



# Jason-1 GDR Quality Assessment Report

**Cycle 015**

**03-06-2002 12-06-2002**

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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 by 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**
- Particular investigations**
- General warnings**

## 2 General quality assessment and cycle overview

### 2.1 Software version

This cycle has been produced with the CMA Reference Software V6.0\_08. 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 appears to be nominal. Analysis of crossovers and sea surface variability indicate that system performances are close to nominal values that are obtained from the TOPEX/POSEIDON data. For this cycle, the crossover standard deviation is 6.52 cm rms. When using a selection to remove shallow waters (1000 m), areas of high ocean variability and high latitudes ( $> |50|$  deg.) it lowers to 5.86 cm rms. The standard deviation of Sea Level Anomalies (SLA) relative to a 7-year mean (based on T/P data) is 10.25 cm.

- Performances from crossover differences are detailed in the dedicated [section Crossover statistics](#).
- Detailed CALVAL results are presented in [section 4](#).

### 2.3 Missing measurements

Two passes are missing and one is partly missing :

- Pass 186 is missing and pass 187 has 98% of missing measurements (100% over ocean). This is due to a ground processing failure.
- Pass 233 is missing as a result of a ground processing failure.

Missing measurements relative to a nominal ground track are plotted on [section Missing measurements](#).

## 3 Poseidon-2 altimeter and sensor

### 3.1 Sensor status

A detailed assessment of the Poseidon-2 sensor is made in separate bulletin to be found on the AVISO website.

### 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 performed to monitor the altimeter internal drifts and to 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 in the PTR

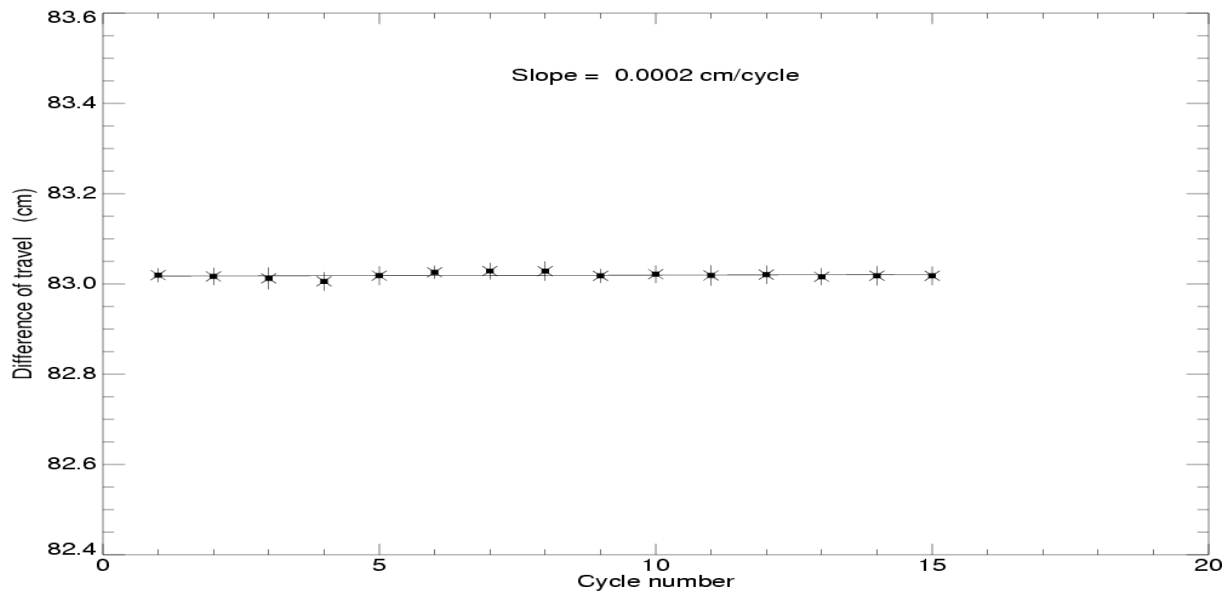
The evolutions of these parameters as a function of time are plotted to monitor the ageing of the altimeter.

**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

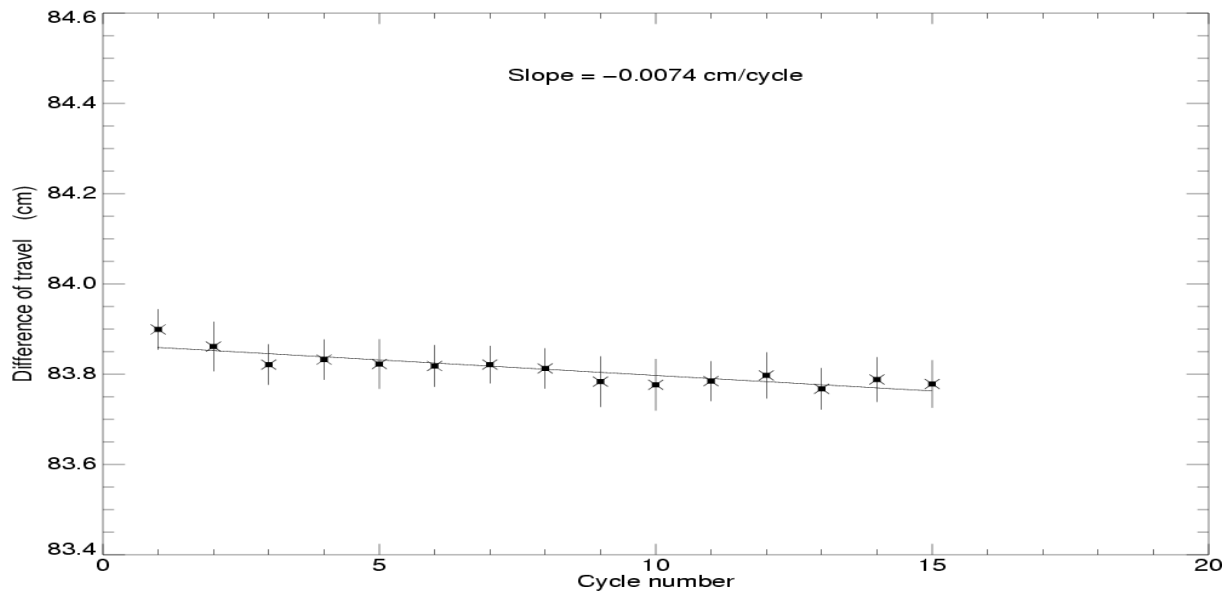
#### POSEIDON2 – Cycle 001 to Cycle 015

Difference of travel between E and R lines of the PTR in Ku band



#### POSEIDON2 – Cycle 015

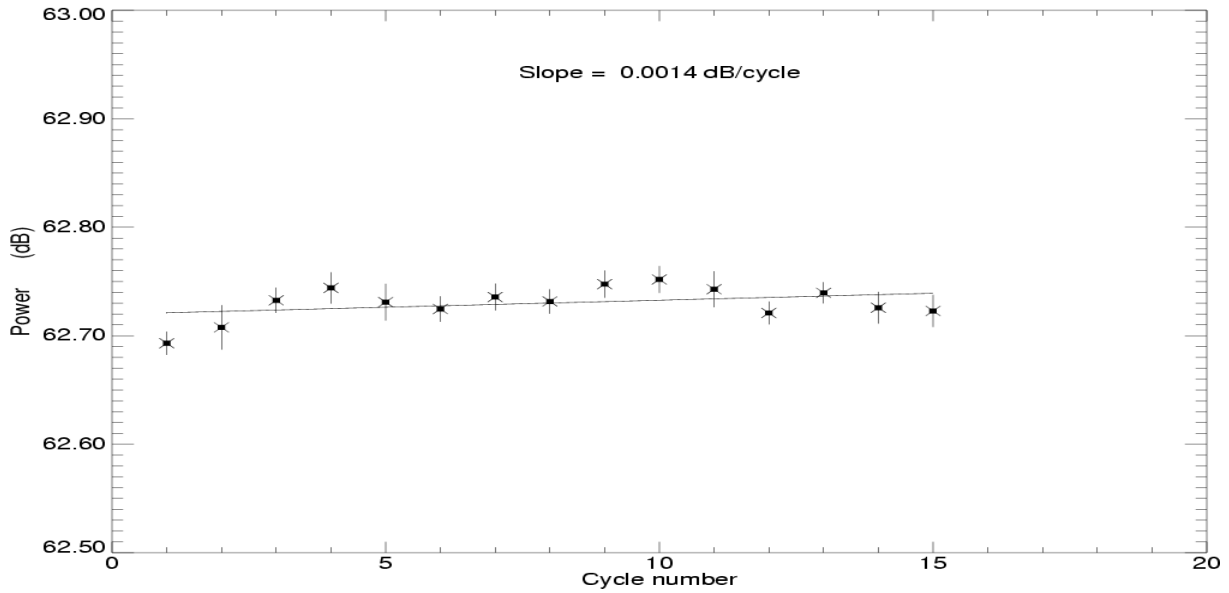
Difference of travel between E and R lines of the PTR in C band



