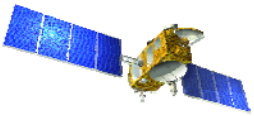
SSALTO CALVAL performance assessment Jason-1 GDR "C"/GDR "B"

L. Commien[1], S. Philipps[1], M.Ablain[1], N.Picot[2]

[1]CLS, Space Oceanography Division, Toulouse, France
[2]CNES, Centre National d'Etudes Spatiales, Toulouse, France



Context

Jason-1 Geophysical Data Records (delayed time) are processed in version C from cycle 233 onward. The whole dataset has been reprocessed in version C. The present poster analyses the global impact of the new GDR-C version on the system performances, and focuses on the specific impact of version C on the mean sea level calculation.

New precise orbit, taking into account the time-varying part of the gravity field, improved calibration of JMR data, new SSB calculation and range estimation, introduction of a pseudo time-tag bias correction, and more accurate rain and ice flags, are the main evolutions of this new GDR release. This poster provides analyses on global performances and shows the improvements of version C with regard to crossover and along-track performances, and the impacts of the new release on mean sea level calculation.

Global performances of GDR-C

GDR's have been reprocessed from cycles 1 to 232 (except for a few anomalous cycles which require reprocessing). The performances prove to be very satisfying. Note that in this study, the Venice sea state bias has been used in the GDR-B SSH calculations, which is already very close to the version C solution.

Crossover analysis

The crossover ascending/descending incoherencies previously present in GDR-B are clearly reduced with GDR-C: the map of mean crossover differences is more homogenous than with GDR-B, especially in the Atlantic, This shows a better coherence between ascending and descending tracks (Fig.1), mainly due to the introduction of a pseudo time-tag bias correction (Fig.2). The new orbit calculation also slightly improves the ascending/descending tracks consistency.

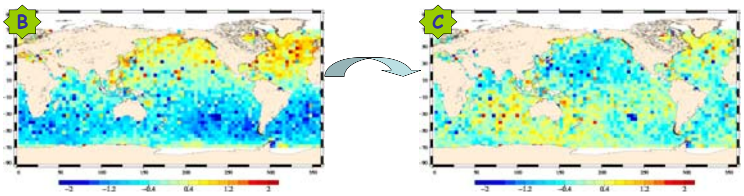


Fig. 1: Mean [cm] of SSH at crossovers, for GDR-B (left) and GDR-C (right) from cycle 1 to 232.

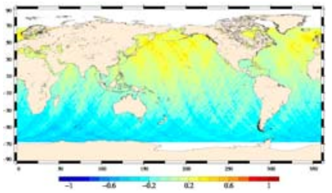


Fig. 2: Mean differences "C" – "B" [cm] of orbits from cycles 1 to 232.

GDR-C orbit is a SLR/DORIS/GPS orbit as GDR-B but uses the EIGEN-GL04C gravity field. Contrary to the GDR-B orbit, GDR-C POE takes into account annual and semi-annual time variability and atmospheric contribution of the gravity field, and ocean pole tide effects. The new reference frame used is ITRF2005, contrary to ITRF2000 in version B. Figure 2 shows the mean differences between GDR-C and GDR-B orbits for cycles 1 to 232. The main feature is north/south bias, due to the change of reference frame.

The variance difference is negative almost everywhere (var(SSH_{GDRC})-var(SSH_{GDRB})), from 1 to 8cm², which is a clear improvement of GDR-C (Fig.3, left). Performances are similar in the tropical Pacific and Indian oceans (variance with version 'C' is less than 1cm² higher than in version 'B'. Temporally, the variance gain is about 1cm², which is low but still an improvement too (right).

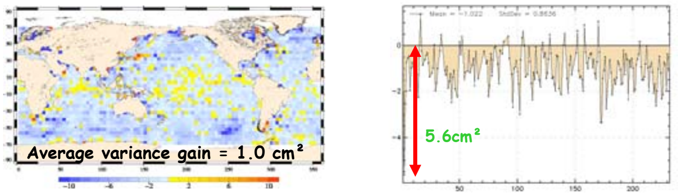


Fig. 3: Variance differences ('C'-'B') of crossover SSH. Spatially (left) and temporally (right), from cycle 1 to 232 [cm²]

Along-track analysis

The variance difference of along-track SLA between both GDR versions, highlights an annual signal (Fig.4). Most of the time, the variance is reduced with GDR-C (~1.7 cm²), and the reduction can reach almost 8 cm². This is mainly related to the orbit change (Fig.6). Note that this improvement enlarges with time. This highlights the add of the time-varying part of the gravity field in the new orbit calculation. This feature has also been observed when comparing altimetry to in situ measurements (tide gauges and ARGO T/S profiles).

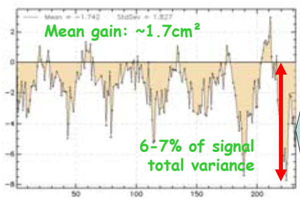


Fig. 4: SLA variance differences "C" – "B" [cm²] of along-track SLA from cycles 1 to 232.

