Jason-1 GDR
Quality Assessment Report

Cycle 190

04-03-2007 / 14-03-2007

Prepared by :	M. Ablain, CLS S. Philipps, CLS P. Thibaut, CLS	
Accepted by :	J. Dorandeu, CLS	
Approved by :	N. Picot, CNES	

SALP-RP-P2-EX-21072-CLS190

Edition 01.0, May 2007

1 Introduction. Document overview

The purpose of this document is to report the major features of the data quality from the Jason-1 mission. The document is associated with data dissemination on a cycle per cycle basis.
This document reports results from Jason-1 GDRs.

The objectives of this document are:

- To provide a data quality assessment
- To provide users with necessary information for data processing
- To report any change likely to impact data quality at any level, from instrument status to software configuration
- To present the major useful results for the current cycle

It is divided into the following topics:

- **General quality assessment and cycle overview**
- **Poseidon-2 altimeter and sensor**
- **CALVAL main results**
- **Jason-1 Long term performance monitoring**
- **Mean Sea Level (MSL)**
- **Particular investigations**

2 General quality assessment and cycle overview

2.1 Software version

This cycle has been produced with the CMA Reference Software V8.0_03. The content of this science software version is described by N.Picot (electronic communication, October 21, 2005) [1]). The results presented in this report have been performed with GDR products in version B.

2.2 Cycle quality and performances

Data quality for this cycle is nominal.
Analysis of crossovers and sea surface variability indicate that system performances are close to usual values that are obtained from the TOPEX/POSEIDON data. For this cycle, the crossover standard deviation is 6.34 cm rms. When using a selection to remove shallow waters (1000 m), areas of high ocean variability and high latitudes (> |50| deg.) it decreases down to 5.26 cm rms. The standard deviation of Sea Level Anomalies (SLA) relative to a 7-year mean (based on T/P data) is 10.70 cm. When using a selection to remove shallow waters (1000 m), areas of high ocean variability and high latitudes (> |50| deg) it lowers to 9.67 cm .

- Performances from crossover differences are detailed in the dedicated **section Crossover statistics**.
- Detailed CALVAL results are presented in **section 3**.
- Note that for this cycle, minimum values of orbit are outside of ± 1km window.

2.3 Missing measurements

This cycle has no missing pass. Missing measurements relative to a nominal ground track are plotted on **section Missing measurements**.

2.4 End of scientific mission for TOPEX/Poseidon

Since cycle 139, there are no results from intercalibration between Jason-1 and TOPEX/Poseidon data. During TOPEX/Poseidon cycle 481, on 9th October 2005, the pitch reaction wheel showed an anomalous behavior, followed by stalling. Despite of several attempts to restart the wheel, it continues to stop working after a short warm-up phase. In consequence the TOPEX/Poseidon satellite is currently in a sun-pointing safe mode on two-wheel control.

3 Poseidon-2 altimeter and sensor

3.1 Sensor status

A detailed assessment of the Poseidon-2 sensor is made in a separate bulletin to be made available on request.

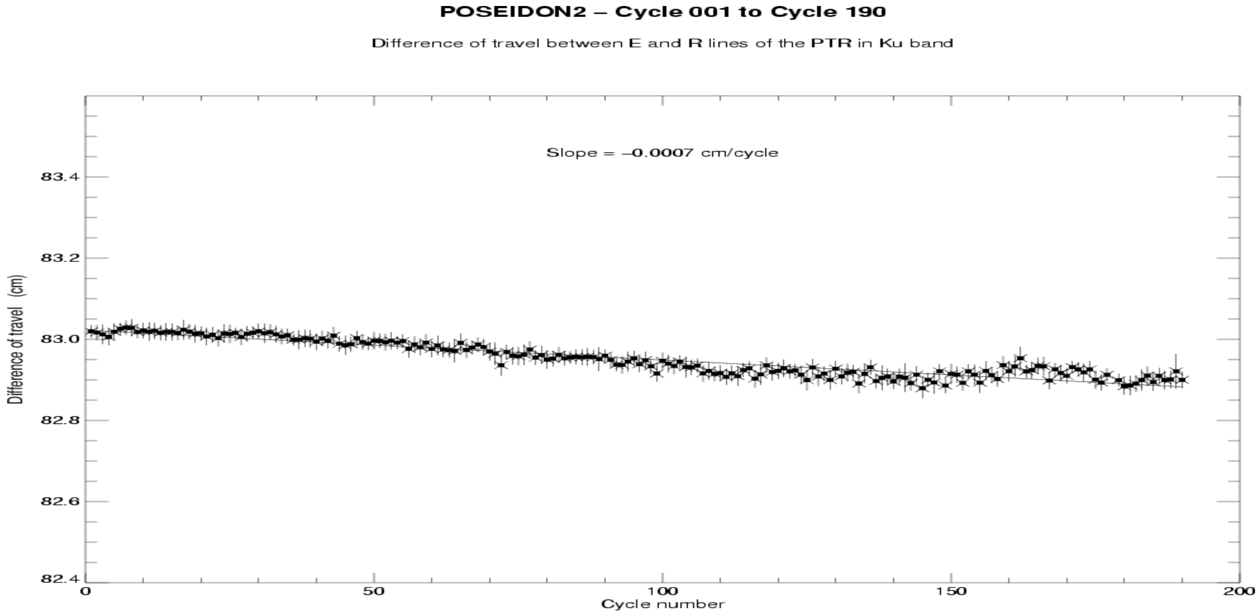
3.2 Poseidon-2 altimeter status

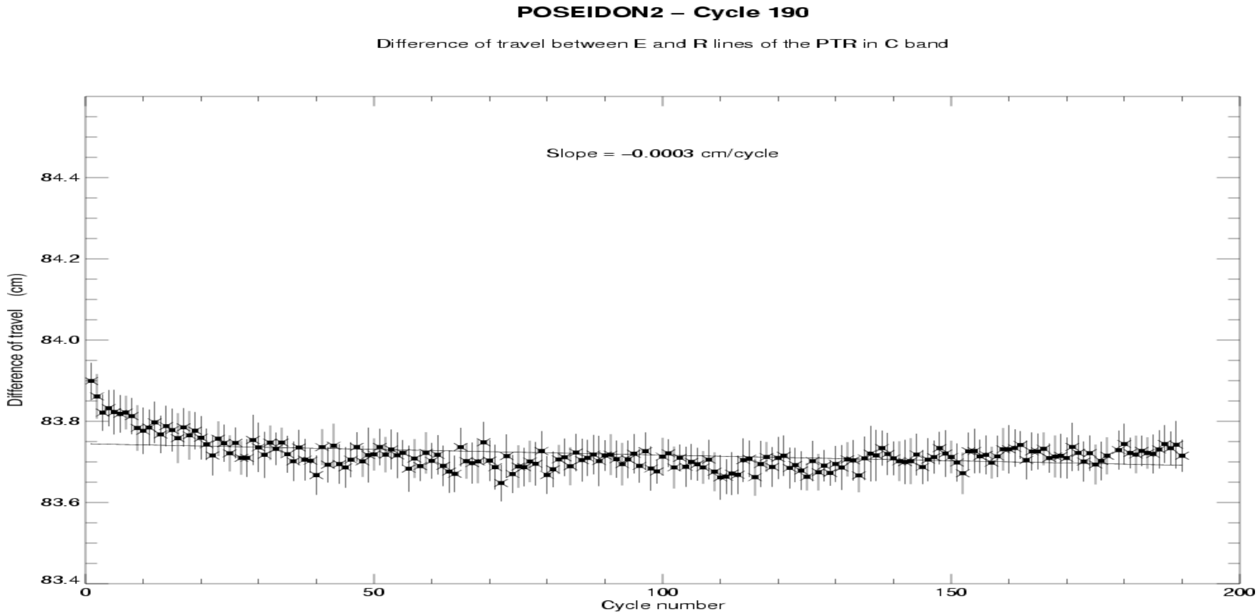
This section presents the general status of the altimeter for main instrumental variations through the Jason-1 mission. Two calibration modes are used to monitor the altimeter internal drifts and compute the altimetric parameters. They are programmed about three times per day, over land.
The CAL1 mode measures the Point Target Response (PTR) of the altimeter in Ku and C bands. Among the parameters extracted from the PTR are:

- the internal path delay
- the total power of the PTR

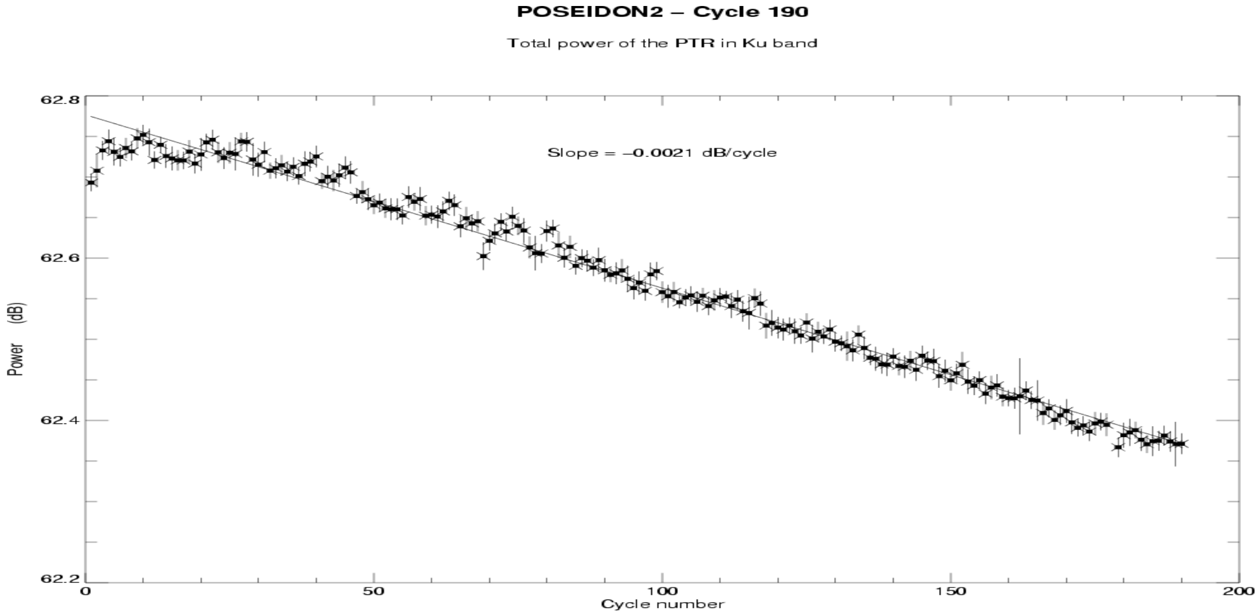
The evolutions of these parameters as a function of time are plotted to monitor the ageing of the altimeter.
Notice that in the Jason-1 products, the range is corrected for the internal path delay and the backscatter coefficient takes into account the total power of the measured PTR.

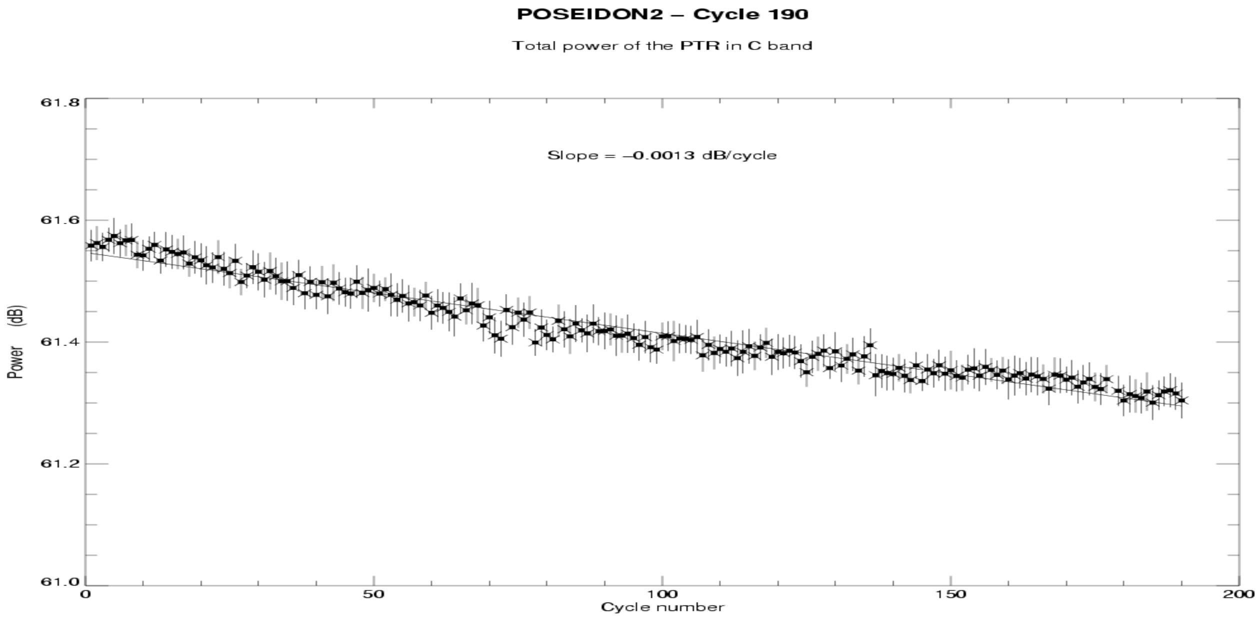
3.2.1 Monitoring of the internal path delay





3.2.2 Monitoring of the total power in the PTR



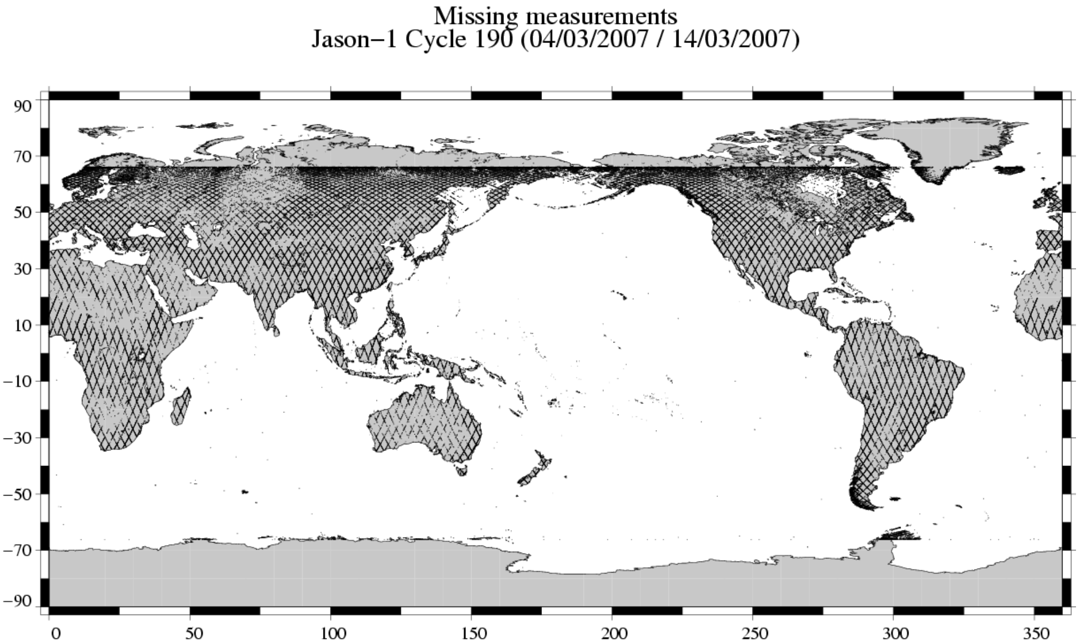


4 CALVAL main results

This section presents results that illustrate data quality during this cycle. These verification products are produced operationally so that they allow systematic monitoring of the main relevant parameters.