### 3.2.2 Monitoring of the total power in the PTR

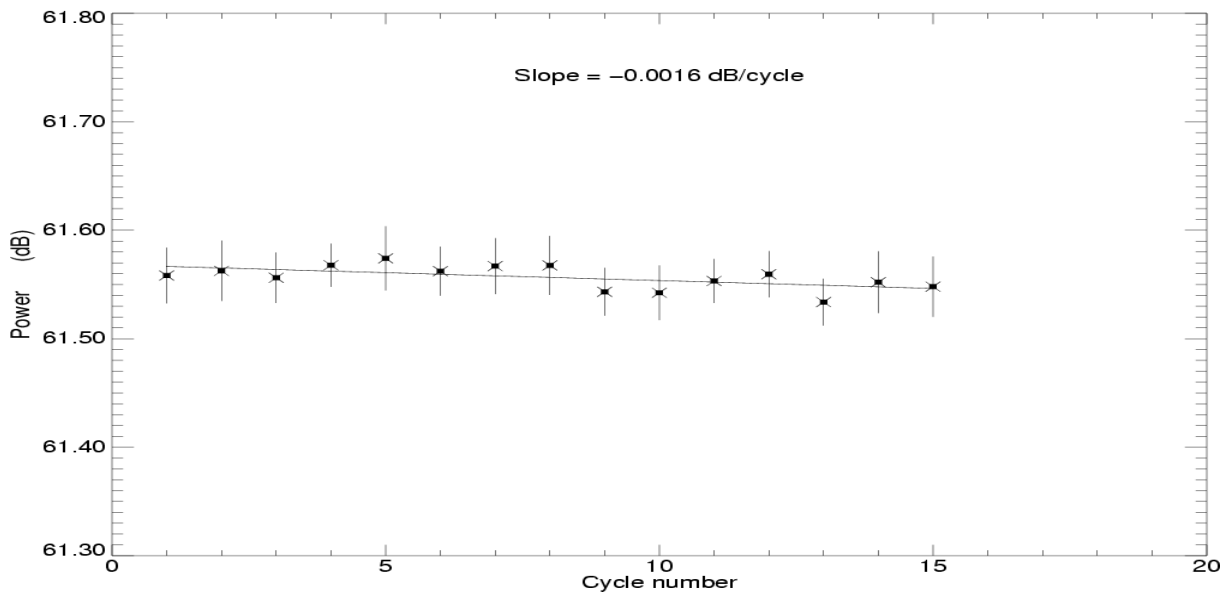
#### POSEIDON2 – Cycle 015

Total power of the PTR in Ku band



#### POSEIDON2 – Cycle 015

Total power of the PTR in C band



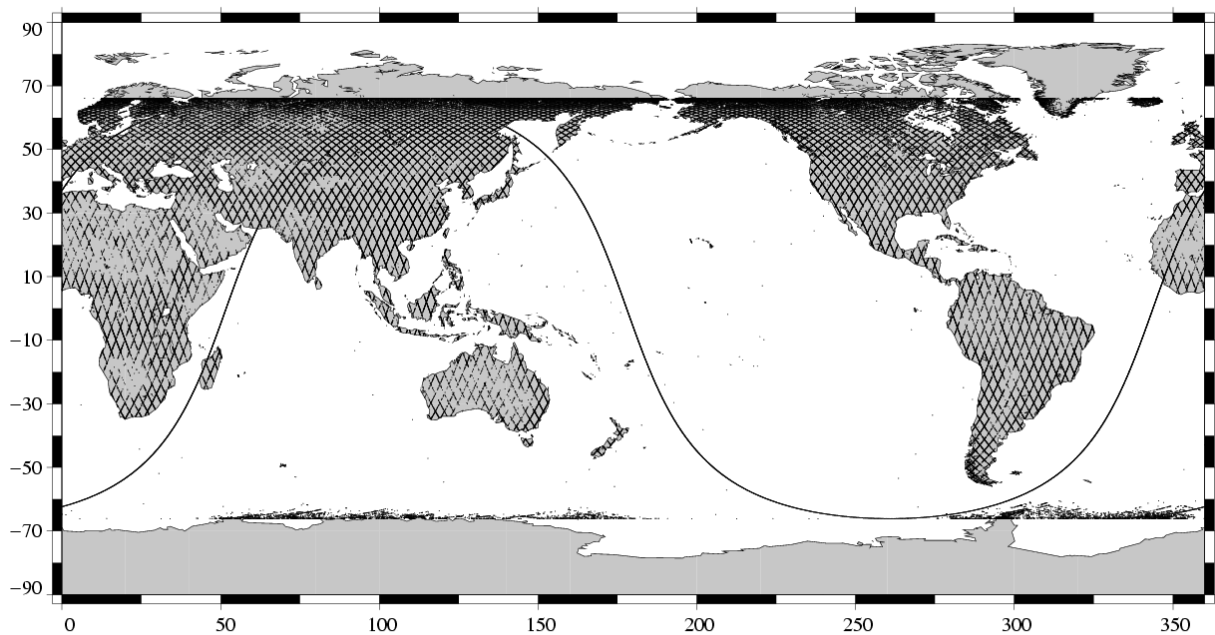
## 4 CALVAL main results

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.

Missing measurements  
Jason-1 Cycle 015 (03/06/2002 / 12/06/2002)



## 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 (14.68 % of points removed) and ice flag ( 7.48 % of points removed).

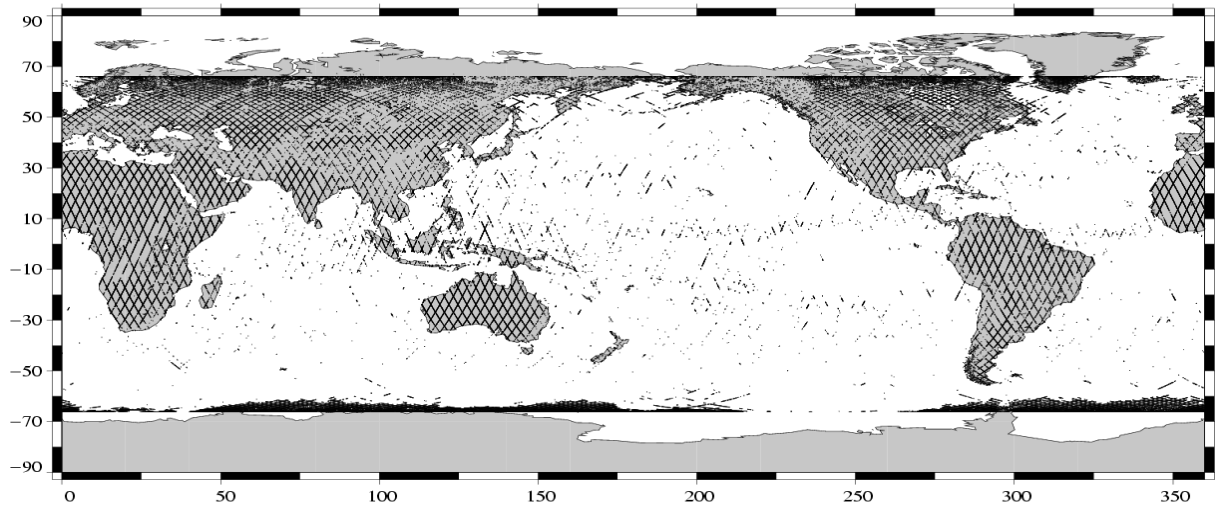
Parameters	Min thresh- old	Max thresh- old	Unit	Nb removed	% re- moved
Sea surface height	-130.000	100.000	<i>m</i>	8552	1.59
Sea level anomaly	-10.000	10.000	<i>m</i>	12315	2.30
Nb measurements of range	10.000	-	-	10706	2.00
Std. deviation of range	0.000	0.200	<i>m</i>	10972	2.05
Square off nadir angle	-0.200	0.160	<i>deg</i> <sup>2</sup>	8901	1.66
Dry tropospheric correction	-2.500	-1.900	<i>m</i>	26	0.00
Inverted barometer correction	-2.000	2.000	<i>m</i>	18	0.00
JMR wet tropospheric correction	-0.500	-0.001	<i>m</i>	456	0.08
Ionospheric correction	-0.400	0.040	<i>m</i>	9565	1.78
Significant wave height	0.000	11.000	<i>m</i>	6681	1.25
Sea State Bias	-0.500	0.000	<i>m</i>	6892	1.28
Backscatter coefficient	7.000	30.000	<i>dB</i>	5709	1.06
Ocean tide	-5.000	5.000	<i>m</i>	4584	0.85
Equilibrium tide	-0.500	0.500	<i>m</i>	0	0.00
Earth tide	-1.000	1.000	<i>m</i>	0	0.00
Pole tide	-15.000	15.000	<i>m</i>	0	0.00
Altimeter wind speed	0.000	30.000	<i>m.s</i> <sup>-1</sup>	7693	1.43
Global statistics of edited measurements by thresholds	-	-	-	19222	3.58



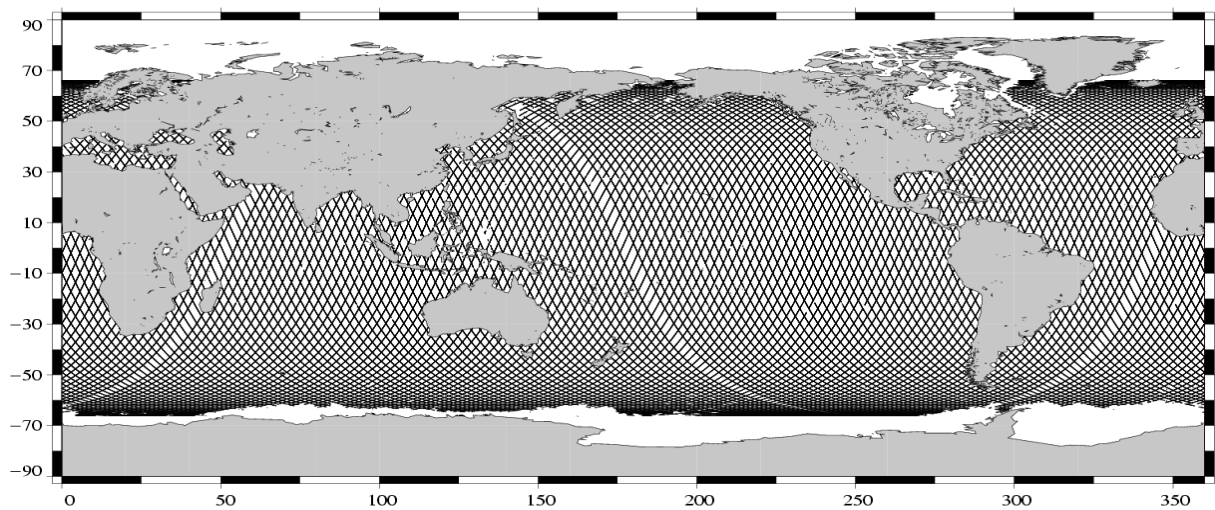
## 4.2.1 Figures

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

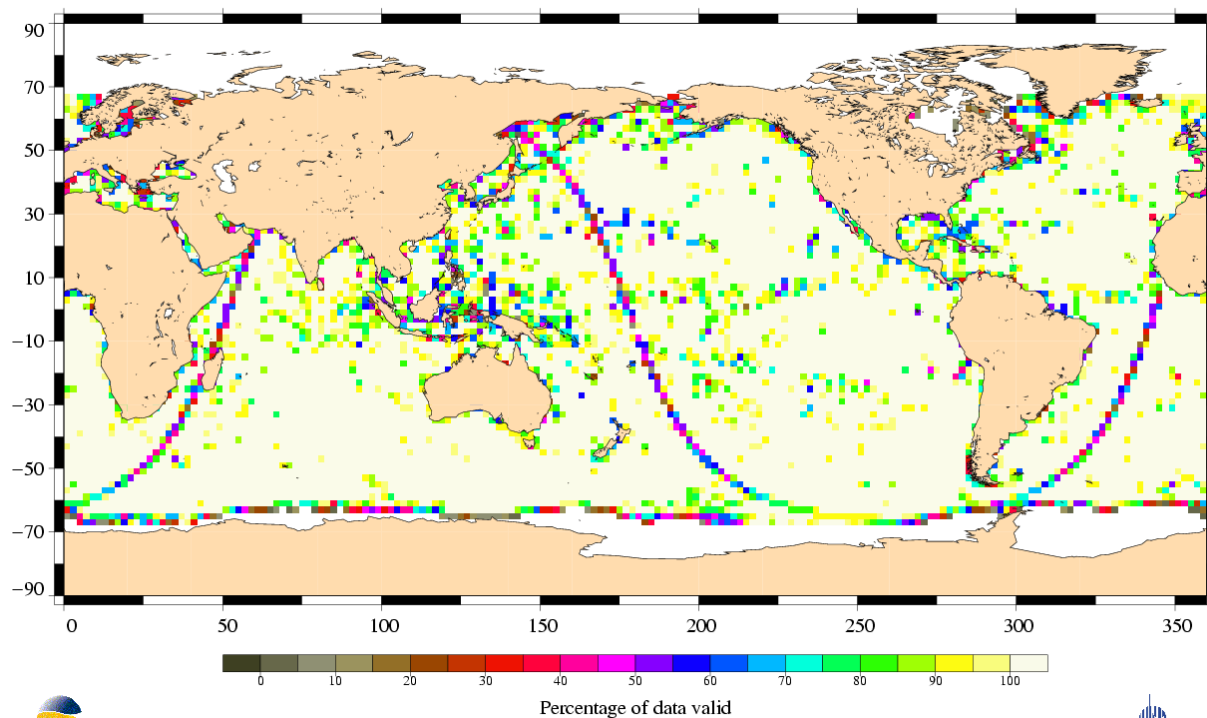
Edited measurements  
Jason-1 Cycle 015 (03/06/2002 / 12/06/2002)



