Global Jason-2 Data Analysis of Reprocessed Gdr-D Products

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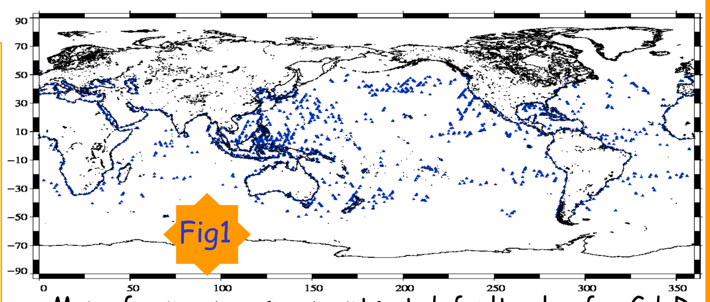
Overview

Since the beginning of the Jason-2 (JA2) altimeter mission in July 2008, the GDR (Geophysical Data Record) product version available was GdrT. JA2 data are currently reprocessed in version GdrD. It contains numerous evolutions (e.g. orbit, altimeter and radiometer derived corrections, ocean tide, mean sea surface). The main objective of this study is **to assess the data quality** of the reprocessed **Jason-2 GDR-D products**. More than 2 years are currently available in version D: cycles 1 to 36, and 87 to 145. From cycle 146 onwards, the operational Gdr have also switched to version D standard.

Data availability and quality

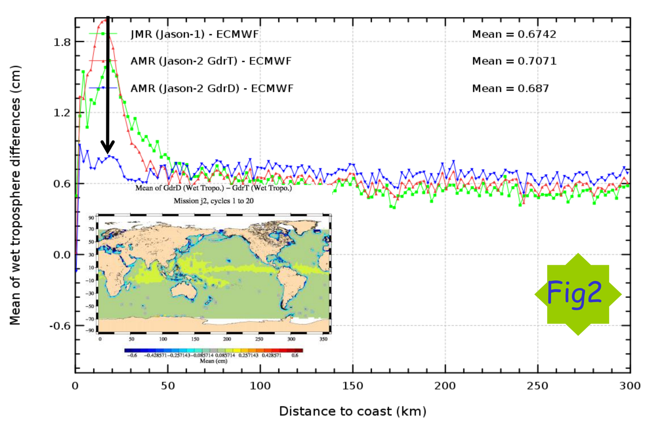
The data availability of GdrD is globally similar to the GdrT data set.
The GdrD data set has slightly more (0.1%) edited measurements than GdrT (increased sea ice and altimeter parameters at default values).

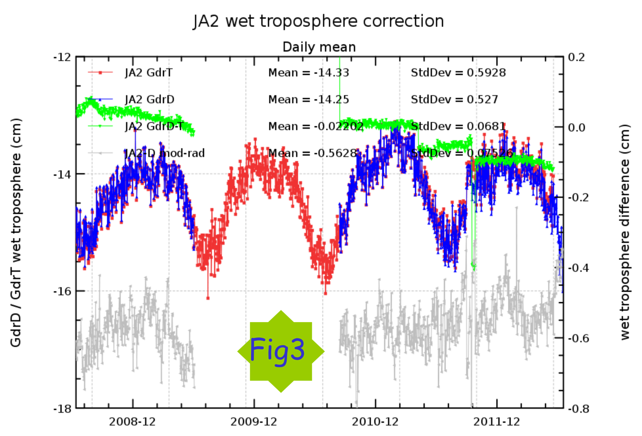


Map of range measurements at default value for GdrD cycle1.

Explanation: Use of MQE setting during the 20 Hz to 1 Hz data compression -> number of elementary 20 Hz data is decreased (for disturbed sea states).

Radiometer parameters





Radiometer minus ECMWF model wet troposphere correction differences stay for GdrD quite stable when approaching the coast (figure 2). Comparison between GdrD and GdrT radiometer wet troposphere correction shows an evolution of 1.5 mm over the 4 years (figure3).

