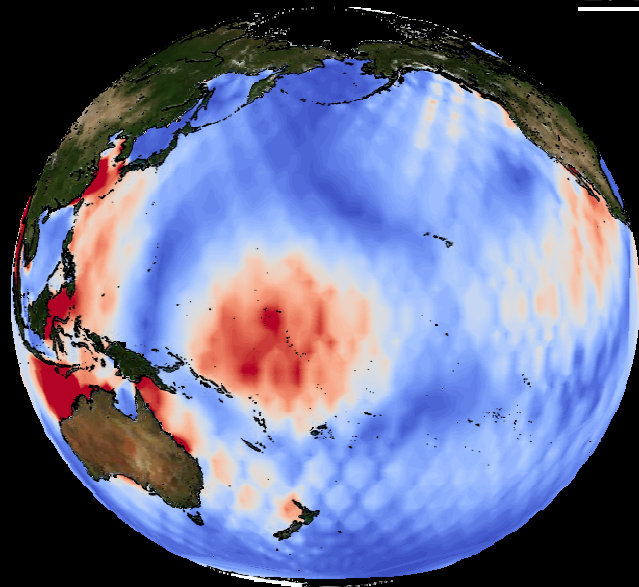# Reduction of the 58.77-day Signal in the Mean Sea Level derived from TOPEX/Poseidon, Jason-1 and Jason-2 data with the latest FES and GOT ocean tide models

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Introduction

- Former studies (2010) highlighted a strong 58.77-day signal in Jason-1 & 2 Global Mean Sea Level (GMSL) time-series whereas it is smaller in TOPEX/Poseidon.
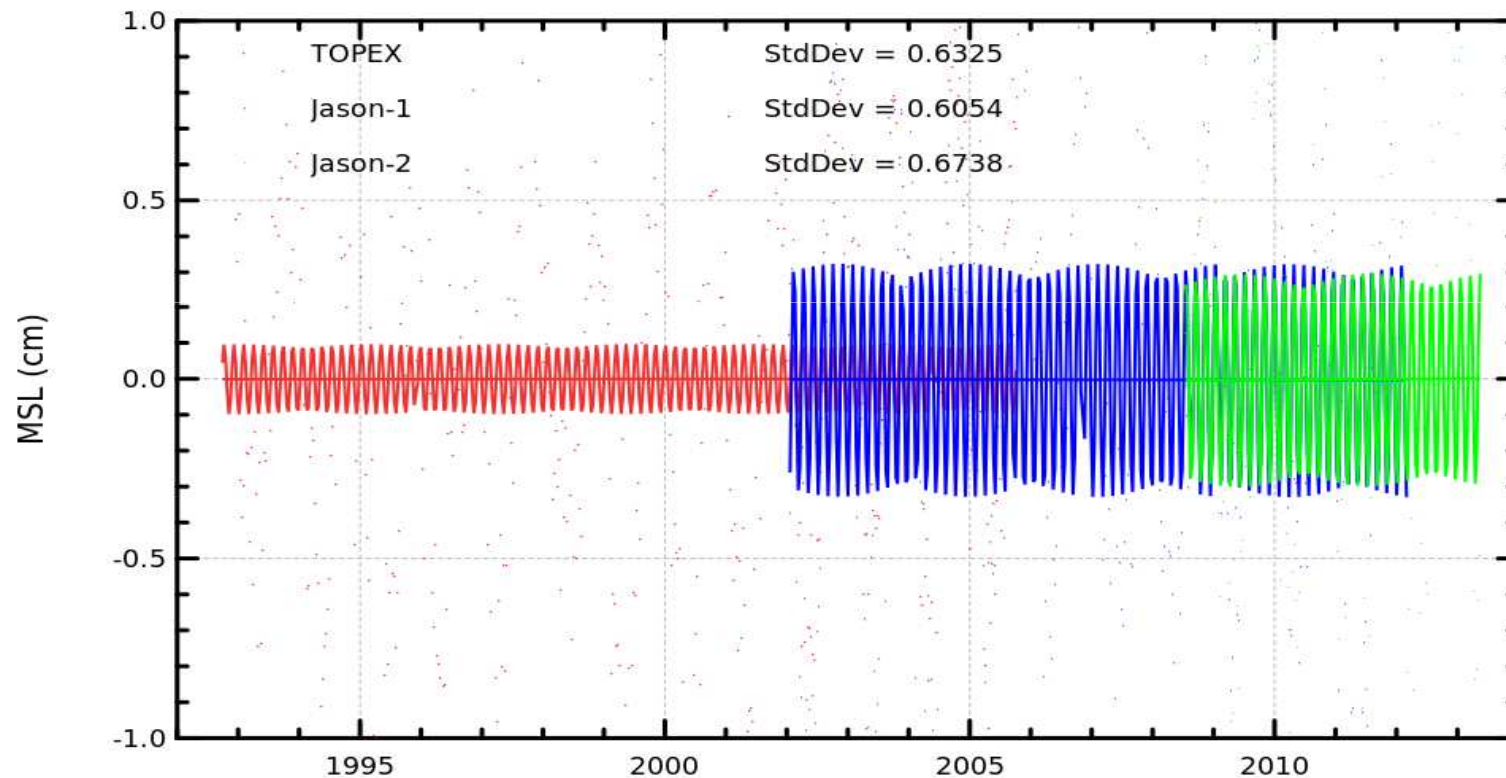
Fig. 1: Amplitude of 58.77-day signal in TOPEX, Jason-1 and Jason-2 GMSL series, extracted from Ablain et al., 2010 (OSTST oral)

