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Assessment of the impact on the SSS of the frequency calibration of the Local Oscillators of SMOS

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The European Space Agency's Soil Moisture and Ocean Salinity (SMOS) mission was launched on the 2nd November 2009. The aim of the mission is to measure Ocean Salinity (OS) and Soil Moisture (SM) over the continents with an adequate accuracy for climatological studies. SMOS carries the Microwave Imaging Radiometer using Aperture Synthesis (MIRAS), a L-band (1.4 GHz) synthetic aperture radiometer that thanks to the interferometric processing (69 antennas) can achieve good spatial resolution (30-50 Km) and temporal coverage for its scientific objectives.

After the commissioning phase, which lasted 6 months (20 May 2010), the frequency of the calibration of the instrument Local Oscillators (LO) was set to 10 minutes, while waiting for in-depth analysis of the impact of this choice. This value is a trade off between the very accurate brightness temperature (TB) measurements needed for Ocean Salinity retrieval and the not as much accurate but frequent measurements needed for Soil Moisture application.

The aim of the local oscillator calibration is to track the phase of the reference tones along time in order to correct the phase drifts introduced by the local oscillator. The LO phases are measured injecting a common internal reference signal, also known as correlated noise injection, to the receivers. Recent findings (R. Oliva, ESA, 2010) showed that when calibrating the LO every 10 minutes, the de-phase can reach up to 180º (counter phase), leading to significant errors on the measured TB.

The aim of this work is to quantitatively analyze the impact of phase errors on the retrieved Sea Surface Salinity for different LO time calibration periods.

In March 2010 the SMOS payload was set to perform a calibration of the local oscillator every 1 minute during 2 orbits. Thereafter the data from these orbits was processed applying the calibration in several time intervals: every 1, 2, 4, 6, 8 and 10 minutes. This decimation allows comparing the impact of the calibration time interval on the brightness temperature and on the retrieved SSS with good precision. By using the same data, one can isolate the problem and avoid other factors that can impact the results, as for example, geophysical conditions variations, sun inclination, etc.

Preliminary analysis shows that calibrating the LO every 10 minutes leads to errors of up to 0.8 K in TB and 3 psu in retrieved SSS, which is far beyond mission requirements. When calibrating the LO every 6 minutes instead, the TB and SSS errors are substantially reduced. An additional reduction is noticeable when calibrating every 4 minutes.