Microwave radiometer aboard SARAL/ALtiKa: Correction of 37GHz channel

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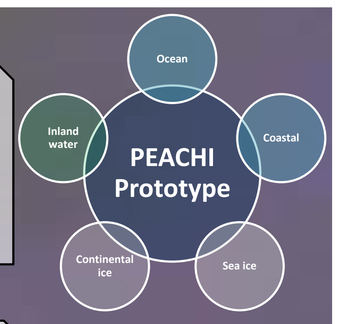
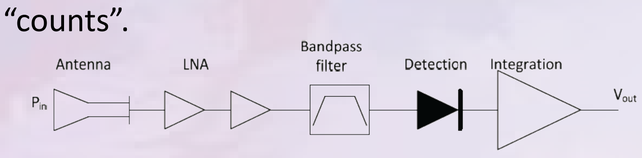


A saturation of hot calibration counts

A Microwave radiometer reveiver

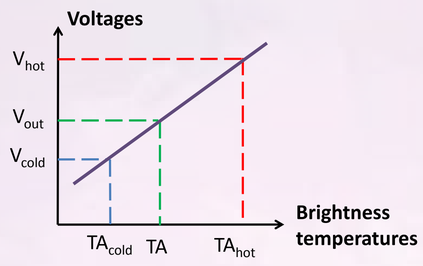
The Ka band altimeter aboard SARAL/AltiKa is combined to a two-channels microwave radiometer (23.8GHz and 37GHz). The AltiKa radiometer is a full power radiometer with direct detection receivers. The receivers ensure the low-noise amplification of the signal, band pass filtering and integration. The outputs are voltages which are digitilized to give the so-called “counts”.



Basically the receivers transform a brightness temperature in counts through a linear calibration law.

$$V_{out} = G_{rec}(TA + T_{rec}) + V_{offset}$$

Where G_{rec} (mV/K) is the slope of the linear function



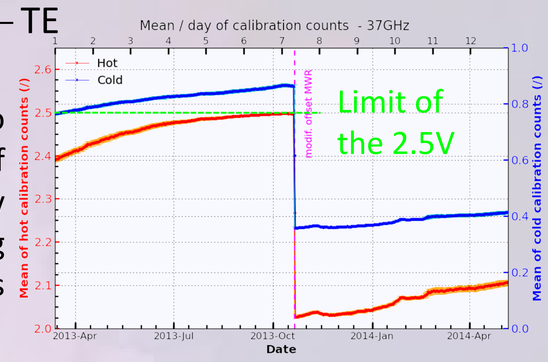
Calibration counts

In flight, the internal calibration should be performed regularly to adjust the calibration function. For SARAL/AltiKa, the internal calibration of the radiometer is performed every 3 seconds either by connecting the receiver to a skyhorn receiving the cold sky brightness temperature, or to an internal hot load.

The cold calibration and hot calibration counts are used to estimate the gain of the receiver, required to retrieve the antenna temperature:

$$\tilde{G}_{rec} = \frac{V_{hot} - V_{cold}}{TA_{hot} - TA_{cold}} \qquad TA = \frac{V_{out}}{\tilde{G}_{rec}} - TE$$

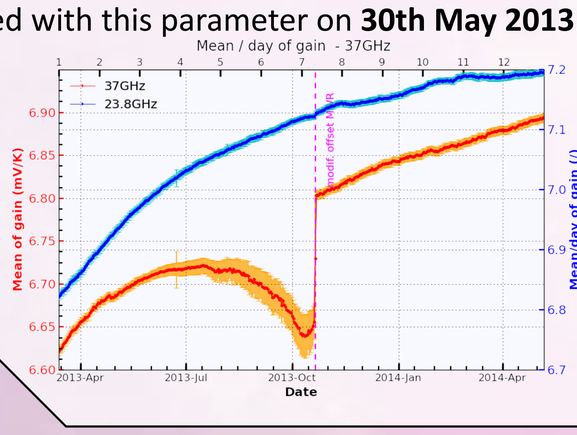
For SARAL/AltiKa, the hot counts have grown to reach the upper bound of nominal conversion of the Analogic/Digital concerter of 2.5V. So they have been received saturated leading to a wrong estimation of the gain and of the brightness temperatures.



