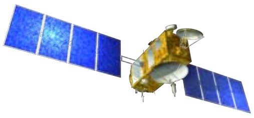
SSALTO CALVAL performance assessment Jason-1 GDR "C"/GDR "B"



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Context

Jason-1 data have been processed in GDR version C from cycle 233 onward. The beginning of the dataset is currently being reprocessed in version C. The present poster analyses the global impact of the new GDR-C version on the system performances for the yet reprocessed cycles (196 to 232), and also focuses on the specific impact of new precise orbit and JMR data on the mean sea level calculation from the whole series.

Three datasets are available. GDRs have been reprocessed from cycle 196 to 232. This first dataset is used to assess the performances of the system (crossover SSH and along-track SLA statistics). New precise orbit, taking into account the time-varying part of the gravity field is available from cycle 1 to 239. Improved calibration of JMR data from cycles 1 to 212 is also used in this study. These are the main evolutions from version B to version C, along with the use of high resolution dynamic atmospheric correction, new SSB calculation and range estimation, introduction of a pseudo time-tag bias correction, and more accurate rain and ice flags.

Global performances of GDR-C

GDR's have been reprocessed from cycle 194 to 232 (except for cycle 195). The performances prove to be very satisfying.

Crossover analysis

The crossover ascending/descending incoherencies are 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 new orbit calculation and the introduction of a pseudo time-tag bias correction.

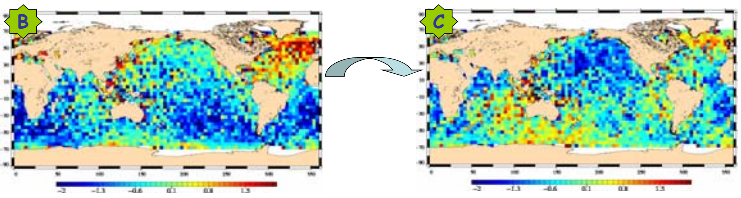

Fig. 1: Mean [cm] of SSH at crossovers, for GDR-B (left) and GDR-C (right).

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.2, left). Temporally, the variance gain is about 1cm², which is low but still an improvement too (right).

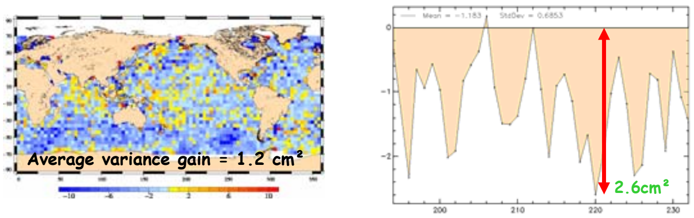

Fig. 2: Variance differences ('C'-'B') of crossover SSH. Spatially (left) and temporally (right), from cycle 194 to 232 [cm²]

Along-track analysis

The variance difference of along-track SLA between both GDR versions, highlights an annual signal (Fig.3). Most of the time, the variance is reduced with GDR-C (~2 cm²), but the variance reduction reaches almost 8 cm². This is mainly related to the orbit change (see below).

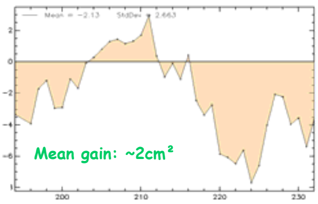

Fig. 3: SLA variance differences "C" – "B" [cm²] from cycles 194 to 232.

Analysis of new orbit over the whole period

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 GDR-B (ITRF2000). Figure 4 shows the mean differences between GDR-C and GDR-B orbits for cycles 1 to 239. The main feature is north/south bias, due to the change of reference frame.

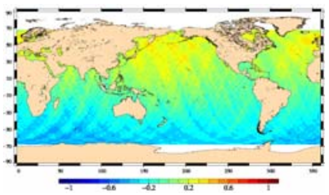

Fig. 4: Mean differences "C" – "B" [cm] of orbits from cycles 1 to 239.

Mean differences at crossovers are geographically more homogeneous, proving a better coherence with version C (not shown). The SSH variance at crossovers decreases slightly. Temporally, a slight improvement is noticed, the quality of both products is equivalent regarding the crossovers performances, with variance reduction similar to the statistics shown on the global performances of GDR-C box (above).

Figure 5 shows a peculiar annual pattern on along-track SLA variance differences. The variance is significantly decreased, reaching 6cm², which approximately corresponds to 7% of the signal's total variance. 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 the altimetry to in situ measurements (tide gauges and ARGO T/S profiles).

