AltiKa MWR In-Flight Validation and Calibration - First Results

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Context

- MWR on-board SARAL/AltiKa
  - Two-channels (23.8GHz and 37GHz),
  - Using the same reflector than the altimeter (Nadir pointing)
  - Very good resolution (12km : 23.8GHz, 8km : 37GHz)
- Objective for the MWR is to provide products necessary to the altimeter data processing
  - **Wet tropospheric correction**: excess path delay resulting from the presence of water vapour in the troposphere
  - **Atmospheric attenuation of the sigma0**: necessary for wind speed then SSB then range estimation (important in Ka band)
  - **Cloud water content**: not directly used, but interesting parameter especially in Ka band
  - **Water vapor** : climate studies

Introduction

- Objective:
  - First assessment of the radiometer measurements (TBs)
  - In-flight adjustment for inversion algorithms

- Outlines:
  1. Over ocean, assessment of the quality of the MWR by comparison to AMSU measurements
  2. Over continental reference areas, comparison to other instruments (J2, AMSU-A, EN)
  3. Inversion algorithms development and application
  4. Adjustment of measurements
  5. Conclusion and Perspectives

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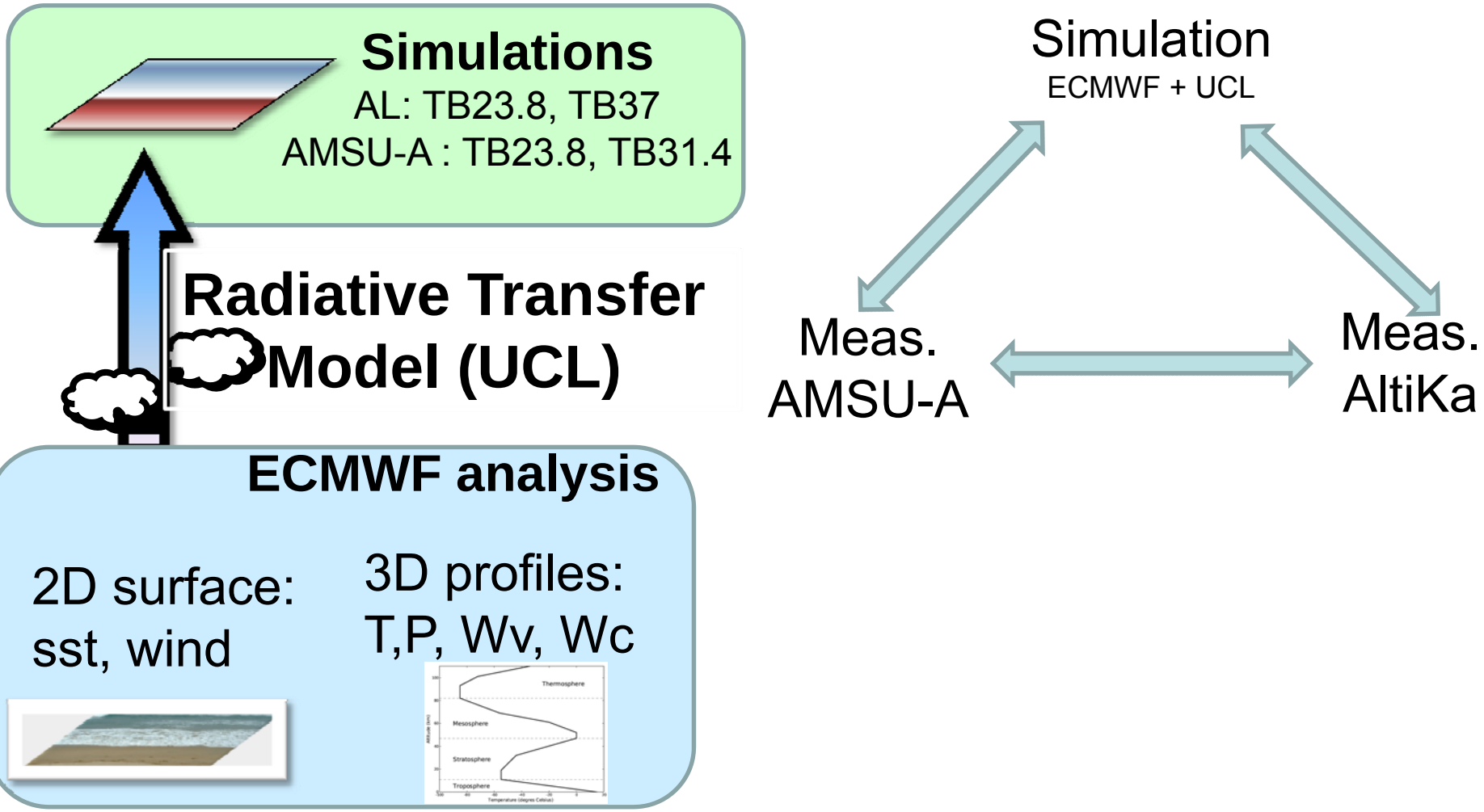
Over ocean: comparison AltiKa/AMSU-A