On the **22th october 2013**, a new value of the offset voltage has been uploaded in the on-board database which allowed to retrieved a correct dynamic of the gain.

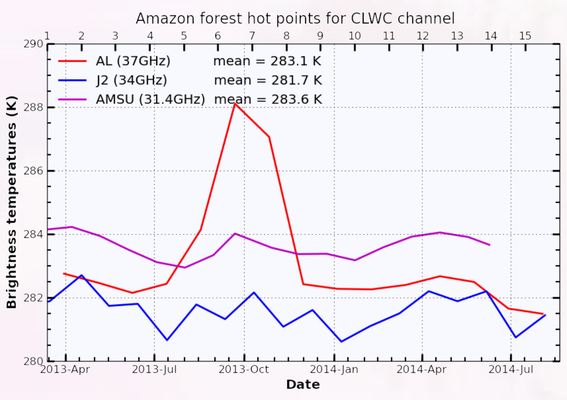
Estimated gain of the system

The impact of the saturation of the hot calibration counts had a direct impact on the gain. While the standard deviation of the hot calibration counts decreased, the standard deviation of the gain increased. The beginning of the saturation can be clearly defined with this parameter on **30th May 2013**.



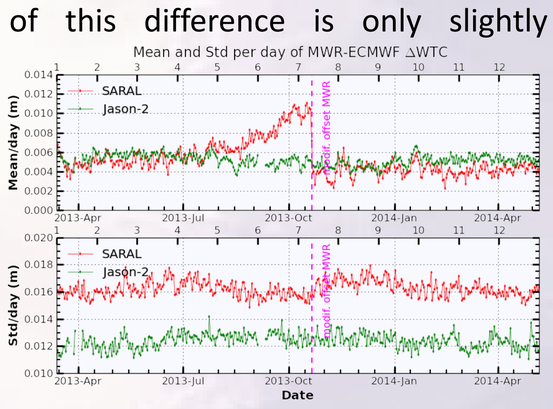
Retrieved brightness temperatures

The impact on the brightness temperatures is higher on the hotter brightness temperatures than for the colder brightness temperatures. The anomaly reaches in average ~6K over land, and ~3K over ocean.



Wet tropospheric correction

On the MWR wet tropospheric correction (WTC), the increase of the bias with respect to the ECMWF wet tropospheric correction from 5mm to 1 cm in average is related to the saturation of the hot calibration counts. The standard deviation of this difference is only slightly impacted.



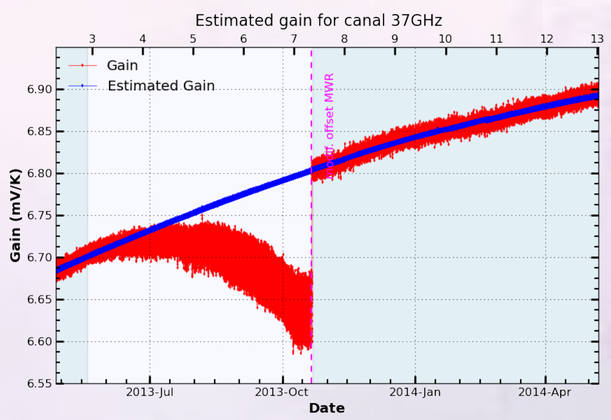
Correction of the system gain

A method has been implemented to give an estimation of the gain during the period of saturation. The gain retrieved from the measured calibration counts has been subsamples with a resolution allowing a correct sampling of small scales variation and a reasonable number of data.