4.1 Missing measurements

The map below illustrates missing 1Hz measurements in the GDRs, with respect to a 1 Hz sampling of a nominal repeat track.



4.2 Edited measurements

Editing criteria are defined for the GDR product in Aviso and PODAAC User Handbook [2].
The editing criteria are defined as minimum and maximum thresholds for various parameters. Measurements are edited if at least one parameter does not lie within those thresholds. These thresholds are expected to remain constant throughout the Jason-1 mission, so that monitoring the number of edited measurements allows a survey of data quality.
In the following, only measurements over ocean are kept. This is done by applying an ocean-land mask, instead of using the altimeter state flag (alt_state_flag) or the radiometer state flag (rad_state_flag). There is no impact on global performance estimations since the more significant results are derived from analyses in open ocean areas.
The rain flag is not used for data selection since it is not yet tuned.

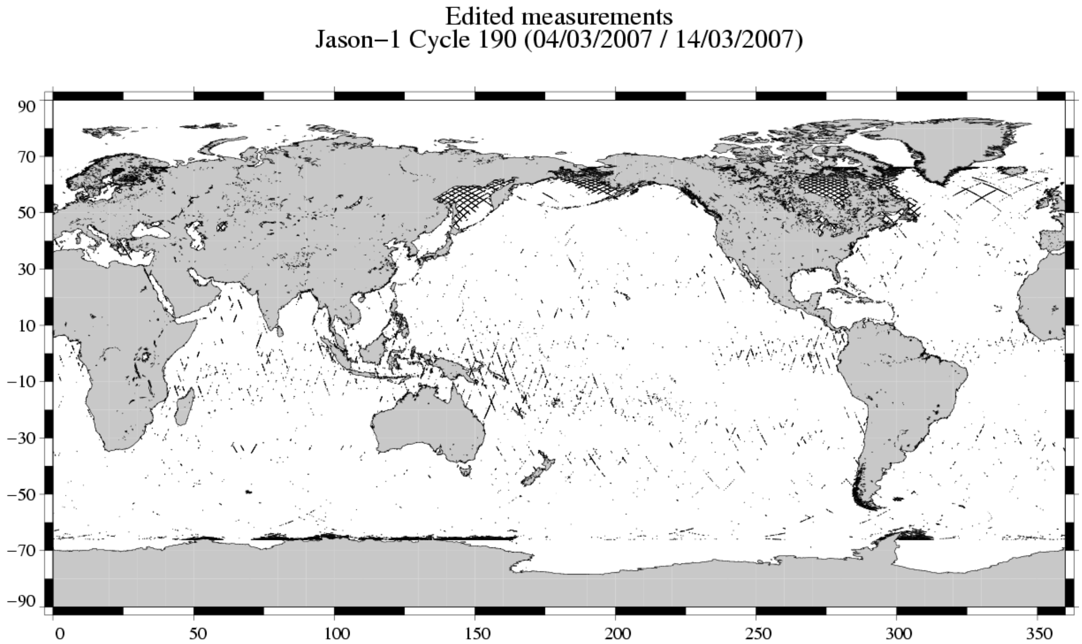
The number and percentage of points removed by each criterion is given on the following table. Note that these statistics are obtained with measurements already edited for ice flag (4.11 % of points removed).

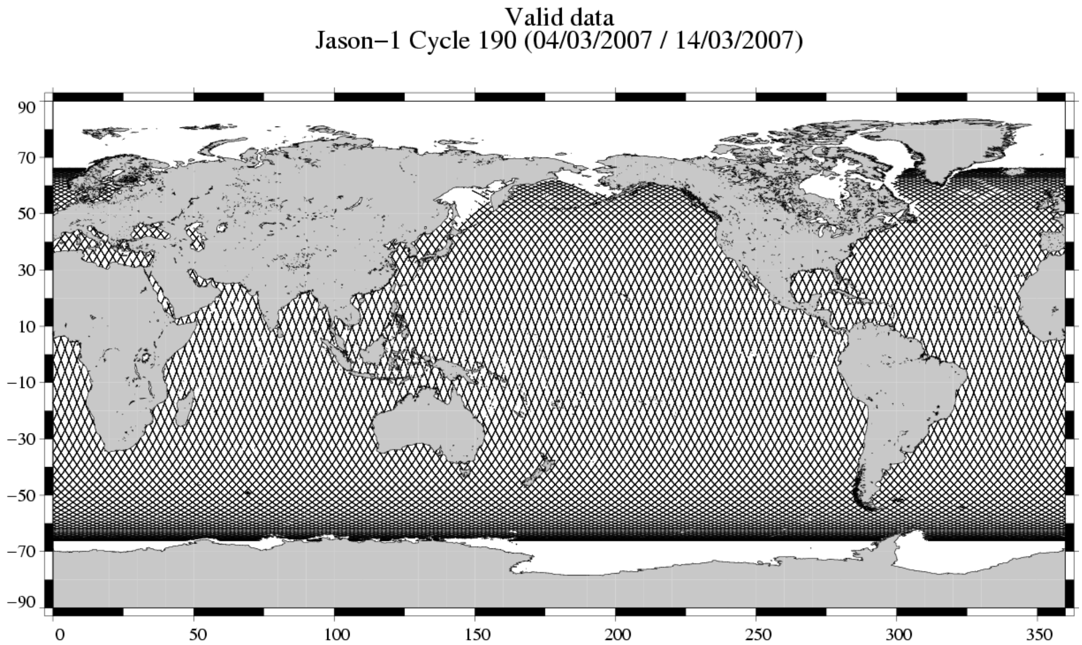
Instead of the ice flag available in the GDR, an ice flag similar to ERS ice flag was used. It takes into account the difference between (dualfrequency) radiometer and ecmwf model wet troposphere correction. It has the advantage to better detect sea ice in the Hudson Bay, which was previously only removed by the other parameters.