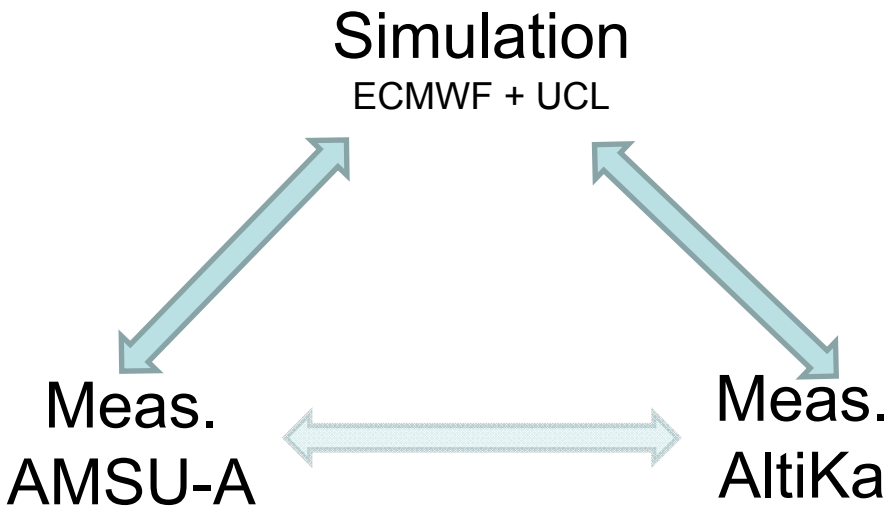
Over ocean, a comparison to AMSU-A (Metop02) by double difference method is performed with simulations as a common reference using 4 month of data



