Innovative and Efficient Strategy of Calibrating Sentinel-1

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As part of the GMES system, Sentinel-1 is designed to provide an independent and operational information capacity to the European Union to warrant environment and security policies and to support sustainable economic growth. Sentinel-1 is a satellite system designed to operate a ground segment for 20 years supporting a system of up to three satellites. One satellite is built to perform at least seven years in the reference orbit and to operate a SAR instrument in C-band. Product quality is of paramount importance. Hence, the success or failure of the mission is essentially dependent on the calibration of the Sentinel-1 system ensuring the product quality and the correct in-orbit operation of the entire SAR system.

The essential task of calibrating Sentinel-1 is to estimate and correct systematic error contributions throughout the complete SAR system and to tie-down image information (magnitude and phase) to reference units in geophysical terms. The quality of this calibration process is dependent on the inherent stability of the radar system and the capability to determine and monitor the radiometric and geometric characteristics.

The time frame for performing all calibration activities is defined by the tight duration of the commissioning phase of Sentinel-1. Considering a repeat cycle of 12 days, 3 months commissioning phase results in 7.5 repeat cycles. Assuming half a cycle for the check out of the complete Sentinel-1 System including both space and ground segment as well as one cycle for product release at the end of commissioning Sentinel-1, 6 repeat cycles remain for performing all calibration activities. The minimum number of measurements being performed and consequently of passes being required is driven by the radiometric accuracy budget and the strategy to execute the radiometric calibration on selected beams.

Due to the high demand on the radiometric accuracy of 1dB (3σ) in all 4 operation modes, it is recommended to measure:

- at least one beam of each mode,
- twice each beam being selected (ascending/descending),
- against three reference targets deployed across the swath,
- at least one beam with low, one with mid and one with high incidence angle.

Considering these aspects, five test sites à three reference targets are required to cope with the tight schedule of commissioning Sentinel-1.

The paper will described the strategy and the in-orbit calibration plan of performing all calibration procedures required in an efficient way. The described external calibration scenario is a first assessment to demonstrate the capability to perform the different calibration procedures within the tight commissioning phase.