(A) SSALTO CALVAL Performance assessment Jason-1 GDR "B" / GDR"A"

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Context

Jason-1 data (GDR: geophysical data record) were processed in version A until cycle 135 and in version B from cycle 136 until current cycle. Recently, a reprocessing of the GDR was done by JPL (cycles 1 to 21) and CNES (cycles 128 to 135). The objective of this study is to compare the 'A' and 'B' versions of the GDRs. The impact of each change in GDR 'B' is analyzed as well as the global impact on SSH performances.

Data and processing

In this study we concentrate on Jason-1 cycles 1 to 21. The main evolutions in the GDR 'B' are the implementation of a new retracking algorithm (order 2 MLE-4), a new precise orbit based on a GRACE gravity model and new geophysical corrections (tidal models, MOG2D, Sea State Bias). As done for GDR 'A', data have been processed to eliminate bad measurements. The following statistics have been computed over the 21 cycles which represent a significant amount of data.

Impact of new orbit

GDR 'B' orbit is a SLR/DORIS/GPS[1] orbit and uses the EIGEN-CG03C gravity field. GDR 'A' is a SLR/DORIS orbit with JGM-3 gravity model. Figure 1 shows mean SSH Crossover differences (ascending / descending bias). Using GDR 'A' orbit (left), large structures of high positive or negative differences can be seen, whereas the right figure using orbit of GDR 'B' is much more homogenous as it shows smaller differences at crossovers. The gain in SSH variance with the new orbit is about 1.6 cm rms.

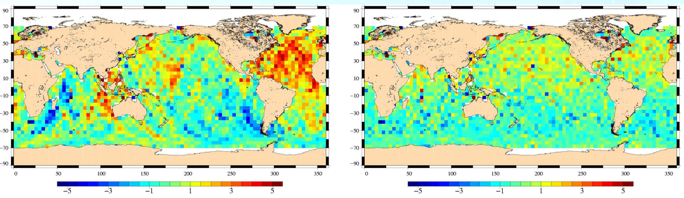

Figure 1: Mean differences [cm] of SSH at crossover. Left: using GDR A orbit. Right: using GDR B orbit.

With this new orbit quality, small signals can now be detected such as an hemispheric bias at crossovers (figure 1 right) using GDR 'B' data. This bias is removed using GDR 'A' altimeter data and the GDR 'B' orbit (figure 2).

A time shift of 0.173 ms has been added in the GDR 'B' L1-B processing. A wrong sign in this time shift might explain the observed hemispheric bias. This is presently under investigation.

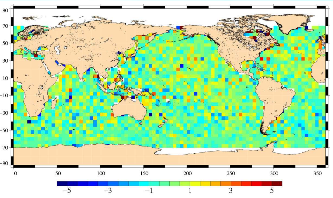

Figure 2: Mean differences [cm] of SSH at crossover, using data from GDR 'A' with orbit of GDR 'B'.

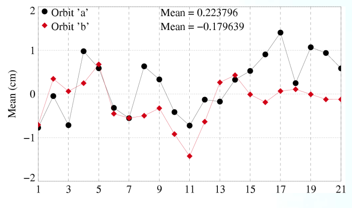

Fig. 3: Cycle per cycle mean SSH differences at crossovers

Figure 3 shows that mean SSH differences at crossovers are very stable for cycles 15 to 21 when using the GDR 'B' orbit. Figures from cycles 10 to 12 are quite negative. This effect could be partly reduced by refining the GPS data processing in orbit calculation.

Impact of retracking

-GDR 'A': Waveforms are retracked with a Maximum Likelihood Estimator (MLE) solving for three parameters: range, significant wave-height and sigma naught.
-GDR 'B': Because of casual abnormal behavior of the star tracker system, potentially leading to possible significant mispointing angle, the waveforms are retracked with a MLE solving for the same three parameters plus the square of the mispointing angle (See P.Thibaut's poster).
-Threshold criteria in editing procedure has been increased from 0.16 deg² to 0.64 deg² to take into account the new valid range of the mispointing angle.

First impact:

Some passes previously partly edited in GDR 'A' due to mispointing values greater than 0.4 degree are no more edited in GDR 'B'. For cycle 135, only 1% of the GDR 'B' data are edited by the mispointing criteria instead of 6% with GDR 'A' (this cycle was impacted by the star tracker unavailability).

Second impact:

The SLA variance is significantly reduced (5.3 cm²) at crossovers or along-track differences The variance reduction represents 12% of the total signal. Along-track SLA variance differences (figure 4, left) shows that the gain (in red) is strongly correlated with the absolute value of the square mispointing value (figure 4, right).

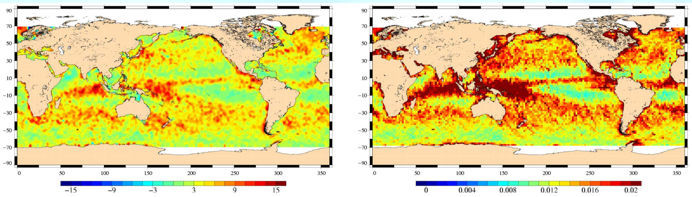

Fig. 4: SLA variance differences "A" – "B" [cm²] (left) and mean of absolute value of square mispointing [deg²] (right).