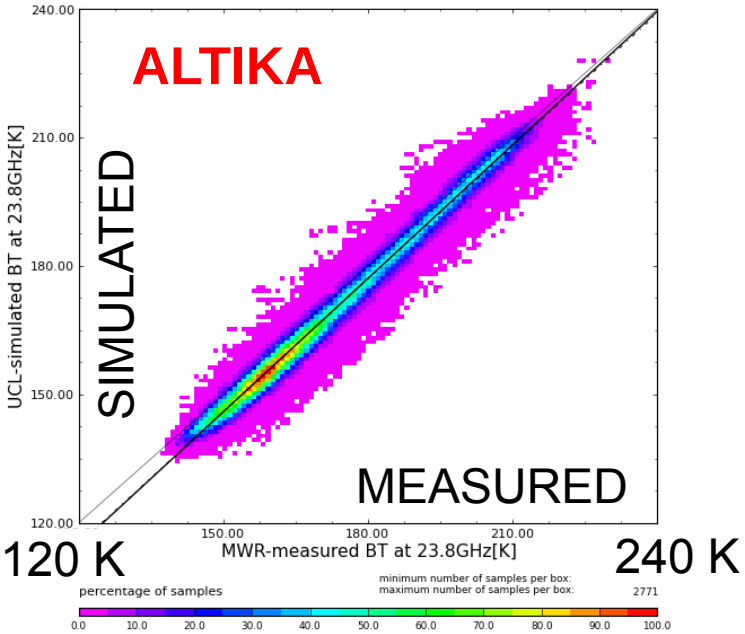
Over ocean: comparison AltiKa/AMSU-A

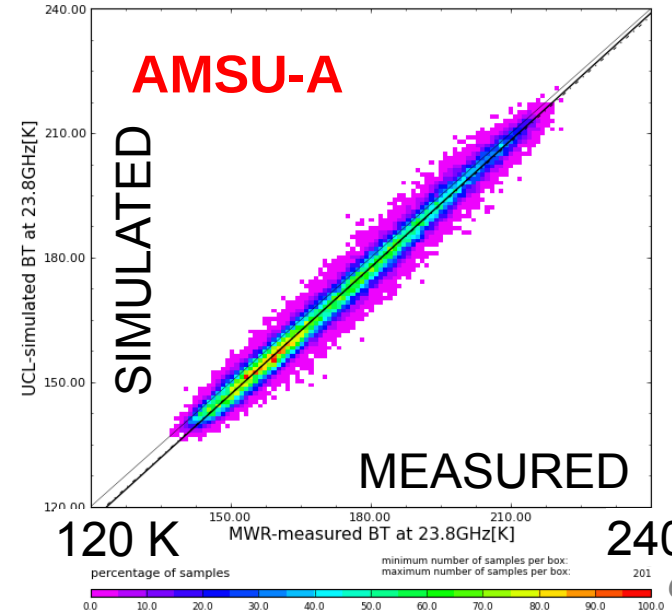
Set up of two databases (Mars to June 2013) :

- AltiKa: Measurements from GDR products
- AMSU-A: L1C products
- Colocalisation of simulations and measurements
- Selection of open ocean and clear sky situations by filtering both measurements and simulations



