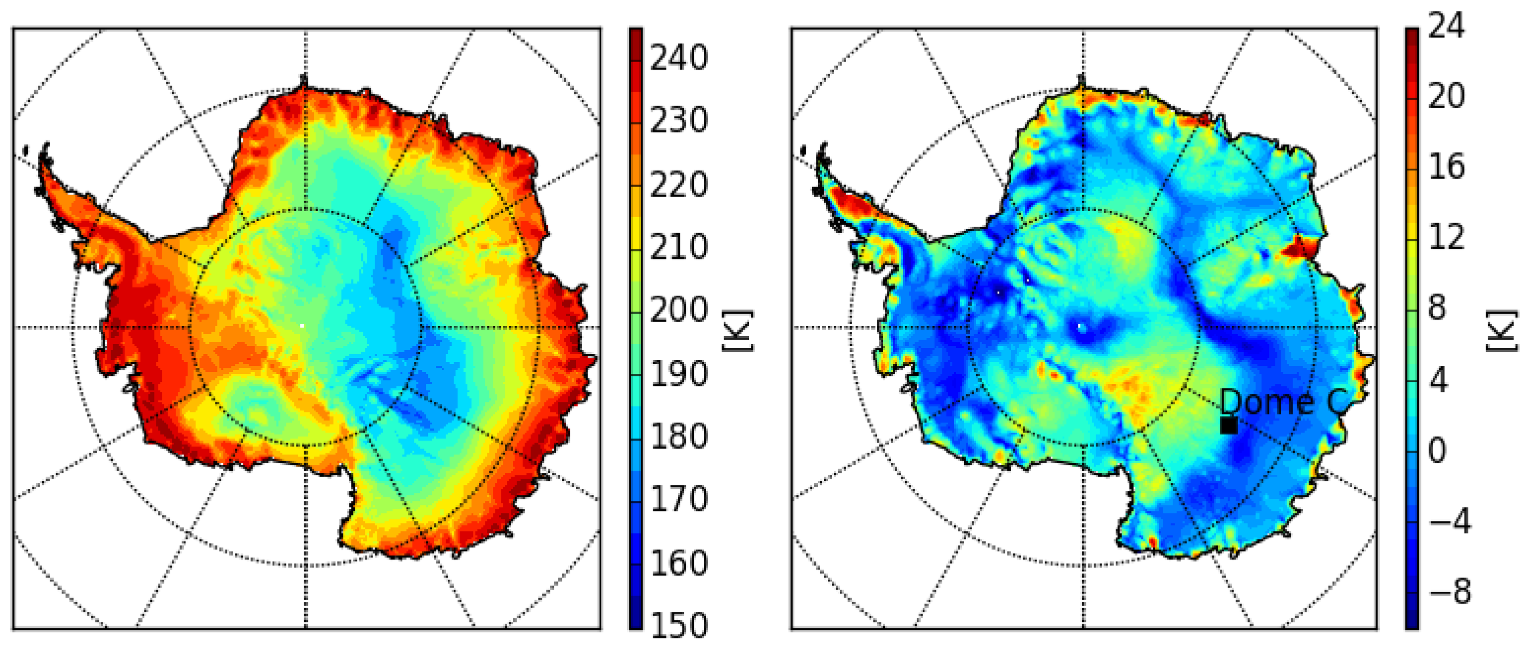


Figure 3 : Brightness Temperature at 89GHz (left) and the difference between 89 and 37GHz (right) of Antarctica ice sheet.