Valid data  
Jason-1 Cycle 015 (03/06/2002 / 12/06/2002)



Percentage of valid data relative to the nominal pass  
Jason-1 Cycle 015 (03/06/2002 / 12/06/2002)



#### 4.2.2 Comments

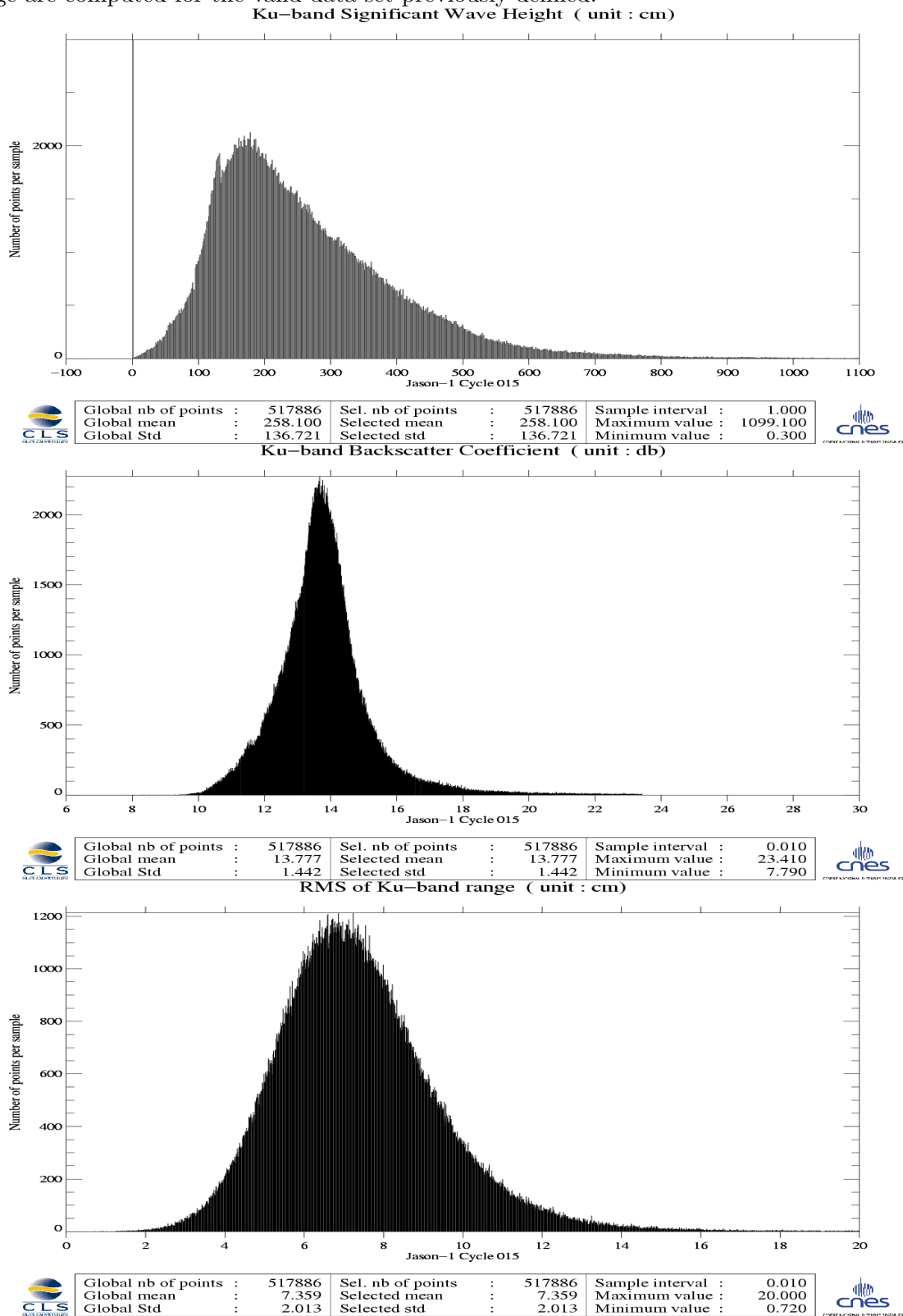
For the purpose of this quality assessment report, the GOT99.2 GDR field tide model has been replaced by GOT99.3 since the former is not available over the Black Sea, the Caspian and the Baltic sea.

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 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.

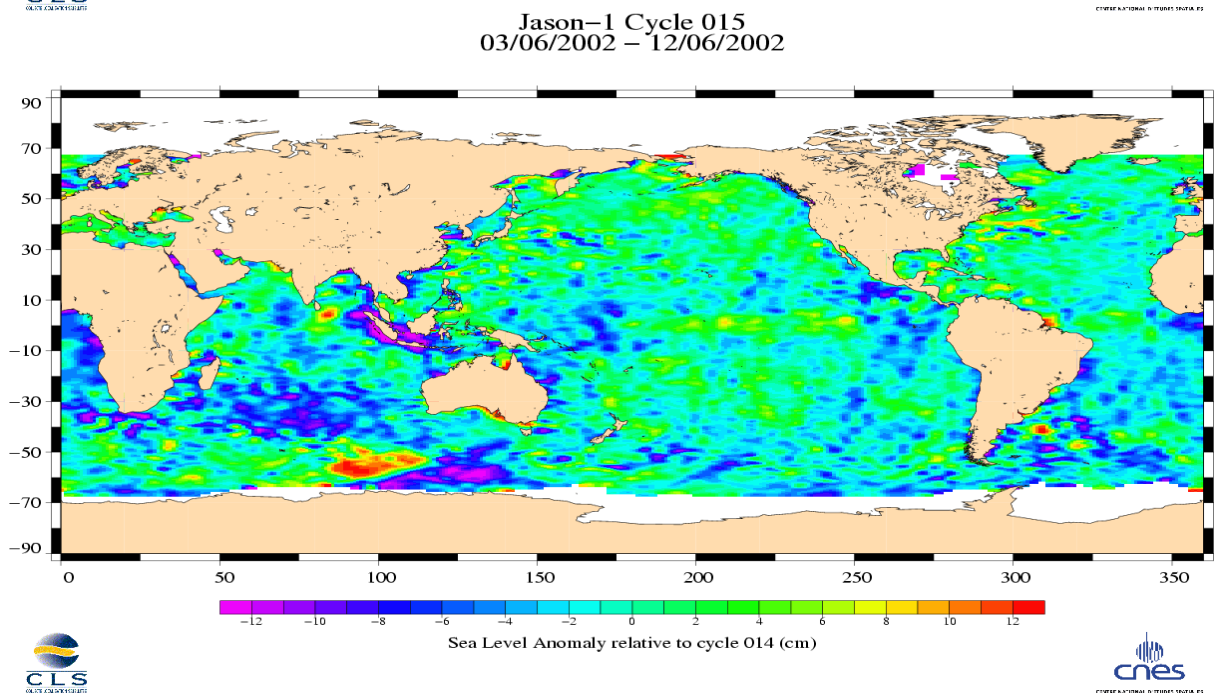
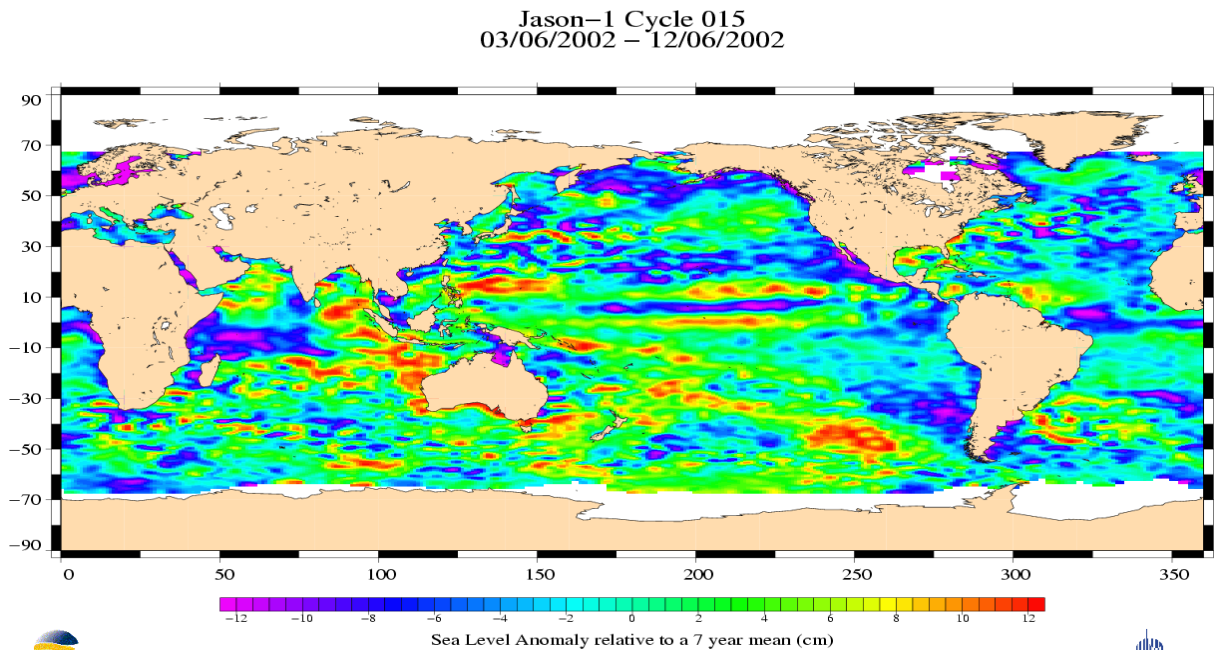
After data editing and using the standard Jason-1 algorithms, the crossover standard deviation is about 5.86 cm rms, when using a selection to remove shallow waters (1000 m), areas of high ocean variability and high latitudes ( $> |50|$  deg.).

