Jason-1 GDR
Quality Assessment Report

Cycle 123

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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:

2 General quality assessment and cycle overview

2.1 Software version

This cycle has been produced with the CMA Reference Software V6.3_05. The content of this science software version is described in (Vincent et al., 2003 [1]).

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 6.72 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 5.81 cm rms.
The standard deviation of Sea Level Anomalies (SLA) relative to a 7-year mean (based on T/P data) is 10.62 cm. When using a selection to remove shallow waters (1000 m), areas of high ocean variability and high latitudes (> |50| deg) it lowers to 9.68 cm .

- Performances from crossover differences are detailed in the dedicated **section Crossover statistics**.
- Detailed CALVAL results are presented in **section 3**.

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 General warnings

2.4.1 Jason-1 Radiometer wet troposphere correction

Several scientific applications are impacted by some unusual variations detected on Jason-1 Radiometer wet troposphere correction. For instance the long term monitoring of mean sea level is less accurate as a result of jumps observed on the JMR correction. For more information about the JMR correction, see section TP and Jason-1 Radiometer wet troposphere correction comparisons, page 22.

2.4.2 Altimeter wind speed default values

The altimeter wind speed algorithm was adjusted on TOPEX data before the Jason-1 launch. It gives very few negative values which are set to default values in the GDR. The user may note that a valid SSB value is present in the product when altimeter wind speed values are set to default : this is because negative wind values enter the SSB algorithm; such a feature remain to be corrected to clean up the wind algorithm. It is also clear that the wind algorithm should be better tuned to Jason-1 data in the near future.

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.

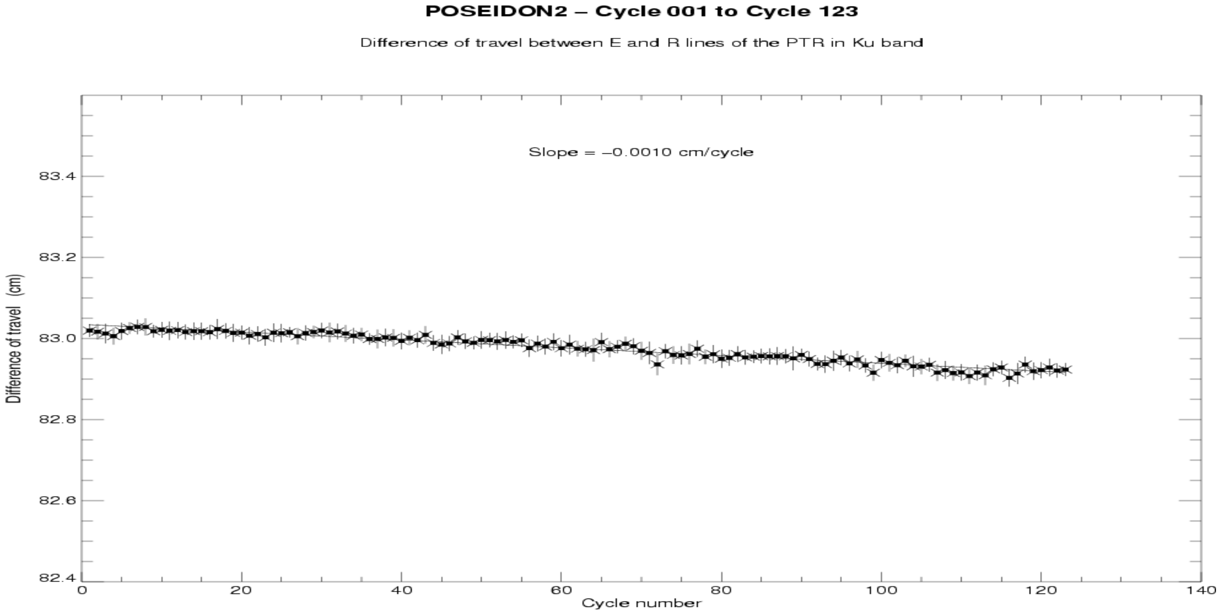
3.2 Poseidon-2 altimeter status

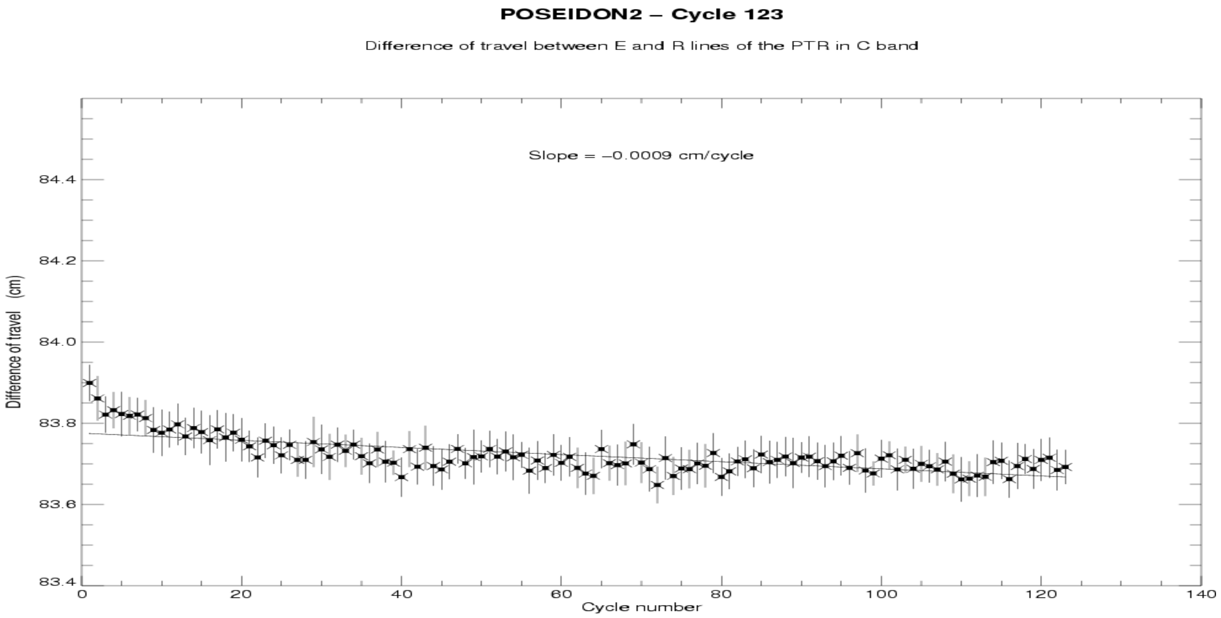
This section presents the general status of the altimeter for main instrumental variations through the Jason-1 mission. Two calibration modes are used to monitor the altimeter internal drifts and compute the altimetric parameters. They are programmed about three times per day, over land.
The CAL1 mode 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

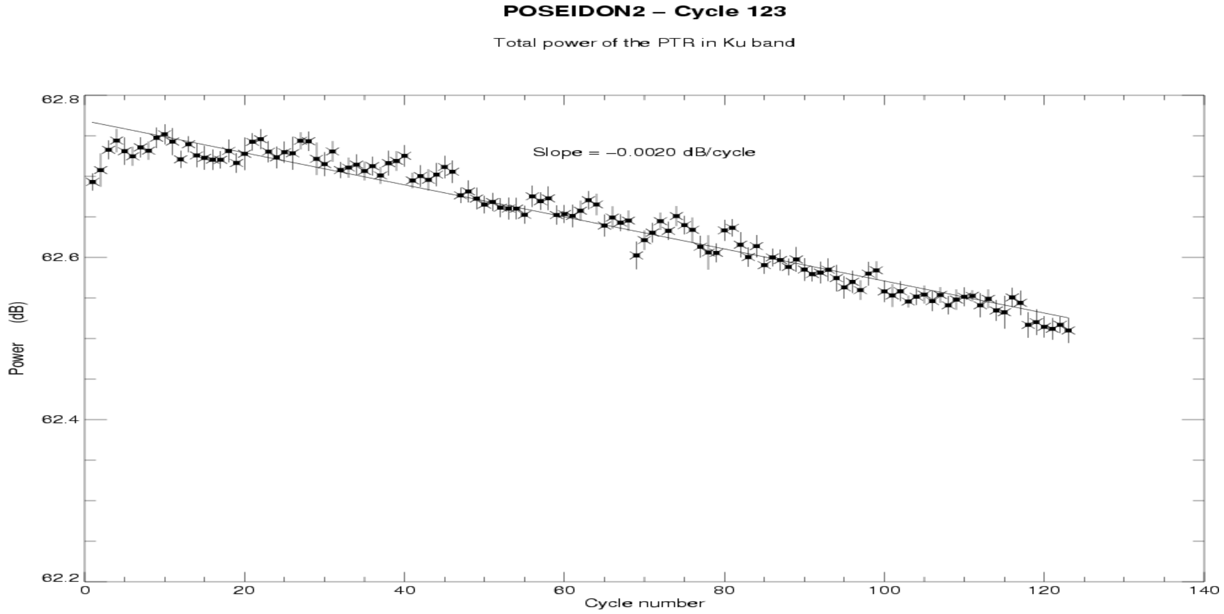
The evolutions of these parameters as a function of time are plotted to monitor the ageing of the altimeter.
Notice that in the Jason-1 products, the range is corrected for the internal path delay and the backscatter coefficient takes into account the total power of the measured PTR.

