COMAPI: A NEW GLOBAL LOW FREQUENCY DYNAMICAL ATMOSPHERIC CORRECTION

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CONTEXT

In the context of a study supported by CNES, NOVELTIS has explored a new global low frequency dynamical atmospheric correction (DAC). The low frequency part of the DAC (for periods greater than 20 days) is generally computed using the inverted barometer formula. Though, this method is not always adapted to eliminate the low frequency variability of the sea surface height induced by the atmospheric pressure variations, in particular in confined or semi-enclosed basins.

A new global low frequency DAC was computed in the frame of the COMAPI project (Coastal Modelling for Altimetry Product Improvement), using the TUGOm-2D model (Toulouse Unstructured Grid Ocean model 2D) in an only-pressure run configuration. Four areas of study were chosen in order to estimate this new correction impact in the altimetry sea level anomalies (SLA): the Mediterranean Sea, the Black Sea, the Red Sea and the Baltic Sea. The results of the study show a large improvement in the variance reduction of the sea surface signal in very enclosed areas.

METHODOLOGY

Classical method: The inverted barometer formula

$$sla_1 = sla_{detided} - \left(DAC_{HF(tugo)} + DAC_{LF(IB)}\right)$$

Where:

$DAC_{HF(tugo)}$ is the low-frequency filtered (periods < 20 days) TUGO global simulation (pressure and wind)

$DAC_{LF(IB)}$ is the inverted barometer correction (periods > 20 days)

→ ***The high frequency variations of the sea surface height, due to the pressure and the wind effects, are thus isolated.***

NOVELTIS method for confined or semi-enclosed basins

$$sla_2 = sla_{detided} - \left(DAC_{HF(tugo)} + DAC_{LF(tugo(p))}\right)$$

Where:

$DAC_{LF(tugo(p))}$ is the low frequency component (periods > 20 days) of the global simulation (forced only with pressure)

→ ***The low frequency variations of the sea surface height, due to the pressure alone, are isolated.***

RESULTS

Validation method: To estimate the impact of the new DAC on the altimetry SLA, a comparison was made between two Jason-1 SLA datasets corrected respectively with a DAC computed using each of the methods. The evaluation of the temporal variance reduction at each observation point gave a picture of the new DAC impacts.

The altimetry dataset was provided by the CTOH and generated using the X-TRACK software (Roblou *et al.*, 2007), which allows recovering altimetry data in the marginal and coastal zones where they are systematically eliminated by classical processing chains.

MEDITERRANEAN SEA AND BLACK SEA

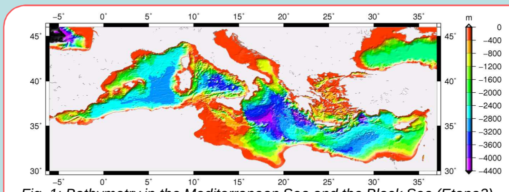


Fig. 1: Bathymetry in the Mediterranean Sea and the Black Sea (Etopo2).

The Mediterranean Sea is a wide enclosed basin, whereas the Black Sea is a small basin, which only communicates with the Mediterranean Sea through the narrow and shallow Bosphorus Strait.

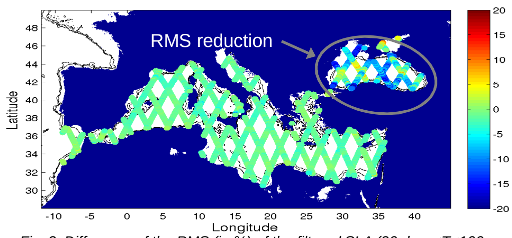


Fig. 2: Difference of the RMS (in %) of the filtered SLA (20 days<T<100 days) Jason-1, cycles 1 to 213 – TUGO Low Freq - IB

Due to the seasonal signal, predominant in both regions, the altimetry datasets have been filtered in order to retrieve the periods between 20 days and 100 days, where the impact of the low frequency DAC is the most significant.

Zone	Total signal	Filtered signal (20d<T<100d)
Mediterranean Sea	**-0.9mm**	**-0.5mm**
Black Sea	**3.5mm**	**-2.4mm**

Table 1: Mean difference of the SLA RMS in both regions.

→ **No significant improvement in the Mediterranean Sea: TUGO Low Freq is equivalent to the inverted barometer in this wide basin.**

→ **Large reduction of the SLA variability in the Black Sea for periods < 100d with the TUGO Low Freq DAC. Less energetic than the IB DAC for periods > 100d**

➔ **Erroneous modelling of the very low freq. exchanges through the Bosphorus strait probably due to the bathymetry used in the model (strait not deep enough)**

BALTIC SEA

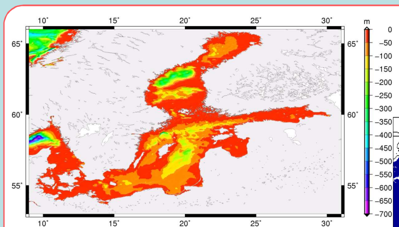


Fig. 3: Bathymetry in the Baltic Sea (Etopo2).

The Baltic Sea is a shallow region opened on the North Sea through very narrow straits.

Zone	Total zone	Without the Eastern part
Baltic Sea	**-5.4mm**	**-5.6mm**

Table 2: Mean difference of the SLA RMS.

→**Significant reduction of the SLA RMS when using the TUGO Low Freq. DAC (up to 20mm, ie 10% of the signal).**

→**Even if the SLA variability increases in the Eastern part of the Baltic Sea, the difference of RMS is not representative as a lot of altimetry data is missing in that very shallow and narrow area.**

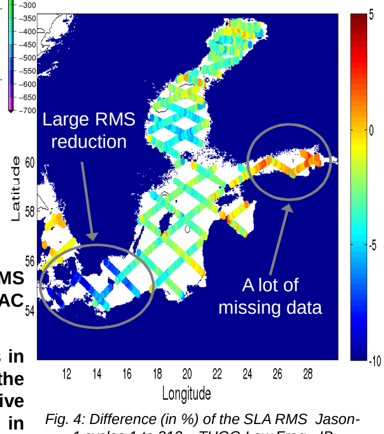
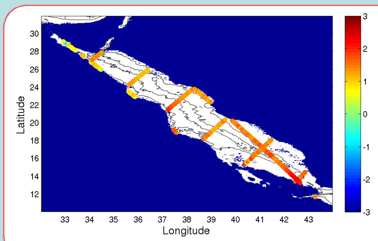


Fig. 4: Difference (in %) of the SLA RMS Jason-1 cycles 1 to 213 – TUGO Low Freq - IB

RED SEA



The Red Sea is a narrow and long semi-enclosed basin opening on the Aden Gulf through the Bab El Mandeb strait.

The two low frequency DAC are equivalent in this region for periods <200 days, with differences around 1mm (2% of the signal). This is not significant when considering altimetry data. The strait is probably not very restrictive for the dynamical adjustments.

Fig. 5: Difference (in %) of the filtered SLA (<200d) RMS – Jason-1 cycles 1 to 213 – TUGO Low Freq - IB

CONCLUSIONS:

- **In large basins or regions where the dynamical adjustments are not restricted by straits, the TUGO low freq. DAC is equivalent to the inverted barometer DAC.**
- **In confined areas, the TUGO low freq. DAC significantly reduces the SLA variability, more particularly for periods between 20 days and 100 days.**

REFERENCES

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