Introduction

Conclusions of the dedicated OST/ST Session (Lisbon, 2010):

- The signal is an error, aliasing of a 0.5-day error with the TOPEX and Jason repetitivity (9.91 days)

- Using a pure hydrodynamic model, it has been shown that a TOPEX error has been assimilated in GOT (and to a lesser extent FES) S2-waves.

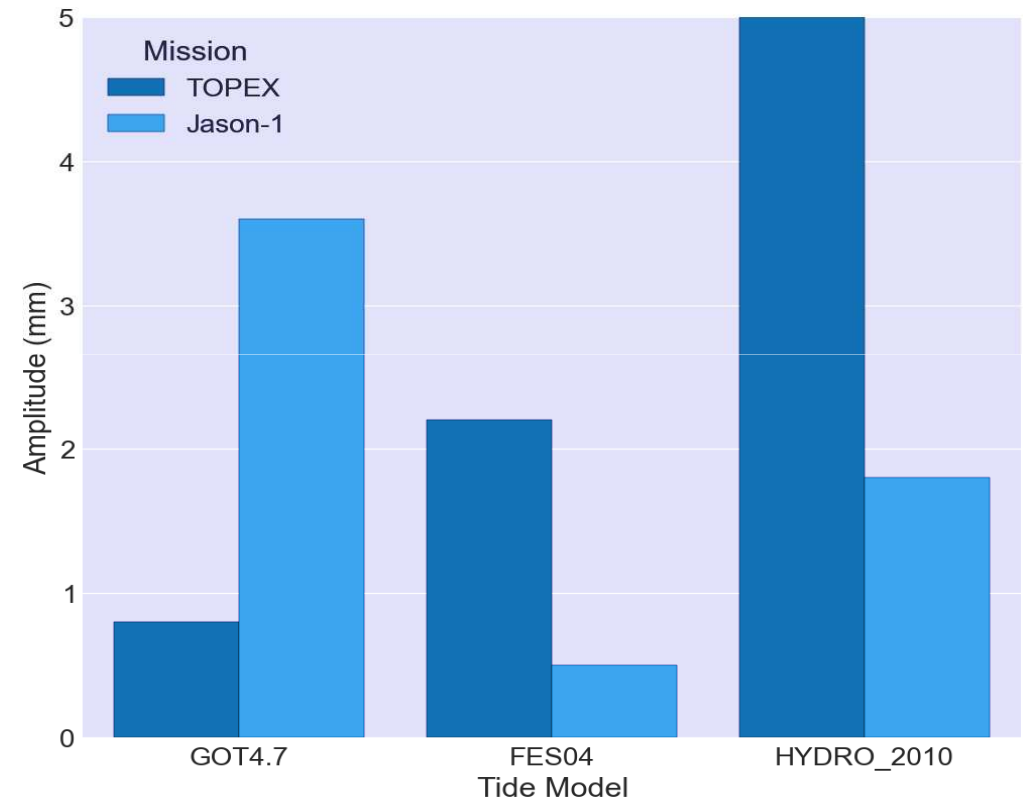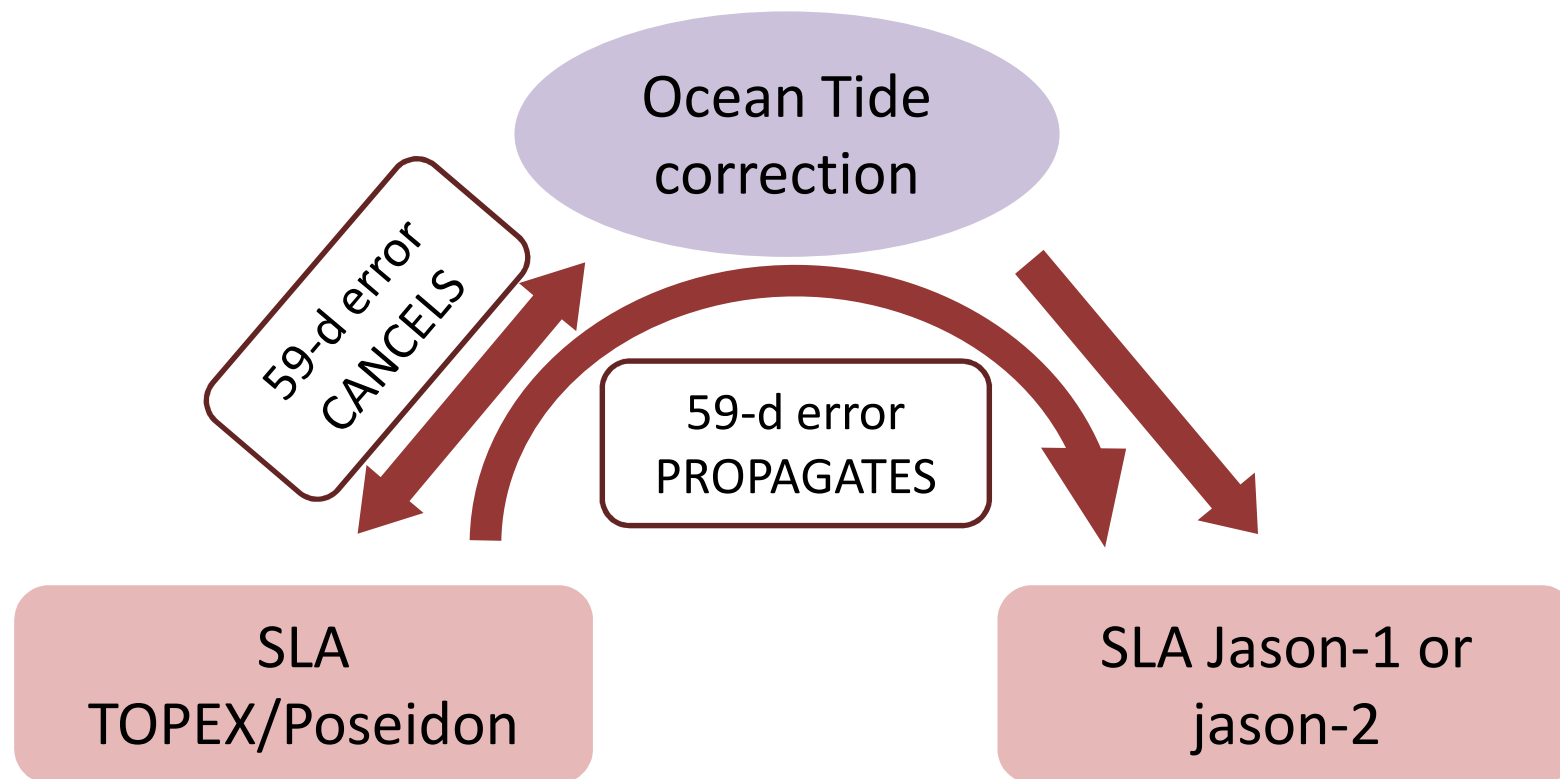(Average amplitude of S2 ocean tide ≈ 90 mm at global scale)

Fig. 2: Amplitude of 58.77-day signal in TOPEX and Jason-1 GMSL series, changing ocean tide correction. Amplitudes extracted from Ablain et al., 2010 (OSTST oral)

Introduction

Objectives

1. Quantify the reduction of this error with the latest GOT and FES tide corrections

2. Update 2010 analyses with FES2014 hydrodynamic solution

3. Extend 2010 results with regional analyses

Reduction of 58.77-day error...