Over ocean: Meas vs sim for 23.8GHz

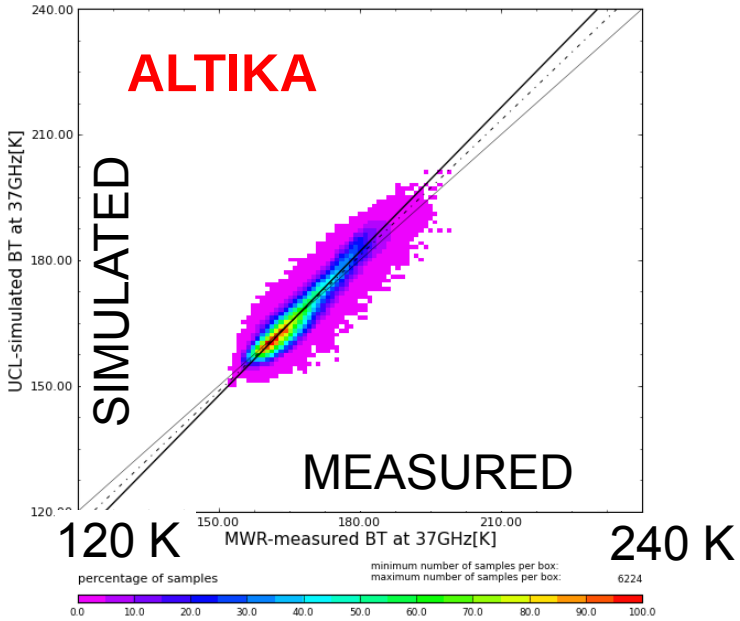


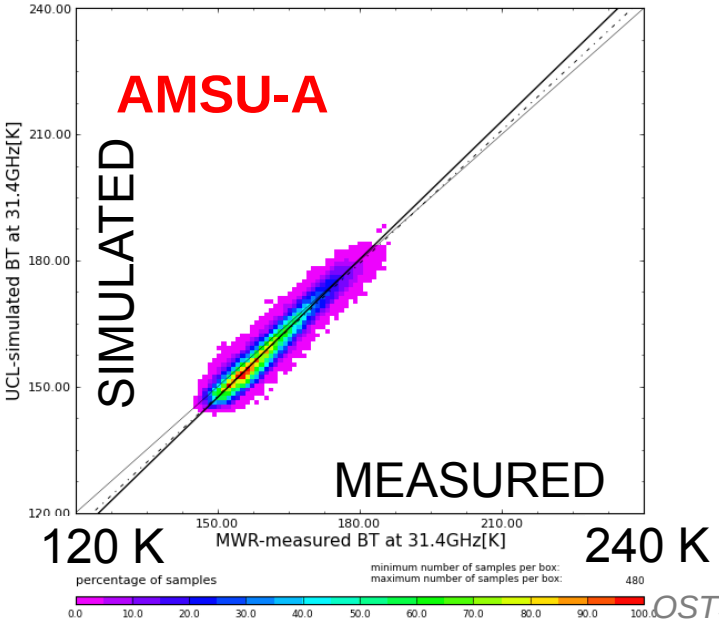


- Good agreement between measurements and simulations for both instruments
- Good agreement between both scatterplots
  - Hot Tbs meas. close to hot Tbs sim.
  - Cold Tbs meas. warmer than cold TBs sim.

Sim-Meas	AltiKa	AMSU-A (nadir)
Bias	-3.1 K	- 2.5 K
Std	2.8 K	2.7 K

Over ocean: meas vs sim for 37/31.4GHz





- Good agreement between measurements and simulations for both instruments
- Quite good agreement between both scatterplots, not as good as for channel 23.8GHz but not the same frequency

Sim-Meas	AltiKa	AMSU-A (nadir)
Bias	0.3 K	- 1.5 K
Std	3 K	2.6 K

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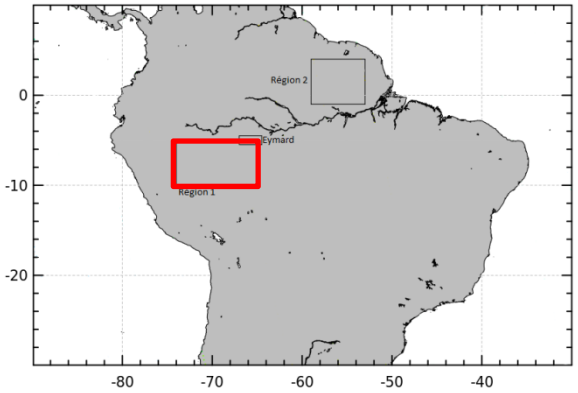
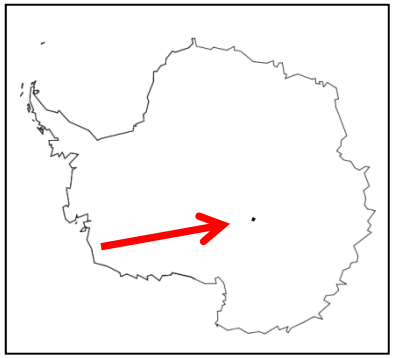
Continental reference areas

- Lack of **absolute** natural reference target

- Amazon :
  - Naturel target closest to a black body
  - Weak dependency with the frequency, polarisation and incidence
  - Weak annual cycle
  - Diurnal cycle

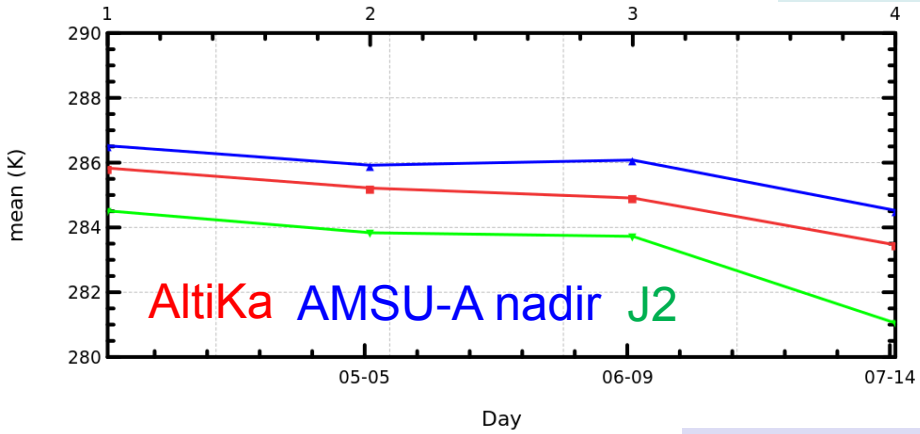


- Antartic plateau:
  - Dry atmosphere throughout the year,
  - Weak temporal variability
  - Coldest temperatures over the year



