Regional CALVAL method in Corsica: Calibration of the Jason-2 and Envisat missions on non-dedicated sites

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CONTEXT

In situ calibration allows insuring regular and long-term control of altimeter sea surface height (SSH) time series with independent records. Usually, *in situ* calibration of altimeter SSH is done at the vertical of a specific CALVAL site by direct comparison of the altimeter data with the *in situ* data. In the framework of CNES and ESA oceanographic projects, the OCA established the Senetosa and Ajaccio calibration sites in Corsica, respectively in 1998 and 2005. The **Senetosa site is dedicated to** the absolute calibration of the **Topex/Jason nominal orbits**, whereas the **Ajaccio site was used for the Envisat mission** up to its orbit change in October 2010.

At the same time, NOVELTIS developed a **regional CALVAL technique**, which aimed at increasing the number and the repeatability of the altimeter bias assessments by determining the altimeter bias both on overflying passes and on satellite passes located far away from the calibration site. The strong interest of this principle is to extend the single site approach to a wider regional scale. It is also a mean to keep on calibrating a mission when good-quality *in situ* data happen to be missing at its dedicated calibration site. In order to evaluate the stability and generality of the method, an **exercise of cross-calibration** was carried out where the biases of both **Envisat and Jason-2 missions were quantified at the two Corsican calibration sites.**

METHOD

Regional CALVAL method: combining absolute and offshore CALVAL

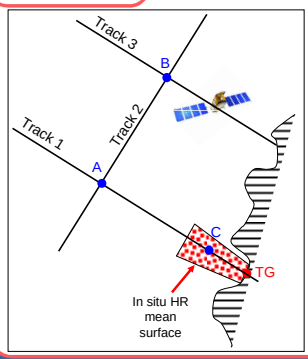


Figure 1: Diagram of the regional CALVAL method

Absolute CALVAL: Direct comparison between the altimeter SSH and the tide gauge measurements (point C on *Figure1*).

→Only for satellite passes flying over the calibration sites.

→Comparable to the bias estimations in Harvest, Bass Strait, Gavdos

Offshore CALVAL: Computation of the bias on off-shore passes, at crossover points:

→Following a succession of accurate mean sea surface profiles, combining several missions

→Using a high resolution mean surface to link the *in situ* and altimetry SSH measurements

Generic method: Estimation of the bias for Jason-1 (nominal and interleaved orbits), Jason-2 and Envisat

Possible ways of improvement:

→Good-quality SSH data (altimetry / *in situ*)

→Accurate mean sea surface profiles

→High resolution *in situ* mean surface

→Ocean dynamics corrections: tide and atmospheric effects between the offshore passes and the coast

$$bias_{alti,tr3}(t) = (SSH^{alti}_{B,tr3}(t) - dyn_{B,tr3}) - (SSH^{gauge}_{TG,tr1}(t) - dyn_{TG,tr1}) + (\overline{SSH}^{insitu}_{TG,tr1} - \overline{SSH}^{insitu}_{C,tr1}) + (\overline{SSH}^{alti}_{C,tr1} - \overline{SSH}^{alti}_{A,tr1}) + (\overline{SSH}^{alti}_{A,tr2} - \overline{SSH}^{alti}_{B,tr2})$$

RESULTS

Tide gauge datasets

Senetosa:

• 4 tide gauges (2 couples of twin instruments), since 1998

➔Redundancy to avoid gaps in the bias series

Ajaccio:

• 1 tide gauge (Sept. 2000 to Feb. 2011)

• 1.5-year of bad quality data (March 2008 to September 2009)

➔ No absolute CALVAL for Envisat from cycles 66 to 82

For both sites:

• DAC: regional TUGO simulation

• Tide:

→harmonic analysis in Senetosa

→FES2004 in Ajaccio (big hole in the data)

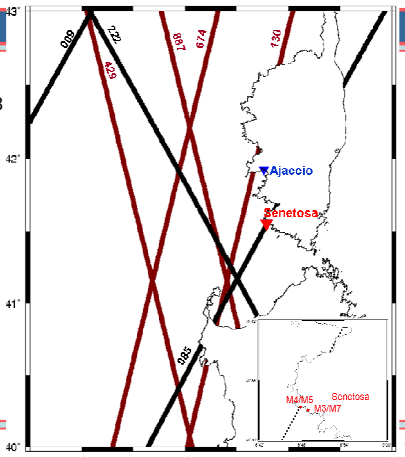


Figure 3: Configuration of the Corsican calibration sites. Envisat ground-tracks in brown, Jason-2 ground-tracks in black.

