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SMOS calibration impact on scientific data

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The Soil Moisture and Ocean Salinity satellite (SMOS), part of the European Space Agency's Earth Observation programme, is designed to measure Earth's sea surface salinity and soil moisture by means of the L-band surface emissivity. Following SMOS's launch in November 2009, several studies have been initiated during its Commissioning Phase in order to assess and improve calibration and image reconstruction algorithms on final scientific results.

This paper presents the results of the analysis of the main calibration activities to support the key decisions on how to operate and process SMOS calibration during its mission lifetime, giving special attention to the impact of the Local Oscillator on the phase of the visibility function.

Good calibration is paramount to ensure the quality of the geophysical data. The SMOS instrument uses a variety of calibration activities to ensure that any errors do not cause significant performance degradation. These activities include:

- self-calibrating the correlations by means of a comparator offset correction and a quadrature correction;
- phase and amplitude visibilities calibration using Correlated-Noise injection from different Noise sources in the Calibration Subsystem;
- visibility offset correction using Uncorrelated-noise injection at every antenna;
- the so-called "fringe-washing" correction;
- a flat target transformation in order to reduce antenna pattern errors by means of a know target;
- the absolute calibration of the instrument using the same known target.

The SMOS instrument response is particularly dependent on temperature variations, therefore the calibration activities must be performed regularly enough to follow them. One particular element was found to be critical in this aspect. During the test campaign at the Large Space Simulator in ESTEC, the European Space Agency's testing facilities location, it was discovered that the temperature variations between the Local Oscillators controlling different receivers caused a significant degradation on the phase of the visibility function. This behaviour has been confirmed during the first in-orbit analysis and results in a large impact on the final quality of the Brightness Temperature images and thus on the Soil Moisture (SM) and Ocean Salinity (OS) retrievals.

Regular monitoring of the errors introduced by the local oscillator ensures well-calibrated data. However a trade-off has been necessary between obtaining highly calibrated Brightness Temperature data against the loss of acquisition data as a consequence of monitoring activities which impact OS and SM retrieval. A special study, involving the instrument engineers and the scientists from both the Land and the Ocean communities, has been devoted to help solving this particular trade-off. Results have had to be accounted in terms of Brightness Temperature, Soil Moisture, and Ocean Salinity.

Similar studies were done for other calibration activities and will also be presented, although its impact is less critical in terms of monitoring rate.