Jason-3 validation and cross calibration activities

Executive Summary - Annual Report 2024

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By succeeding to TOPEX/Poseidon, Jason-1 and Jason-2 on their primary ground track, Jason-3 has extended the high-precision ocean altimetry data record. It was launched on January 17th 2016 and is still on orbit at this date.

During each cycle, missing measurements were monitored, spurious data were edited, and relevant parameters derived from instrumental measurements and geophysical corrections were analysed for OGDR, IGDR and GDR. Please note that analysis are done over ocean only, no assessment is done over hydrological targets. GDR cyclic reports are publicly available through the AVISO web page.

Please note the change in orbit standard solution available in the products:

- GDR-F data orbit solution is POE-F ;
- until Jason-3 cycle 094, MOE-E orbit standard is available in IGDR products (MOE-F from cycle 095 onwards) ;
- from Jason-3 cycle 113 onwards, MOE orbit standard uses both DORIS and GPS data.

1 Orbit History

1.1. Tandem Phase with Jason-2

During Jason-3 tandem phase with Jason-2 (February 12th to October 2nd 2016), both satellites were on the same ground-track (with only 80 seconds delay), which was a unique opportunity to precisely assess parameter discrepancies between both missions and detect geographically correlated biases, jumps or drifts. At the end of this tandem phase, Jason-3 was declared fully operational and became the reference mission for the GMSL computation, and Jason-2 continued its mission on another orbit.

1.2. Reference Mission Period

From October 2nd 2016 to April 7th 2022, during 5 and a half years, Jason-3 was the reference mission for the GMSL computation. OGDR and IGDR products have been publicly available since June 30th 2016. OGDR were firstly generated in version “T” for the first cycles, and then turned into “D” version. GDR products have been available in version “T” since early October 2016 (more details on products versions on Jason-3 handbook. From cycle 174 onwards (29/10/2020), respectively cycle 171 onwards (29/09/2020), IGDR and GDR have been produced in standard F. The complete reprocessing to standard “F” of the GDR data was achieved during 2021. GDR data have been distributed in standard F from cycle 171 onwards (16/12/2020).

1.3. Tandem Phase with Sentinel-6A / Michael Freilich

In order to ensure the extension of the legacy of SSH measurements, Sentinel-6A / Michael Freilich satellite was launched on November 21st 2020: it reached Jason-3 orbit at the end of 2020. From cycle 179 onwards (18/12/2020), Jason-3 is used as a reference for Sentinel-6A tandem phase. At the end of cycle 226 (07/04/2022), the tandem-phase is completed and Sentinel-6A takes the lead as the reference mission.

1.4. Interleaved Orbit Period

At the end of the tandem phase, Jason-3 was moved to an interleaved orbit. The maneuver took place between April 7th 2022 and April 25th 2022, and it was decided to start over the cycle count at 300. This report focuses on the period of 2024 during which the satellite was in the interleaved orbit.

2 Data Availability

Data availability is excellent for Jason-3. Jason-3 presents 98.8% of data availability over ocean and 99.4% over the 2024. No major event occured during 2024. The only noticeable event was a GPS anomaly occuring during cycle 394, with passes 239 to 241 partly missing.

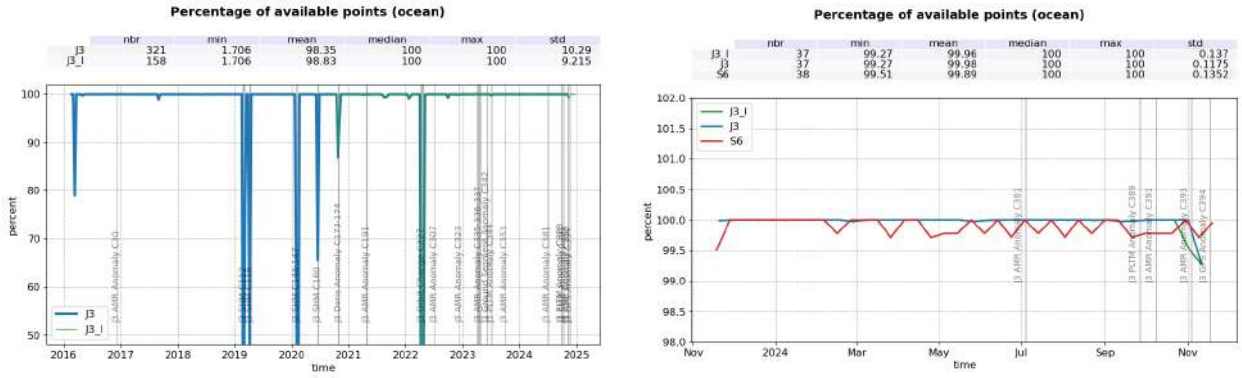

Figure 1: Jason-3 GDR and IGDR data availability over ocean (per cycle) in the whole period (left) and in the last year with comparison to Sentinel-6A (right).