## 4.5 SSH variability

### 4.5.1 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.

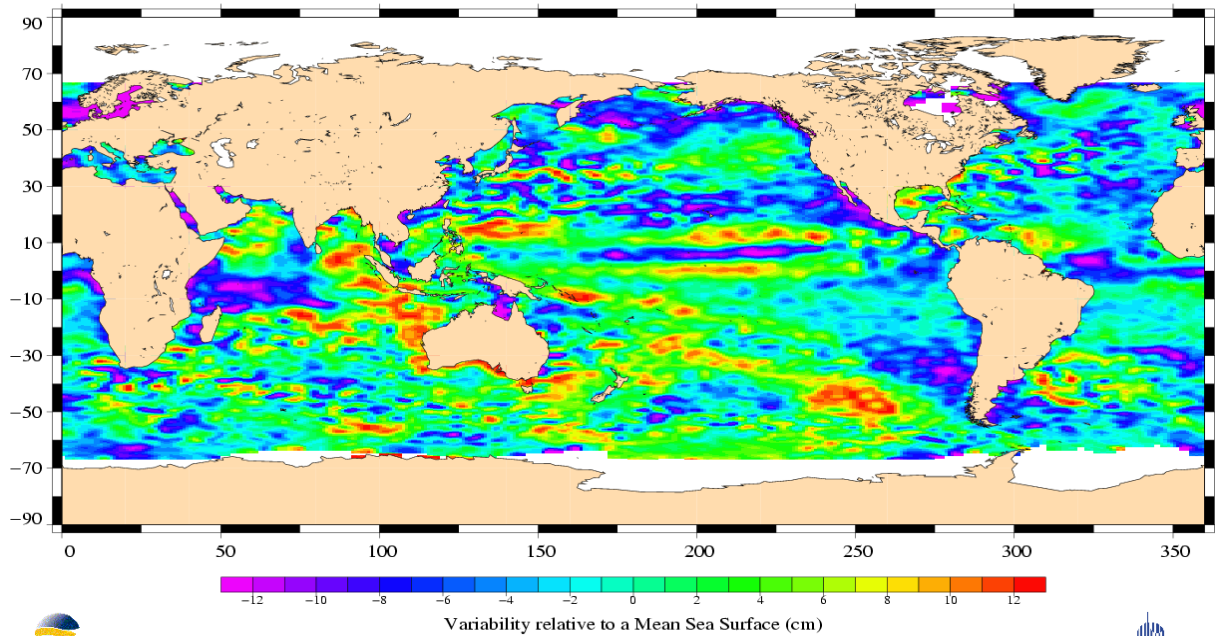
The SSH differences relative to the previous cycle 014 are plotted on the bottom figure. The differences seem homogeneous and do not exhibit any particular trackiness pattern, showing the good quality of the orbit calculation in the Jason-1 GDRs.



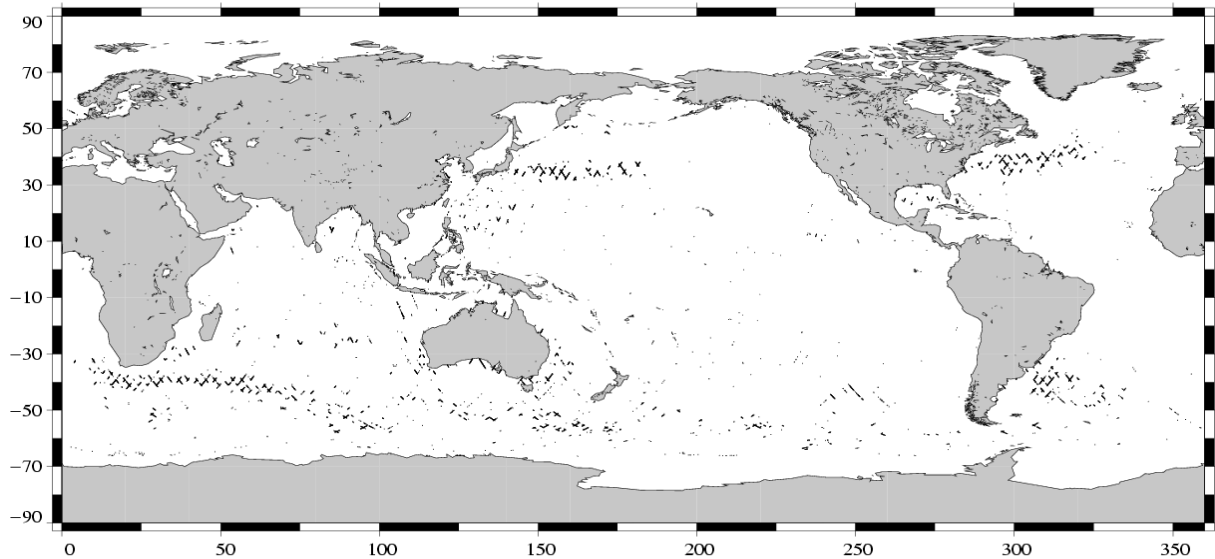
#### 4.5.2 Comparison to a Mean Sea Surface

The two following 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.

Jason-1 Cycle 015  
03/06/2002 – 12/06/2002



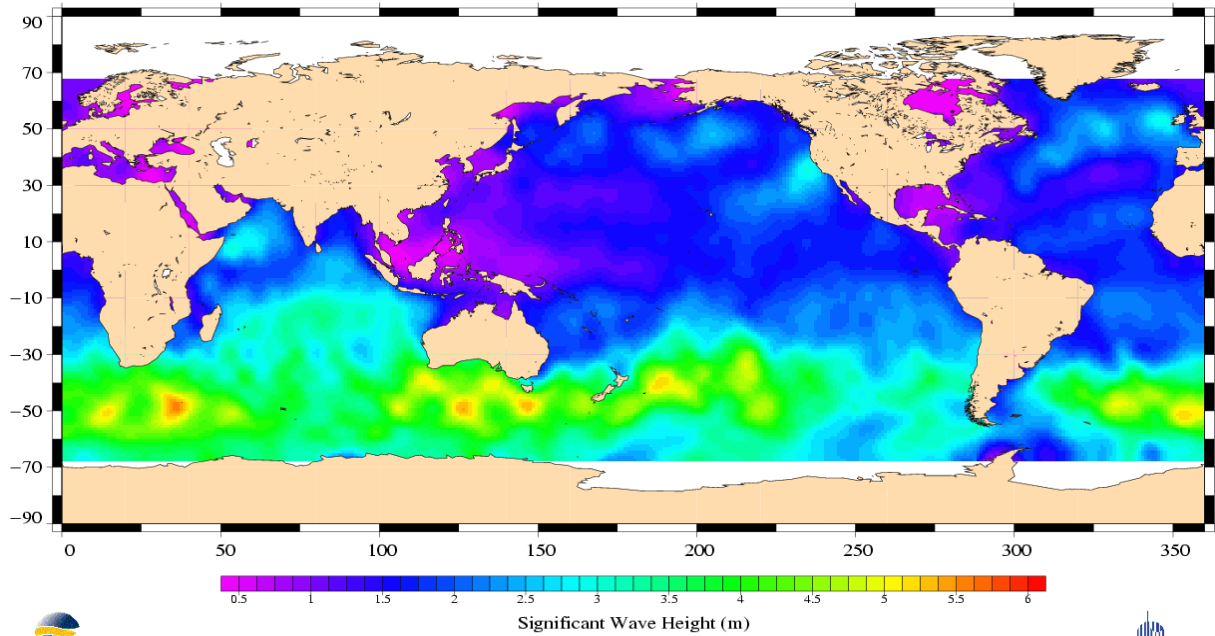
(SSH – MSS) differences greater than 30 cm  
Jason / Cycle 015



