X-track, a new processing tool for altimetry in coastal areas

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ABSTRACT:

Oceanographic applications using satellite altimeter data become very challenging when leaving the deep ocean for the coastal regions. Close to the coast, altimeter observations are often of lower quality for a number of reasons, including land contamination of the satellite footprints or inaccurate resolution of the corrections of the high frequency ocean response to tidal and atmospheric loading. This poster presents a new processing toolbox, called x-track, to derive improved altimeter products, such as SSH, MSS or SLA, dedicated for coastal applications. Starting from classical GDR products, particular attention is made to recover a maximum amount of exploitable data (dedicated data editing, interpolation of missing corrective terms). Where possible, local modelling of the high frequency response of the ocean to the tidal and atmospheric loading is applied instead of standard, global corrections given in the GDRs. In addition, orbit errors are reduced by a stability criterion and a high resolution mean sea surface consistent with the altimeter data set is computed along the satellite ground track. Finally, x-track produces altimeter SLA time series collocated onto mean tracks dedicated for coastal applications.
This poster presents preliminary results when using x-track to determine the Jason-1 SSH bias at Senetosa calval site.

X-track processor description:

The new processing presented hereinafter was originally developed within the framework of the ALBICOCCA (Altimeter-Based Investigations in Corsica, Capraia and Contiguous Areas) Project in the Northern Western Mediterranean Sea. Additional developments were made within the MAP context and lead to the **x-track** processor.

The objective is to improve both the quantity and quality of altimeter sea surface measurements in coastal regions, mainly by redefining the data editing strategy to minimize the loss of data during the correction phase and by using improved local modelling of tidal and short-period atmospheric forcing.

In the frame of coastal altimetry applications, an highly accurate mean sea surface is needed and there are no prior guaranty that the horizontal resolution of the global MSS sets are adequate, especially in the case of along-shore circulation studies. First, coastal circulation and bottom topography can be responsible for centimetric MSS variability on very short wavelength. Also, the mean sea surface depends on the data set used to derived it in terms of editing, applied geophysical corrections and time window. Thus **x-track** processor computes an along track MSS consistent with the altimeter data set on a regular grid following the satellite ground track.

Although the GRACE mission greatly improved the gravity field estimates and consequently the quality of the orbit ephemerises, it can remain geographically correlated errors in the orbit solutions. **X-track** processor reduces the effects of these orbit errors by monitoring the basin level variations cycle after cycle.

x-track processor main products are along track sea level anomalie, along track mean sea surface and sea level anomalies on mean tracks. These products are available at both 1Hz and high rate (10/20 Hz) for the TOPEX/Poseidon, Jason-1, Geosat-Follow-On and Envisat altimetric missions.

fig. 1: snapshot of the computation of an along track anomaly product with the **x-track** processor

Material:

- **x-track** processor SSH 1 Hz products
- Jason-1 passes 222 and 085 (Fig. 2)
- cycles 1 to 135, corresponding to GDRa products
- Senetosa M3 tide gauge records

Tidal correction: optimal regional spectrum, mainly based on Mog2D/T-UGO 2D Mediterrean Sea model

- Atmospheric forcing correction from Mog2D/T-UGO 2D Mediterrean Sea model simulations

Study area:

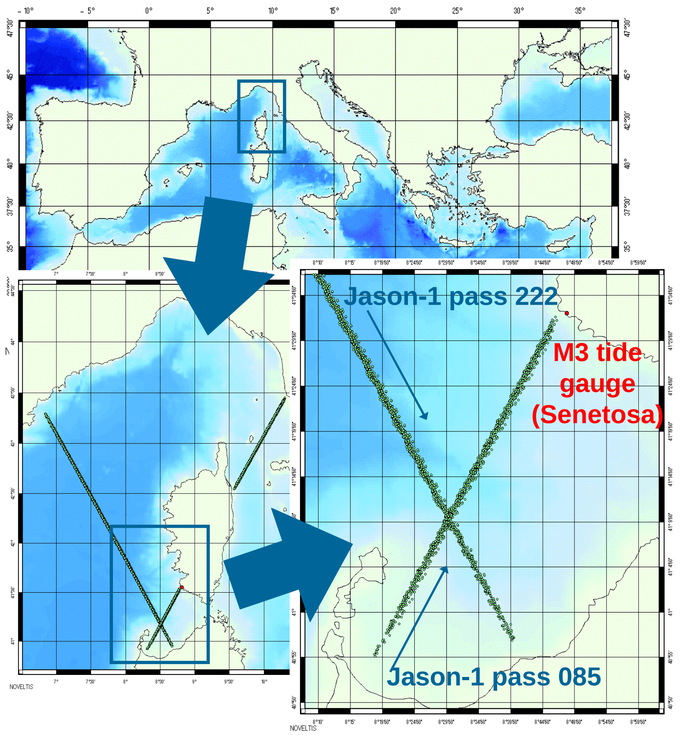

Fig.2: Jason-1 data available for passes 085 and 222 in the x-track SSH product for cycles 1 to 135