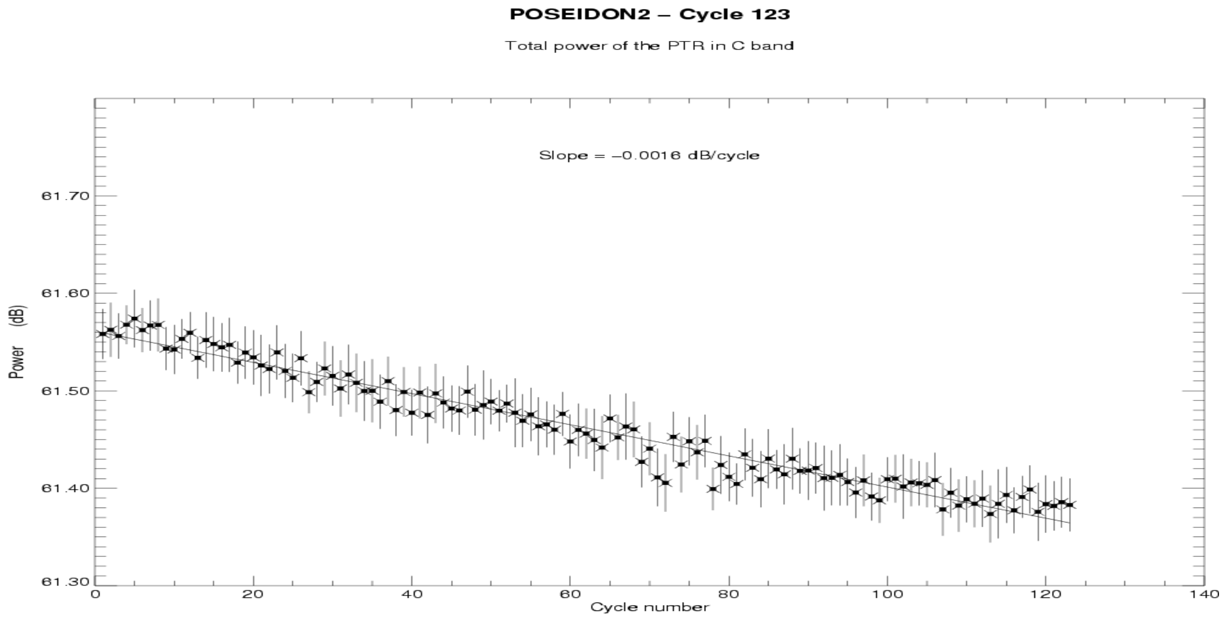
3.2.1 Monitoring of the internal path delay





3.2.2 Monitoring of the total power in the PTR



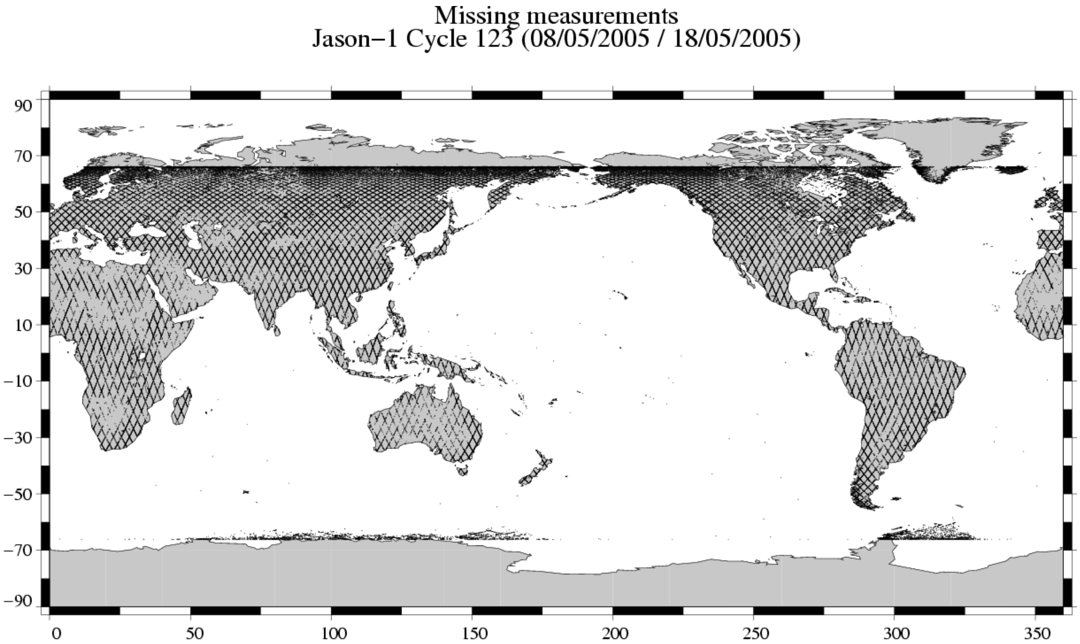


4 CALVAL main results

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

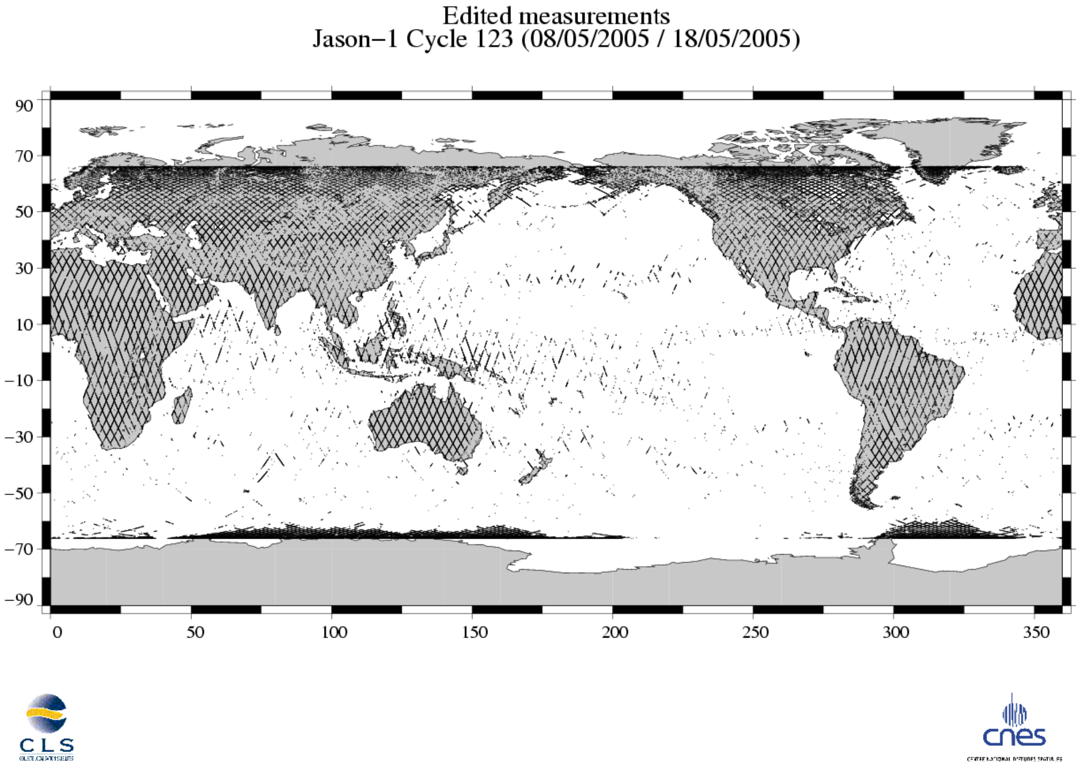
Editing criteria are defined for the GDR product in Aviso and PODAAC User Handbook [2]. The editing criteria are defined as minimum and maximum thresholds for various parameters. Measurements are edited if at least one parameter does not lie within those thresholds. These thresholds are expected to remain constant throughout the Jason-1 mission, so that monitoring the number of edited measurements allows a survey of data quality.
In the following, the altimeter state flag (alt_state_flag) is used instead of the radiometer state flag (rad_state_flag). Indeed, this allows to keep more data near the coasts and then to detect potential anomalies in these areas. Furthermore, 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.

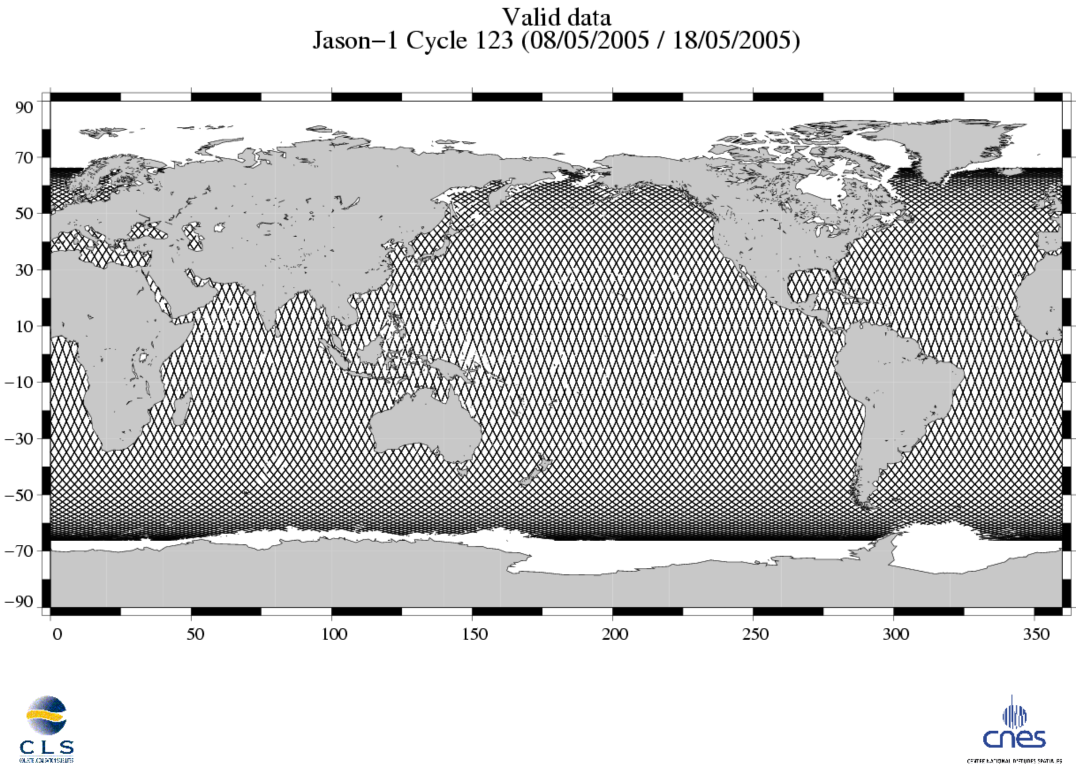
The number and percentage of points removed by each criterion is given on the following table. Note that these statistics are obtained with measurements already edited for altimeter land flag (14.99 % of points removed) and ice flag (6.72 % of points removed).