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GOT4.7	- T/P measurements only for S2 wave. - No correction of the atmospheric tides S1/S2 in the dry troposphere correction used in the data.
GOT4.8	Same as GOT4.7, but includes a correction of the atmospheric tides S1/S2 in the dry troposphere correction.
GOT4.10	-Jason-1 and Jason-2 measurements only for S2-wave. - Dry troposphere correction is OK.

FES2004	-Hydrodynamic model -T/P measurements only (plus Tidal gauges) for S2 wave.
FES2012	-Hydrodynamic model updated -T/P (extended series), Jason-1 and Jason-2 measurements (no Tidal gauges) for S2 wave.
FES2014	-Hydrodynamic model updated -T/P, Jason-1 (extended series) and Jason-2 (extended series) measurements (plus Tidal gauges) for S2 wave.

Reduction of 58.77-day error…

- Comparison between GOT releases and FES releases at global scale.
- Average amplitude of S2 ocean tide ≈ 90 mm at global scale
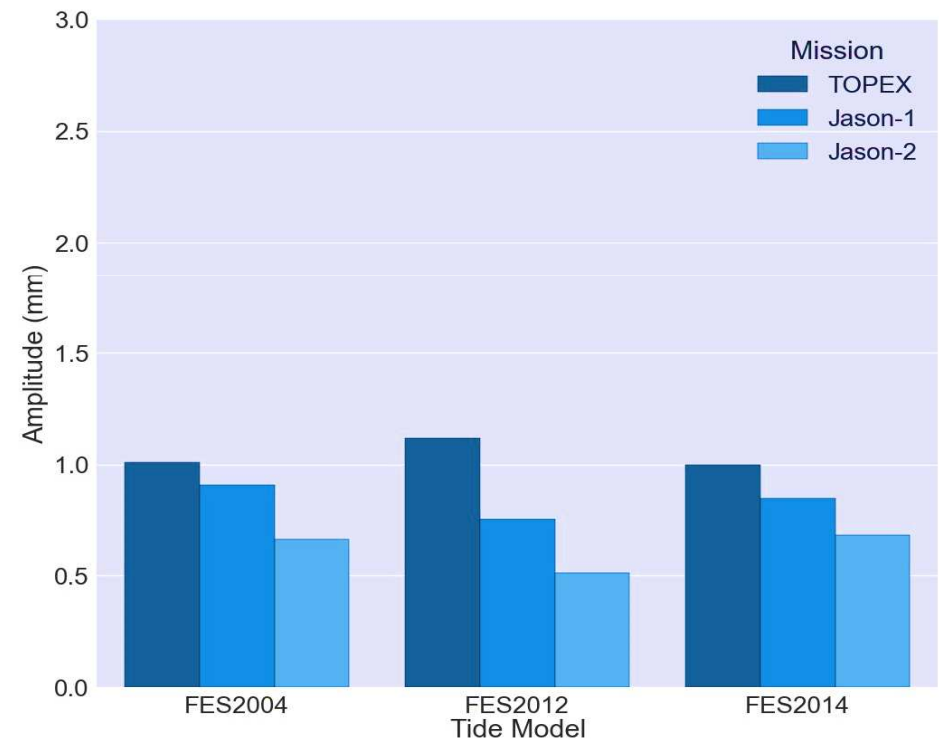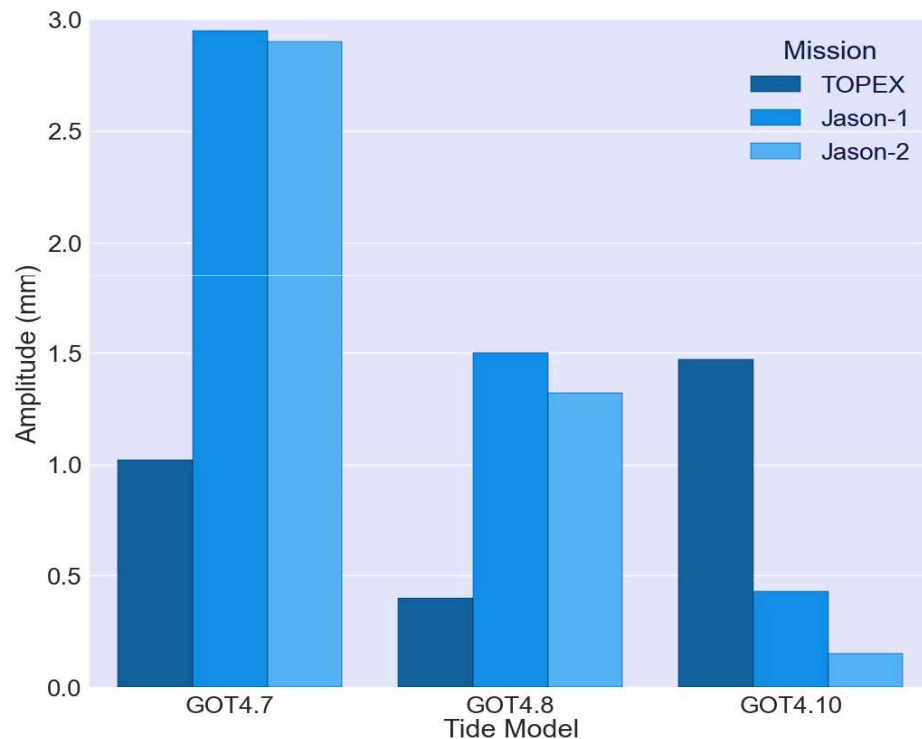- Comparison also performed at regional scale (not shown)