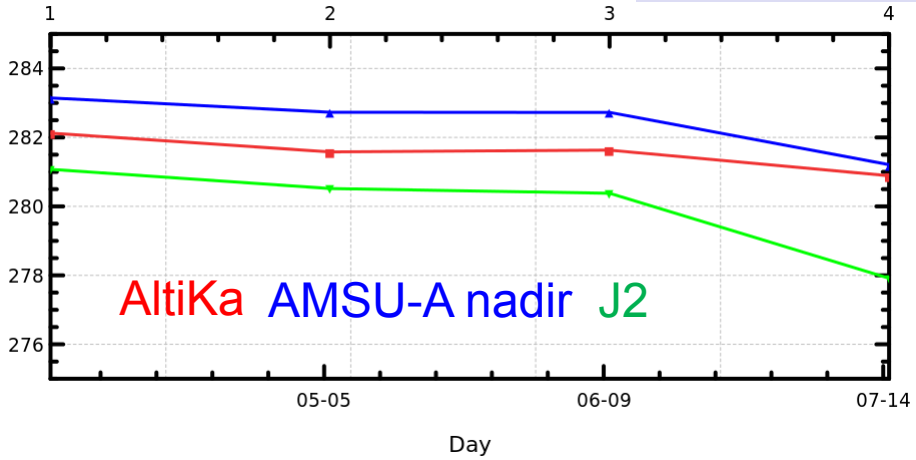
AltiKa/AMSU-A/J2 over Amazon (night)

TB 23.8GHz



AltiKa	AMSU-A(nadir)	J2
284.9 K	285.8 K	283.3 K

TB (37/31.4/34) GHz



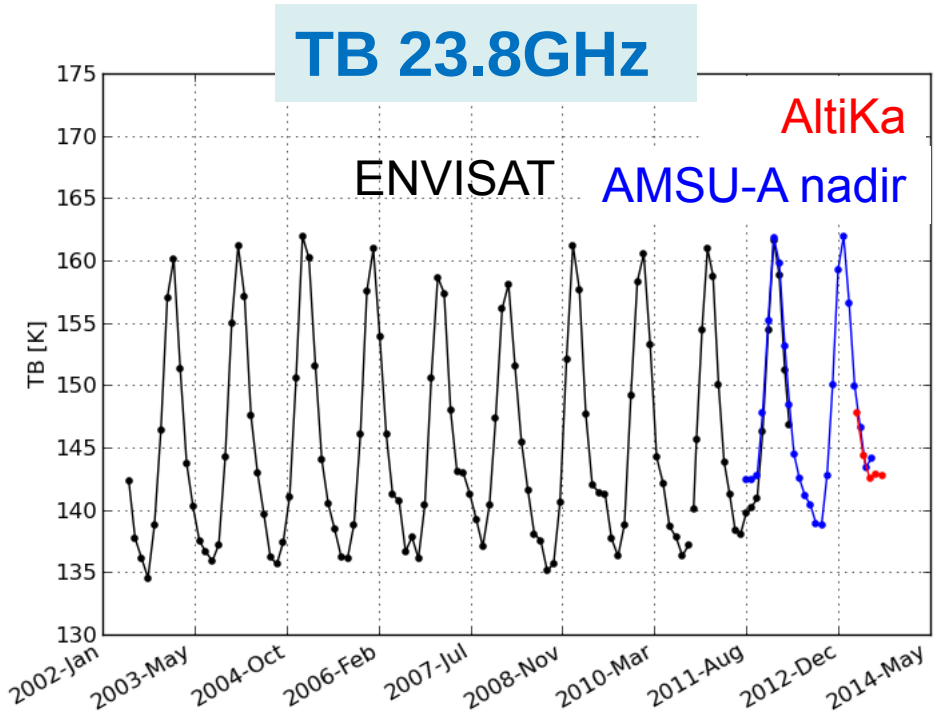
AltiKa	AMSU-A(nadir)	J2
281.6 K	282.5 K	280 K