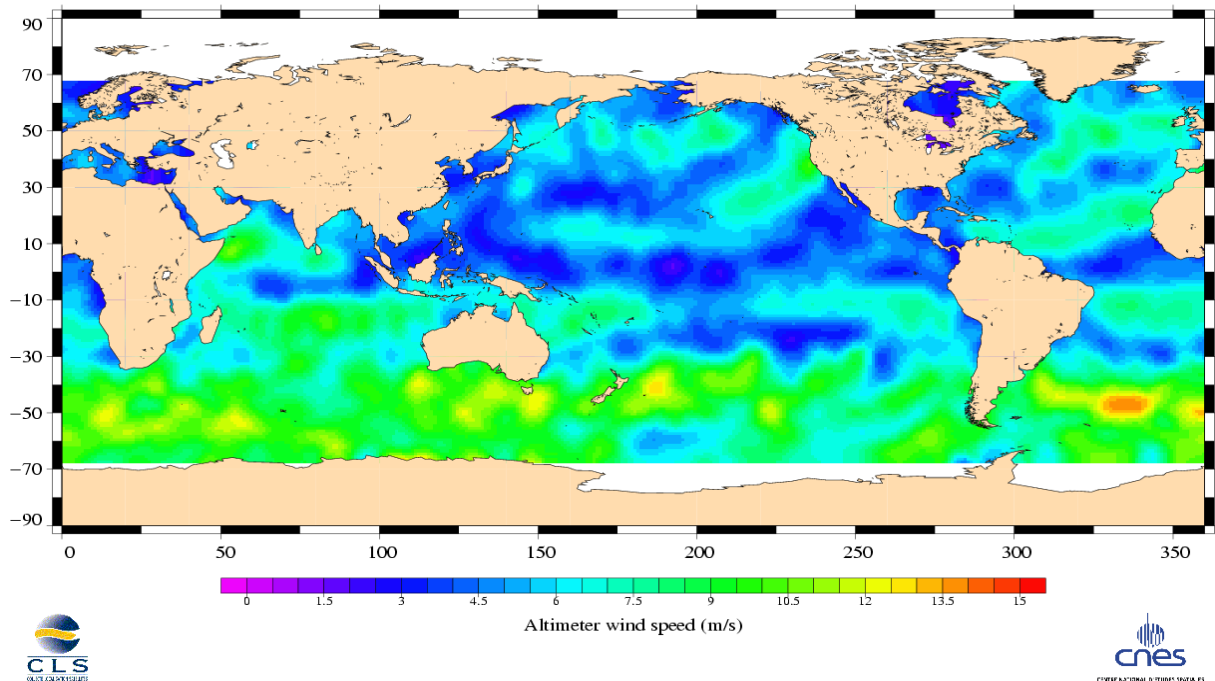
## 4.6 Wind and wave maps

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

Jason-1 Cycle 015  
03/06/2002 – 12/06/2002



Jason-1 Cycle 015  
03/06/2002 – 12/06/2002





## 5 Jason-1 long term performance monitoring

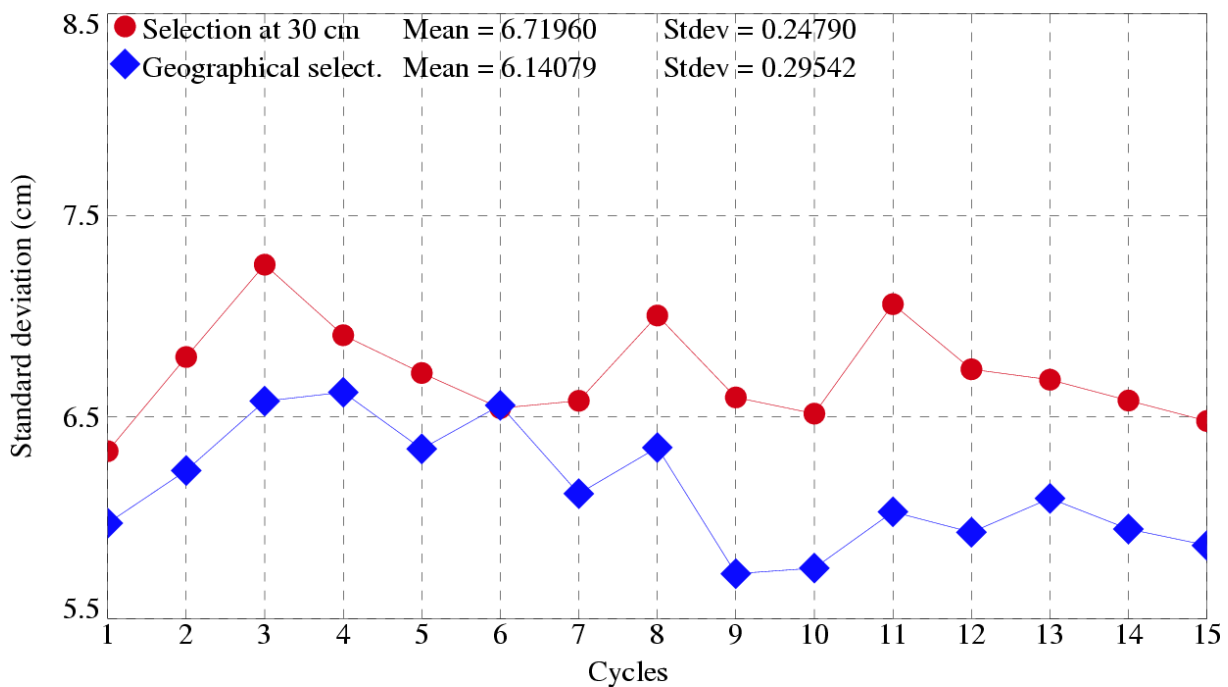
Statistics of SSH variability are computed after crossover and repeat-track analyses. This allows to estimate how Jason-1 data fulfill the mission objectives in terms of performances.

### 5.1 Crossover standard deviation

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 with two different selections:

- 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.

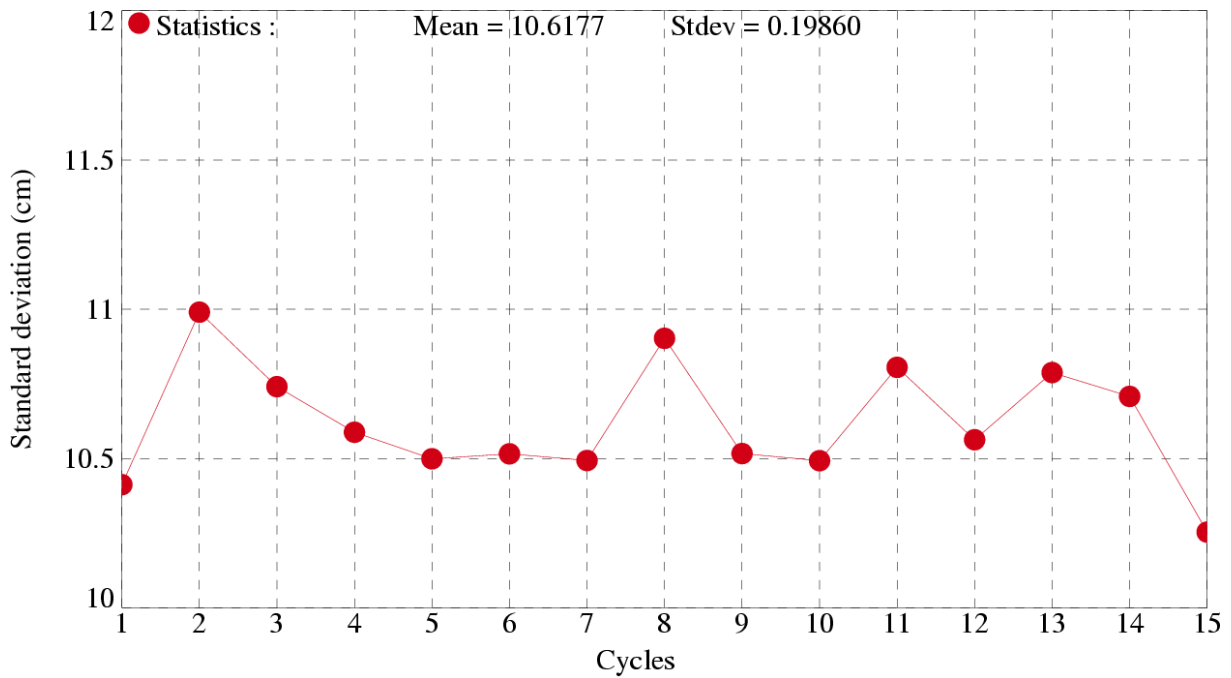
#### Crossover standard deviation



## 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.

### Standard deviation of Sea Level Anomalies



## 6 Particular investigations

### 6.1 Square of the mispointing angle

During pass 27, a boresight calibration maneuver is performed and lead to slightly higher than usual off nadir angles values on this pass (0.15 deg), with no impacts on scientific applications.

### 6.2 TP – Jason-1 cross-calibration results

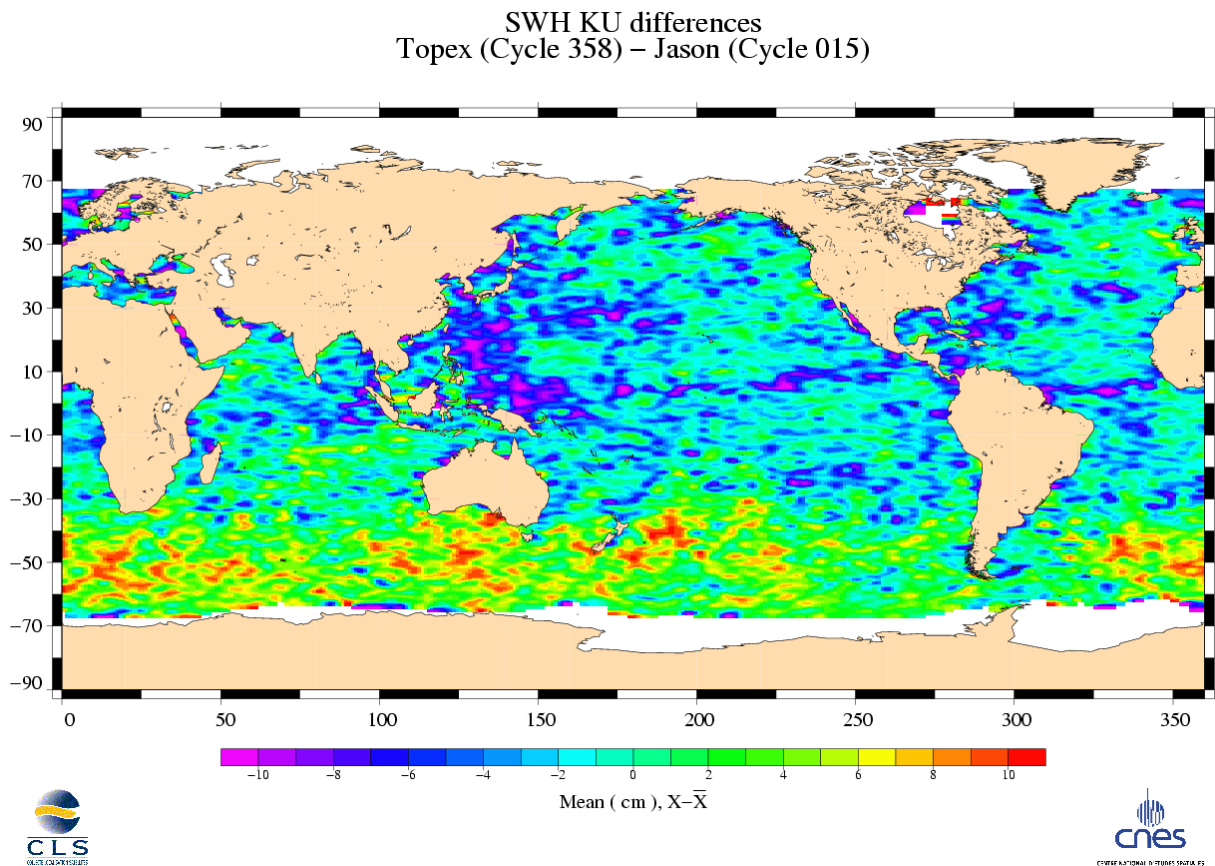
Jason-1 cycle 015 data are collocated to data from TOPEX GDR cycle 358 in order to compare the main parameters from repeat-track analysis.

#### 6.2.1 TP – Jason-1 Ku SWH differences

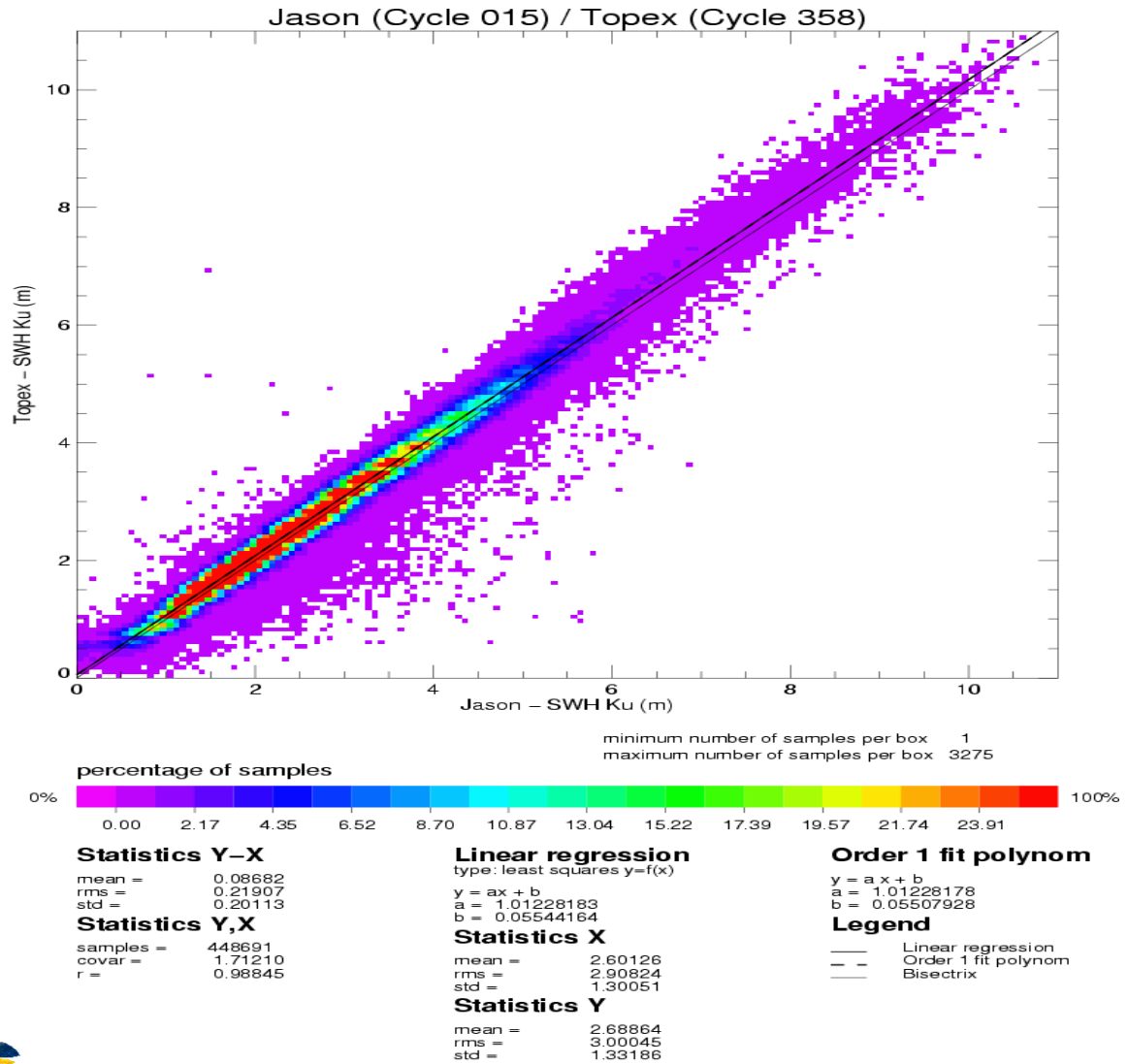
The global statistics of (TP – Jason-1) Ku SWH differences are:

Number of estimates	Mean	Standard deviation
449098	8.779 cm	20.057 cm

These differences are plotted on the following figure (data are centered about the mean value) :



The scatter plot between Jason-1 and TOPEX Ku SWH measurements is given on the following figure:



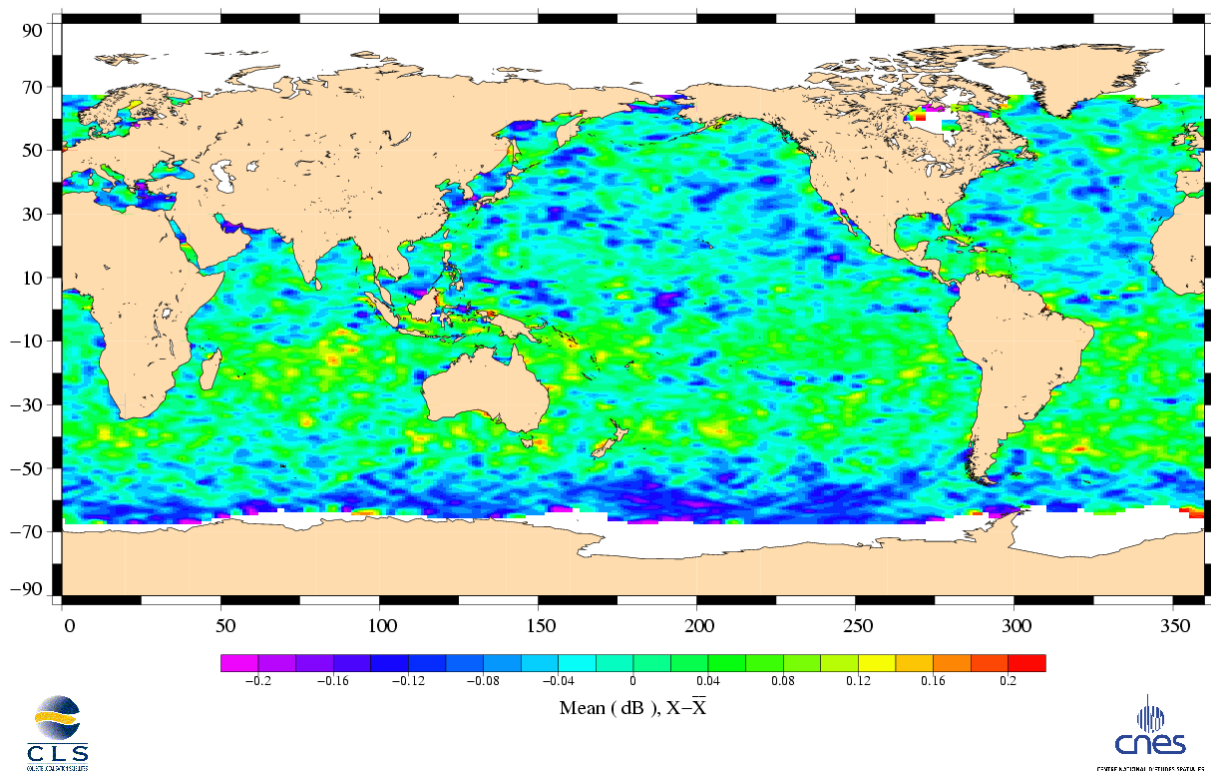
## 6.2.2 TP – Jason-1 Ku Sigma0 differences

The global statistics of (TP – Jason-1) Ku Sigma0 differences are:

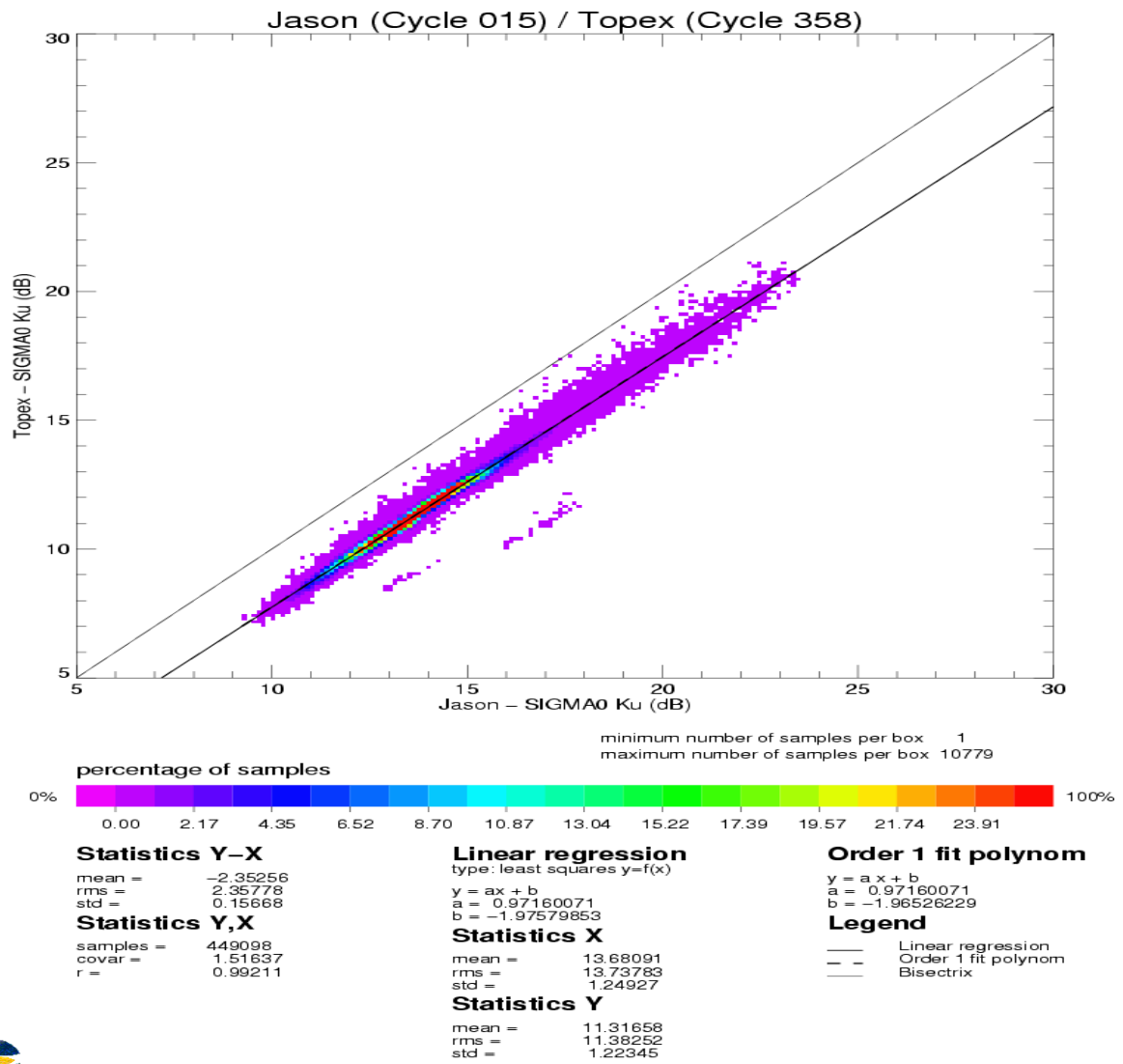
Number of estimates	Mean	Standard deviation
449098	-2.364 dB	0.149 dB

Keep in mind that, in the science ground processing, Jason-1 Ku-band sigma naughts are biased by a -2.26 dB value to get the geophysical quantities such as the altimeter wind speed. This value compares very well with the mean difference reported in the above table. These differences are plotted on the following figure (data are centered about the mean value) :

Ku SIGMA0 differences  
Topex (Cycle 358) – Jason (Cycle 015)



The scatter plot between Jason-1 and TOPEX Ku Sigma0 measurements is given on following figure:



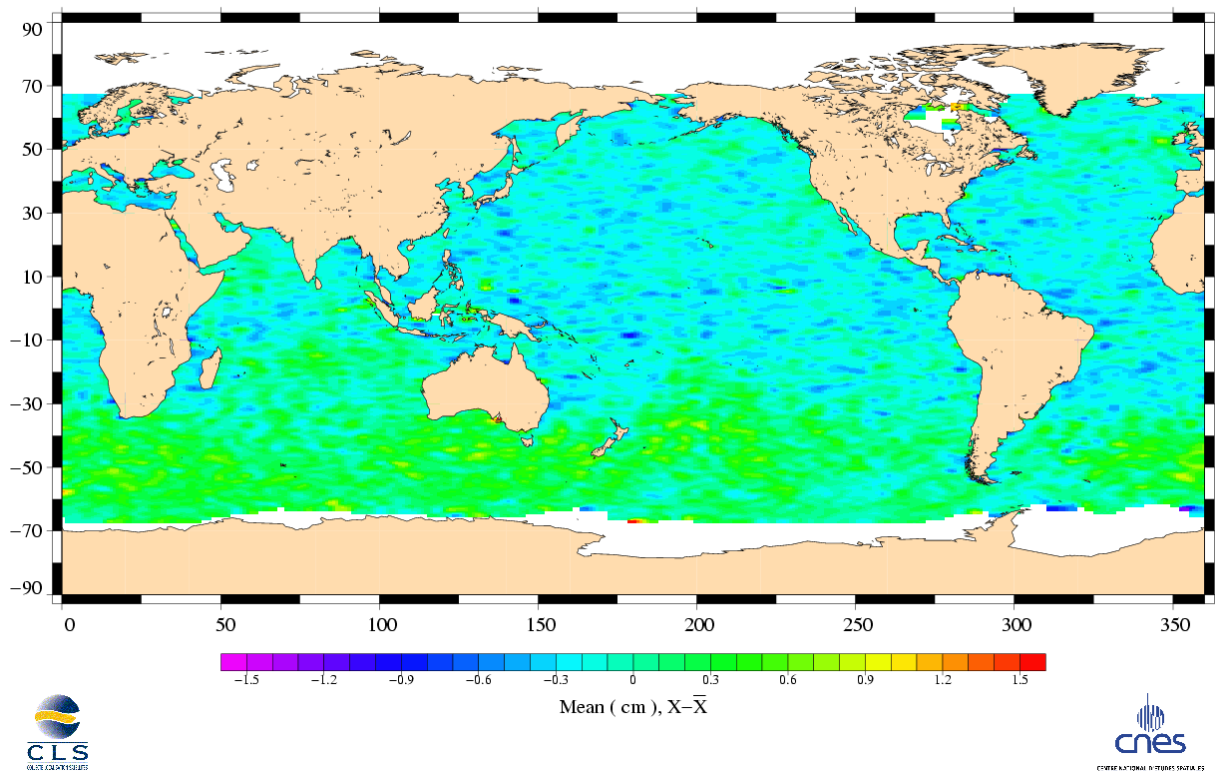
### 6.2.3 TP – Jason-1 dual-frequency ionosphere correction differences