Fig. 4: Amplitude of 58.77-day signal in TOPEX, Jason-1, Jason-2 GMSL series, changing ocean tide correction. Selection on latitudes (<50°), bathymetry (>1000m) and oceanic variability (<20cm)

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Characterization using the hydrodynamic solution of FES2014 (not impacted by altimetry errors).
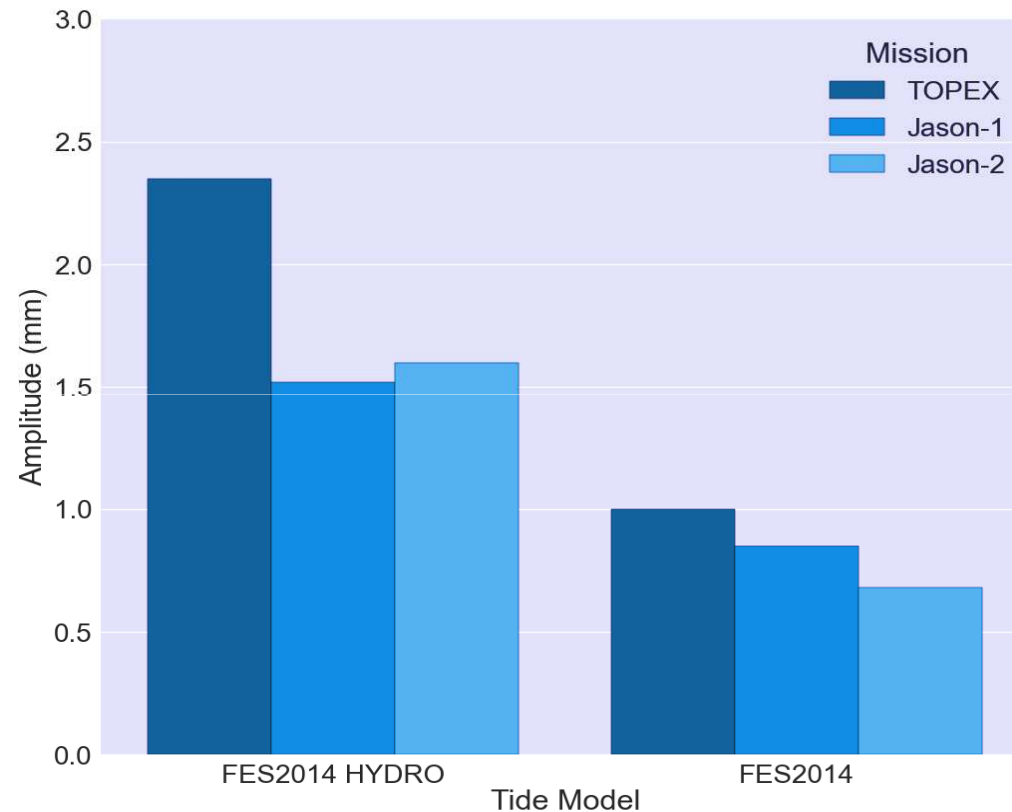