Altimetry datasets

Envisat mission

• GDR-A, B & B with new POE products

• Cycles 10 to 93

Jason-2 mission

• GDR-C products

• Cycles 1 to 93

For both missions

• Wet troposphere: ECMWF model

• Dry troposphere: ECMWF model

• Ionosphere: GIM (available for the whole Envisat period)

• Solid, polar, and load tides, and SSB: models available in the products

• DAC: regional TUGO simulation (provided by the LEGOS)

• Tide: FES2004

Envisat in Corsica

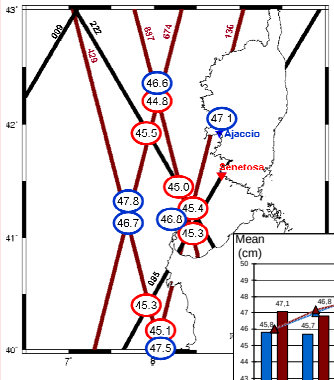


Figure 4: Envisat bias estimations (in cm) at both calibration sites (Ajaccio in blue and Senetosa in red), applying the ocean dynamics corrections.

For both sites and both missions

More homogeneous results when applying the ocean dynamics correction

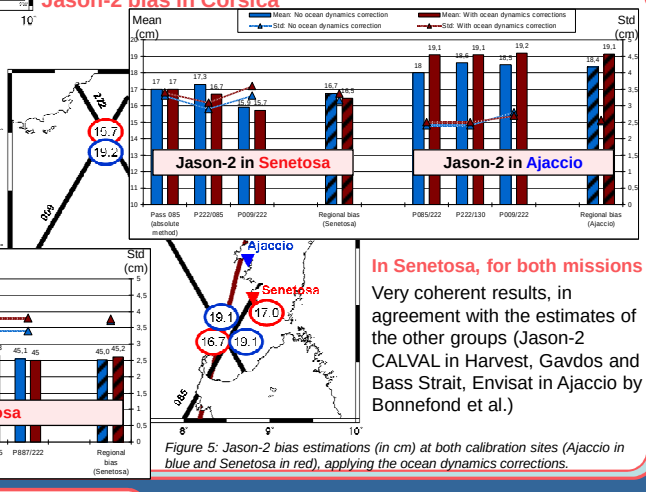
In Ajaccio, for both missions

Increase of about 1.5cm in the bias estimates when using the FES2004 tide correction (2cm when applying a harmonic analysis to the tide gauge timeseries, due to bad quality data)

➔ Still under investigation

Coherent results for Envisat on both sites without tide correction

Jason-2 bias in Corsica



In Senetosa, for both missions

Very coherent results, in agreement with the estimates of the other groups (Jason-2 CALVAL in Harvest, Gavdos and Bass Strait, Envisat in Ajaccio by Bonnefond et al.)

Figure 5: Jason-2 bias estimations (in cm) at both calibration sites (Ajaccio in blue and Senetosa in red), applying the ocean dynamics corrections.

CONCLUSIONS

The results of this study show a **high coherency between the two calibration sites, for both missions.**

The **few discrepancies** in Ajaccio (1.5-cm differences) are probably **partly due to the bad-quality *in situ* data**: large gap of 1.5 year, shifts and jumps in the SSH timeseries (still to be explained). ➔ **The accuracy and the precision of the altimeter bias estimates dramatically rely on the quality of the data (either satellite or *in situ*).**

This exercise demonstrates the **capacity of the regional CALVAL method** developed by NOVELTIS to **quantify any mission's bias, at any calibration site.**

Finally, by **multiplying the number of estimates,** this method **reduces the noise** in the mission bias quantification.

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PERSPECTIVES

Calibration of new orbits

The regional CALVAL method can be used to compute the bias of missions right after an orbit change (ex: Envisat since October 2010).

Calibration of non-repetitive orbits

It can as well be adapted to estimate the bias for missions on non-repetitive orbits (ex: Cryosat), at various calibration sites.

This efficient method should consequently be considered for the calibration of recent and future missions such as AltiKa, Cryosat, Sentinel-3, Jason-3, Jason-CS…

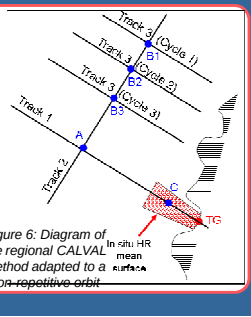

Figure 6: Diagram of the regional CALVAL method adapted to a non-repetitive orbit