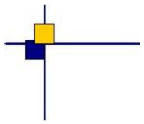
SALP Service Altimetrie & Localisation Precise

CLS Collecte Localisation Satellites

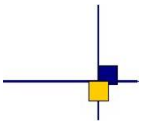
cnes Centre National d'Études Spatiales

CalVal Jason-3



Jason-3 validation and cross calibration activities

2022 executive summary



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 [1]. It was launched on January 17th 2016 and is still on orbit at this date.

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.

Reference Mission Period

From October 2nd 2016 to April 7th 2022, during 5,5 years, Jason-3 was the reference mission for the GMSL computation. OGDR and IGDR products have been publicly available since June 30th 2016. OGDRs 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 [2]). **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.** [see OSTST2020 dedicated presentation[3]]. GDR data have been distributed in standard F from cycle 171 onwards (16/12/2020).

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 [4].

Tandem Phase with Sentinel-6 / Michael Freilich

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

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] https://www.aviso.altimetry.fr/?id=601&L=0

[2] https://www.aviso.altimetry.fr/fileadmin/documents/data/tools/hdbk_j3.pdf

[3] https://meetings.aviso.altimetry.fr/fileadmin/user_upload/tx_ausyclsseminar/files/CVL_J3_GDRF_ready_v02_oostst2020_02.pdf

[4] https://www.aviso.altimetry.fr/en/data/calval/systematic-calval/validation-reports/jason-3-gdr.html

Data availability

Data availability is excellent for Jason-3. Jason-3 presents 99.3% of data availability over ocean after removing specific events (99.98% for Jason-2, see figure 1). Such events occured only a few times over Jason-3 full period. **Some of these events occured during 2022**:

- during cycle 3, where 21.02% of measurements are missing due to the GPS platform upload,
- during cycle 57, where 1.76% of measurements are missing due to the DEM-onboard upload.
- during cycles 112/113, where 79.89% (for cycle 112) and 24.21% (for cycle 113) of measurements are missing due to SHM from 24/02/2019 09:57:16 until 06/03/2019 08:44:21.
- during cycle 116, where 53.19% of measurements are missing due to SHM from 06/04/2019 23:17:22 until 12/04/2019 02:20:01.
- during cycles 146/147, SHM occured from 31/01/2020 04:51:17 until 05/02/2020 09:37:14, and another time from 05/02/2020 21:00:53 until 13:02:2020 08:42:44. Due to those SHM events, missing data rate is 38.94% for cycle 146 and 88.81% for cycle 147.
- during cycle 160, SHM occured from 15/06/2020 21:50:42 until 19/06/2020 07:32:46. Due to this SHM event, missing data rate is 33.58% for cycle 160.
- during cycles 173/174, there is a DORIS anomaly from 27/10/2020 13:23:01 until 29/10/2020 11:36:00. Due to this event, missing data rate is 13.46% for cycle 173 and 7.02% for cycle 174.
- between cycle 227 and cycle 300 : Orbit change maneuver from 07/04/2022 until 25/04/2022. Over this event, the altimeter is off and the radiometer does not send any data.
- during cycle 316, where 1.4% of measurements are missing due to the DEM-onboard upload.

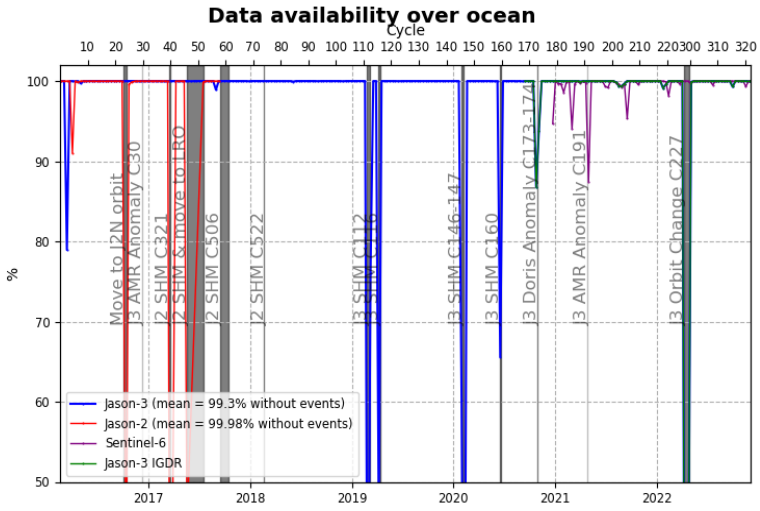


Figure 1 – Jason-2 and Jason-3 GDR data availability over ocean (per cycle)

Sea Level Anomalies

During Sentinel-6 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-6. 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. The orbit change over 2022 had no impact on the SLA stability of Jason-3 mission which shows a strong consistency with what was previously observed.