Fig. 5: Amplitude of 58.77-day signal in TOPEX, Jason-1, Jason-2 GMSL series, with FES2014_HYDRO (pure hydrodynamic ocean tide solution), an alternative solution of FES2014 and FES2014. Selection on latitudes (<50°), bathymetry (>1000m) and oceanic variability (<20cm)

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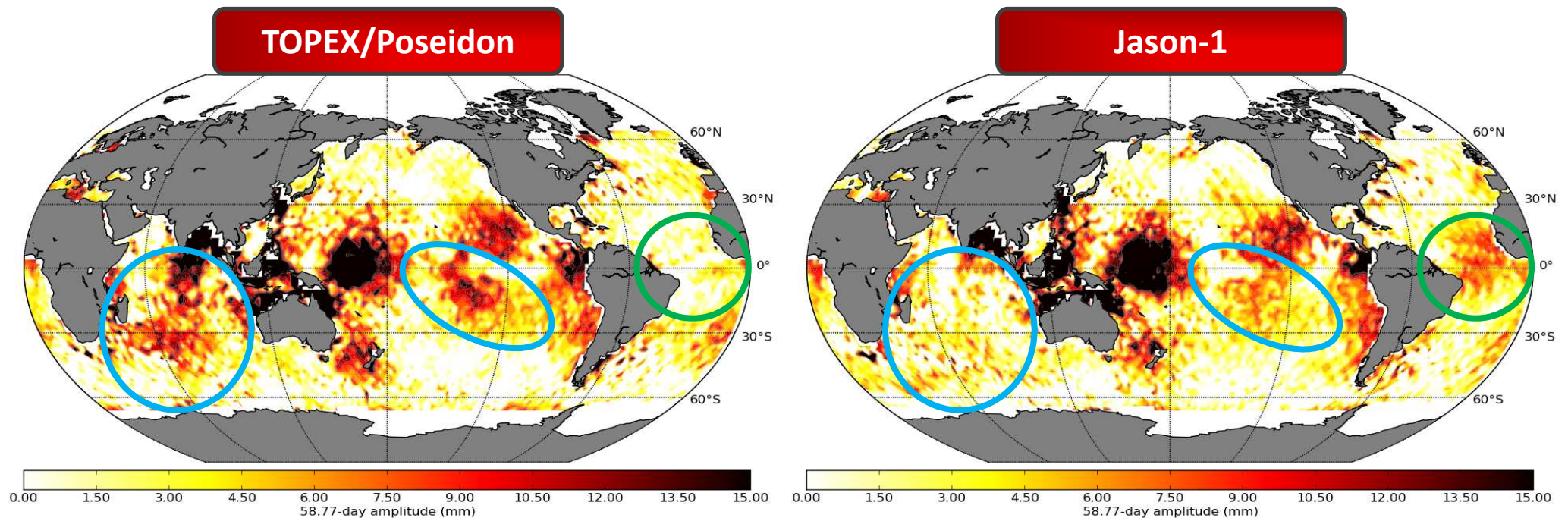Characterization using the hydrodynamic solution of FES2014 (not impacted by altimetry errors).

