Confidence envelop of the Global MSL time-series deduced from Jason-1 and Jason-2 altimetric missions.

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Overview

With satellite altimetry missions (TOPEX/Poseidon, Jason-1, Jason-2) , the Global Mean Sea Level (GMSL) has been calculated on a continual basis since January 1993.

Knowledge of the errors impacting MSL calculation is needed in order to respond to users' requirements, see Tab 1.

→ Releasing a confidence envelop is an adequate means to monitor errors in time. It also provides a complementary approach to estimate the error budget of GMSL rate, see Ablain et al, 2009 and 2012.

Spatial Scales	Temporal Scales	User Requirements	Altimetry errors
Global Mean Sea Level (10-day averaging)	Long-term evolution (> 10 years)	0.3 mm/yr	< 0.5 mm/yr
	Inter annual signals (< 5 years)	0.5 mm over 1 year	< 2 mm over 1 year
	Periodic signals (Annual, 60-days,…)	Not defined	Annual < 1 mm 60-day < 5 mm

Tab 1: User Requirements (URs) (GCOS, 2011) with respect to temporal scales (nb: altimeters scientific goals have lower requirements than URs)

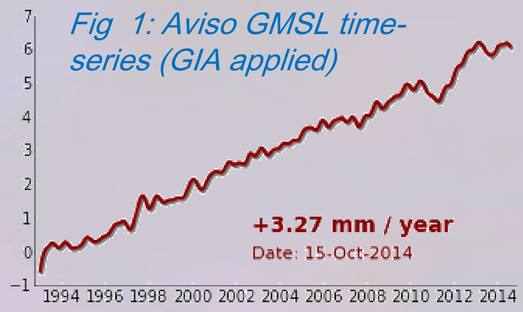


Fig 1: Aviso GMSL time-series (GIA applied)

Objectives

1. Compute Global Mean Sea Level (GMSL) confidence envelops meeting users' needs
2. Interpret the confidence envelops

Methodology

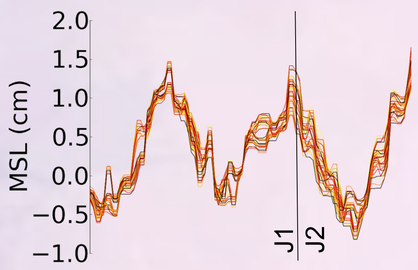
Approach: Generate a set of GMSL time-series that a priori have equivalent qualities by tuning identified parameters.

→ Choices made to design the GMSL set requires exhaustive preliminary studies.

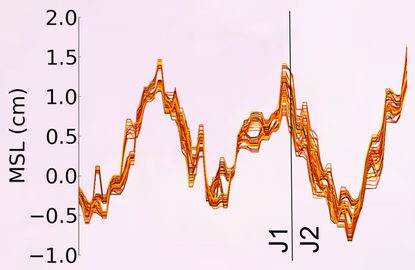
→ Dispersion of time-series will draw confidence envelops which will need to be adapted according to analyses' objectives.

Standards + Data Selection + Average Mesh grids + Missions Linking → Set of GMSL time-series with a priori equivalent accuracies

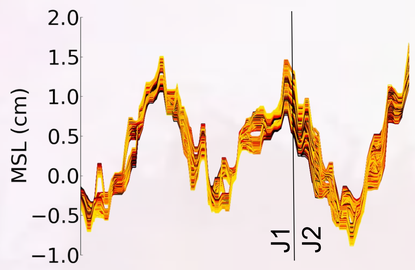
More than 18000 times-series are produced to allow a significant statistical approach



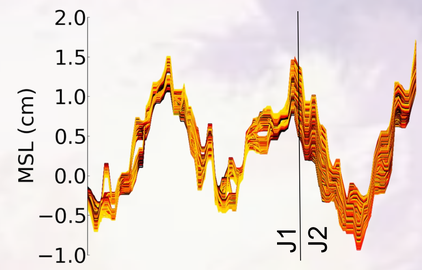
Generation of a set of GMSL time-series by choosing several combinations of standards that have equivalent qualities.:
→ MSS (CNES/CLS, DTU), Tidal models, etc…



Selection of near-coast measurements is a cause for uncertainty:
→ data is selected in 3 different ways (bathymetry > 0, 100 or 200 m)



Several mesh grids with a priori the same relevance are used in the set to compute the average grid at each cycle:
→ 1°x3°, 1.5x3°, 1x3.5°, etc …



Choice of the central cycle and the width of the window used to compute the inter-mission linking bias during « verification phases » is subjective.
These 2 parameters take several values in the set.