3 Sea Level Anomalies

During Sentinel-6A first tandem phase with Jason-3, the averaged difference of gridded SLA shows little difference between both missions as they have a very small temporal shift, similar to Jason-2/Jason-3 tandem phase. One noticeable difference between both missions is the dependency of range to SWH for Sentinel-6A. This issue has been resolved just like the equatorial band in the map difference. See Analysis of the Sentinel-6A SLA biais correction.

The daily monitoring of mean SLA for Jason-3 is computed on figure 2. Comparison with Sentinel-6A highlights a good consistency between both missions in spite of a constant bias.

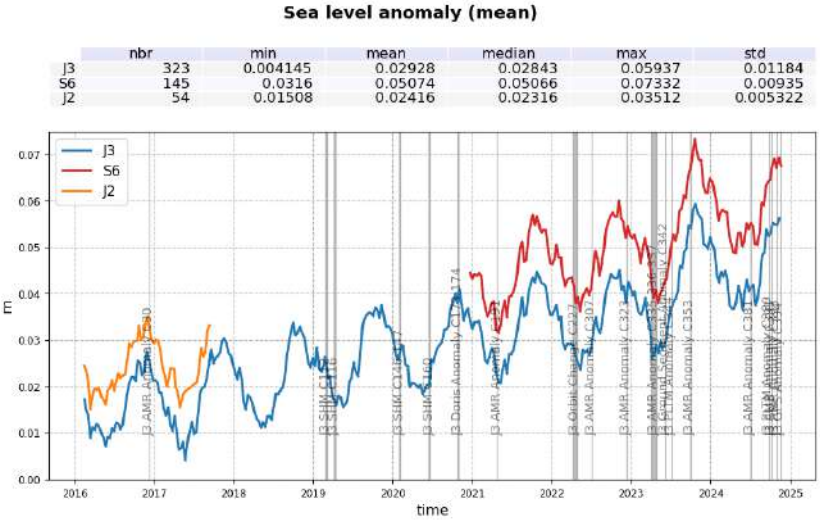

Figure 2: Cyclic monitoring of SSH bias between Jason-3, Sentinel-6A and Jason-2

4 Performances at crossover points

Looking at SSH difference at crossovers (figure 3), the standard-F is used for the whole record and this reduces the orbital 120-days signal.
Concerning SSH error at crossover points ($standard\ deviation\ /\ \sqrt{2}$), Jason-3 mission show very good and stable performances with an error of 3.28 cm. This satisfying performance is confirmed from cycle 15 onwards for Sentinel-6A.

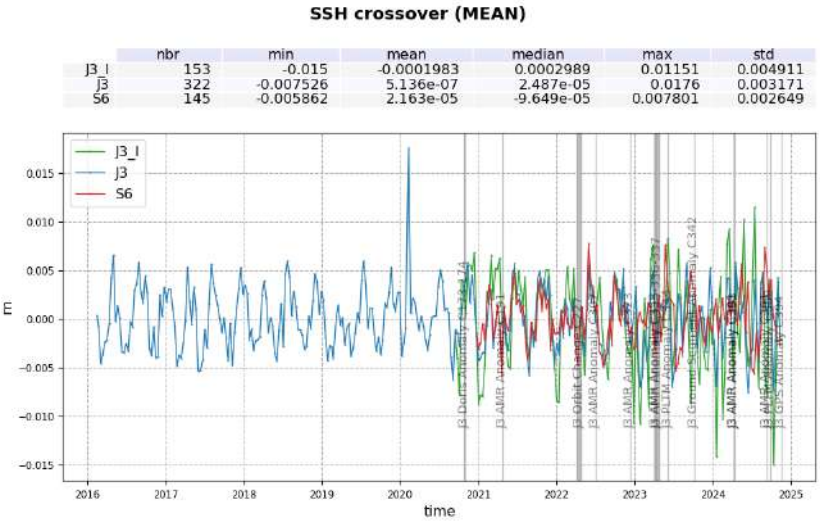

Figure 3: Monitoring of mean of Jason-3 and Sentinel-6A SSH crossover differences for IGDRs (only Jason-3) and GDRs. Only data with $|latitude| < 50$ °, bathymetry < -1000 m and low oceanic variability were selected. (ocean_tide_sol1 = FES is used in SSH computation)