Parameters	Min threshold	Max threshold	Unit	Nb removed	% removed	% mean removed
Sea surface height	-130.000	100.000	m	3646	0.65	0.75
Sea level anomaly	-2.000	2.000	m	6289	1.11	1.40
Nb measurements of range	10.000	_	_	5312	0.94	1.09
Std. deviation of range	0.000	0.200	m	6493	1.15	1.28
Square off nadir angle	-0.200	0.640	deg^2	2319	0.41	0.48
Dry tropospheric correction	-2.500	-1.900	m	0	0.00	0.00
Combined atmospheric correction	-2.000	2.000	m	0	0.00	0.00
JMR wet tropospheric correction	-0.500	-0.001	m	508	0.09	0.17
Ionospheric correction	-0.400	0.040	m	5113	0.90	1.08
Significant wave height	0.000	11.000	m	2935	0.52	0.55
Sea State Bias	-0.500	0.000	m	4364	0.77	0.91
Backscatter coefficient	7.000	30.000	dB	2700	0.48	0.51
Nb measurements of sigma0	10.000	_	_	5252	0.93	1.08
Std. deviation of sigma0	0.000	1.000	dB	7896	1.40	1.61
Ocean tide	-5.000	5.000	m	228	0.04	0.04
Equilibrium tide	-0.500	0.500	m	0	0.00	0.00
Earth tide	-1.000	1.000	m	0	0.00	0.00
Pole tide	-15.000	15.000	m	0	0.00	0.00
Altimeter wind speed	0.000	30.000	$m.s^{-1}$	4364	0.77	0.91
Global statistics of edited measurements by thresholds	_	_	_	14301	2.53	2.94

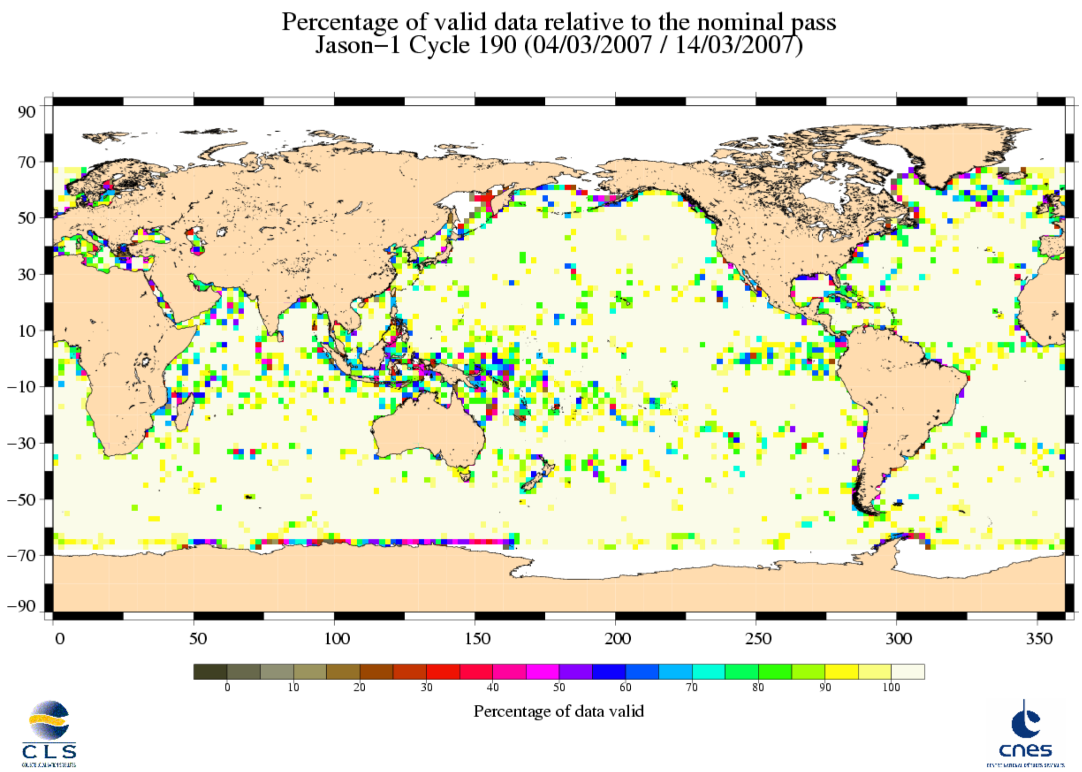
4.2.1 Figures

The following two maps are complementary: they show respectively the removed and selected measurements in the editing procedure.





The next map shows the percentage of valid measurements by sample.



4.2.2 Comments

Wet zones appear in the plot of removed data, as it was also the case for Topex and Poseidon altimeters: measurements may be corrupted by rain. Compared with the usual maps obtained for Topex, there are less removed data in these zones and in the areas of strong sea states.

4.2.3 Impact of product version "b"

The new MLE4 retracking algorithm based on a second-order altimeter echo model is more robust for large off-nadir angles (up to 0.8 degrees). For product version "a" (previous CMA version 6.3), the maximum threshold on square off-nadir angle proposed in Jason-1 User Handbook document was set to 0.16 deg^2. Henceforth, this threshold is too restrictive and has to be set to 0.64 deg^2.

However, this editing criteria had the side effect of removing some bad measurements impacted by rain cells, sigma0 blooms or ice. With the new threshold (0.64 deg^2), these measurements are not rejected any more even though the estimated SSH is not accurate for such waveforms.
Therefore 2 new criteria have to be added to check for data quality:

- Standard deviation on Ku sigma0 $\leq$ 1 dB
- Number measurements of Ku sigma0 $\geq$ 10

The Jason-1 User Handbook suggests the following editinig criteria for the version "a" GDRs:

- -0.2 $deg^2 \leq$ square of off-nadir angle from waveforms (off_nadir_angle_ku_wvf) $\leq$ 0.16 deg^2
- sigma0_rms_ku < 0.22 dB (optional criterion)

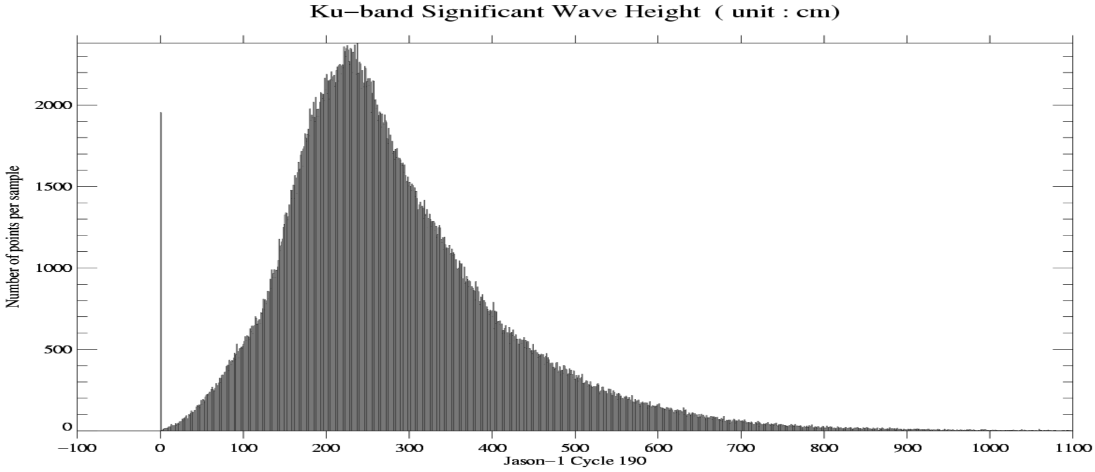
For the version "b" GDRs these two edit criteria should be replaced by:

- -0.2 $deg^2 \leq$ square of off-nadir angle from waveforms (off_nadir_angle_ku_wvf) $\leq$ 0.64 deg^2
- and sigma0_rms_ku $\leq$ 1.0 dB
- and sig0_numval_ku $\geq$ 10