Confidence Envelop use cases

Instantaneous uncertainty

• The approach allows the computation of an instantaneous uncertainty envelop, see Fig 2 and 3
•. Fig 3 is a detrended and centered view of Fig 2 in order to better analyze the dynamics of the confidence envelop.
• One may notice the error remains relatively stable over time. It rises mainly during strong *La Niña* or *El Niño* episodes (e.g. 2011, 2013). Our first analyses attribute it to the Wet Troposphere Correction sensitivity (Legeais et al., 2014) and the choices in computation methodology (Henry et al., 2014)

Comparison between Global MSL time-series

• Deducing the long-term error from the instantaneous uncertainty requires: the propagation in time of systematic errors (e.g. linking errors) and setting a common same reference for each time-series (e.g. averaged at 0 over 2002).
• The resulting envelop allows to verify Colorado University and Aviso products both stay within the confidence interval, see Fig 4.

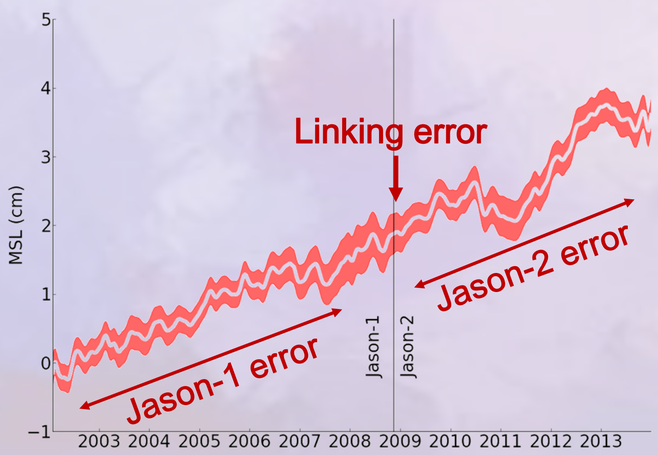


Fig 2: GMSL confidence envelop over Jason-1 and Jason-2 missions. Annual, semi-annual signals have been removed, GIA is applied.

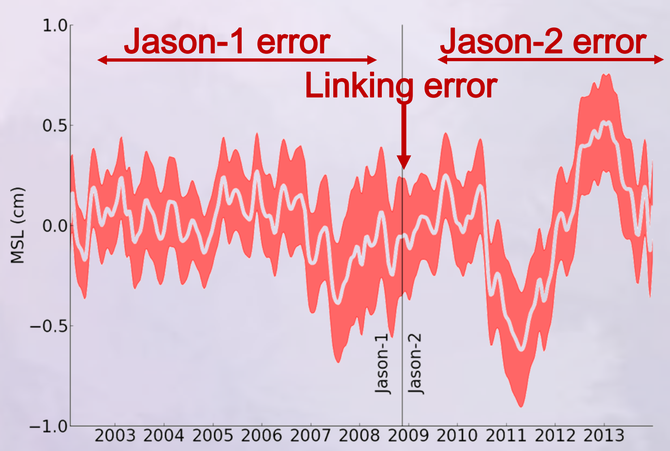


Fig 3: GMSL confidence envelop over Jason-1 and Jason-2 missions. Annual, semi-annual signals and the trend have been removed..

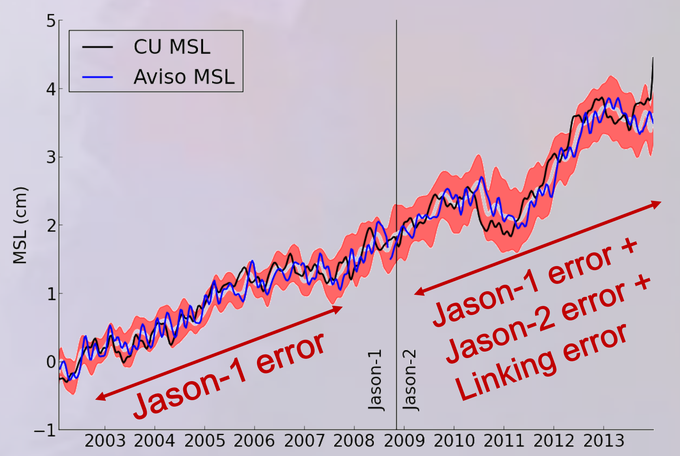


Fig 4: Comparison between GMSL time-series products (Colorado University and Aviso). GMSL confidence envelop with accumulation of uncertainties, Annual and semi-annual signals have been removed, GIA is applied.

Conclusions & Outlooks

→ GMSL confidence envelops permit a complementary approach to estimate altimetry errors in agreement with former studies,
→ they have been requested by users involved in MSL closer budget studies (combining mass and steric components),
→ they could be specifically designed according to other users' needs : therefore **users feedbacks are essential**,
→ they could be refined by taking into account altimeter instrumental instabilities (neglected here), and extended to other missions (T/P, Envisat, ERS, ….).