The global statistics of (TP – Jason-1) dual-frequency ionosphere correction differences are:

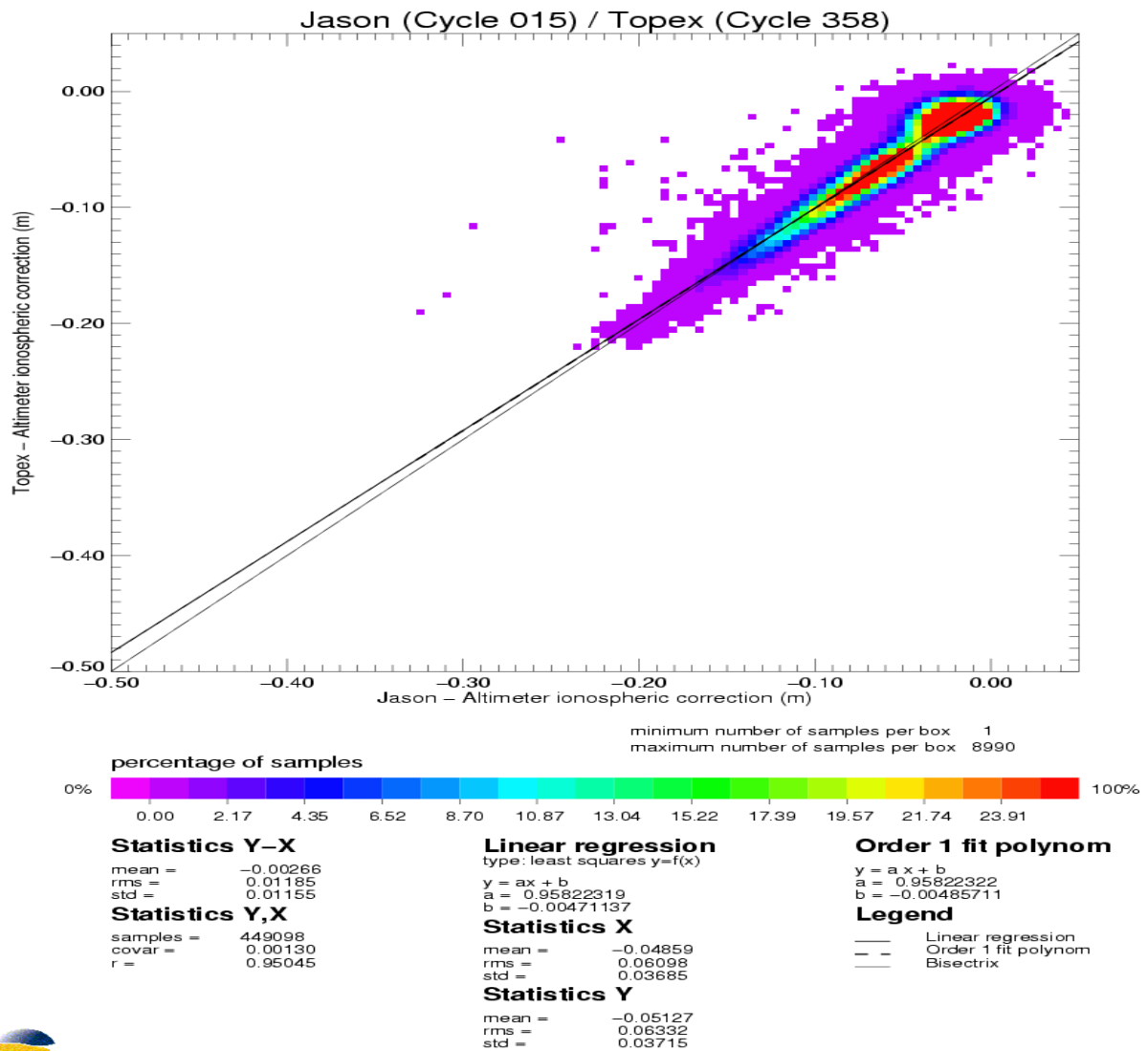
Number of estimates	Mean	Standard deviation
449098	-0.268 cm	1.148 cm

These differences are plotted on the following figure (data are centered about the mean value) :

Altimeter ionospheric correction differences  
Topex (Cycle 358) – Jason (Cycle 015)



The scatter plot between Jason-1 and TOPEX dual-frequency ionosphere corrections is given on the following figure:





### 6.2.4 TP – Jason-1 radiometer wet troposphere correction differences

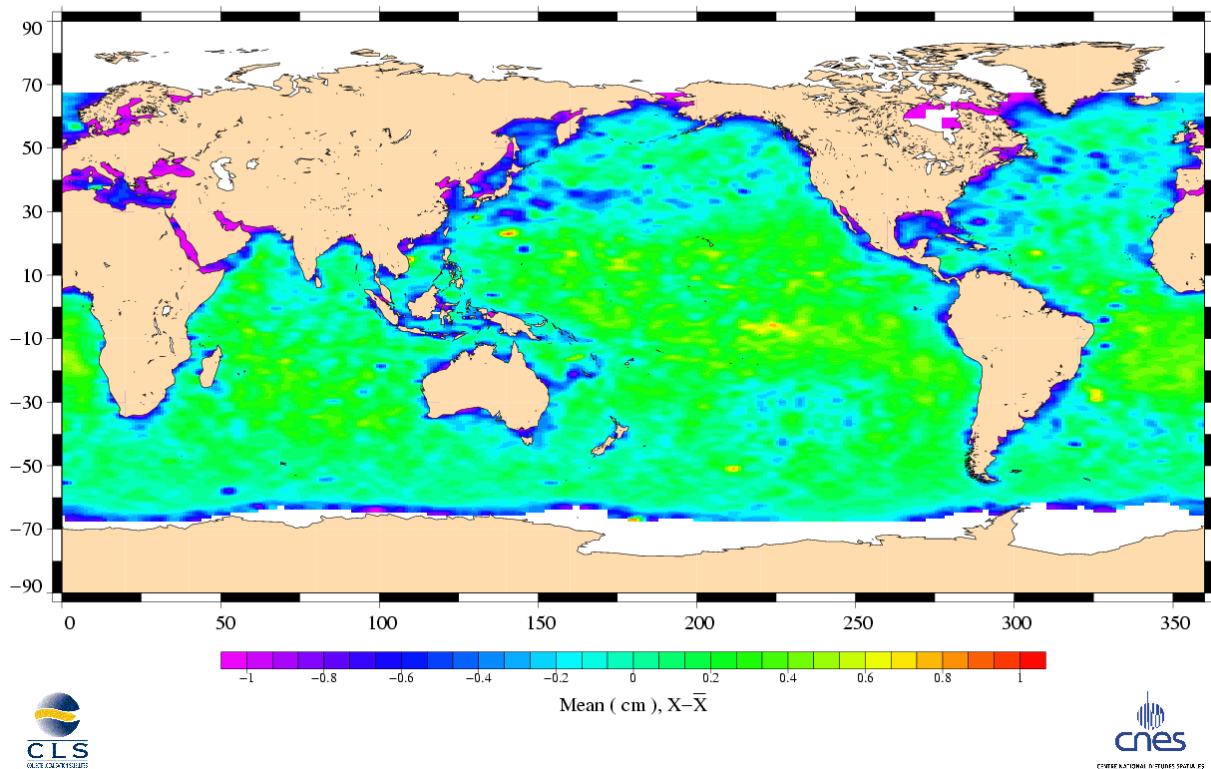
The global statistics of (TP – Jason-1) radiometer wet troposphere correction differences are:

Number of estimates	Mean	Standard deviation
449098	-0.523 cm	0.450 cm

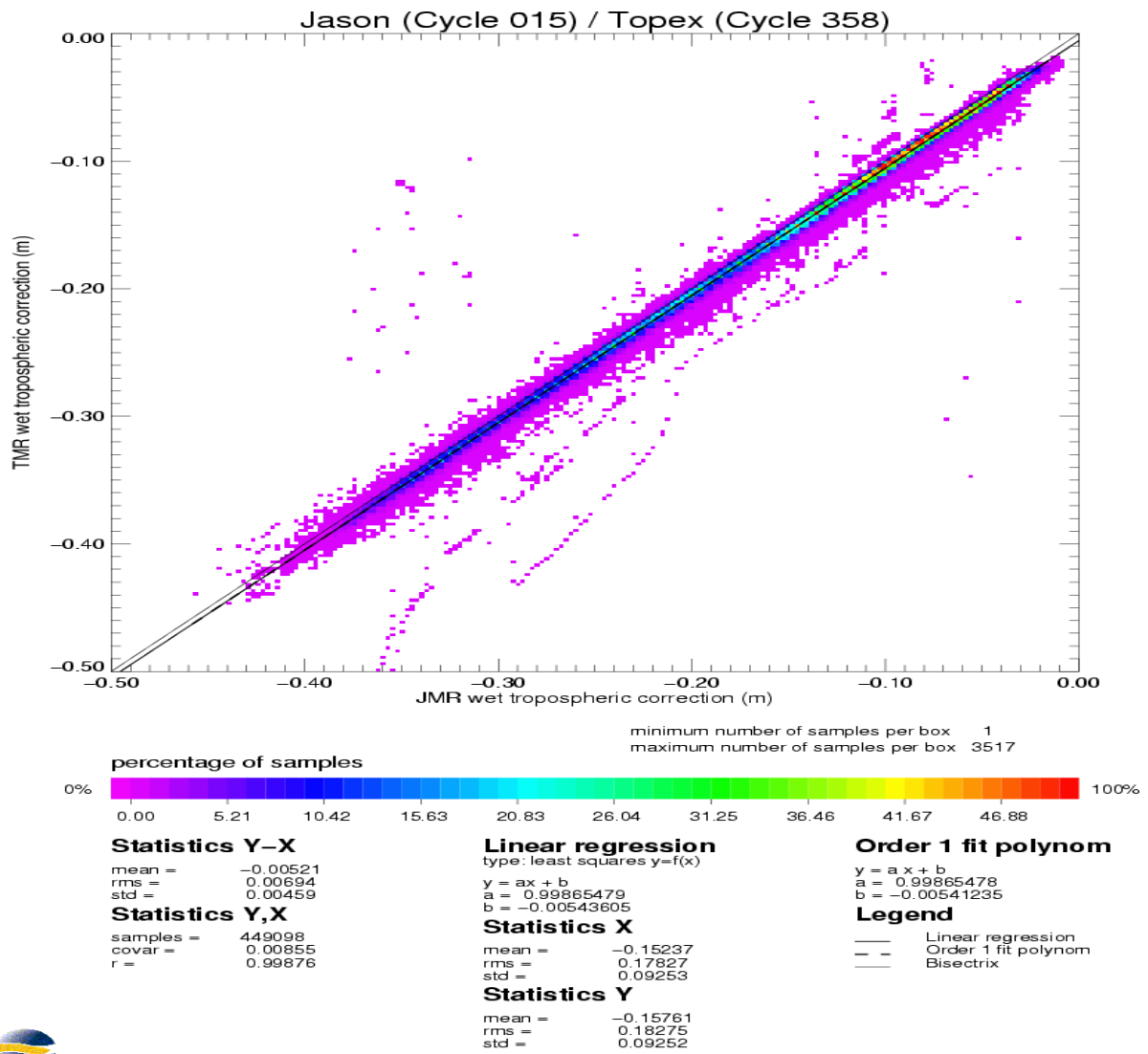
Note that the TMR wet tropospheric correction has been corrected for the drift (Ruf C.S., 2002 [4]) before performing these comparisons with the JMR correction.