Altimeter parameters and related values

Altimeter range: ~15.3cm difference between GdrD and GdrT (reasons tab 1)

Significant Wave Height (SWH): similar between GdrD and GdrT

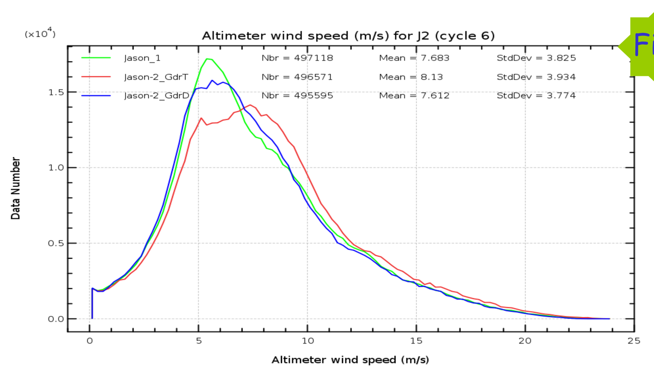
Dual-frequency ionosphere correction: ~6mm bias (with small regional variations) between GdrD and GdrT.

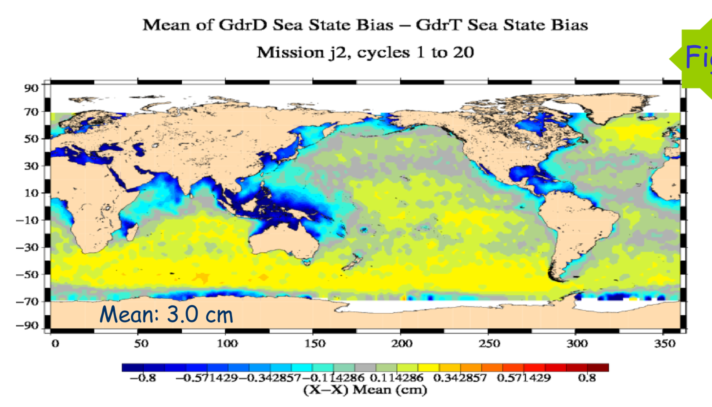
Backscattering coefficient: -0.15dB bias between GdrD and GdrT + regional differences (correlated to the atmospheric attenuation differences).

Mispointing from waveforms: is more centered around zero

Altimeter wind speed: -0.5m/s mean difference between GdrD and GdrT. The shape of the GdrD wind speed histogram is closer to Jason-1, than it was for GdrT (fig. 4).

Sea state bias: ~3cm difference between GdrD and GdrT. Regional GdrD/GdrT differences : correlated with significant wave height values (fig. 5) due to a different approach of low sea states in the GdrD SSB model.





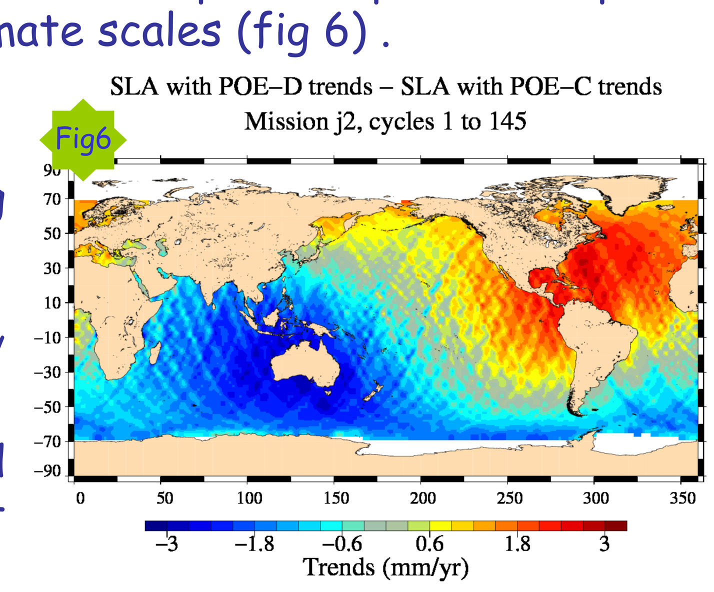
The individual parameters and corrections were implemented in GdrD as planned, giving improved or equivalent results compared to GdrT. Nevertheless, some parameters/corrections increase the differences between Jason-2 and Jason-1.