Parameters	Min threshold	Max threshold	Unit	Nb removed	% removed	% mean removed
Sea surface height	-130.000	100.000	m	9197	1.67	1.66
Sea level anomaly	-10.000	10.000	m	13116	2.38	2.25
Nb measurements of range	10.000	_	_	11433	2.07	2.08
Std. deviation of range	0.000	0.200	m	11916	2.16	2.13
Square off nadir angle	-0.200	0.160	deg^2	10057	1.82	1.75
Dry tropospheric correction	-2.500	-1.900	m	0	0.00	0.007
Inverted barometer correction	-2.000	2.000	m	0	0.00	0.005
JMR wet tropospheric correction	-0.500	-0.001	m	1070	0.19	0.20
Ionospheric correction	-0.400	0.040	m	11170	2.02	1.85
Significant wave height	0.000	11.000	m	7608	1.38	1.32
Sea State Bias	-0.500	0.000	m	7284	1.32	1.35
Backscatter coefficient	7.000	30.000	dB	6596	1.19	1.13
Ocean tide	-5.000	5.000	m	4931	0.89	0.85
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	$m.s^{-1}$	9357	1.69	1.61
Global statistics of edited measurements by thresholds	_	_	_	22072	4.00	3.70

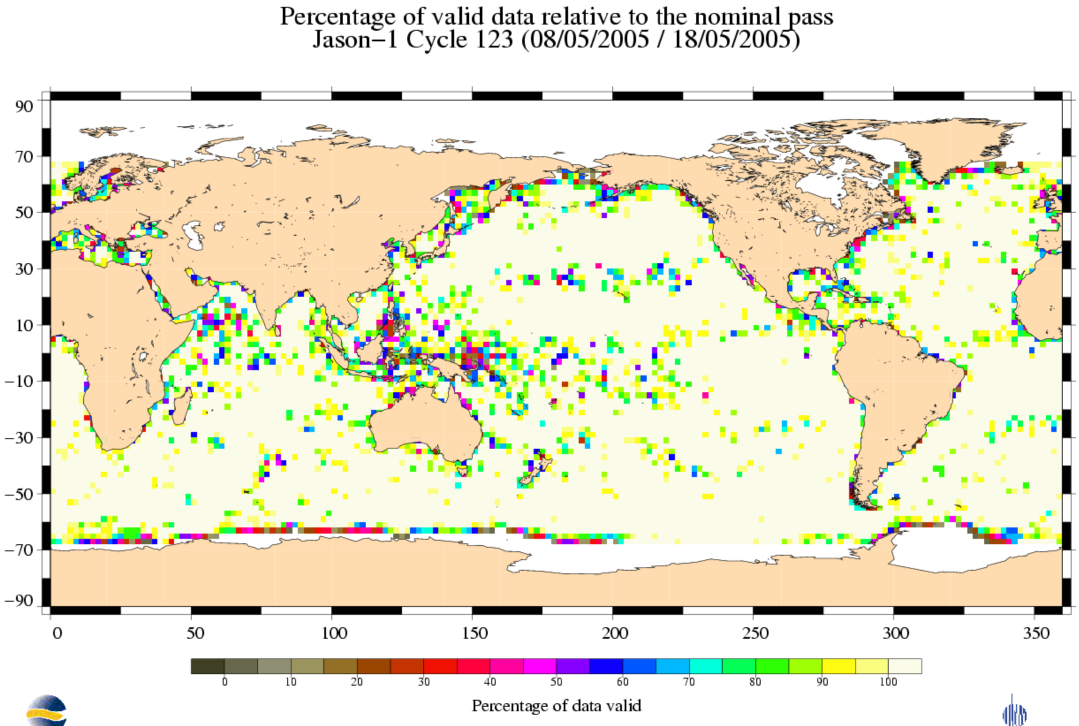
4.2.1 Figures

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.

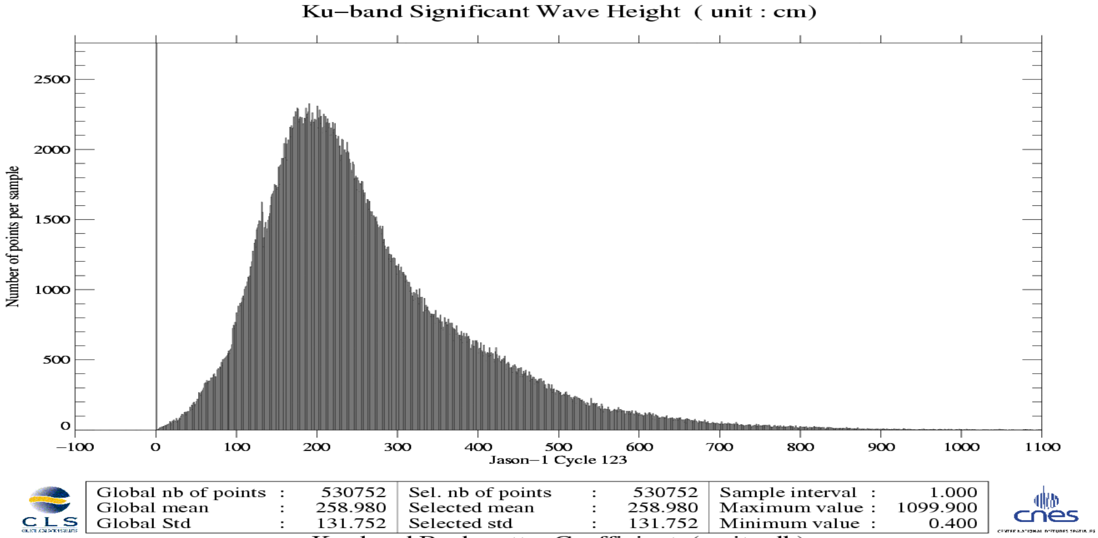


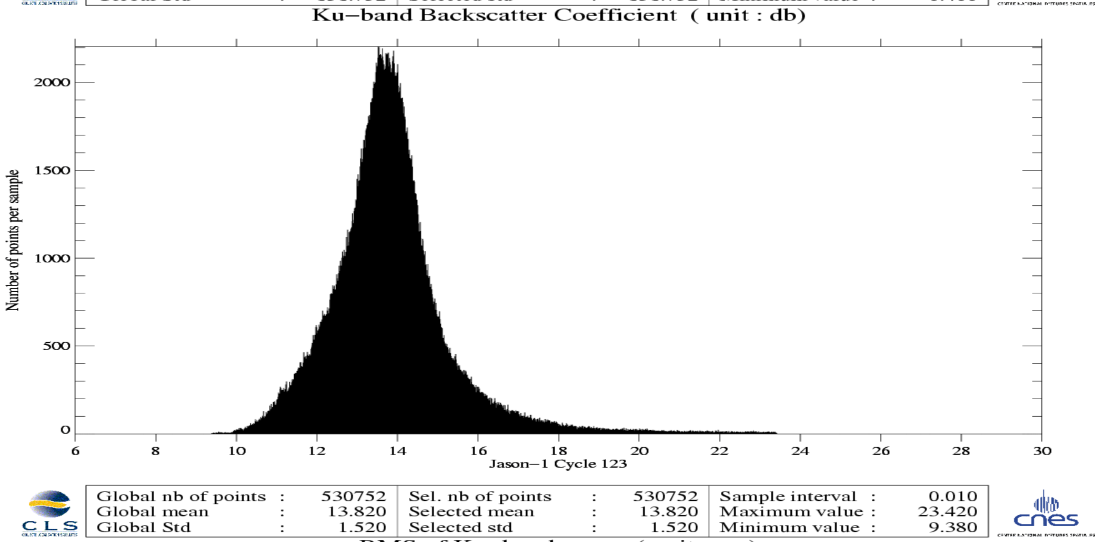
4.2.2 Comments

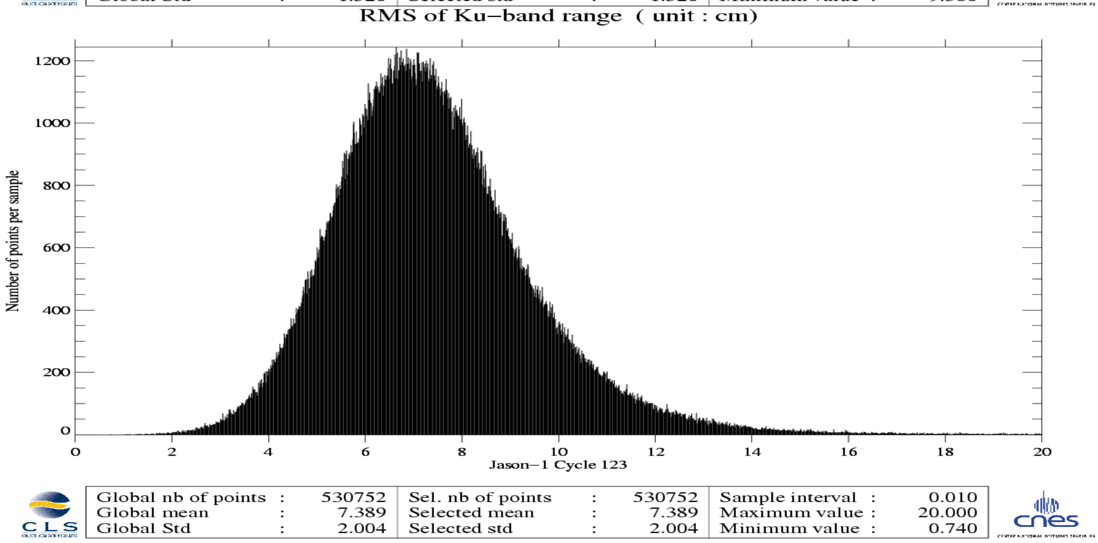
For the purpose of this quality assessment report, the GOT99.2 GDR field tide model has been replaced by GOT99.3 since the former is not available over the Black Sea, the Caspian and the Baltic sea.
Wet zones appear in the plot of removed data, as it was also the case for Topex and Poseidon altimeters: 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.

4.3 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.