The differences between JMR and TMR corrections are plotted on the following figure (data are centered about the mean value) :

Radiometer correction differences  
Topex (Cycle 358) – Jason (Cycle 015)



The scatter plot between Jason-1 and TOPEX radiometer wet troposphere corrections is given on the following figure:



### 6.2.5 TP – Jason-1 SSH differences

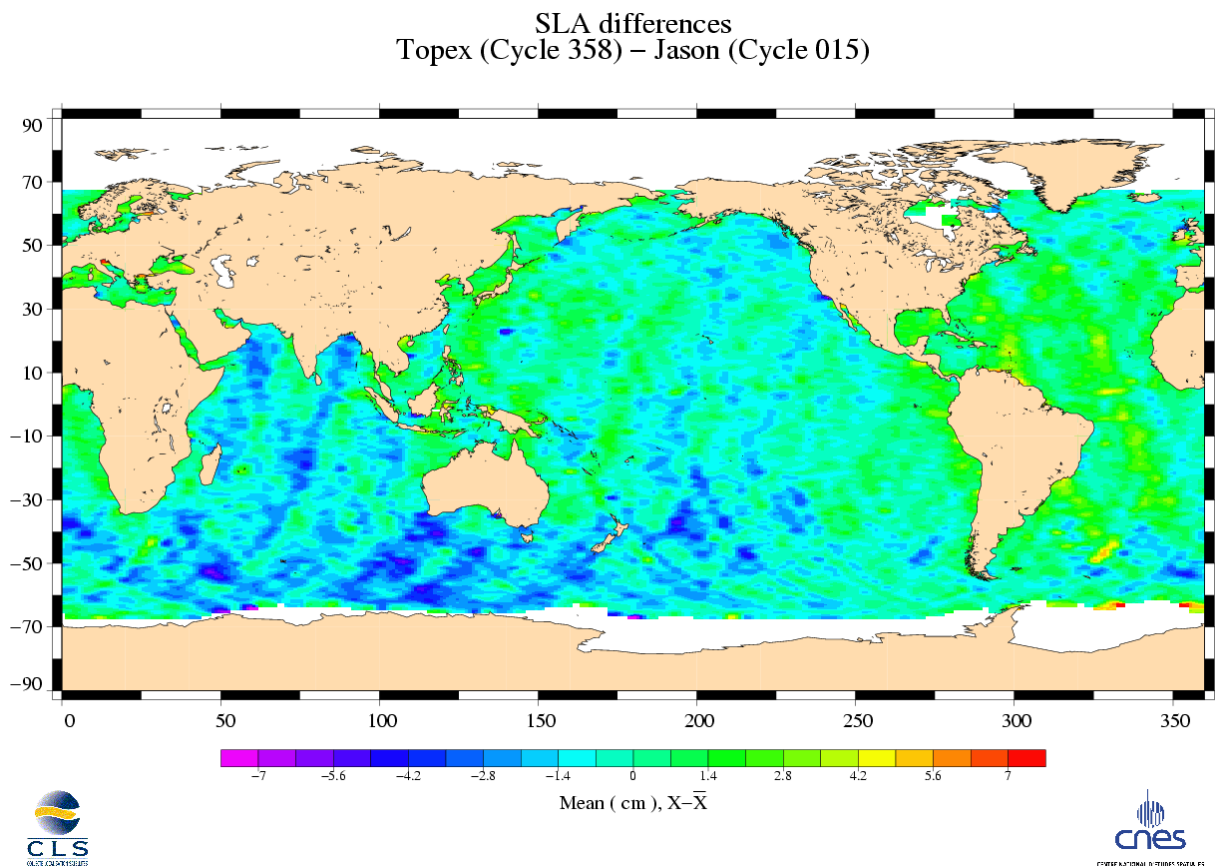
In order to compare the TOPEX SSH with the Jason-1 SSH, TOPEX GDRs have been updated with the non parametric sea state bias estimated on Topex-B data, all the other corrections remaining similar to Jason-1.

Note that TOPEX-B non-parametric sea state bias has been computed with the same method as TOPEX-A (Gaspar et al., 2002 [3]).

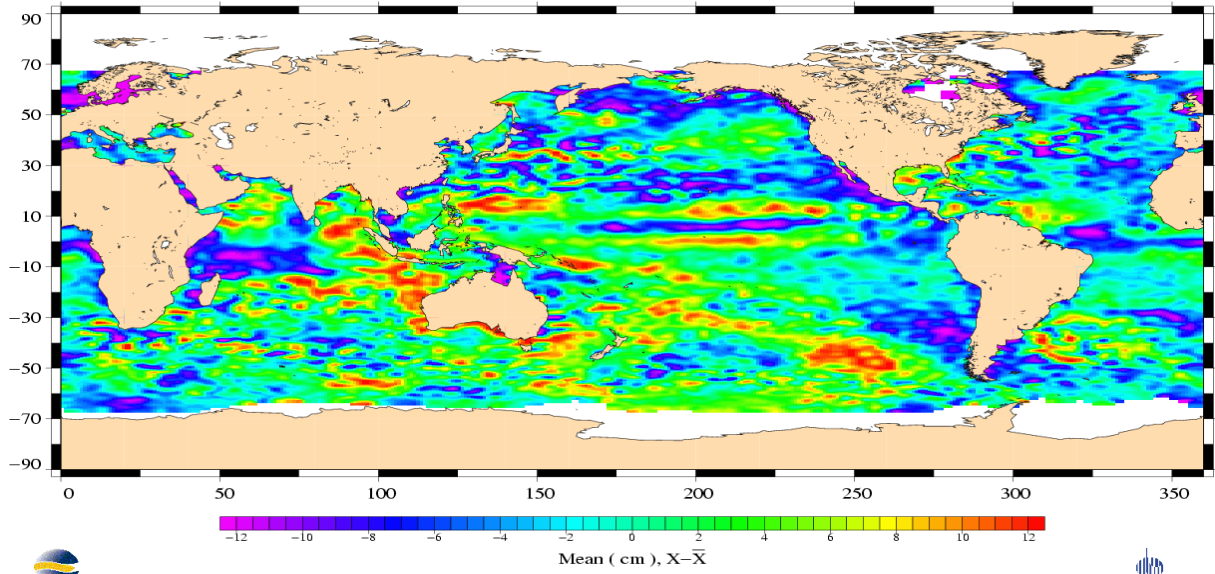
The global statistics of (TP – Jason-1) corrected SSH differences lead to :

	Number of estimates	Mean	Standard deviation
Corrected SSH	449031	-13.598 cm	3.750 cm

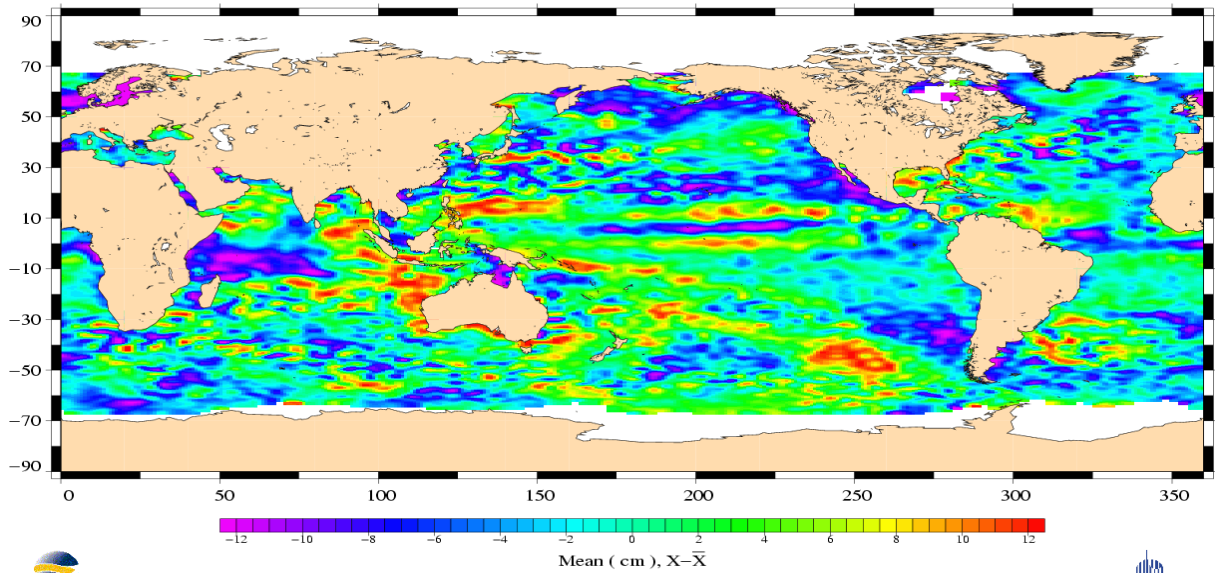
To illustrate these comparisons, the following figures show corrected SSH (TP – Jason-1) differences, SLA maps from Jason-1 GDR cycle 015 and TOPEX GDR cycle 358. Note that data are centered about the mean value.



SLA  
Jason Cycle 015 (03/06/2002 – 12/06/2002)



SLA  
Topex Cycle 358 (03/06/2002 – 12/06/2002)



## 7 General warnings

### 7.1 Altimeter wind speed default values : minor warning

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.

## References

- [1] Vincent,P., Desai S.D., Picot N. & Case K., April 8, 2003 : The first generation of IGDRs and GDRs products to be made available after completion of the Jason-1 verification phase. *Memo to Jason-1 PIs and CoIs.*
- [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] Ruf C.S., June 2002 : TMR Drift - Correction to 18 GHz Brightness Temperatures, Revisited. *Report to TOPEX Project.*