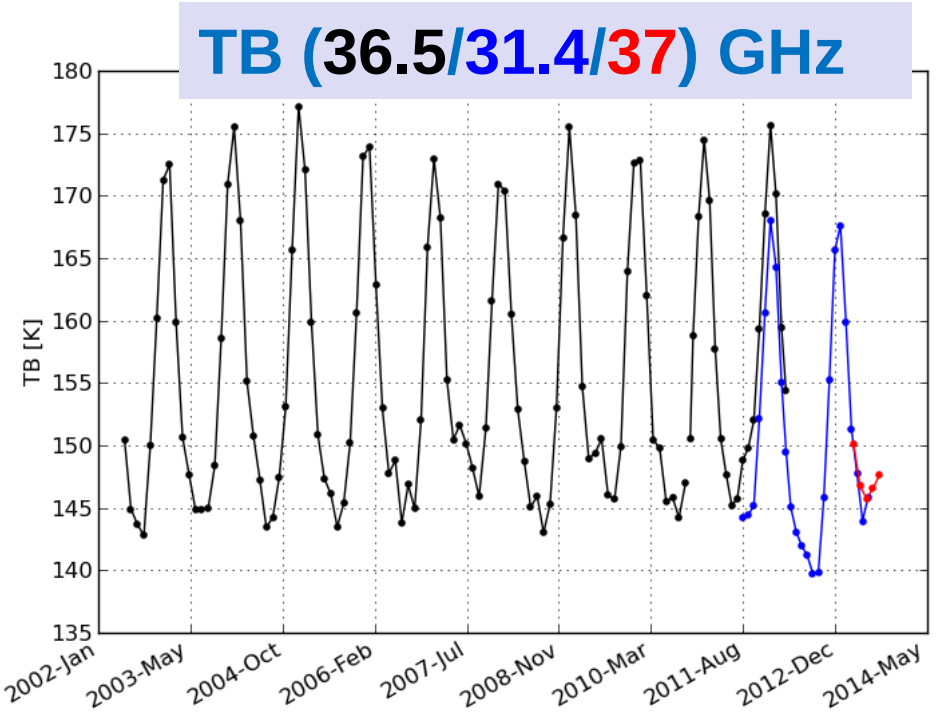
➔Good agreement between the three instruments for hot TBs

➔ Long-term monitoring of the brightness temperatures

Antartic plateau (EN/AMSU-A/AltiKA)

- Long-term monitoring of the brightness temperatures
- AltiKa follow-on mission to Envisat





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Before launch: Inversion algorithm development

E. Obligis, L. Eymard, et al,
"*First three years of the microwave radiometer aboard ENVISAT: In-flight calibration, processing, and validation of the geophysical products,*"
J. Atmos. Ocean. Technol., vol. 23, no. 6, pp. 802–814, Jun. 2006.

Simulations
TB23.8, TB37
Sigma 0 Ka

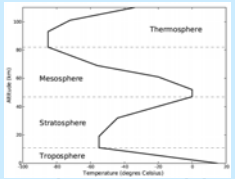
Radiative Transfer model

Neural Network
1 set of {weights, bias} for each geophysical product

ECMWF analysis
1 day per month over 12 months

2D surface:
sst, wind

3D profiles:
T,P, Wv, Wc



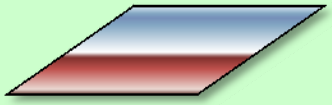
Retrieved Geophysical Products
Wet tropo. correction,
Atmospheric attenuation,
Cloud Liquid Water content,
Water vapor content

After launch: Inversion algorithm application

Measurements

MWR ➔ TB23.8, TB37

Alt ➔ Sigma0 Ka



Simulations

TB23.8, TB37

Sigma 0 Ka

Neural Network

(Weights, Bias)