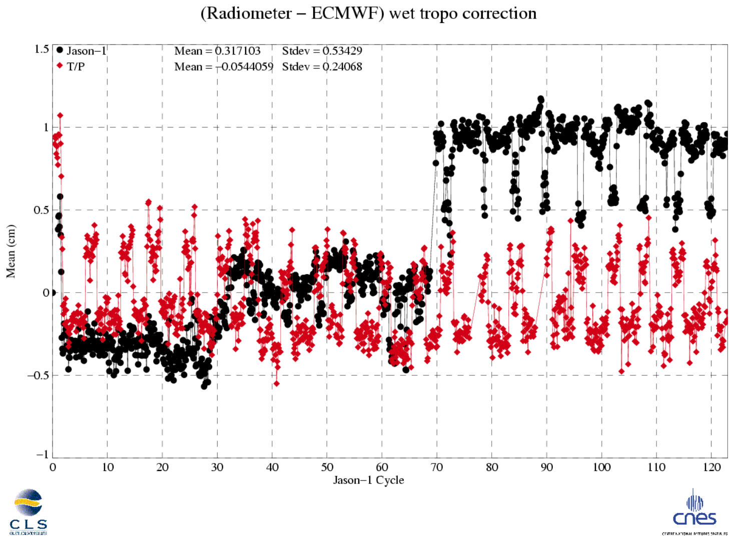






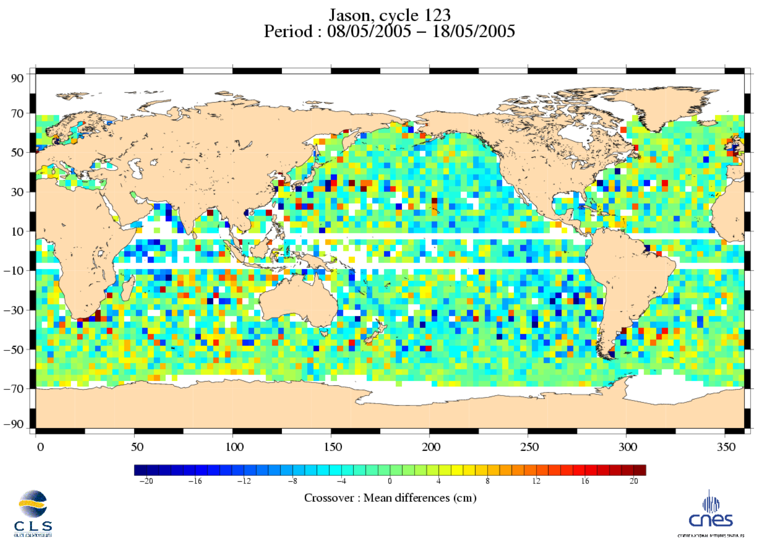
4.4 Radiometer parameters

Daily mean of (Radiometer - ECMWF) wet troposphere corrections is plotted below for Jason-1 and T/P. The signals observed on this figure are explained on the section TP and Jason-1 Radiometer wet troposphere correction comparisons, page 22.



4.5 Crossover statistics

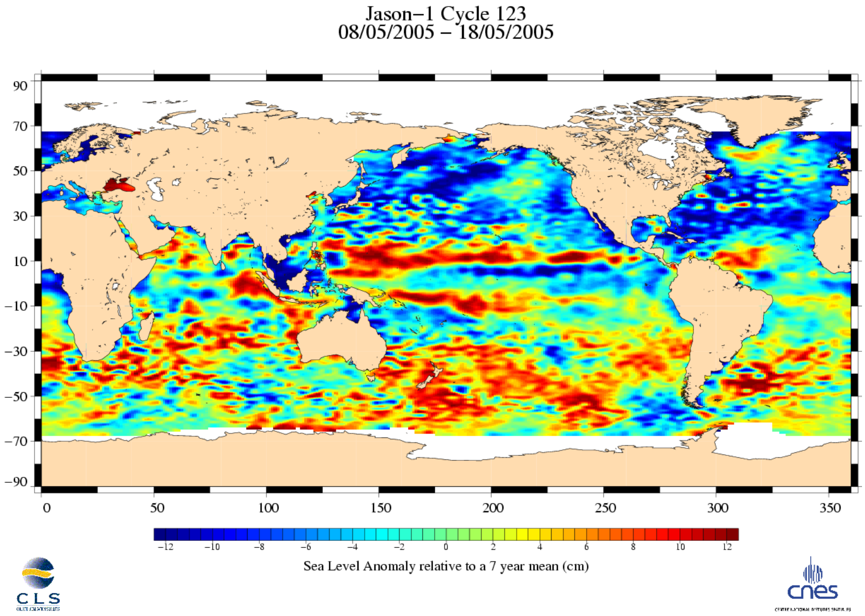
SSH crossover statistics are computed from the valid data set. They are used to estimate the data quality and to monitor the system performances.
After data editing and using the standard Jason-1 algorithms, the crossover standard deviation is about 5.81 cm rms, when using a selection to remove shallow 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.

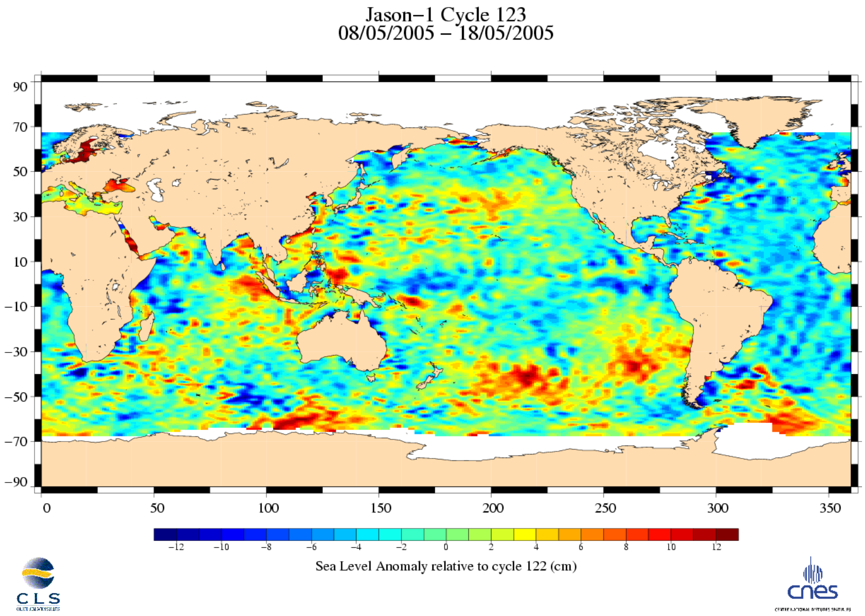


4.6 SSH variability

4.6.1 Jason-1 Sea Level Anomalies

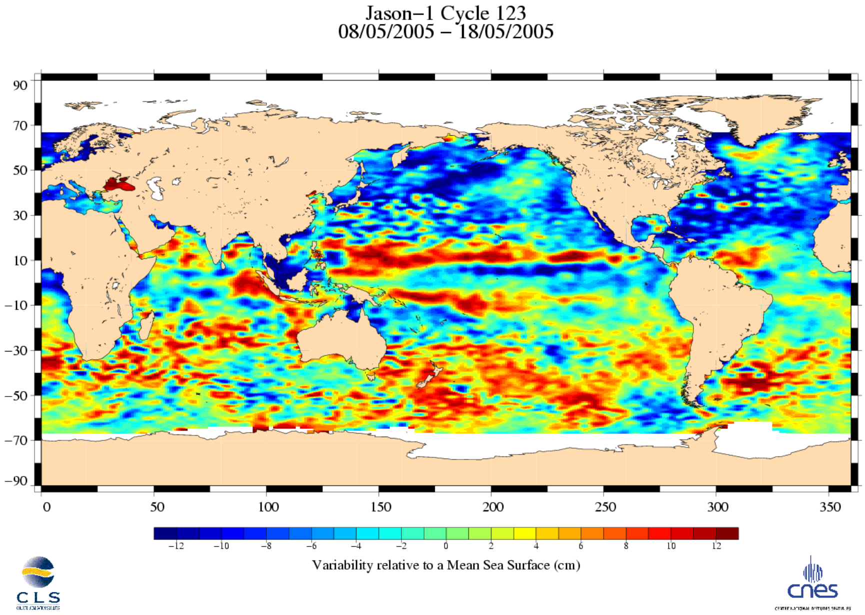
Repeat-track analysis is routinely used to compute Sea Level Anomalies (SLA) relative to the previous cycle and relative to a mean profile. SLA relative to a 7-year mean (based on TOPEX/Poseidon data) shows general oceanic features in good agreement with what is observed with TOPEX/Poseidon.
The SSH differences relative to the previous cycle 122 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.