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Objectives:

- Validate **x-track** processor SSH 1Hz products for calibration/validation studies
- Test the sensitivity of the computation of the SSH absolute bias to the tides and ocean response to atmospheric forcing correction

Results:

Starting from x-track SSH products for Jason-1 passes 085 and 222, the Jason-1 SSH absolute bias at the M3 tide gauge is estimated following the CalVal method described by Jan et al (*Offshore Absolute Calibration of Space-Borne Radar Altimeters*, Marine Geodesy, 2004). Figures 3 and 4 illustrate the SSH absolute bias obtained for cycles 1 to 135. For Jason-1 pass 085, the SSH absolute bias is 10.46 +/-2.52 cm when using x-track processor SSH 1Hz products. This estimates is very close to the absolute SSH bias given by the CalVal teams for the same period (10.19 +/- 2.68cm). When using Jason-1 pass 222 data, the Jason-1 SSH absolute bias is 11.44 +/- 2.63 cm but it is computed only over 27 exploitable cycles. For the same period, the Jason-1 SSH absolute bias given by the CalVal teams is 10.33 +/- 3.71 cm.

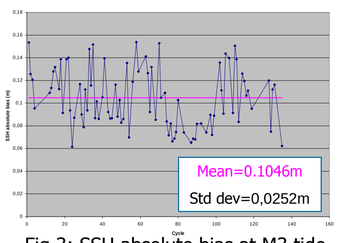

Fig.3: SSH absolute bias at M3 tide gauge, Jason-1 pass 085 (86 exploitable cycles).

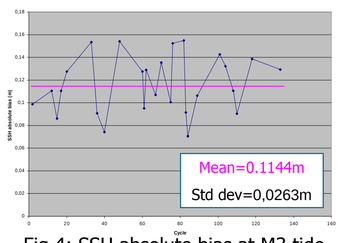

Fig.4: SSH absolute bias at M3 tide gauge, Jason-1 pass 222 (27 exploitable cycles).

Sensitivity test case: use of regional modelling for tides and ocean response to atmospheric forcing correction

In this experiment, both altimeter and in situ data are corrected of tidal and atmospheric loading effects using a regional modelling based on Mog2D/T-UGO 2D Mediterranean model. When correcting the differential dynamical effects between the altimeter last measurement and the tide gauge, the Jason-1 SSH absolute bias computed on pass 085 drops from 11.05 cm to 11.00 cm whereas its standard deviations increases from 2.42 cm to 2.81 cm (Fig.5). In this configuration where the altimeter point of closest approach and the tide gauge are close, there is no significant improvement to use the Mog2D/T-UGO model to correct sea level dynamics effects in the absolute bias computation.

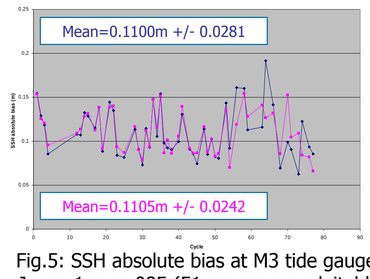

Fig.5: SSH absolute bias at M3 tide gauge, Jason-1 pass 085 (51 common exploitable cycles). Pink curve: no correction; blue curve: tides and ocean response to atmospheric forcing corrected

Conclusions and perspectives:

These preliminary results demonstrate the potential use of **x-track** processor SSH 1Hz products to estimate the SSH absolute bias of Jason-1 satellite. Ongoing tests have to be performed, among other:

- Test the sensitivity to the geoid slope between the altimeter last measurement and the tide gauge location by the use of the **x-track** processor MSS product
- Compute the Jason-1 SSH absolute bias at Macinaggio and Capraia CalVal sites and extend the absolute bias estimation to Envisat/RA2, GFO and TOPEX/Poseidon

Scientific applications: Vignudelli et al (2005), Durand et al (sumbitted), GOCEAN project (ESA), ALTICORE project (INTAS), INSEA project (EU)