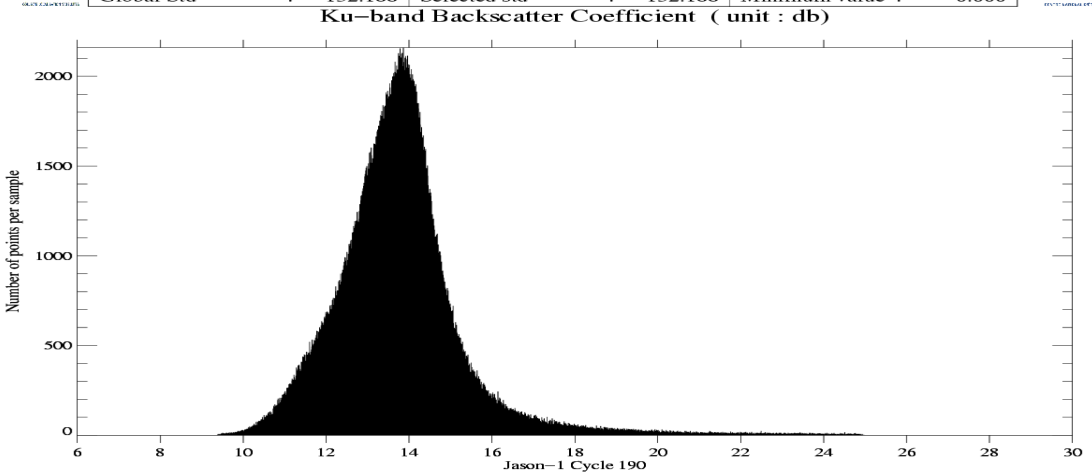
With these new criteria, the editing gives similar results for both product versions. Most of anomalous SSH measurements are rejected. Please note that some of them are still not detected, in particular close to sea ice. This is due to the ice flag which is not perfect.

4.3 Altimeter parameters

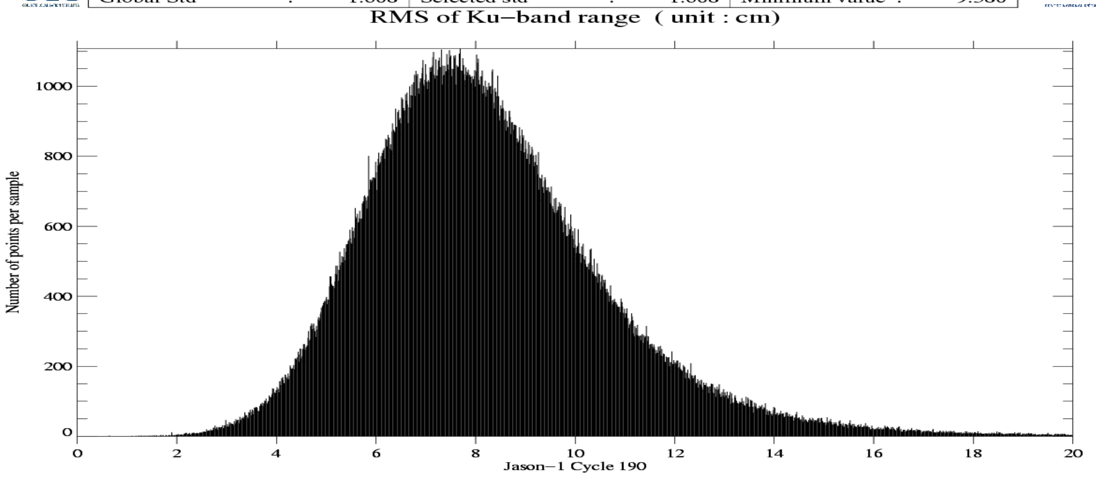
In order to assess and to monitor altimeter parameter measurements, histograms of Jason-1 Ku-band Significant Wave Height (SWH), Backscatter coefficient (Sigma0) and RMS of altimeter range are computed for the valid data set previously defined.



Global nb of points	:	550494	Sel. nb of points	:	550494	Sample interval	:	1.000
Global mean	:	281.064	Selected mean	:	281.064	Maximum value	:	1099.400
Global Std	:	132.188	Selected std	:	132.188	Minimum value	:	0.000



Global nb of points	:	550494	Sel. nb of points	:	550494	Sample interval	:	0.010
Global mean	:	13.767	Selected mean	:	13.767	Maximum value	:	24.970
Global Std	:	1.608	Selected std	:	1.608	Minimum value	:	9.380

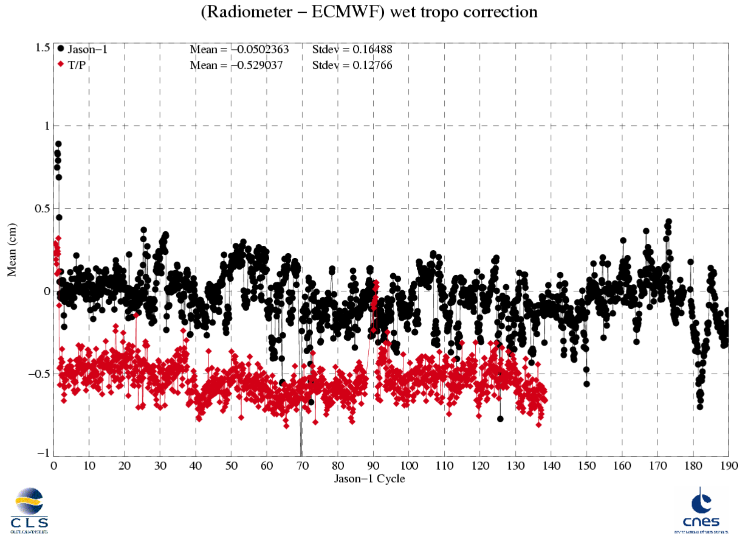


Global nb of points	:	550494	Sel. nb of points	:	550492	Sample interval	:	0.010
Global mean	:	8.194	Selected mean	:	8.194	Maximum value	:	20.000
Global Std	:	2.360	Selected std	:	2.360	Minimum value	:	0.630

4.4 Radiometer parameters

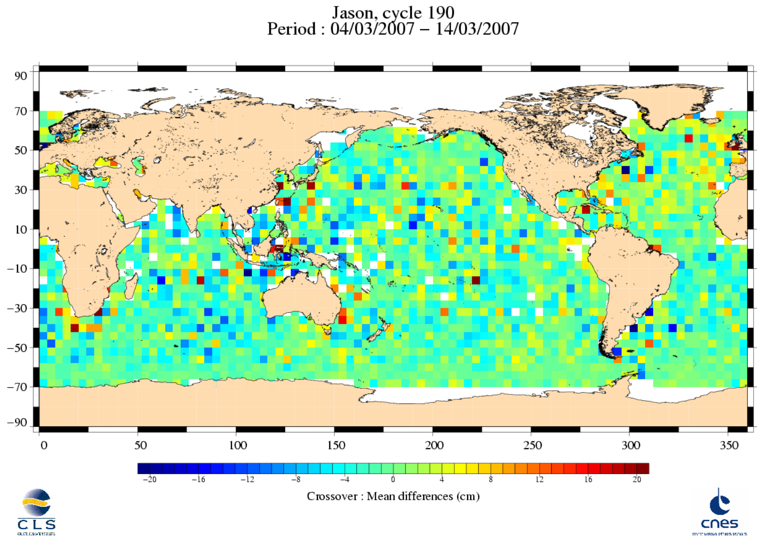
Daily mean of (Radiometer - ECMWF) wet troposphere corrections is plotted below for Jason-1 and T/P. Note that the TMR correction has been corrected for the drift (Sharroo R. et al., 2004 [4]). Moreover the 60-day signal due to TOPEX yaw maneuvers has been partially removed. Since 9th october 2005 scientific mission of TOPEX has stopped.
JMR wet troposphere correction in GDR version "a", used to show a 60-day signal due to Jason-1 yaw maneuvers, as well as jumps. These anomalies are now corrected in the GDR version "b". Nevertheless this long term monitoring exhibits still abnormal variations:

- The 60-day signals due to Jason-1 yaw maneuvers is sometimes still visible.
- After the safehold mode (during cycles 177 to 179), JMR-ECMWF wet troposphere correction decreases about 7 mm, before comming back to normal.



