Absolute and offshore *in situ* calibrations of Jason-2 in Senetosa: Sensitivity analysis of the altimeter bias to the Mean Sea Surface

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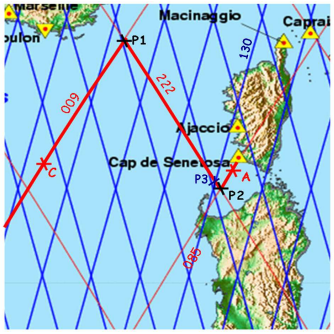
CONTEXT

The NOVELTIS absolute and regional CalVal methods consist in extrapolating the altimeter measurement from the observation point to the reference points situated on a very accurate catamaran surface in Senetosa (Corsica). For this purpose, the variation of the Mean Sea Surface (MSS) height profiles computed on the passes and between the crossover points for the regional method (*) must be taken into account.

For now, the Jason-2 altimeter biases have been estimated by using the MSS heights based on the Jason-2 measurements themselves, which were limited to 64 cycles at the time of this study, *i.e.* less than two years of data. As a consequence, there is a strong interest in considering other MSS retrieved from measurements over a longest period.

The main difficulty is based on the necessity to have the most accurate description of the MSS close to the Senetosa coast. Thus, sensitivity analyses have been performed on 3 reference MSS: CLS01, CNES/CLS10 and DNSC08. These analyses aim at giving a first view of the impact of these MSS on the bias computation and then, at providing a comparison with the catamaran surface, near the coast. The purpose of this study is to verify if these 3 MSS allow computing accurate Jason-2 altimeter biases at the Senetosa calibration site, in the Mediterranean area.



RESULTS

Analysis method: Sensitivity analyse of the JASON-2 altimeter bias to the Mean Sea Surface were carried out considering three MSS (CLS01 – CNES/CLS10 – DNSC08) and comparing the resulting biases with those obtained using mean SSH profiles along the passes.

Name of the MSS	CLS01	CNES / CLS10	DNSC08
Reference ellipsoid	TOPEX / POSEIDON	TOPEX / POSEIDON	TOPEX / POSEIDON
Geoid model used (over land and shoreline / coastal areas)	EGM96	EIGEN_GRACE_5C	EGM2008
Spatial resolution	2min (4km)	2min (4km)	1min (2km)
Altimetric dataset	TOPEX/POSEIDON - 7 years ERS - 5 years GEOSAT - 2 years	TOPEX/POSEIDON - 13 years ERS-2 - 8 years ERS-1 - 2 phases at 168 days GFO - 7 years ENVISAT - 7 years	TOPEX/POSEIDON - 12 years ERS-2 - 8 years JASON-1 - ENVISAT - ICESAT

Short Description of considered MSS

Jason-2 altimeter biases as a function of the MSS

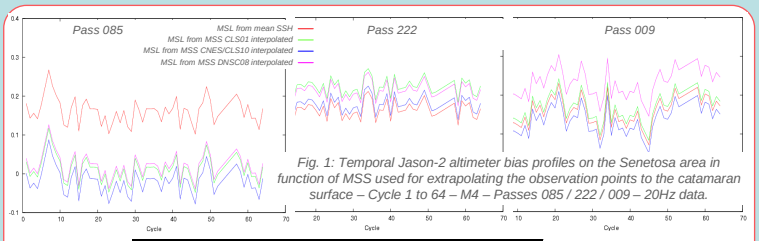


Fig. 1: Temporal Jason-2 altimeter bias profiles on the Senetosa area in function of MSS used for extrapolating the observation points to the catamaran surface – Cycle 1 to 64 – M4 – Passes 085 / 222 / 009 – 20Hz data.

Pass	Name of the MSS: Mean profile SSH	CLS01	DNSC08	CNES / CLS10
085	16.1	1.1	1.9	-1.9
222	16.4	22.3	21.4	17.8
009	15.0	16.2	22.4	12.9

Jason-2 mean bias (cm) computed on cycles 1 to 64, for the M4 tide-gauge

Whatever the MSS, strong inconsistencies in bias values in coastal area !

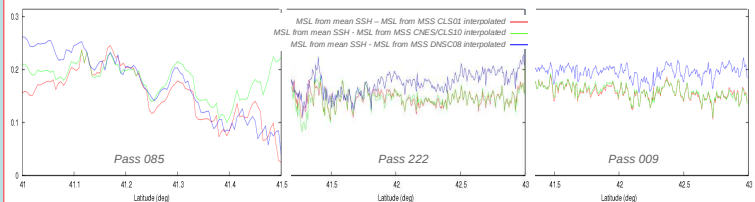


Fig. 2: Differences between the MSS obtained by averaging the Jason-2 Sea Surface Heights over 38 cycles and each of the three MSS considered (CLS01 – CNES/CLS10 – DNSC08) interpolated on the Mean Sea Level as a function of the latitude – Passes 085 / 222 / 009

➔ Low variability of the differences between the MSS for the passes 009 and 222
➔ Dispersion of the differences between the MSS in the coastal zone (pass 085):
- between 7 cm and 12 cm in the area considered for computing altimeter biases on the pass 085, *i.e.* [41.4°-41.5°];
- between 2 cm and 10 cm in the area required for computing altimeter biases corresponding to the pass 222, *i.e.* [41.1°-41.5°].

