Sentinel-3 Transponder Calibration Results

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ABSTRACT

Sentinel-3 is the Earth observation satellite mission designed to ensure the long-term collection and operational delivery of high-quality measurements of, among others, the sea surface topography. Post-launch calibration and validation of the satellite measurements is a prerequisite to achieve the desired level of accuracy and ensure the return of the investment.

Three Calibration/Validation (Cal/Val) services are provided by independent, external Cal/Val facilities that determine the error in satellite measurements, using known and controlled signals of the ground. The Sentinel-3 altimeter calibration site was established in Crete, Greece. This site has been named 52°W Cal/Val site and is located at an elevation of 150m in the western mountains of Crete.

The transponder is used to calibrate SRAL’s range and datation to meet the mission requirements. For this calibration, the 0-3 L1A data is processed with a specialised transponder processor: Atmospheric delays are acquired directly from the calibration site, providing better accuracy to the final range measurement. Ideally, the comparison between the theoretical values provided by the well-known target and the measurement by the instrument to be calibrated provides us with the error that the instrument is introducing when performing its measurement. When this error can be assumed to be constant regardless the conditions, it will provide the bias of the instrument. If the measurements can be repeated over a certain period of time, it can also provide an indication of the instrument drift.

This poster presents the range and datation results using the Crete transponder for the first 20 cycles. This work is been carried out within the Sentinel-3 Mission Performance Center activity 3MPC.

DATA

Sentinel-3 uses SRAL (Sentinel-3 Ku/C Radar Altimeter), which is capable of both LRM (Low Resolution Mode) and SAR (Synthetic Aperture Radar) modes of operation.

THE CRETE SITE

The Crete transponder was developed by the Technical University of Crete in 2011.

The Crete transponder is being cleared, with GNSS receiver, solar panels and wind generators.

THE METHODOLOGY

The SRAL waveform, which is received by the transponder, is processed and compared with the theoretical one of each cycle using a specialised processor (SRP) to deal with atmospheric delays and to produce the range and datation measurements.

RESULTS

The range bias is generally very low, with a mean of only 8.19 mm, and a maximum of just under 3 cm. There is an increase per year of 1.42 mm, but with a low fitting coefficient (R²), so this has not been considered strongly.

CONCLUSIONS

- Mean Range bias is 8.19 mm with 12 mm of noise between measurements.
- Mean Datation bias is -158 ms with 31 ms of noise between measurements.
- Stack range noise lower than 1 mm (7.5 mm with CryoSat-2 over Svalbard TRP).
- The datation bias is causing a stack misalignment of 0.09 mm/beam.
- The effect of this misalignment is an increase of the width (22 mm wider) of the L1B waveform and probably a very little overestimation of the SWH in L2.

Mean

<table>
<thead>
<tr>
<th>Range bias [mm]</th>
<th>Aligned [mm/beam]</th>
<th>Datation bias [µs]</th>
<th>Noise [µs]</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.19</td>
<td>-158</td>
<td>-0.15</td>
<td>0.09</td>
</tr>
<tr>
<td>12.24</td>
<td>0.02</td>
<td>39.66</td>
<td>0.23</td>
</tr>
</tbody>
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