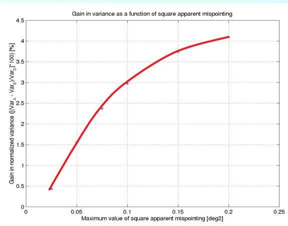

Figure 5: Percentage of gain in variance as a function of square mispointing values (deg²).

SLA variance is improved everywhere by the use of a MLE-4 algorithm and especially where the waveforms are not typical expected waveforms (rain, blooms, ..). For these waveforms, the estimated mispointing angle doesn't reflect of a real mispointing angle but only a distortion of the waveform. The SSH variance gain is clearly linked to the "pseudo" mispointing angle values at crossovers showing again the improvement yielded by the MLE-4 in zones where the waveforms are distorted (figure 5). Moreover, the 20Hz and 1Hz spectra for GDR 'A' and 'B' (figure 6) show that the 20 Hz noise on the SSH is slightly increased by the new algorithm whereas the high frequency content for the 1-Hz data is significantly reduced. This last result is consistent with the gain in variance previously observed.

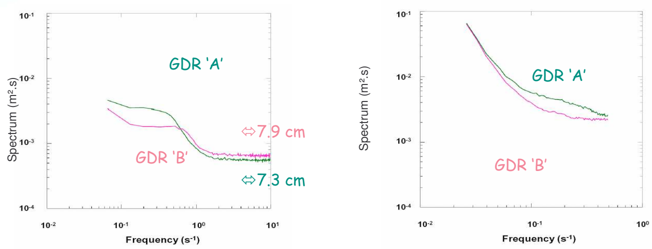

Figure 6: SSH Spectrum on 20 Hz measurements (left) and on 1 Hz averaged measurements (right)

Impact of new geophysical corrections

GDR 'B' now includes new geophysical corrections: non-tidal high frequency correction from Mog2D, FES2004 and GOT00.2 tide models, non equilibrium long period tide, MSS CLS01 model. In addition, diurnal and semidiurnal atmospheric tides (S1/S2) are now handled according to OSTST recommendations. Using Mog2D-derived HF correction instead of inverse barometer (IB) correction brings most of the variance reduction at crossovers (2.9 cm rms), especially in high latitudes (figure 7).

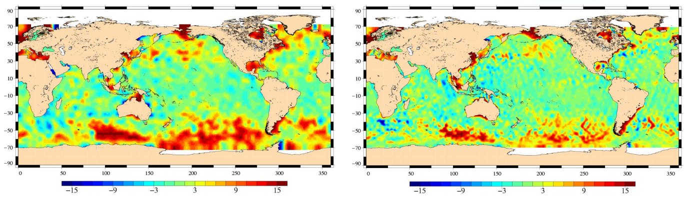

Figure 7: SSH crossover variance difference (Variance of SSH differences with IB – Variance of SSH differences with Mog2D, left) and SLA along track variance differences (right) when using MOG2D correction rather than IB alone.

Global impact of new GDR 'B'

Finally, the use of GDR 'B' data allows us to decrease significantly the variance at crossover in comparisons with the GDR 'A' (figure 8): the variance has been dropped by 35% (3.9 cm rms).

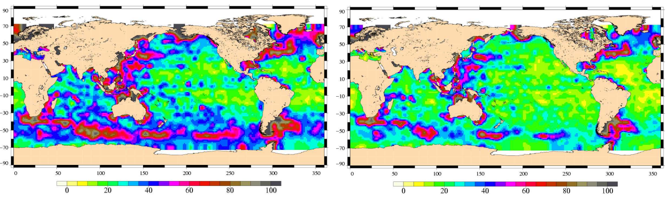

Figure 8: SSH crossover variance when using GDR 'A' data on the left and GDR 'B' on the right (cm²)

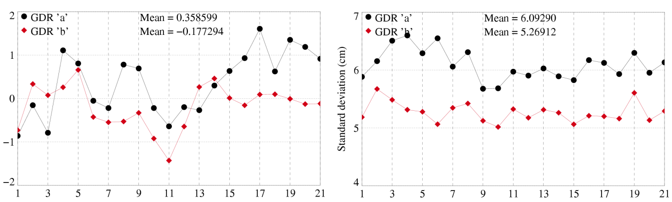

Figure 9: Cycle per Cycle mean (left) and standard deviation (right) of SSH differences at crossover (with geographical selections).

The crossover mean is more stable with the GDR 'B' (figure 9, left) especially for the last cycles thanks to the new orbit. The crossover standard deviation using geographical selections (bathy < -1000m , |latitude| < 50° and ocean variability < 20 cm) decreases from 6.1 cm to 5.3 cm with the GDR 'B' (figure 9, right) : MOG2D HF correction, new orbit and MLE-4 retracking are the main sources of improvement.

Refereces: 1: Choi, K.-R., J.C. Ries, and B.D. Tapley, 2004: Jason-1 Precision Orbit Determination by Combining SLR and DORIS with GPS Tracking Data, Marine Geodesy, Vol. 27, pp. 319-331.
2: Amarouche, L., P. Thibaut, O.Z. Zanife, J.-P. Dumont, P. Vincent and N. Steunou, 2004: Improving the Jason-1 Ground Retracking to Better Account for Attitude Effects. Marine Geodesy, Vol. 27, pp. 171-197.