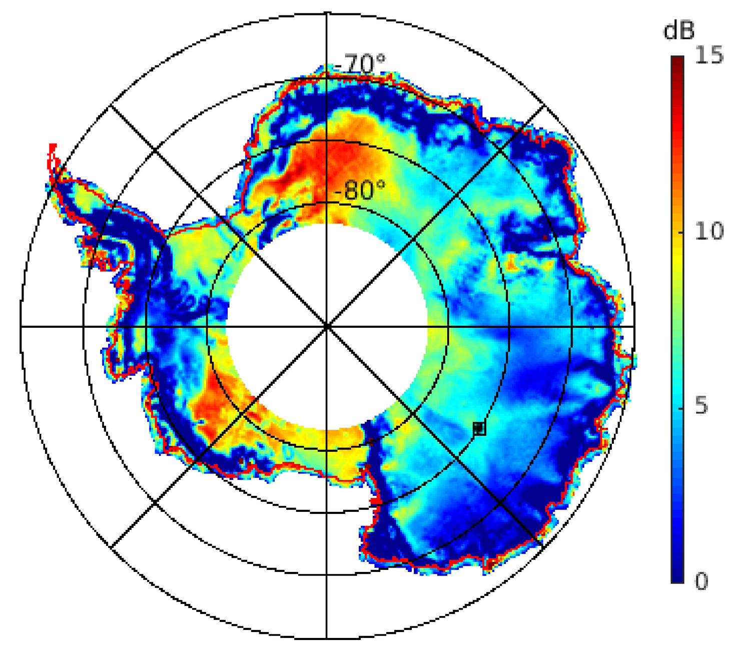
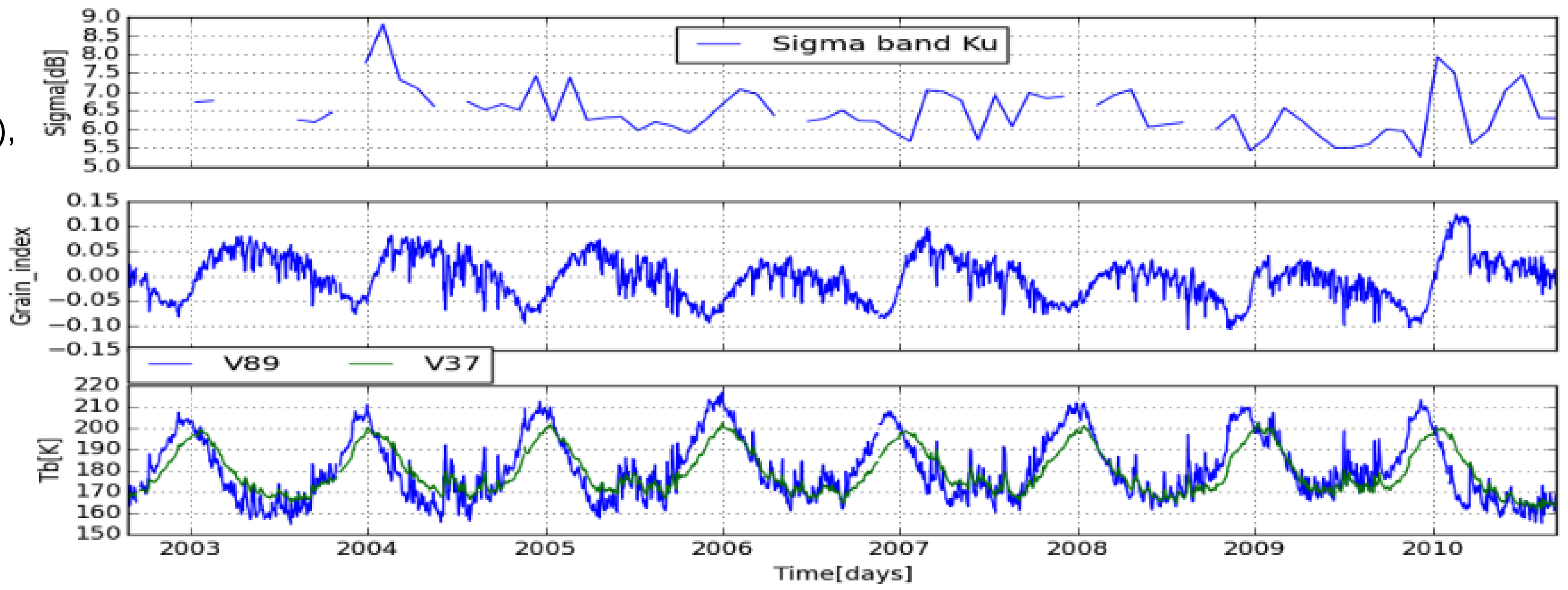