4.5 Crossover statistics

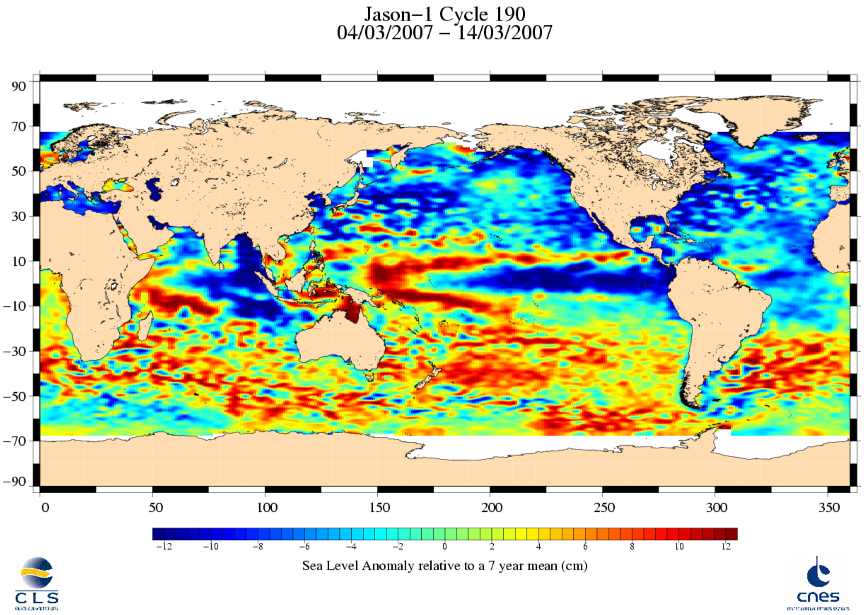
SSH crossover statistics are computed from the valid data set. They are used to estimate the data quality and to monitor the system performances.
After data editing and using the standard Jason-1 algorithms, the crossover standard deviation is about 5.26 cm rms, when using a selection to remove shallow waters (1000 m), areas of high ocean variability and high latitudes (> |50| deg.).
The map of the mean differences at crossovers (4 by 4 degrees by bins) is plotted below.

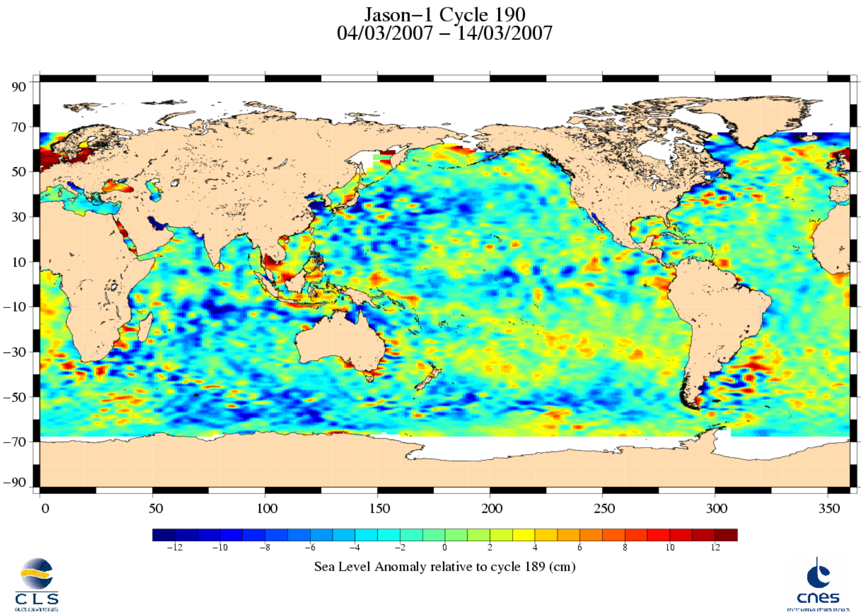


4.6 SSH variability

4.6.1 Jason-1 Sea Level Anomalies

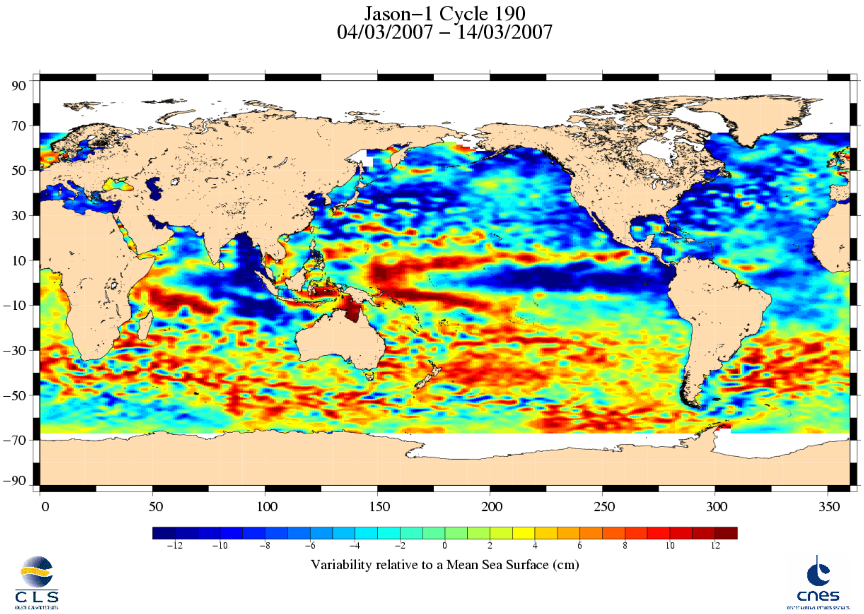
Repeat-track analysis is routinely used to compute Sea Level Anomalies (SLA) relative to the previous cycle and relative to a mean profile. SLA relative to a 7-year mean (based on TOPEX/Poseidon data) shows general oceanic features in good agreement with what is observed with TOPEX/Poseidon. The SSH differences relative to the previous cycle 189 are plotted on the bottom figure. The differences seem homogeneous and do not exhibit any particular trackiness pattern, showing the good quality of the orbit calculation in the Jason-1 GDRs.