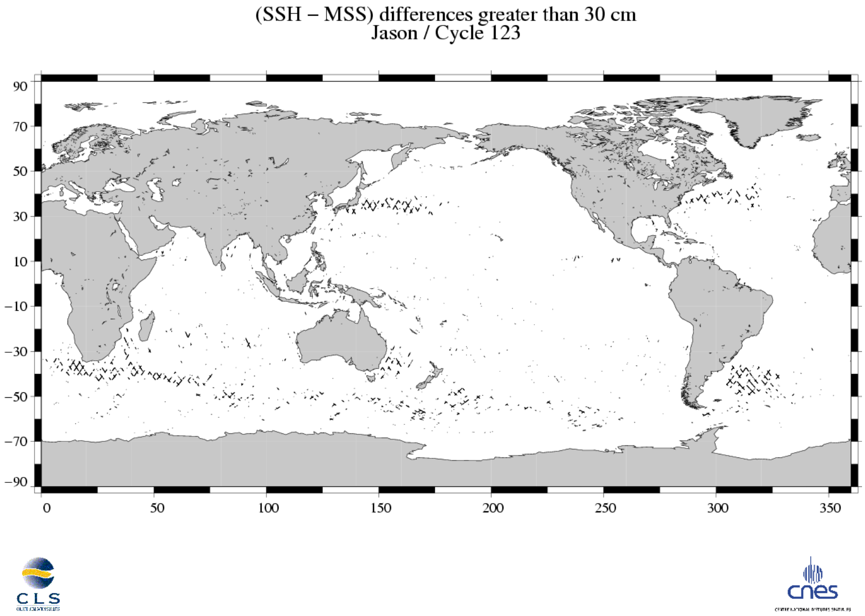




4.6.2 Comparison to a Mean Sea Surface

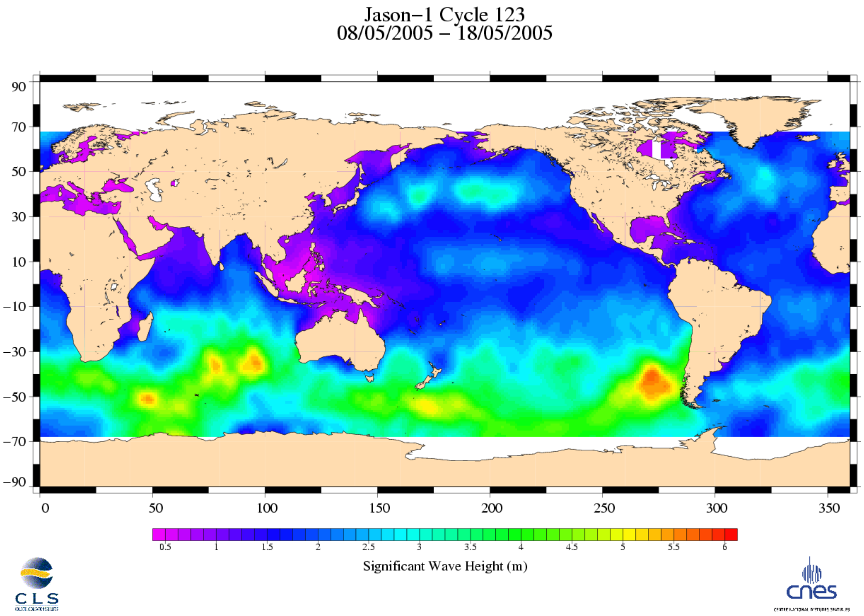
The following two maps respectively show the map of Jason-1 SLA relative to the MSS and differences higher than a 30 cm threshold (after centering the data). The latter figure shows that apart from isolated measurements that should be removed after refining the editing thresholds, higher differences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

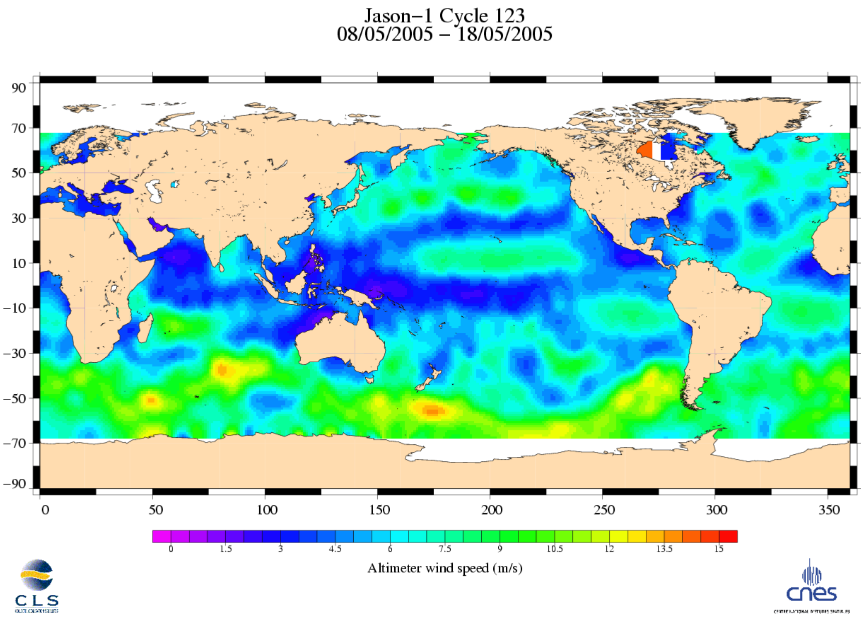




4.7 Wind and wave maps

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





5 Jason-1 long term performance monitoring

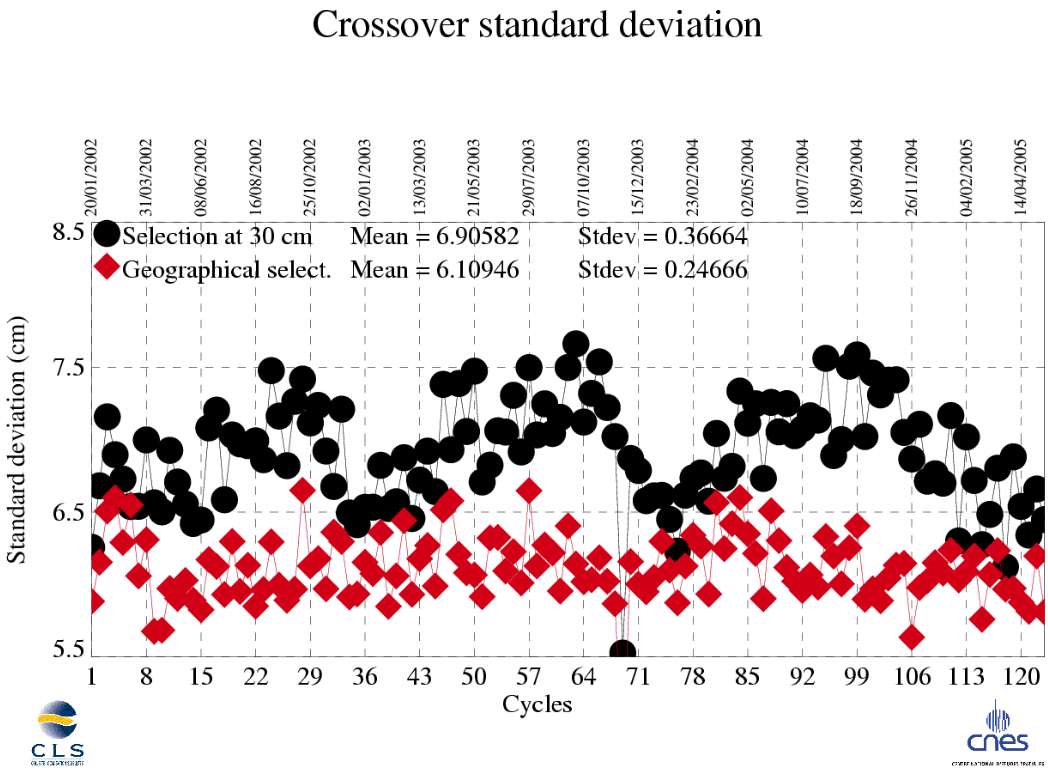
Statistics of SSH variability are computed after crossover and repeat-track analyses. This allows to estimate how Jason-1 data fulfill the mission objectives in terms of performances.

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 aditing selection criteria:

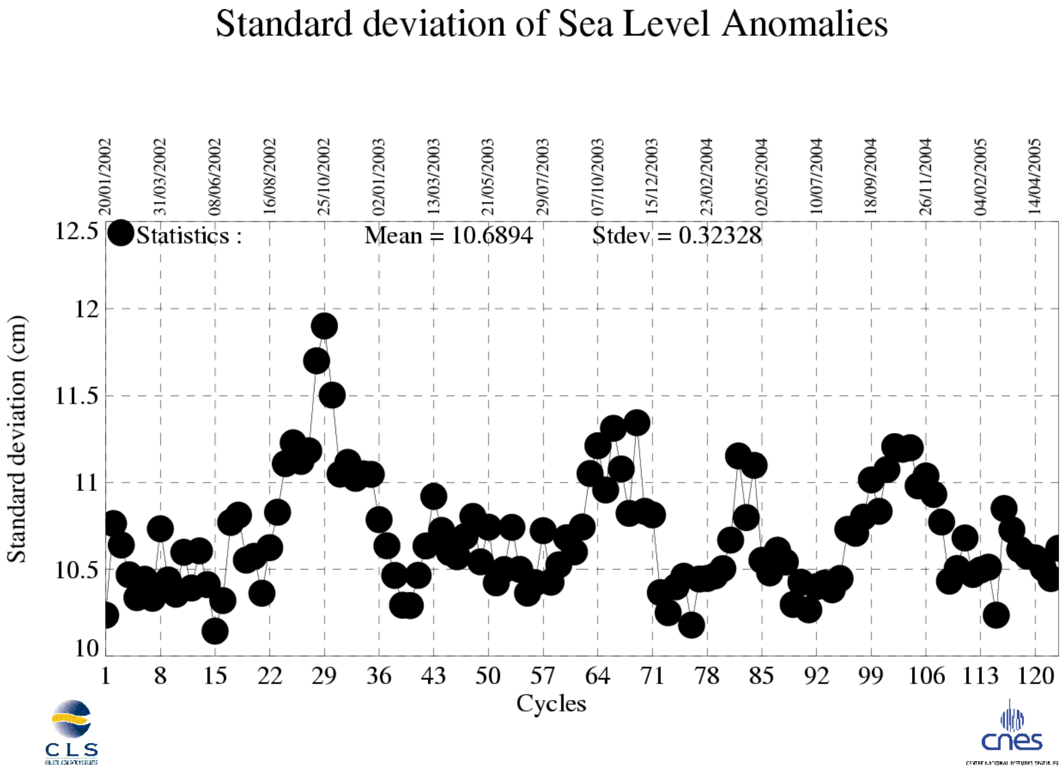
- Selecting crossover differences lower than 30 cm to avoid contamination by remaining spurious data.
- Removing shallow waters (1000 m), areas of high ocean variability and high latitudes (> |50| deg.) to avoid ice coverage effects.

Statistics are not relevant for cycle 69 as a result of Jason-1 mission interruption due to safe hold mode.



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.