Other changes in the GdrD standard

Precise Orbit Ephemiris : Using GdrD POE has an important positive impact on Jason-2 data on short time and also on climate scales (fig 6) .

On Meso-scale:
- reduces the SSH std at crossovers
- improves the coherence between ascending and descending passes (fig. 8).

On climate scales:
- MSL trends separated in ascending/ descending passes are homogenized (fig. 11)
- reduction of geographically correlated biases of regional MSL (e.g. between Envisat and Jason-2)



Global Ocean Tide: The GOT4.8 model improves the coherence between ascending and descending passes. ~0.5 cm² reduction of global sea surface variance (especially important for coastal areas).

References:
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-F. Boy and J.D. Desjonqueres. 2010. **Note techinque datation de l'instant de reflextion des échos altimétres Pour POSEIDON2 et POSEIDON3.** Reference: TP3-JPOS3-NT-1661-CNES.
-GDR-T (T for Test, see: www.aviso.oceanobs.com/fileadmin/documents/ data/products/Jason-2_GDR_T_disclaimer.pdf).

Jason-2 Gdr product standards

Standard	Product Version « T »	Product Version « D »
Orbit	CNES POE standard C	CNES POE standard D
Altimeter retracking	MLE4 + 2nd order Brown model.	Identical to version "T" + MLE3 retacking available
Jason-2 microwave radiometer parameters	Using calibration parameters derived from long term calibration tool developed and operated by NASA/JPL	Like version " T" + new calibration coefficients + enhancement in coastal regions + correction of 34 GHz anomaly • addition of radiometer rain and ice flag • All weather ocean sigma0 attenuation correction
dry troposphere	ECMWF model	Identical to version "T"
Sea state bias model	Empirical model derived from 3 years of Jason-1 MLE4 altimeter data	New look-up table. Empirical model derived from Jason-2 data
Mean Sea Surface Model	CLS01	CNES CLS 2011
Mean Dynamic Topography	Rio 2005 solution	CNES CLS2009 solution
Tide Solution 1	GOT00.2	GOT4.8
Non-equilibrium long-period ocean tide	Mm, Mf, Mtm, and Msqm from FES2004.	Mm, Mf, Mtm, and Msqm from FES2004 + correction for a bug
Pole Tide Model	Equilibrium model.	Equilibrium model + correction of error which was present over lakes and enclosed seas.
Altimeter Wind Speed	Table derived from Jason-1 GDR data.	Table is identical to version "T", but the inputs differ.
Altimeter Rain Flag	Set to default values	Derived from Jason-2 sigma naught MLE3 values
Update of the altimeter characterization file		• more precise PRF value • Bias of 18.092 cm applied on range (corrects the value of the distance between CoG and the reference point of the altimeter antenna) • Antenna aperture angle (at 3dB) changed to 1.29 deg • MQE setting is applied during 20 Hz to 1 Hz compression
Other	LTM calculated over 1 day	• LTM calculated over 7 days • the origin of the constant part of the time tag bias was found and is directly corrected in the Gdr-D datation.

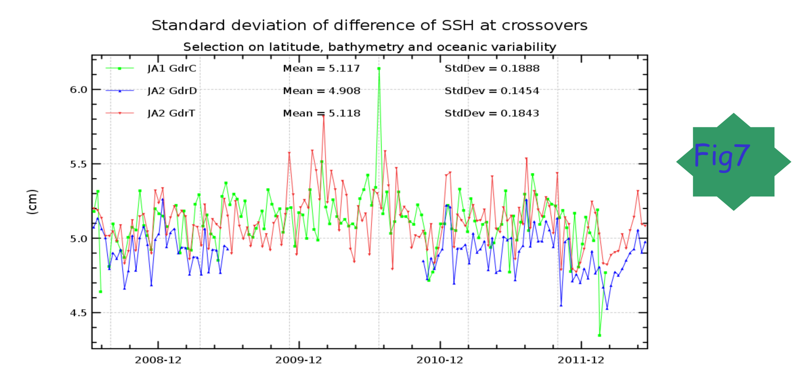
Tab1

Jason-2 GdrD products are available at : ftp://avisoftp.cnes.fr/AVISO/pub/jason-2/gdr_d/