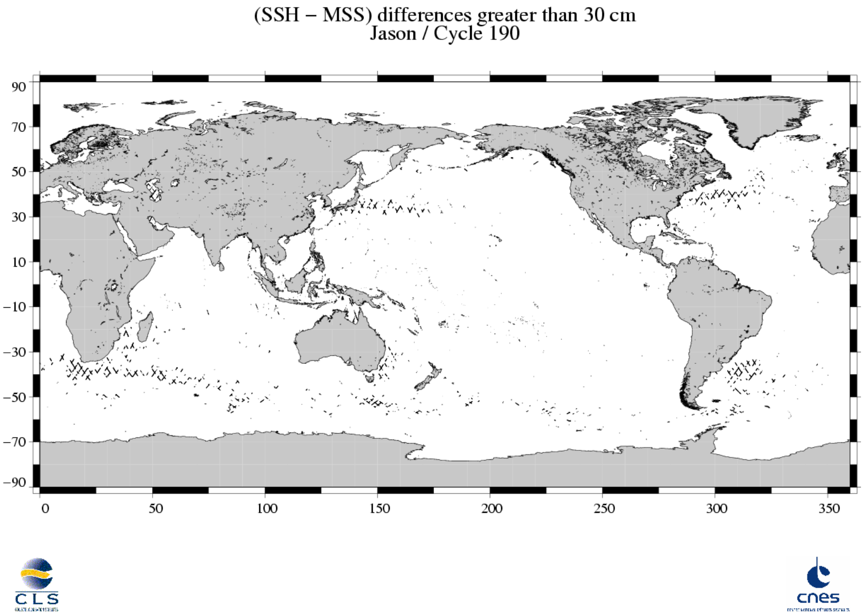




4.6.2 Comparison to a Mean Sea Surface

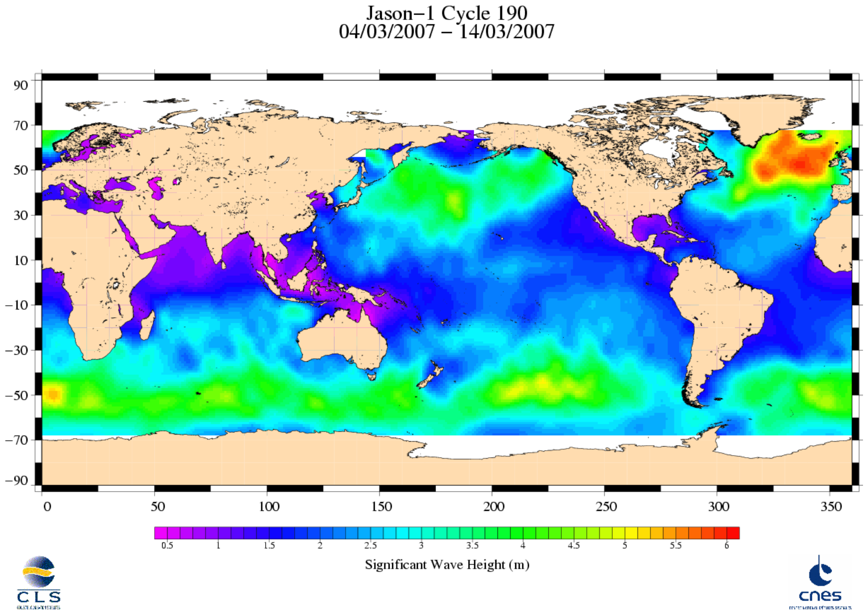
The following two maps respectively show the map of Jason-1 SLA relative to the MSS and differences higher than a 30 cm threshold (after centering the data). The latter figure shows that apart from isolated measurements that should be removed after refining the editing thresholds, higher differences are located in high ocean variability areas, as expected.

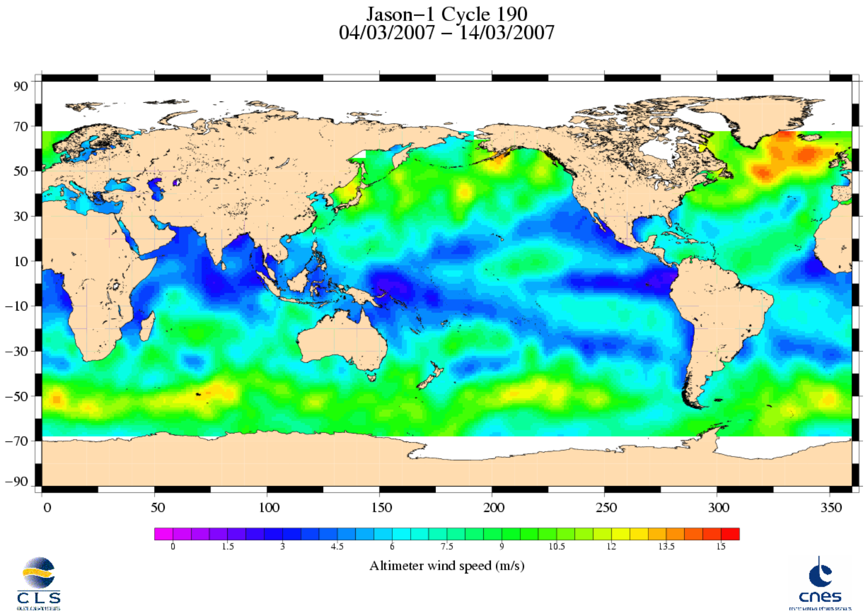




4.7 Wind and wave maps

These two figures show wind and wave estimations derived from 10 days of altimeter measurements.





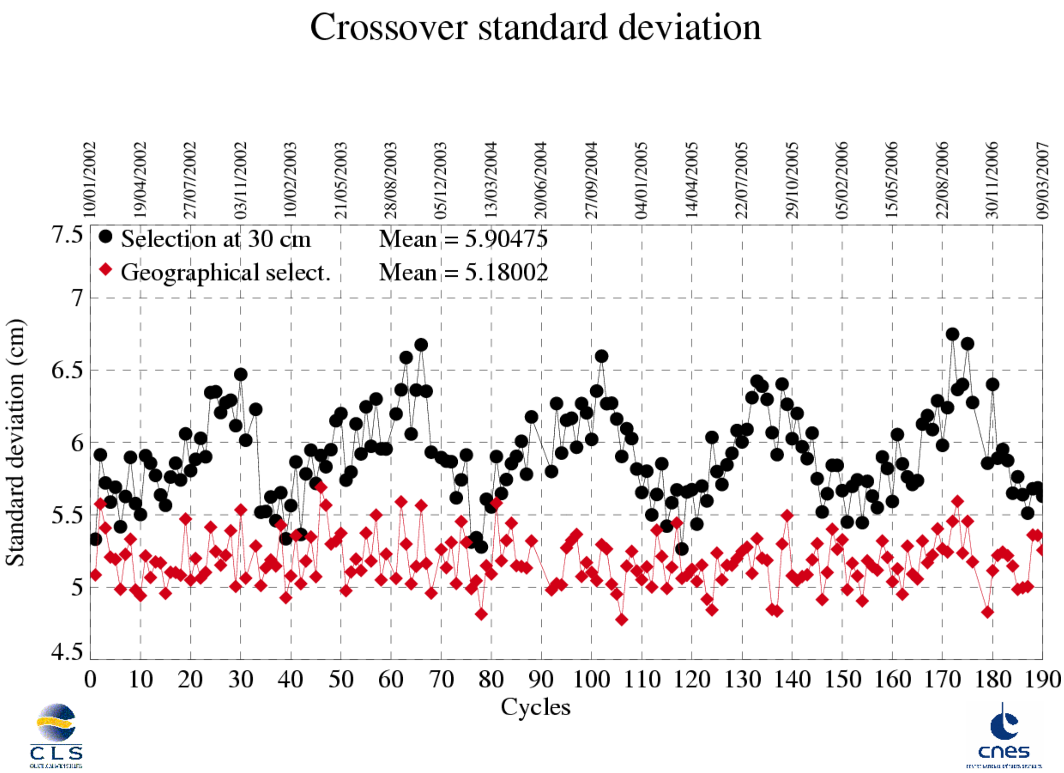
5 Jason-1 long term performance monitoring

Statistics of SSH variability are computed after crossover and repeat-track analyses. This allows to estimate how Jason-1 data fulfill the mission objectives in terms of performances.