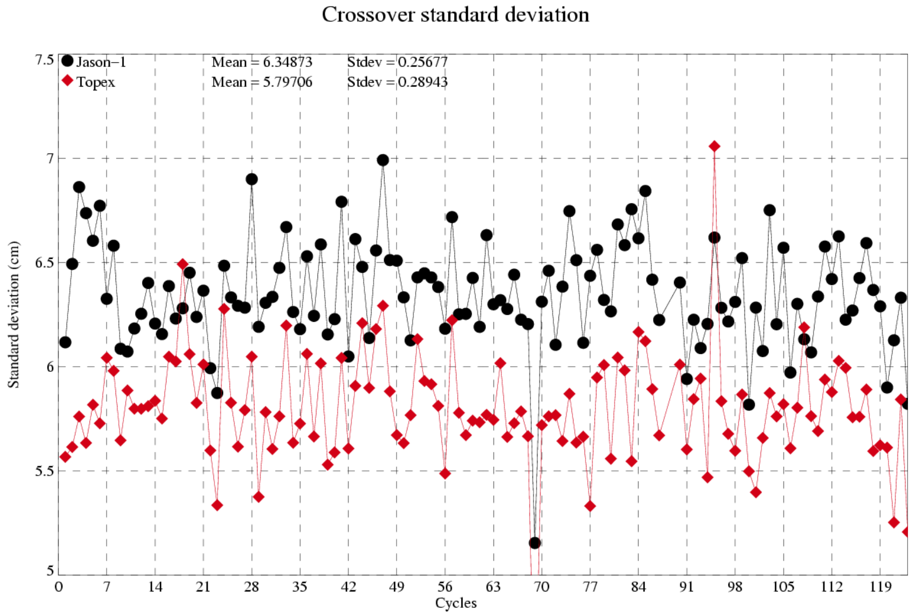
6 TP and Jason-1 comparisons

In order to compare TOPEX with Jason-1 SSH estimations, TOPEX data from M-GDRs have been updated so that all the geophysical corrections are the same as Jason-1. The TOPEX-B non-parametric sea state bias has been applied. This bias has been computed with the same method as TOPEX-A non-parametric sea state bias (Gaspar et al., 2002 [3]).
Note that cycle 1 for Jason-1 corresponds with cycle 344 for TOPEX.
Statistics are not relevant for cycle 69 as a result of Jason-1 mission interruption due to safe hold mode.

6.1 Performance comparisons

6.1.1 Crossover performances

10-day crossovers are computed on a 1 cycle basis both for TOPEX and Jason-1. In order to estimate the system performances, crossovers are selected according to several criteria: shallow waters (1000m), areas of high ocean variability (> 20 cm), and high latitudes (> |50| deg.) are excluded.
Futhermore, because of tape recorder problems, TOPEX measurements are missing over large geographical areas (essentially over the Indian ocean). These areas are then excluded from the selection for the two satellites.
The long term statistics are reported below. The slightly higher standard deviation for Jason-1 might be explained by residual orbit errors and larger high frequency content due to different altimeter processing (Zanife et al., 2003 [5]).
Notice the particular high value for T/P at cycle 95 (T/P cycle 438). This is probably due to a pitch wheel event linked to the T/P safehold mode occurred on cycle T/P 430.

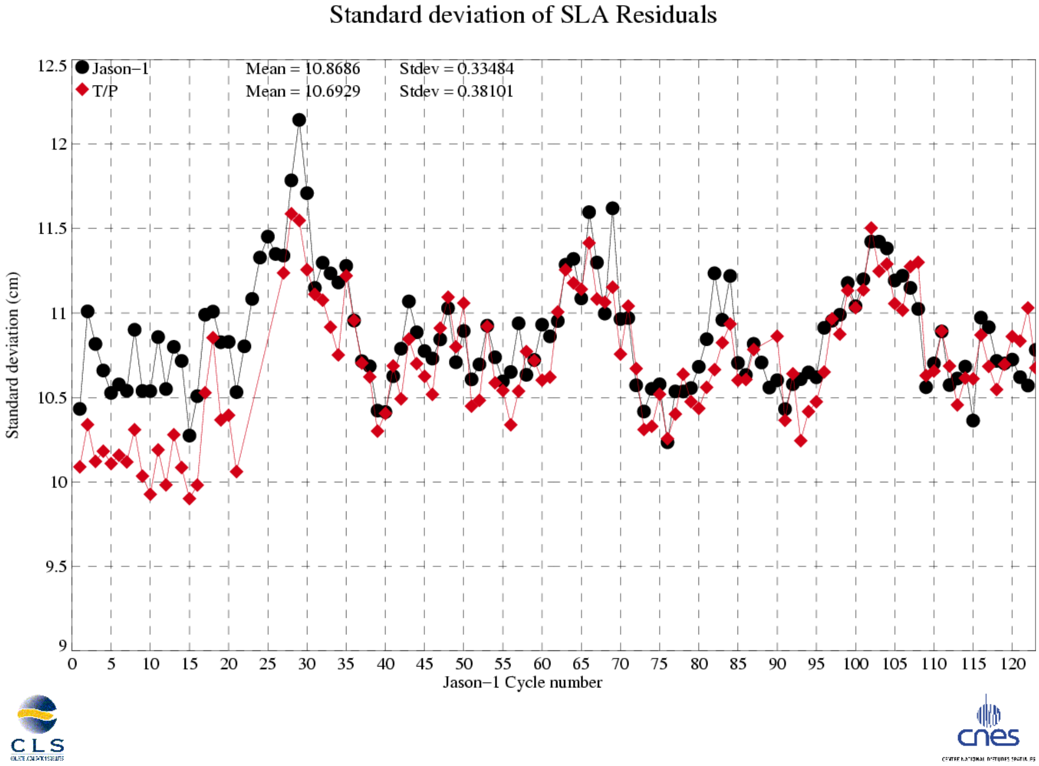


6.1.2 Along-track performances

Sea Level Anomaly (SLA) statistics are computed from repeat-track analysis. The plot below gives the standard deviation of the SLA for each cycle over the whole data set (shallow waters are excluded).

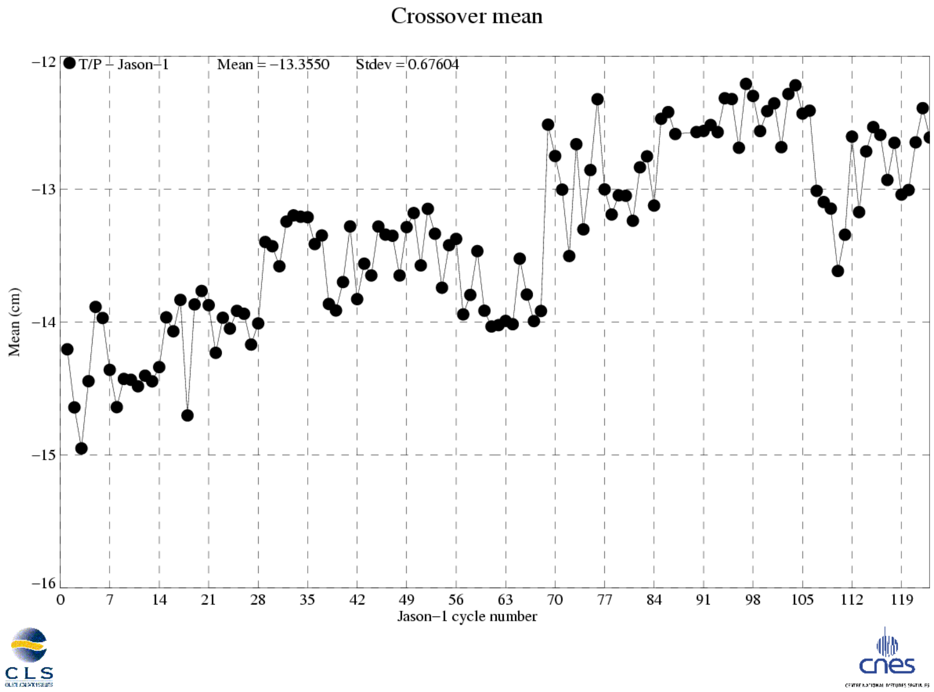
It is not possible to compute the TOPEX SLA through Jason-1 cycles 22-25 (corresponding with TOPEX cycles 365-368) because T/P is not on a repeat cycle orbit. During this period the satellite is moved to the Tandem Mission orbit on the new ground track spacing to the West of Jason-1.

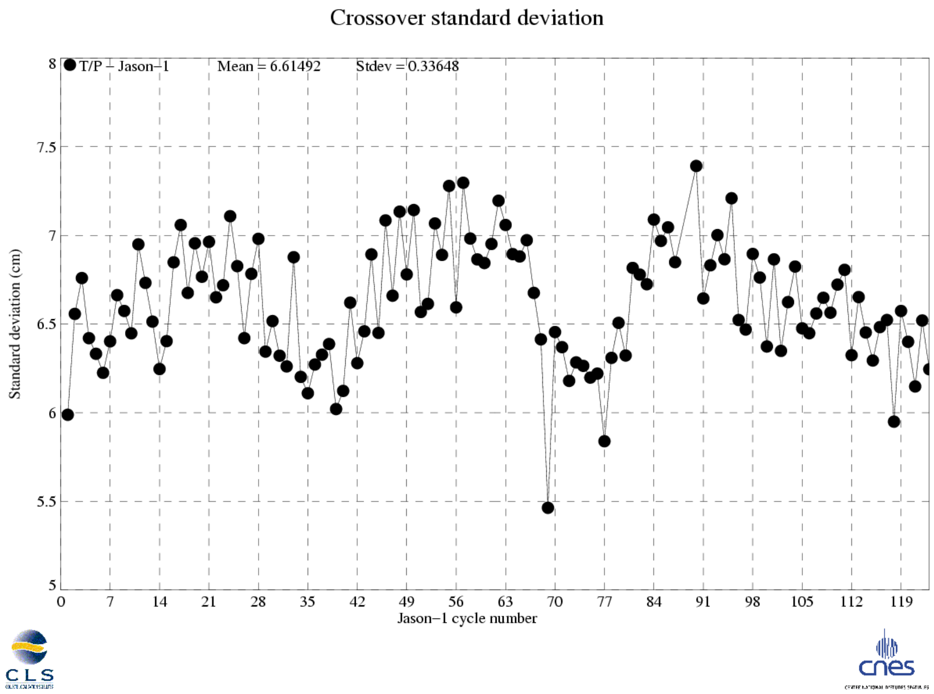
A degradation of TOPEX performance is observed after the orbit change due to the use of a MSS to compute SLA : indeed the MSS adds errors when used outside the nominal T/P - Jason ground track (Dorandeu et al., 2004 [6]).