Retrieved Geophysical Products

Wet tropo. correction,
Atmospheric attenuation,
Cloud Liquid Water content,
Water vapor content

IMPORTANT

Assure a good consistency between simulations and measurements to provide a good quality of the geophysical products

➔ A linear adjustment should be applied to the TBs and the σ_0

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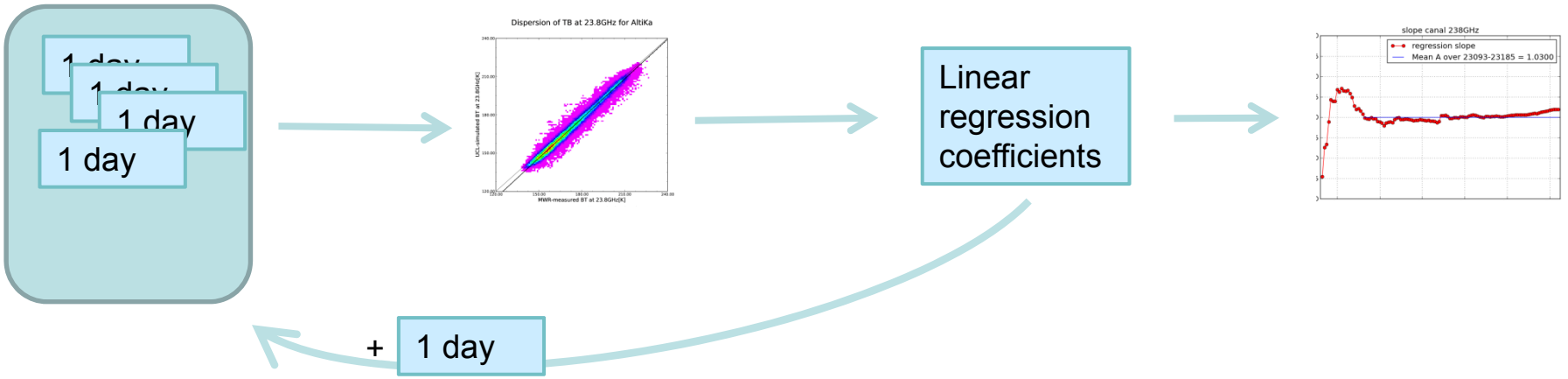
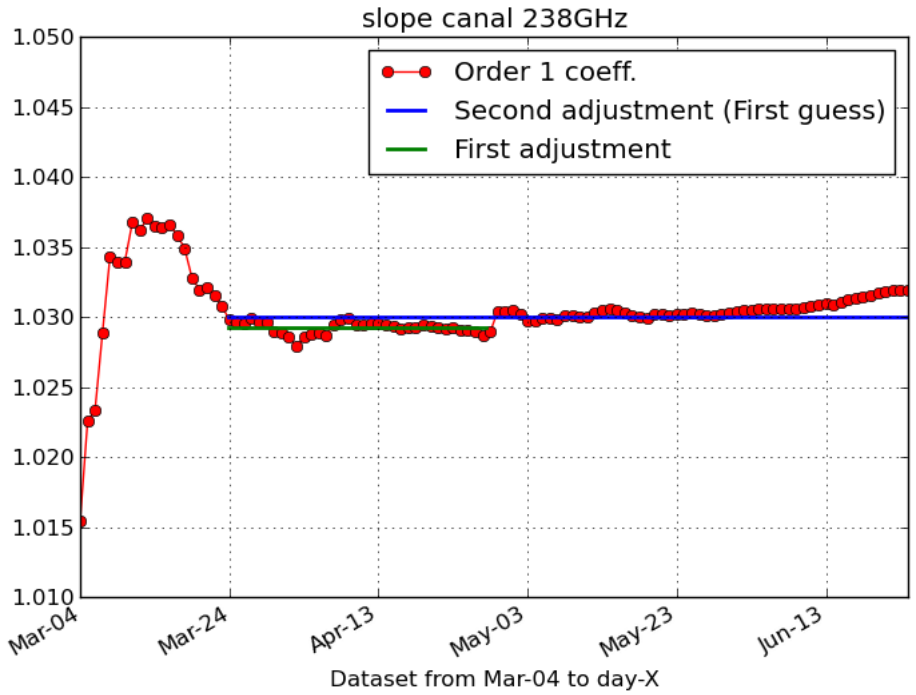
Adjustment of measurements: methodology