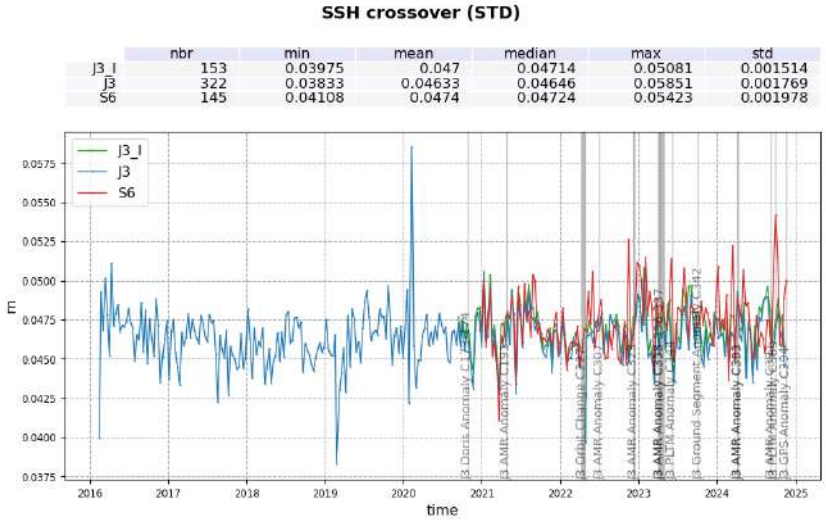

Figure 4: Cycle by cycle standard deviation of SSH crossover differences for Jason-3 and Sentinel-6. Only data with $|latitude| < 50$°, bathymetry < -1000 m and low oceanic variability was selected.

The mean SSH differences at Jason-3 crossovers is highly stable (figure 5), thus proving the accuracy of Jason-3 despite its ageing.

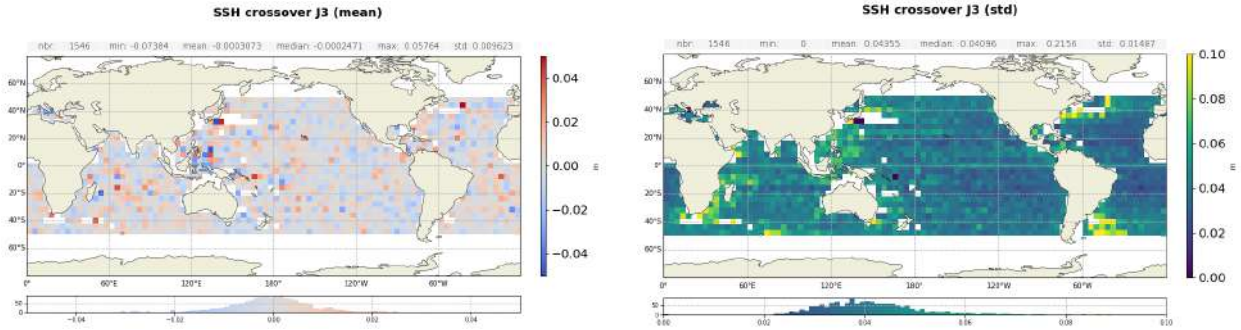

Figure 5: Map of Jason-3 SSH crossover differences over cycles 358 to 393.

5 Contribution to Global Mean Sea Level

From May 2016 (Jason-3 cycle 11) to April 2022, Jason-3 has been the reference altimetry mission to estimate the Global Mean Sea Level (GMSL), replacing Jason-2.

Regional and global biases between missions have to be precisely estimated in order to ensure the quality of the reference GMSL serie on AVISO+ website.

Part of Jason-3 contribution to the GMSL nowadays is to support the constant validation of Sentinel-6A data, which is currently the reference mission.

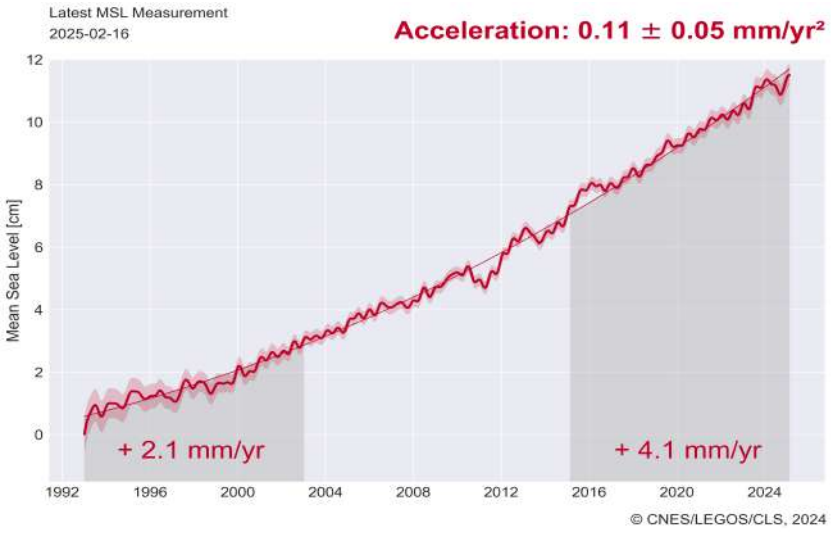

Figure 6: Global (right) and regional (left) MSL trends from 1993 onwards.