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MIRAS characterization and monitoring during the SMOS In-Orbit Commissioning Phase

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1 Introduction

The Microwave Imaging Radiometer with Aperture Synthesis (MIRAS) is the single payload of the Soil Moisture and Ocean Salinity (SMOS) mission. The instrument was completed in early 2007 and thoroughly tested both in anechoic chamber and vacuum thermal chamber during 2007. It was integrated to the platform in early 2008 and re-tested, including compatibility, during 2008. At present, the whole satellite is stowed and waiting to be launched during 2009.

In two weeks after launch, the satellite will be in the final orbit with all deployments completed. Then the In-Orbit Commissioning Phase will start, having an estimated duration of 5.5 months. During this phase, the instrument modes of operation will be systematically checked and the calibration parameters will be fully characterized in real conditions. Also, the first brightness temperature images will be obtained in order to assess the overall retrieval procedures including inversion. In the end, the objective of the In-Orbit Commissioning Phase is to provide verification that the payload meets the scientific requirements of the mission.

The general design and planning of the In-Orbit Commissioning Phase is given in [1]. This abstract presents the foreseen activities to be performed during this phase by the UPC team.

Just after the start of the In-Orbit Commissioning Phase, the instrument will be commanded to perform a sequence of operations oriented at providing a full characterization in terms of calibration parameters. The idea is to reproduce the results obtained during the tests carried out on ground [2]. In particular, the following issues will be covered:

Thermal Stability: To provide understanding of both the intra-orbit and inter-orbit temperature variations. The instrument will be continuously operating during a number of orbits while all temperature sensors being monitored.

Electrical Stability: To re-compute all internal calibration parameters (gains, offsets, receiver noise temperatures, visibility phases and G-matrix elements) and assess about their stability and temperature dependance. The sensitivity coefficients for these parameters will be computed, compared with the ones obtained on ground and used to feed the calibration data base for further use in nominal operation.

Absolute amplitude calibration: Obtained by measuring the brightness temperature of a known target using the reference Noise Injection Radiometer (NIR). The satellite attitude will change so that it will point to the deep sky with known brightness temperature.

Flat Target Response: That is, the visibility corresponding to a target with unit brightness temperature from all directions [3]. This is an important parameter for inversion and will be obtained also with the satellite pointing to the deep sky.

2 Imaging

Once the instrument fully characterized, a continuous set of orbits will provide observation data to allow processing to higher levels and to provide brightness temperature maps of selected zones of the Earth. Two modes of operations will be considered

Dual-polarization operation: In this mode the brightness temperature at two orthogonal polarizations will be obtained after inversion of the corresponding visibility measurements. Since the objective of this processing is to assess about inversion methods and algorithms, the reference frame used will be the one defined by the instrument.

Full-polarimetric operation This mode provides the four Stokes parameters of the Earth emission citepolmiras. Although in principle, this is not the nominal mode of operation, the commissioning phase provides an opportunity to test this mode and compare the results with the dual-polarization mode.

3 Data processing

The data will be processed with the MIRAS Testing Software (MIRAS-TS), a tool specifically developed by UPC to test the payload operation [5]. It was successfully used during the on-ground characterization of the instrument [2] and it is now being updated in order to be efficiently used for the in-orbit commissioning phase.

The tool can ingest raw data from the electronic ground support equipment (EGSE) developed by the instrument manufacturer and also from the nominal level 0 data provided by the SMOS ground segment data acquisition system. The software classifies the input data and applies the calibration procedures to produce calibrated visibility and brightness temperature. Most of the intermediate results, including raw data and calibration parameters, are saved in files for further analysis and processing. The processing has been optimized for speed so that the results are produced in near real time and it is designed to process large amount of data in a continuous way. Finally, the tool includes a user-friendly graphics interface that allows selecting specific data according to different parameters (baselines or receivers, modes of operation or others).

4 Conclusions

During the SMOS In-Orbit Commissioning Phase, a number of tests will be carried out in order to check the payload MIRAS operation and fully characterize it in terms of data consistency and calibration parameters. The UPC team is in charge of analyzing the data and develop the procedures to verify that the final data meets the required specifications. The procedures for this have been summarized and will be presented at the conference in more detail.

References

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