A period of reference (blue patch) before and after the saturation is used to define an estimation of the gain but also to assess the error induced by the method.

The function looked for is a combination of a linear function with the physical temperature of the receiver (Tbhr) and a non linear dependency with time.

$$G_{corr} = p_0 + p_1 * T_{bhr} + p_2 * (t - t_0) + p_3 * (t - t_0)^2$$



A minimisation by the least-square method leads to a corrected gain (blue curve).

This corrected gain is injected in the AltiKa MWR simulator ShERPA which:

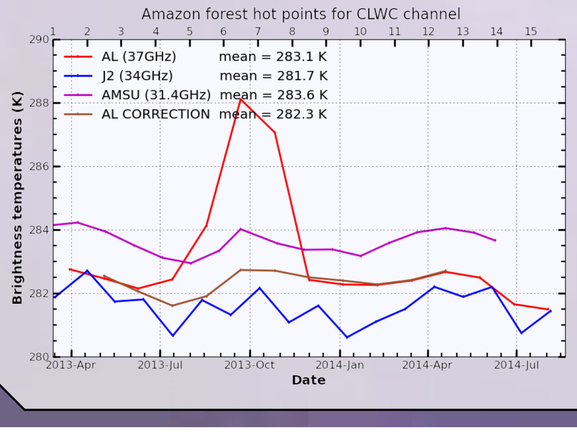
- application of the radiometric model to compute the brightness temperatures at MWR sampling rate
- Computation of the TBs at the altimeter sampling rate.

These corrected brightness temperatures are used in input of the inversion algorithm to retrieve the geophysical parameters.

Corrected parameters

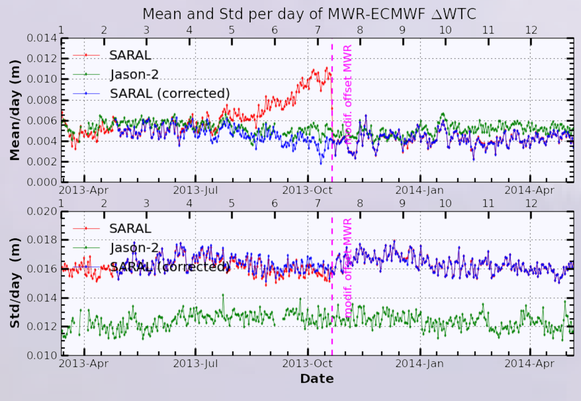
Brightness temperatures

The monitoring of the brightness temperatures over the Amazon forest retrieve the expected evolution of the annual cycle.



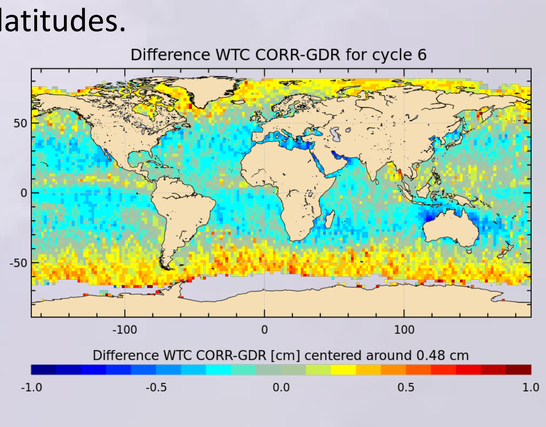
Wet tropospheric correction

The mean of ΔWTC (MWR-ECMWF) retrieves nominal values around 5 mm. The standard deviation is slightly corrected.



Impact on WTC wrt Patch2

A map of the differences of the WTC (Corrected – GDR) for the cycle 6 (the most impacted) shows that the impact of the correction is dependant of the latitudes.



❖ The corrected brightness temperatures for 37GHz channel of SARAL/AltiKa MWR will be soon available to users of the PEACHI products through the ODES system.

❖ This correction will also be implemented in the future version of the GDR (Patch 3).