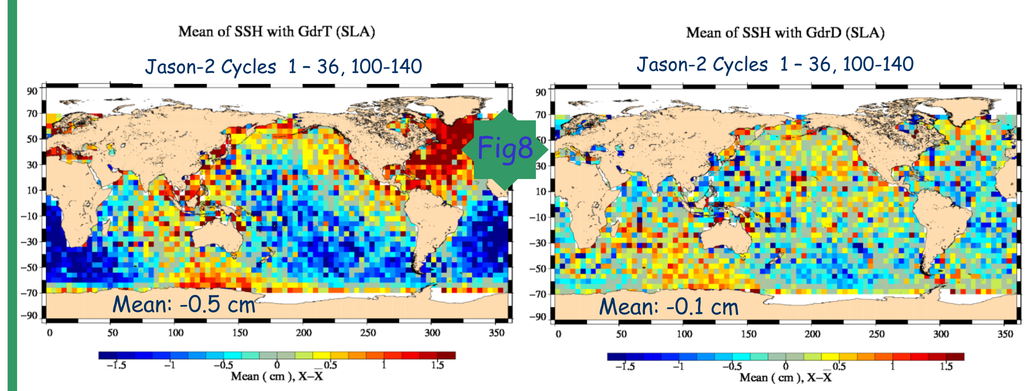
Performances at crossovers

Ascending / descending sea surface height (SSH) differences are computed at crossover points for time differences less than 10 days between ascending and descending tracks.

The standard deviation of SSH differences is systematically lower for GdrD than for GdrT data (fig. 7), leading to a global SSH reduction of variance of 1.4cm²



The GdrD data improve the coherence of ascending/ descending SSH differences. The geographical patterns visible for GdrT (left of fig. 8) are strongly reduced for GdrD (right of fig. 8).



Mean ascending/descending SSH differences at crossovers over Jason-2 cycles 1 to 36 and 100 to 140 period for GdrT (left) and GdrD (right)

These improvements (variance reduction and improved coherence of ascending/ descending passes) are mainly due to the new orbit solution, the use of GOT4.8, and the modified datation used for the GdrD data

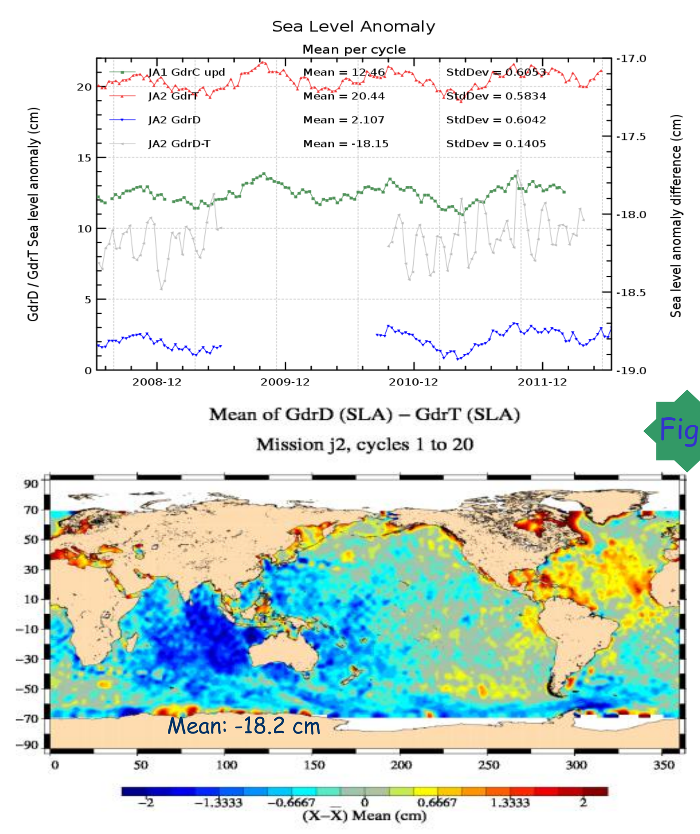
Sea Level Anomalies (SLA)