Figure 4: Backscatter coefficient of Ku band

Figure 5: Time series of backscattering coefficient (top), Grain-index calculate as the ratio between frequencies(89GHz and 37GHz) (middle) and brightness temperature at 89GHz(blue) and 37GHz(green) (bottom) at Dôme C



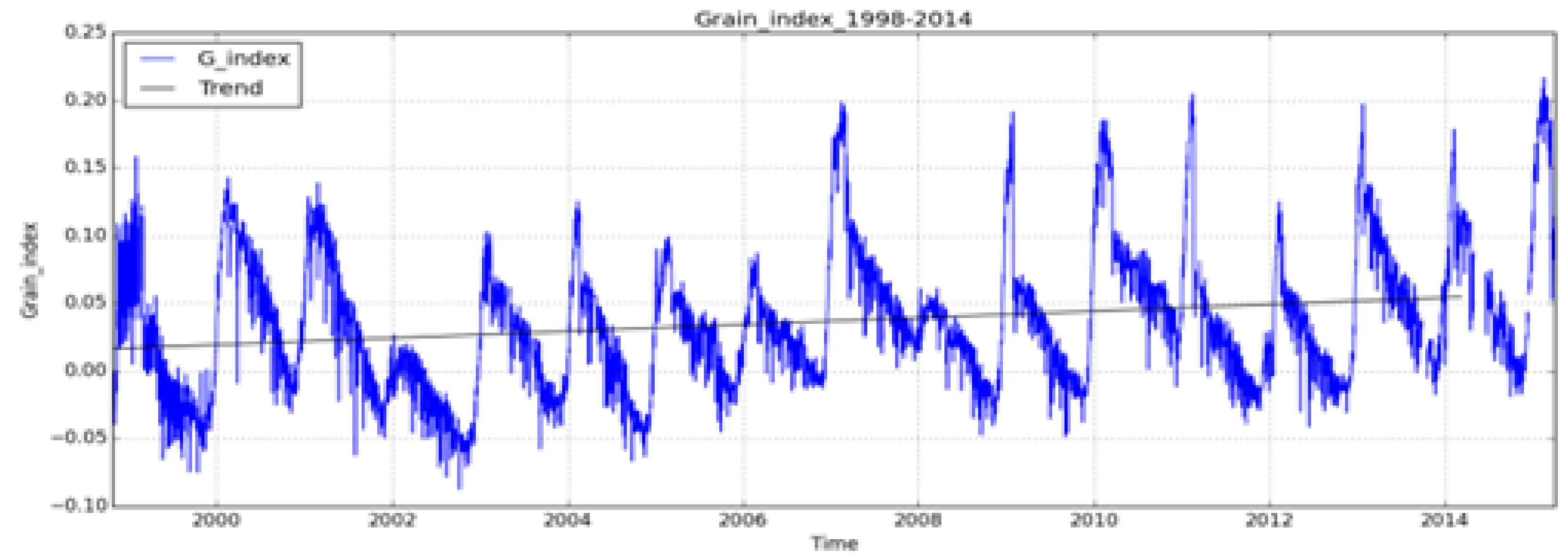


Figure 6: Time series of the grain_index (from AMSU-B data) at Dôme C

Picard and others have shown that $GI = 1 - \frac{TB150}{TB89}$ represents the proxy of the grain size of thick layer of 7cm at Dôme C.

Conclusion and perspectives

- ✓ Positive trend of the Grain index which suggest that surface grains size are increasing at Dome C during the two last decades. A decrease in accumulation rate could explain this trend.
- ✓ Quantification of surface properties (grain size and density) of the snowpack at Dôme C (**Work in progress**).
- ✓ coupling of radiative transfer model DMRT-ML with an altimetry waveform model (**perspectives**)

References

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3 - P. Lacroix, M. Dechambre, B. Legresy, F. Blarel, and F. Remy (2008), “On the use of the dual-frequency ENVISAT altimeter to determine snowpack properties of the Antarctic ice sheet,” Remote Sens. Environ., vol. 112,no. 4, pp. 1712–1729