Hypotheses:
➔ Error caused by the interpolation/extrapolation performed between the MSS and the different geoïd models considered over the continents and in the shoreline areas
➔ Spatial resolution associated with each MSS: unsuitable for achieving *in situ* CalVal, in local areas.

Comparison of the MSS with the catamaran surface in Senetosa

Comparison of the 3 MSS with the highest spatial-resolution MSS available in the Senetosa coastal area: the catamaran surface

➔ catamaran GPS survey campaign carried out in 1998 by the OCA in order to obtain a precise MSS grid with a resolution of 5.10^{-4} degree, near the Senetosa site where the geoïd slope may reach about 6 cm/km.

➔ This MSS is considered as the reference MSS and has been compared to the CLS01, CNES/CLS10 and DNSC08 MSS in order to quantify more precisely their precision and accuracy in this area.

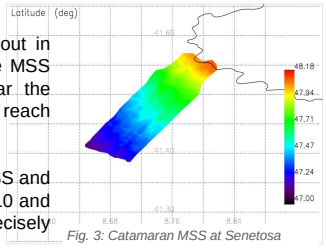


Fig. 3: Catamaran MSS at Senetosa

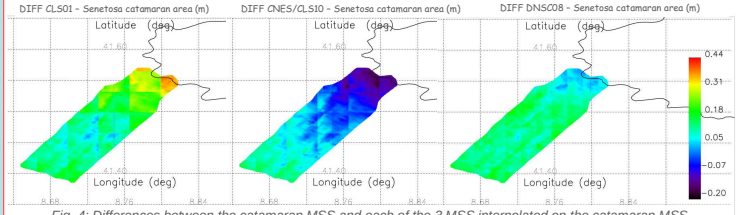
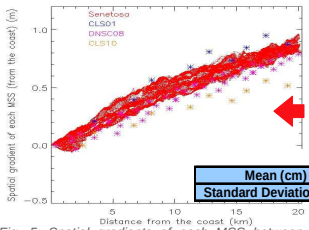


Fig. 4: Differences between the catamaran MSS and each of the 3 MSS interpolated on the catamaran MSS

	CLS01 - Senetosa	DNSC08 - Senetosa	CNES / CLS10 - Senetosa
Standard Deviation (cm)	6.2	3.1	7.0

Statistics on the differences between the MSS and the catamaran surface - comparison at the closest points -

Inhomogeneous differences along the MSS



Spatial "gradient" (m) = difference of MSS between a point on the coast and a point on the area of the analyzed MSS.

DNSC08 MSS : the most consistent with the catamaran surface in terms of spatial gradient

	CLS01 - Senetosa	DNSC08 - Senetosa	CLS10 - Senetosa
Mean (cm)	7.9	-8.5	-17.4
Standard Deviation (cm)	6.4	3.3	8.5

Statistics (Mean / standard deviation) on the differences of the spatial gradients between the 3 MSS and the catamaran surface – comparisons at the closest points.

Fig. 5: Spatial gradients of each MSS between the coast in function of the distance from the coast.

➔ For the 3 MSS, strong differences with the catamaran surface (even in terms of spatial gradient) ➔ These MSS should not be used in the Senetosa coastal area, for computing Jason-2 altimeter biases.

CONCLUSIONS

➔ **These sensitivity analyses of the JASON-2 altimeter bias to the MSS, considering three MSS (CLS01-CNES/CLS10-DNSC08) and comparing with the bias obtained through SSH mean profiles along the passes allow to conclude that these three MSS are not adapted for computing the biases in Senetosa. Indeed, they were developed at a global scale and the spatial resolution is not optimized for the *in situ* CalVal methods.**

➔ **Inconsistencies observed on the biases in the Senetosa coastal area have been confirmed by the comparisons of the MSS gradient with the catamaran gradient, the catamaran surface being the reference MSS in this area. These differences may be induced by the extrapolation/interpolation performed between the MSS and the geoïd model available on the continents.**

➔ **The comparison exercise performed here can be used in order to assess altimetric MSS in coastal areas, where precise and fine-scale MSS obtained by other means are available.**

REFERENCES

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- *F. Hernandez, P. Schaffer – The CLS01 Mean Sea Surface : a validation with the GSFC00.1 surface – December 2001*
- *MSS CNES/CLS10 description - Aviso website, 23/06/2010 – http://www.aviso.oceanobs.com/en/data/products/auxiliary-products/mss/mss-description/index.html*

(*) see poster NOVELTIS "Use of the Corsica site to compute altimeter biases for the missions ENVISAT, JASON-1 and JASON-2/OSTM"

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