5.1 Standard deviation of the differences at crossovers

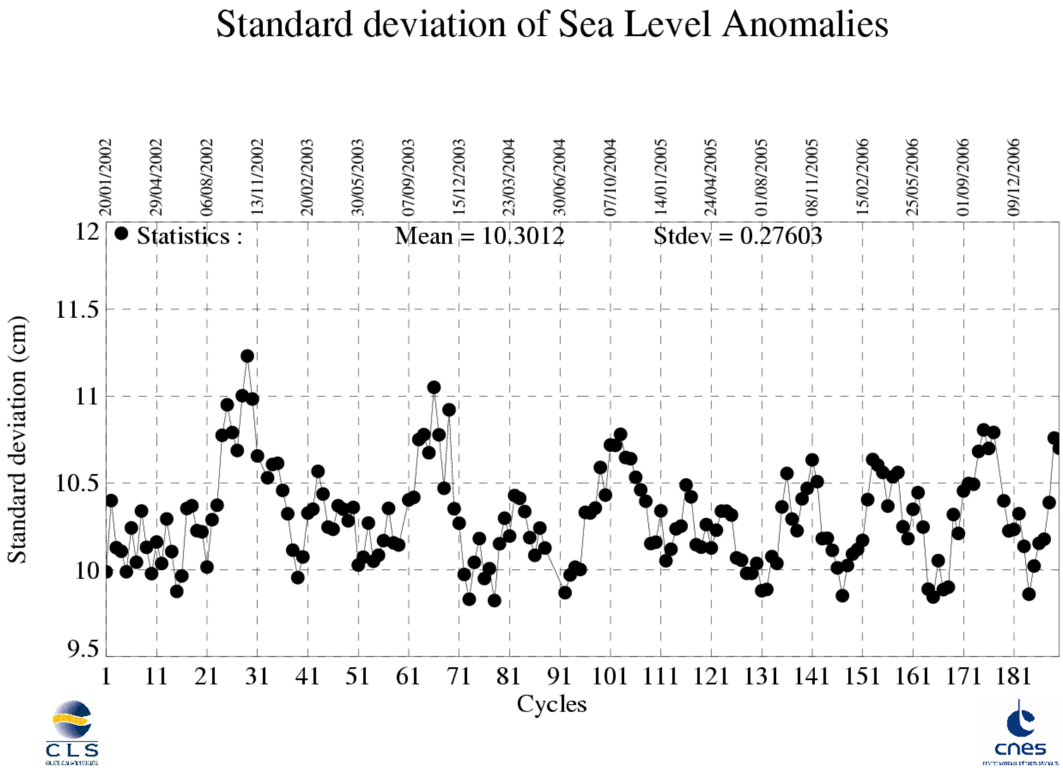
This parameter is plotted as a function of time in a one cycle per cycle basis in the figure below. It is computed after data editing and using 2 additional selection criteria:

- Selecting crossover differences lower than 30 cm to avoid contamination by remaining spurious data.
- Removing shallow waters (1000 m), areas of high ocean variability and high latitudes (> |50| deg.) to avoid ice coverage effects.



5.2 RMS of Sea Level Anomaly

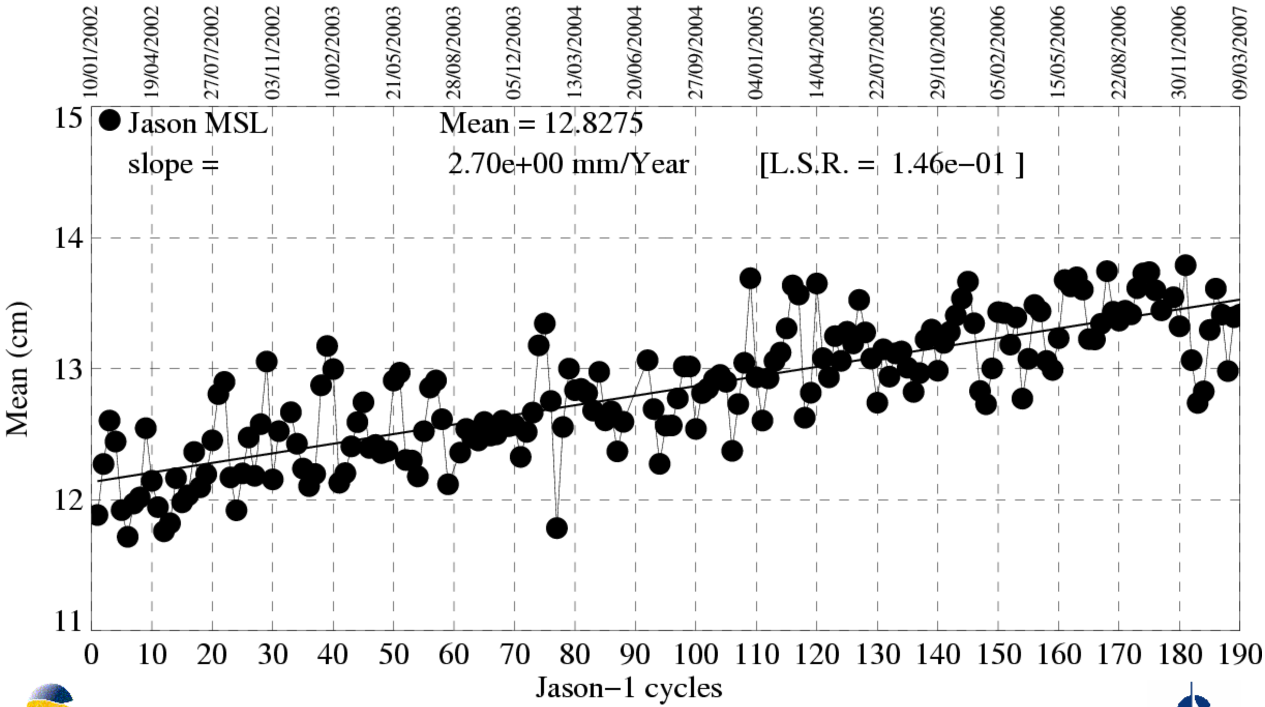
Sea Level Anomalies relative to a mean profile are computed using repeat-track analysis for each Jason-1 cycle. To monitor Jason-1 performances and ocean signals, the cycle per cycle standard deviation of the SLA is plotted as a function of time.



6 Mean Sea Level estimations (MSL)

6.1 Jason-1 MSL

MSL estimations are performed in a cycle basis averaging Sea Level Anomalies relative to a mean profile. The value for each cycle is calculated from averaging over 2 by 3 degree bins, then weighting by latitude to take into account the relative geographical area represented by the bin. Results plotted on the following figure is obtained after annual, semi-annual and 60-day signals reduction. Moreover the JMR correction has been replaced by the ECMWF model wet troposphere correction in order to remove the effect of the JMR slopes.



7 Particular investigations

No particular investigations have been performed on this cycle.

References

[1] Picot N., October 21, 2005: New Jason-1 operational production chain. *Electronic communication.*

[2] Aviso and PODAAC User Handbook, April 2003: IGDR and GDR Jason User Products, *SMM-MU-M5-OP-13184-CN.*

[3] Gaspar, P., S. Labroue & F. Ogor, October 2002: Improving nonparametric estimates of the sea state bias in radar altimeter measurements of sea level *J. Atmos. Oceanic Technol.,* **19,** 1690-1707.

[4] R. Sharroo, J.L. Lillibridge, W.H.F. Smith January-June 2004: Cross-Calibration and Long-Term Monitoring of the Microwave Radiometers of ERS, TOPEX, GFO, Jason, and Envisat. *Marine GEODESY,***27,** 279-297.

[5] O.Z.Zanife, P.Vincent, L.Amarouche, J.P.Dumont, P.Thibaut, and S.Labroue, December 2003: Comparison of the Ku-Band Range Noise Level and the relative Sea State Bias of the Jason-1, TOPEX and POSEIDON-1 Radar altimeters *Marine GEODESY,***26,** 201-238.

[6] J. Dorandeu, M. Ablain, Y. Faugere, F. Mertz & B. Soussi, 2004: Jason-1 global statistical evaluation and performance assessment. Calibration and cross-calibration results. *Marine GEODESY,***27,** 345-372.