The mean SLA passes from ~20.4 cm (GdrT) to ~2.1 cm (GdrD), leading to a global difference of -18.2 cm between GdrD and GdrT (top of fig. 9):

⇒the global MSL bias to link Jason-1/Jason-2 is now -10.6 cm instead of 7.6 cm before the reprocessing (using AVISO method)

There are also geographical SLA differences due to orbit, SSB, MSS (bottom of fig. 9):

⇒They increase the discrepancies with Jason-1 : to be investigated

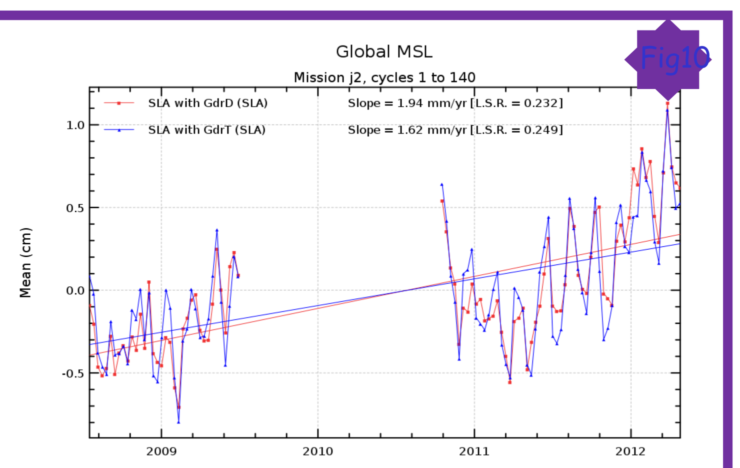


Impact on global Mean Sea Level trend

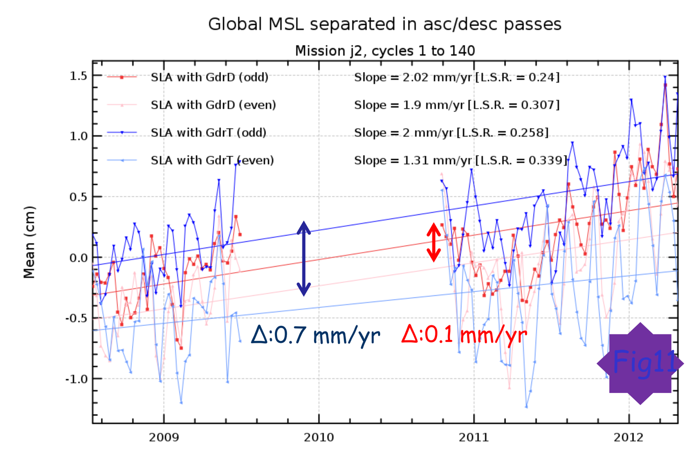
GdrT mean sea level trend is 1.76 mm/yr over the whole JA2 mission (cycle 1 to 145). Over the 2.5 yr reprocessed data, new Jason-2 MSL trend is higher by about 0.3 mm/yr than GdrT MSL trend:

⇒ Main contributor to this rise is the new radiometer wet troposphere correction

⇒ The reprocessing has first to be completed, before reliable figures can be obtained.



Thanks to the GdrD POE, the MSL trend separated in ascending and descending passes is much more homogenized for GdrD than for GdrT (fig. 11).



Summary

- The data availability of GdrD is equivalent to the one of GdrT.
- The SSH performances at crossovers are improved for GdrD: the consistency of ascending/descending SSH differences is improved.
- The reprocessing increases the Jason-2 MSL trend by ~0.3 mm/yr and the MSL trends separating ascending/descending tracks are more homogeneous for GdrD than for GdrT.

For further details concerning results of reprocessed GdrD data see: ftp://avisoftp.cnes.fr/AVISO/pub/jason-2/documentation/gdr_d_calval_report/ JA2_GDR_D_validation_report_cycles1to20_V1_1.pdf