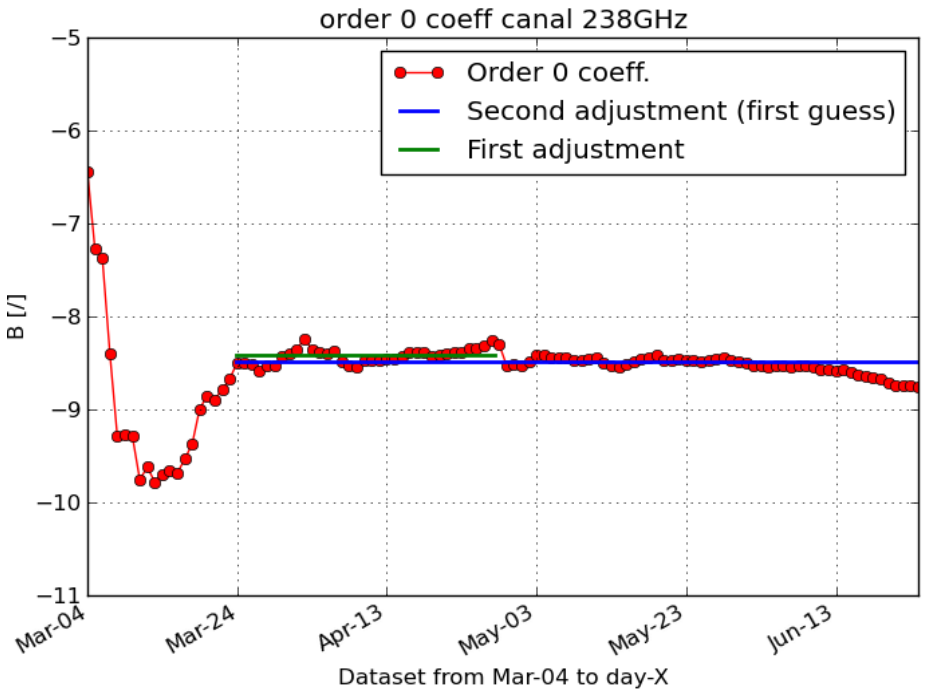
- Usually about 6 months of data is processed for the adjustment of brightness temperatures (to catch seasonal impact)
- For SARAL/AltiKa, a first intermediate adjustment (channel 23.8GHz) was performed on July 2013 (patch P1) with 2 months of data.
- A second adjustment is planned at the end of the year (Dec 2013) (available with patch P2).
- Dataset of colocated measurements and simulations (ECMWF+RTM), filtered to keep only open ocean and clear sky situations
- Iterated process to assess the statistical representativity of the data set



Adjustment of measurements: example : 23.8 GHz

- The results show that a dataset of approx. 1 month of data seems statistically representative
- First adjustment computed from average over second month of data
- Future adjustment given by taking the average of the coefficients over the last three month of data





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Conclusions

- Excellent quality of the instrument
- Comparison with other instruments performed with brightness temperatures without adjustment
  - Double-difference analysis show a good agreement with AMSU-A over ocean
  - Over continental area, good agreement with other instruments (AMSU-A,J2)

➢ On ground calibration is confirmed by in-flight results

- But an adjustment is required to provide consistency between inversion algorithms and instrument measurement =>condition for accurate geophysical products

Perspectives

- Final adjustement coefficients by the end of the year

- Constant Long-term monitoring of the radiometer TBs over reference areas: Amazon rain forest (hot TBs) and Antarctic plateau (cold TBs). Coldest ocean points will be added soon

- In addition, quality of the products is also assessed by higher level diagnostics (see N.Picot talk)