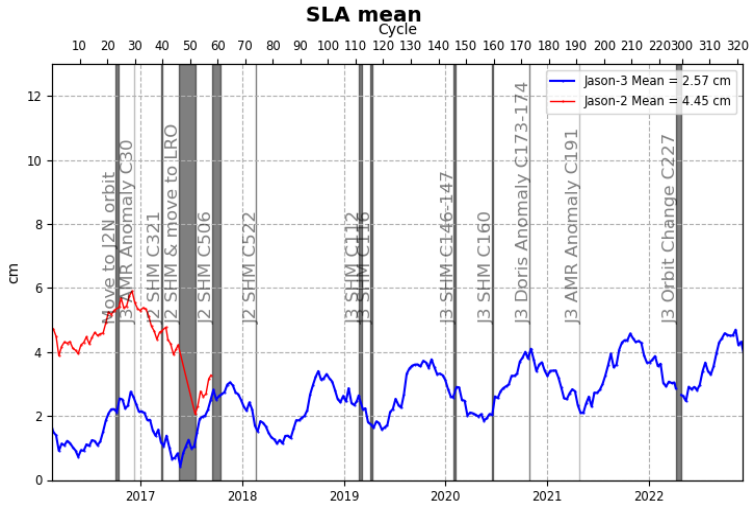


Figure 2 – Daily monitoring of SSH bias between Jason-2 and Jason-3 before Jason-2 moved to interleaved ground-track in October 2016 (using GDRD data for Jason-2 only).

Performances at crossover points

Looking at SSH difference at crossovers (red curve on figure 5), a 120 day signal is way less visible than before on the mean for Jason-3 GDR data now that the orbit standard is homogeneous for the whole record (standard-F).
Concerning SSH error at crossover points ($standard\ deviation\ /\ \sqrt{2}$), Jason-3 mission show very good and stable performances with an error of 3.39 cm (3.48 cm for Jason-2). This satisfying performance is confirmed from cycle 15 onwards for Sentinel-6.

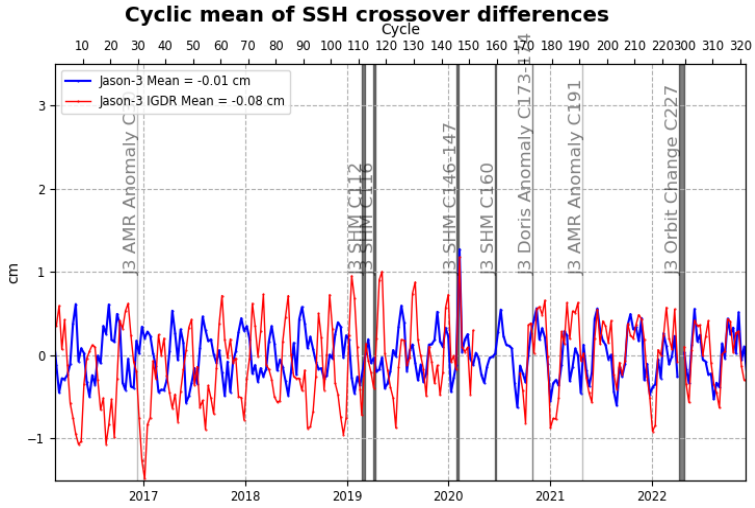


Figure 3 – Monitoring of mean of Jason-3 SSH crossover differences for IGDRs and GDRs. Only data with $|latitude| < 50°$, bathymetry < -1000m and low oceanic variability were selected. (ocean_tide_sol1 = FES is used in SSH computation)