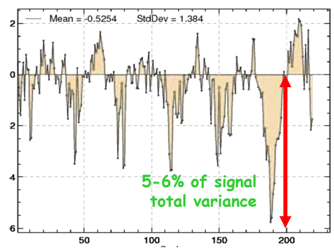

Fig. 5: Cycle per cycle variance differences [cm²] of along-track SLA. ("C" – "B"), with selections on latitude [50°N;50°S] and bathy<1000m.

Impact on MSL

JMR contribution

An improved JMR calibration is used, which corrects for scale error, provides additional reduction of yaw state effects and avoids small shifts that may have occurred after the last two safehold events.

The new radiometer wet troposphere correction has minor effects on mean sea level trends (Fig. 6).

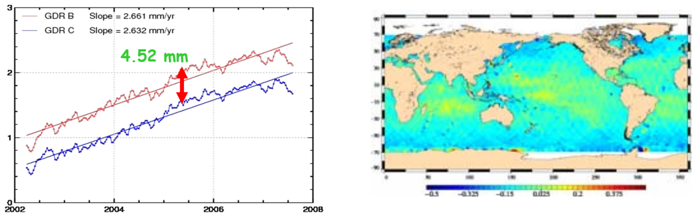

Fig. 6: Filtered MSL trends with "C" and "B" radiometer wet tropospheric correction (left) and local slopes differences (right) [mm/year].

Orbit contribution

The orbit change has geographic impacts on MSL trends, as shown on Figure 7. This north/south difference is due to the ITRF change (2000/2005, see the box about orbit changes). 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 0.066mm/yr decrease of the global slope using GDR-C orbit (2.5% of signal amplitude).

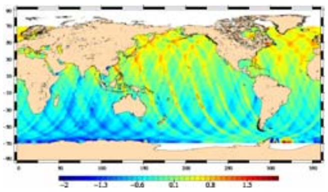

Fig. 7: Differences of MSL trends between "C" and "B" orbits, 2002-2008 [mm/year].

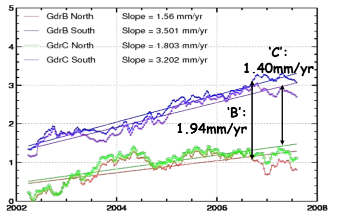

Fig. 8: Cycle per cycle MSL trends [cm] for "B" and "C" by hemisphere.

The slope divergence between north and south, shown on Fig.8, is slightly reduced with GDR-C: in version B, there was a 1.94mm/yr slope difference between north and south, which has cropped to 1.40mm/yr with version C. The impact is significant, since the slope difference corresponds to ~14% of the signal north, and ~9% south. However, the expected N/S slope divergence reduction is low compared to what was observed when using the GSFC ITRF2005 orbit (see Ablain's poster : Error estimation of the global and regional mean sea level trends).

GDR-C/GDR-B linking

A global and hemispheric bias was calculated using the mean of the last 4 GDR-B cycles, 229 to 232. Attention should be paid to the fact that applying a fixed bias is sufficient for global MSL studies but NOT when considering local (hemispheric) MSL evolutions.

The applied bias differs when using radiometer (-9.5 mm) or model wet tropospheric correction (-5.75 mm). The correction, when applied to GDR-C, fits very well with GDR-B MSL.

The map of mean SLA differences from cycle 229 to 232 shows geographically correlated biases (Fig.9, left), related to the change of reference frame (ITRF2000/2005). This map should always be subtracted from the GDR-C-computed MSL maps before watching temporal evolution of MSL trends if local analyses are performed. The same map can also be used for global MSL (Fig.9, right). This has already been taken into account in the AVISO Mean Sea Level products.

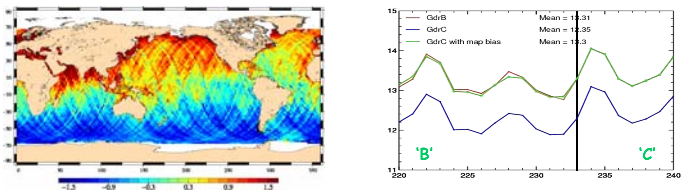

Fig. 9: Mean [cm] along-track differences for cycle 229 to 232 (left) and MSL GDR-C/B linking when subtracting the map (right).

Conclusion

With a year of reprocessed data, the first assessment of GDR-C Jason-1 data is satisfying, showing better SSH performances at crossover 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 GDR-B/C MSL bias is not homogeneous geographically and should be corrected using a map, a feature already available on the AVISO website. The new JMR correction has almost no impact on mean sea level trends, and the orbit reduces the north/south drift of MSL trends, although a stronger impact could have been expected.

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