6.2 TP − Jason-1 crossovers

The following two figures show the mean and the standard deviation of (TP − Jason-1) 10-day SSH crossovers. The statistics are computed removing shallow waters (1000 m).
Two jumps have been detected respectively around cycle 30 and 69 on the crossover mean curve. This is linked to the still unexplained variations of the Jason-1 Radiometer wet troposphere correction in these periods (see section TP and Jason-1 Radiometer wet troposphere correction comparisons, page 22 for more information).



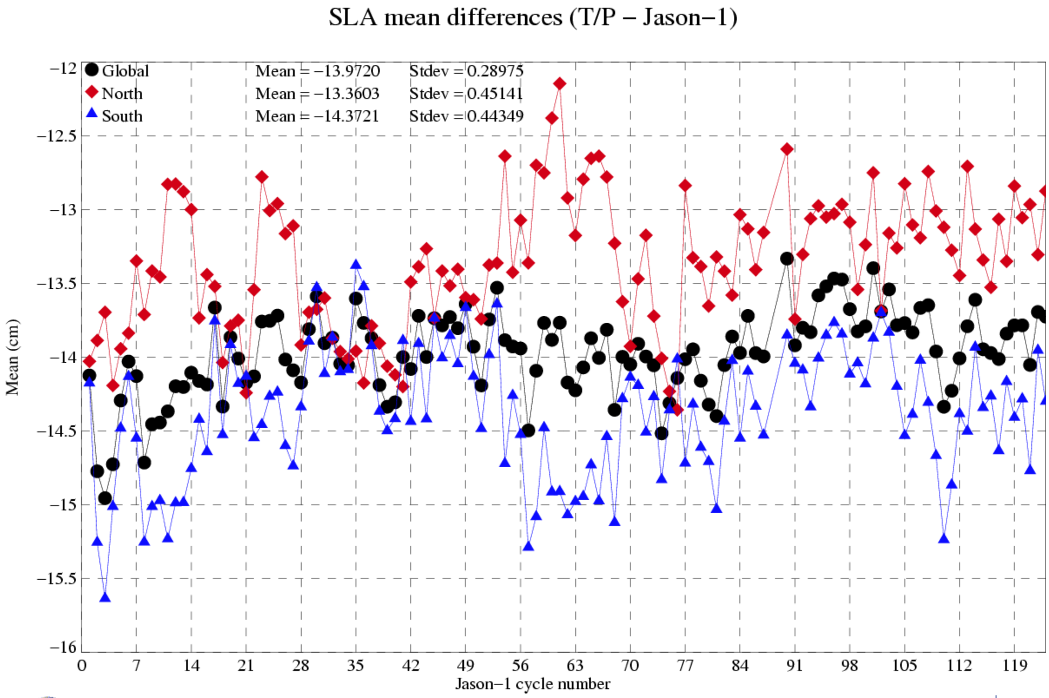


6.3 Colocated comparisons

Crossover points with time lags ($< 1h$) are only located at high latitudes and are very few. They cannot be used to cross-calibrate altimeter and radiometer parameters.
A colocation procedure is used to get homogeneous datasets on both missions. Differences are then averaged on a one cycle basis. This provides a large amount of data and a global coverage.

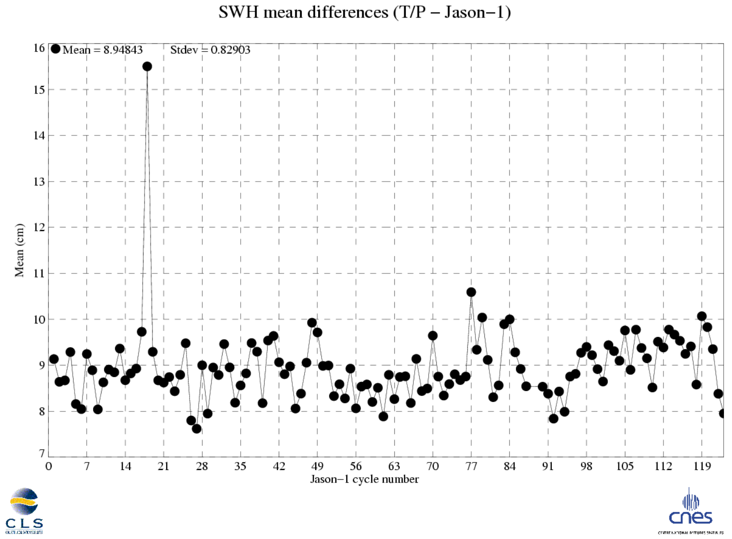
6.3.1 TP – Jason-1 SSH differences

The cycle per cycle SSH bias between T/P and Jason-1 has been computed over each hemisphere and globally (figure below). In order to compute the SSH bias (T/P -Jason-1), the same corrections have been used to calculate the Jason-1 and T/P SSH. The radiometer wet troposphere correction has been replaced by the ECMWF wet troposphere correction which prevents from JMR correction impact.
The overall bias is quite stable about -14 cm, but significative differences up to 2 cm are observed at hemispheric scales. This is probably due to orbit calculation. On early cycles, the Jason-1 POE orbit has not been reprocessed and from cycle 22 to 25, the T/P orbit changed in August 2002. But from cycles 54 to 72, no event allows us to explain this differences. This topic is still under investigation.



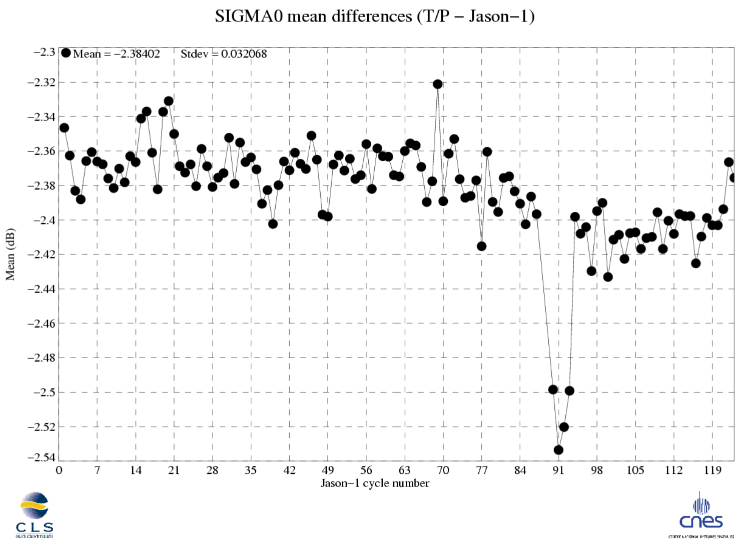
6.3.2 TP – Jason-1 Ku SWH differences

The cycle per cycle mean differences of Ku-band SWH betwenn T/P and Jason-1 is plotted as a function of the cycle number on the following figure. It shows that the bias is quite stable around 8.8 cm except for the Poseidon-1 which is about 15 cm.



6.3.3 TP – Jason-1 Ku SIGMA0 differences

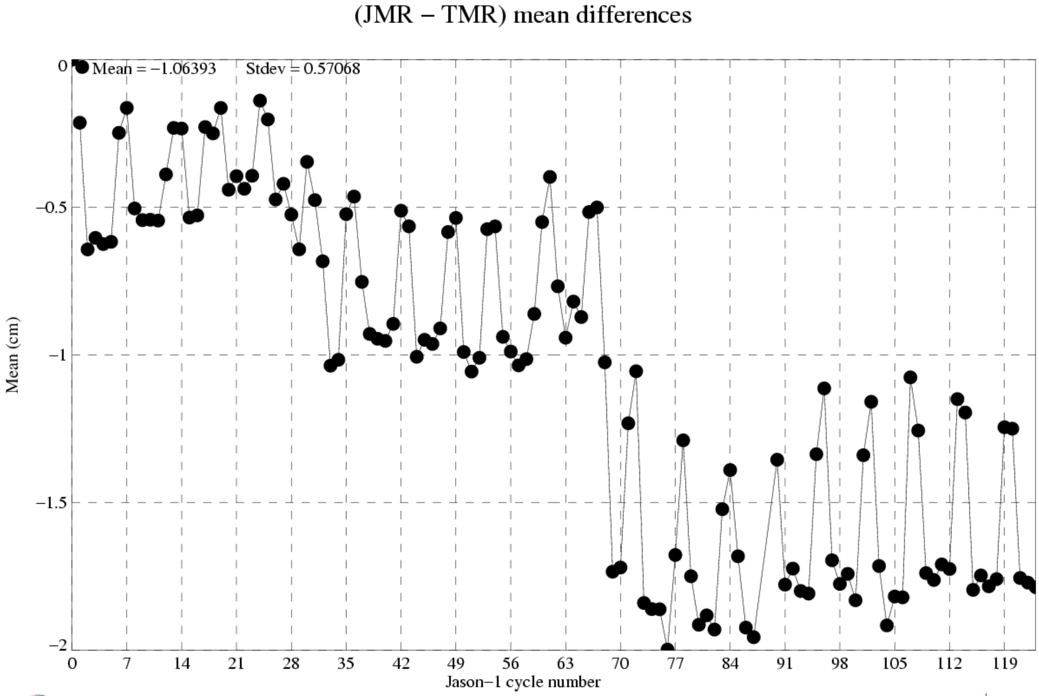
The following parameter is the Ku-Band Sigma0. The same statistics as for SWH are plotted on the below figure. The bias between the two parameters is quite stable around -2.4 dB. This value is near from the a priori -2.26 dB bias which is applied in the ground processing.
Notice that the absolute bias is higher than usual from cycle 90 to 93 (TOPEX cycle 433 to 436) by 0.1 dB : this is due to the TOPEX Sigma0. Indeed, the satellite attitude was impacted by a pitch wheel event linked to the T/P safehold mode occurred on cycle T/P 430. This anomaly has probably biased the TOPEX sigma0 during this period. After this period, the absolut bias is slightly more important than before the incident, nevertheless this does not impact the data quality.