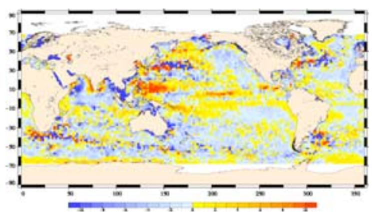


Fig. 5: SLA variance differences "C" – "B" [cm²] of along-track SLA.

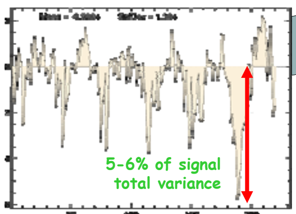


Fig. 6: SLA variance differences "C" – "B" [cm²] of along-track SLA using either GDRB or GDRC POE calculation.

The SLA variance is geographically globally reduced, except for some high variability zones (Fig.5), where more signal may be observed, and heavy rain areas (warm pool) where the radiometer new calibration enables to detect more signal.

Impact on MSL

Global impact

A minor slope decrease is observed with the new release, about -0.17mm/yr (Fig.7). The main impact of the version change is the sharp reduction of slope divergence between northern and southern hemisphere: in the North, the MSL slopes increases from 1.33 to 1.78mm/yr, while in the South it decreases from 3.22 to 2.55mm/yr. Therefore, the hemispheric slope difference decreases from 1.89mm/yr in version B, to 0.75mm/yr in version C, showing a better hemispheric coherence (Fig.8). Such hemispheric coherence reduction had already been pinpointed using ITRF2005 in GSFC POE solution.

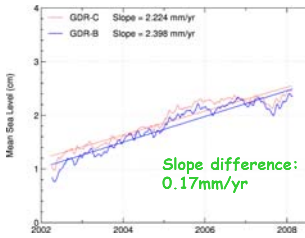


Fig. 7: Cycle per cycle MSL trends [cm] for "B" and "C" (global).

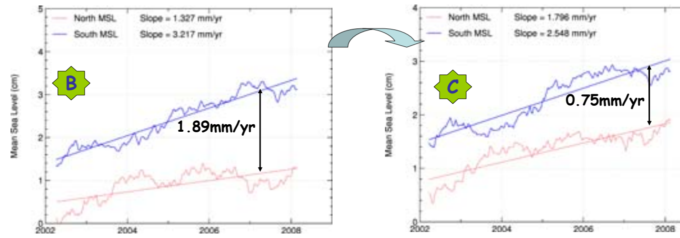


Fig. 8: Cycle per cycle MSL trends [cm] by hemisphere for version "B" (left) and "C" (right).

Regional impact

The orbit change has geographical impacts on MSL trends, as shown on Figure 9. This north/south difference is mainly due to the ITRF change from ITRF2000 to ITRF2005. The observed bias usually ranges between -1.5 and 1.5 mm/yr, the positive bias ('C'-'B') being found in the northern hemisphere. There is a 0.20mm/yr decrease of the global slope, which is more than the impact of the new orbit alone (0.066mm/yr).

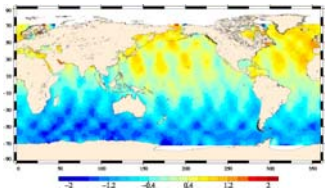


Fig. 9: Differences of MSL trends between "C" and "B" orbits, 2002-2008 [mm/year].

Backscattering coefficient (SIGMA0)

A Sigma0 drift (-0.02 dB/yr) is observed in version B. It could be linked with the atmospheric attenuation drift also observed in GDR-B (this correction is used to correct the Sigma0). In version C, this small drift (-0.002 dB/yr) is well corrected for, but not enough to correct for the Sigma0 drift that is observed both in versions B and C. It remains a -0.018 dB/yr in version C (Fig.11).

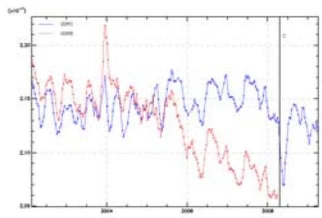


Fig. 10: Atmospheric attenuation of Sigma0 for versions "B" and "C" [dB].

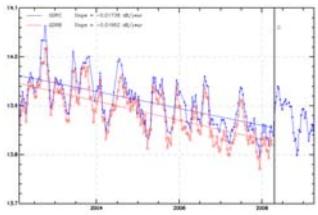


Fig. 11: Backscattering coefficient (Sigma0) for versions "B" and "C" [dB].

Whether the Sigma0 drift is an error or a physical signal is still to be determined. This 0.02dB/yr drift, through the wave calculation, impacts the mean sea level trends by 0.1mm/yr.

Conclusion

With almost the whole dataset reprocessed, the assessment of GDR-C Jason-1 data is satisfying, showing better SSH performances at crossovers and also along-track. Particularly, the CNES POE orbit enables to decrease the SLA variance significantly, mainly thanks to the time-varying part of the gravity field used in its calculation.

The new release has a negligible impact on the global MSL trend, but reduces significantly the north/south sea level rise divergence which used to be observed in the previous release. In the same way, temporally averaged sea level rise is quicker in the North when using version C, but slower in the South compared to version B. This is also related to the orbit change.