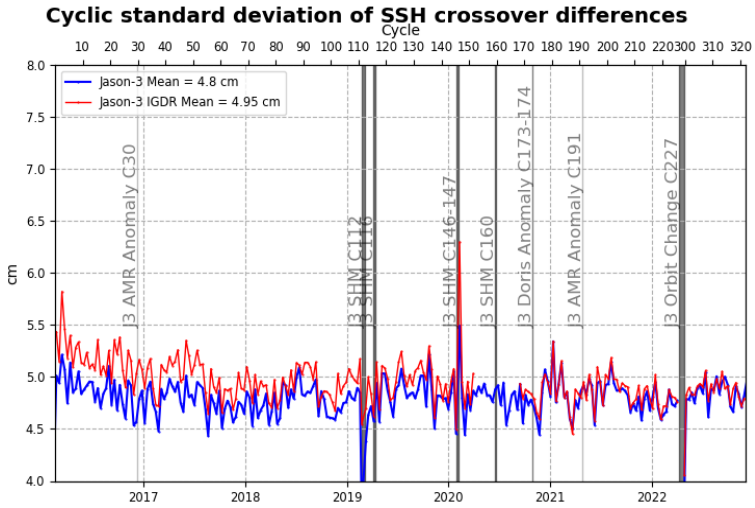


Figure 4 – Cycle by cycle standard deviation of SSH crossover differences for Jason-3. Only data with $|latitude| < 50°$, bathymetry < -1000m and low oceanic variability was selected.

The mean SSH differences at Jason-3 crossovers is highly stable and around 3cm in average (figure 5), thus proving the accuracy of Jason-3 as the reference mission.

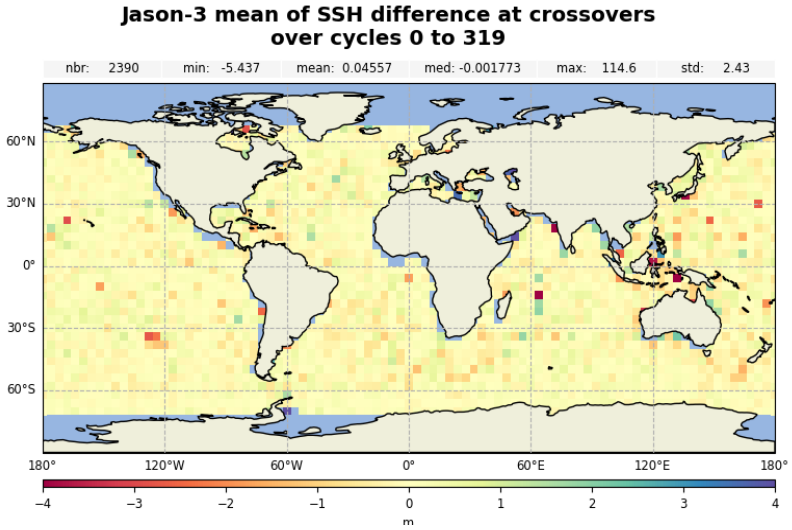


Figure 5 – Map of Jason-3 SSH crossover differences over cycles 1 to 319 (right).

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. For more precisions, see the dedicated section on AVISO+ website [5].

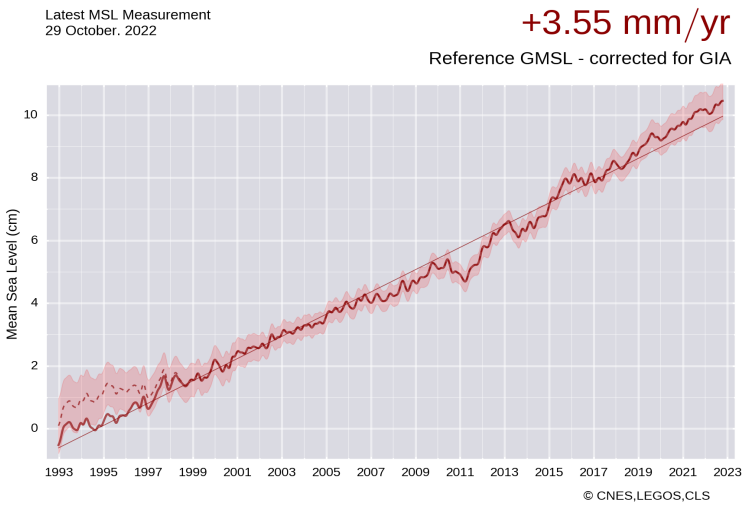


Figure 6 – Global (right) and regional (left) MSL trends from 1993 onwards.

[5] https://www.aviso.altimetry.fr/en/data/products/ocean-indicators-products/mean-sea-level.html