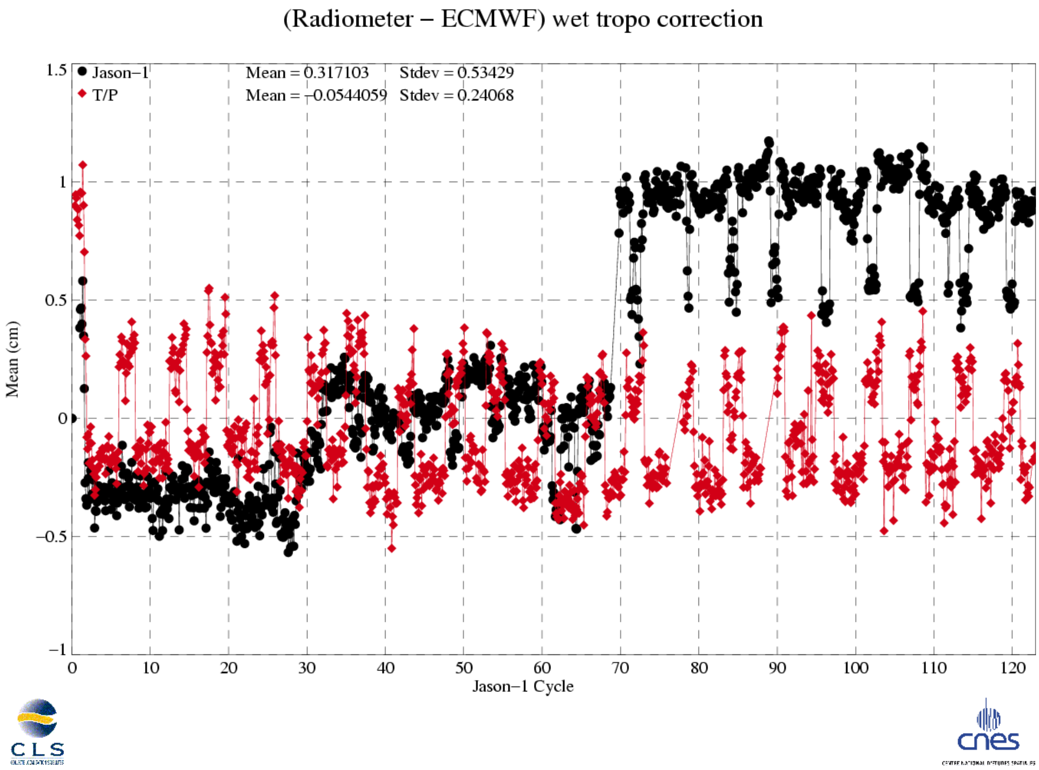
6.3.4 TP and Jason-1 Radiometer wet troposphere correction comparisons

The cycle per cycle mean differences between JMR and TMR wet tropospheric corrections are plotted on the following figure. Note that the TMR correction has been corrected for the drift (Ruf C.S., 2002 [4]). This long term monitoring exhibits the following abnormal variations :

- A 60-day signals is observed
- A significant decrease of about 4mm is observed from cycle 27 to 32.
- A jump of about 9mm is observed at cycle 69. This jump occurs after the safehold mode on this cycle.



In order to decorrelate TMR and JMR effects, the daily mean of (Radiometer - ECMWF) wet troposphere corrections has been plotted. The previous jumps are only observed on the Jason-1 curve while the TOPEX one is quite stable and exhibits only the 60-day signal due to the TMR yaw steering modes. Moreover, a signal linked to yaw steering modes is observed on the Jason-1 differences from cycle 32 onwards (after the first jump). These results tend to show that there are some unexpected effects in the JMR correction. JMR behavior is presently under analysis at JPL both at the intrumental level (diodes) and at the science processing level.



7 Mean Sea Level estimations (MSL)

7.1 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 top figure on the next page are obtained after annual, semi-annual and 60-day signals reduction.

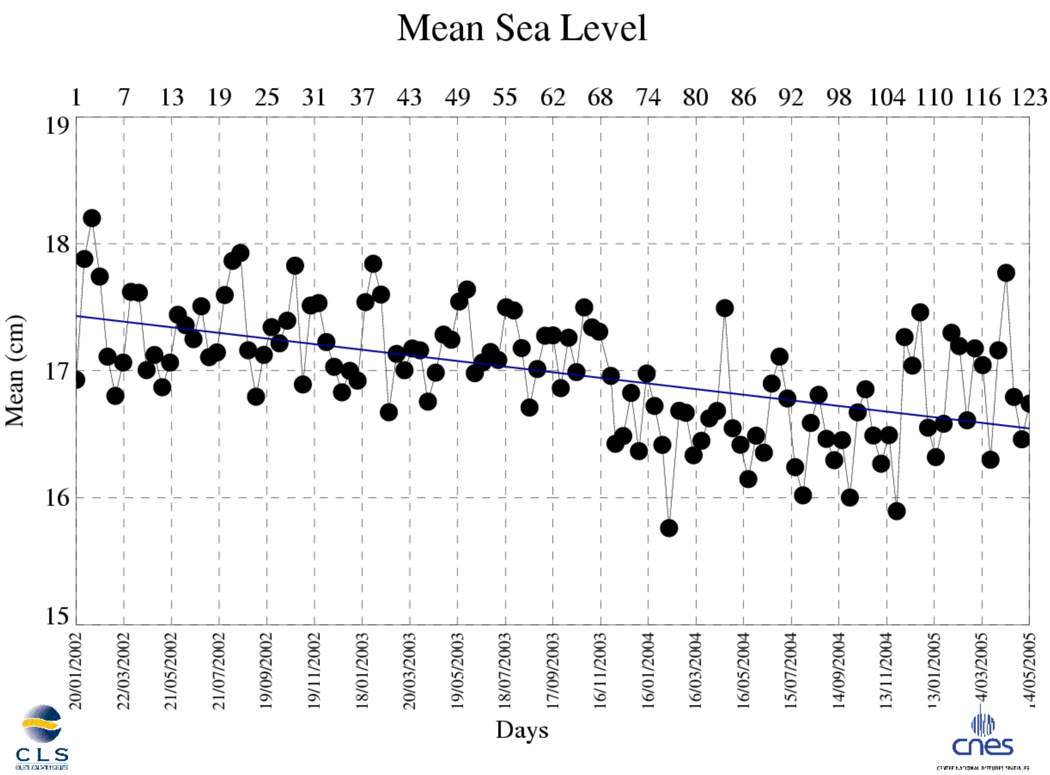
IMPORTANT NOTE : The MSL trend observed is of the opposit sign of the expected MSL rise. As explained in section Mean Sea Level comparisons (page 24), JMR measurements anomalies largely impact Jason-1 observations.

7.2 Jason-1 and TOPEX MSL

Jason-1 MSL and T/P MSL are displayed on the same figure (bottom figure on the next page). In order to compute the T/P MSL, the TMR correction has been corrected for the drift (Ruf C.S., 2002 [4]).

Seasonal variations are observed on both MSL but the mean slope is different.

This is linked to the JMR correction which introduces abnormal variations into the Jason-1 MSL calculation. For more information about the JMR correction, see section TP and Jason-1 Radiometer wet troposphere correction comparisons, page 22.


Mean Sea Level
1 7 13 19 25 31 37 43 49 55 62 68 74 80 86 92 98 104 110 116 123
19
18
17
16
15
Mean (cm)
20/01/2002
22/03/2002
21/05/2002
21/07/2002
19/09/2002
19/11/2002
18/01/2003
20/03/2003
19/05/2003
18/07/2003
17/09/2003
16/11/2003
16/01/2004
16/03/2004
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Days
CLS
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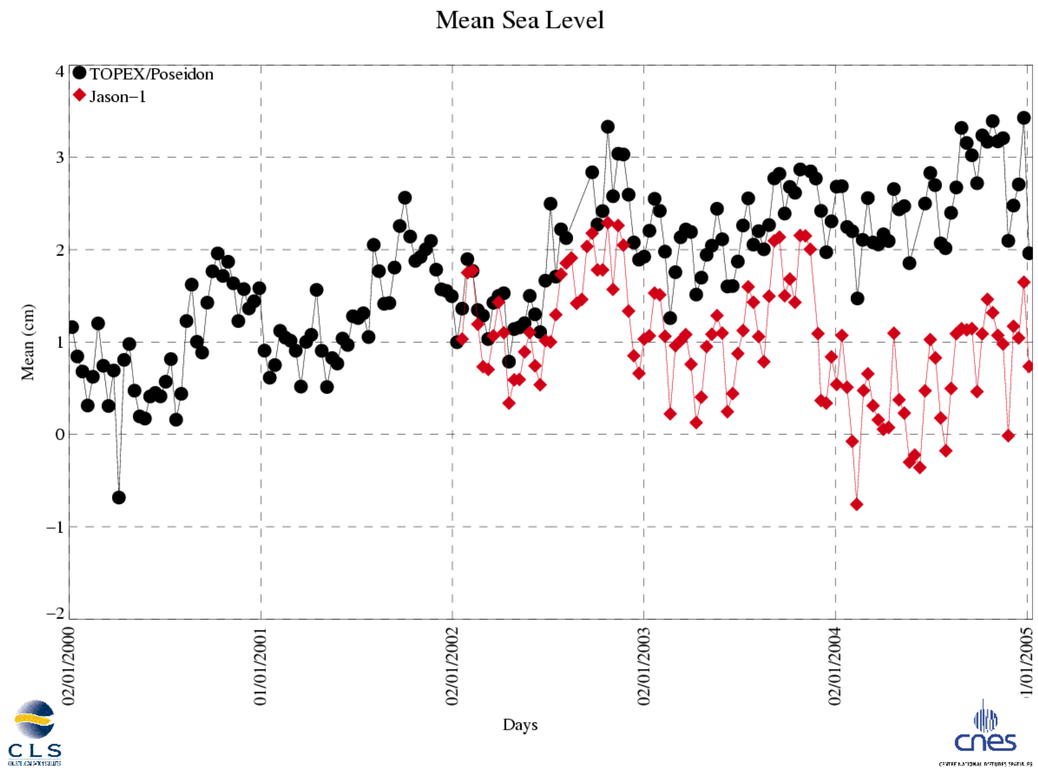
Mean Sea Level
TOPEX/Poseidon
Jason−1
4
3
2
1
0
−1
−2
Mean (cm)
02/01/2000
01/01/2001
02/01/2002
02/01/2003
02/01/2004
01/01/2005
Days
CLS
cnes

8 Particular investigations

No particular investigations have been performed on this cycle.

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