Fig. 6: Local Amplitudes of 58.77-day signal in TOPEX (Left panel) and Jason-1 (Right panel) MSL corrected with FES2014_HYDRO (pure hydrodynamic ocean tide solution)
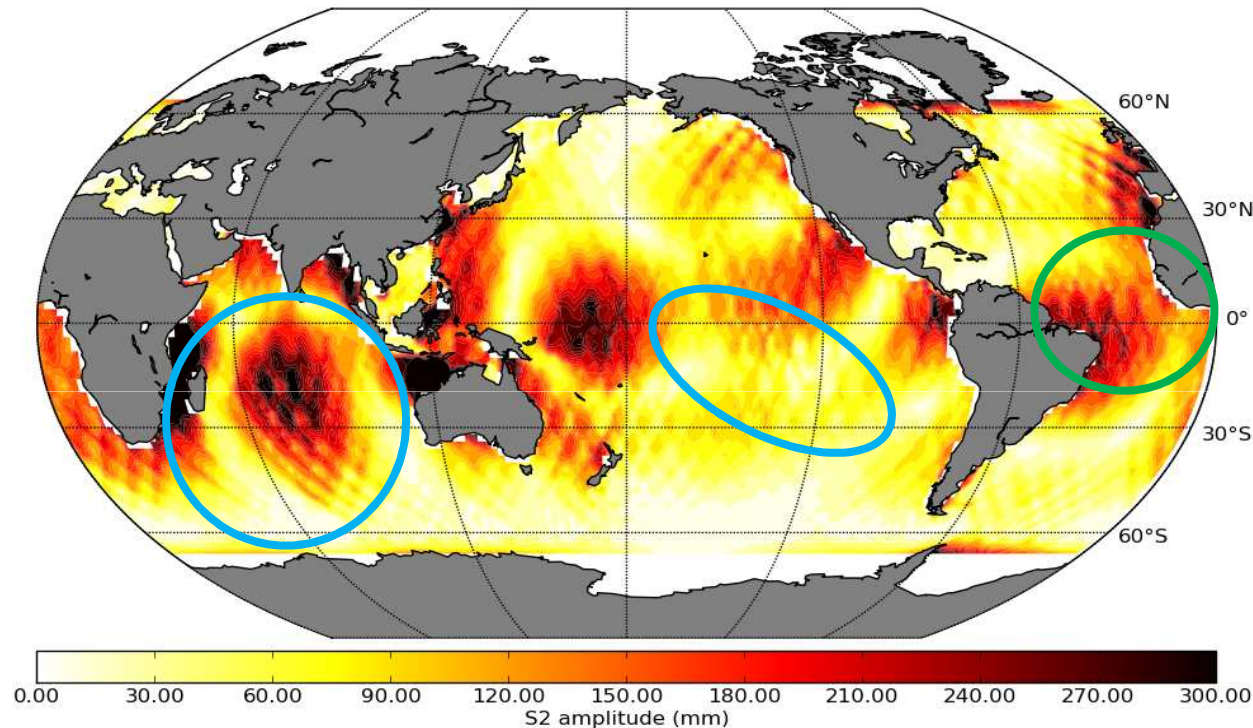
Fig. 7: Local Amplitudes of S2 ocean tide signal on Jason-1 tracks (GOT4V10)

Conclusions & Outlooks

1. The 58.77-day error in Global MSL has been significantly reduced thanks to the latest GOT and FES models

2. GOT4.10 and FES2014 are two valid solutions to ensure a low 58.77-day error on Jason-1 and Jason-2 MSL (<1mm)

3. FES2014 is a good compromise to ensure a consistent error between T/P and Jason MSLs for studies at climate scale

4. Most of the 58.77-day error is due to the assimilation of T/P SSH (Indian Ocean)

5. Part of the error is however due to the assimilation of Jason-1 and Jason-2 SSH (Atlantic Ocean)

Conclusions & Outlooks

1. Can the assimilation of ocean tide in the orbit modeling induce the 58.77-day error? (ongoing study)
2. Can the Solar Radiation Pressure model or the Reduced dynamic method have an impact on this error? (ongoing study)
3. Could there be an error in T/P radiometer (TMR) data? (ongoing study)
4. Where does the low error in ionosphere correction come from?
5. A 12h error cannot be aliased with Envisat or ERS cycles, but can we detect it with Cryosat-2? (Leuliette et al, OSTST 2014 Konstanz)
6. Finally, a complementary study (results not shown) showed that the Aviso L4 products (Duacs DT MSLA grids) do not seem impacted by this error. Which part of the process eliminates the 58.77-day error? Are along-track L3 products impacted?

To be published: "Reduction of the 58.77-day Signal in the Mean Sea Level derived from TOPEX/Poseidon, Jason-1 and Jason-2 data with the latest FES and GOT ocean tide models", L. Zawadzki, M. Ablain, L. Carrere, A. Guillot, N. Picot, F. Lyard, R. Ray, N. Zelensky