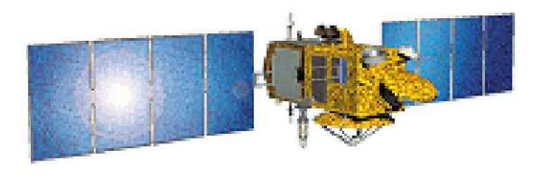

Jason-1: Initial Sea Surface Height Analysis

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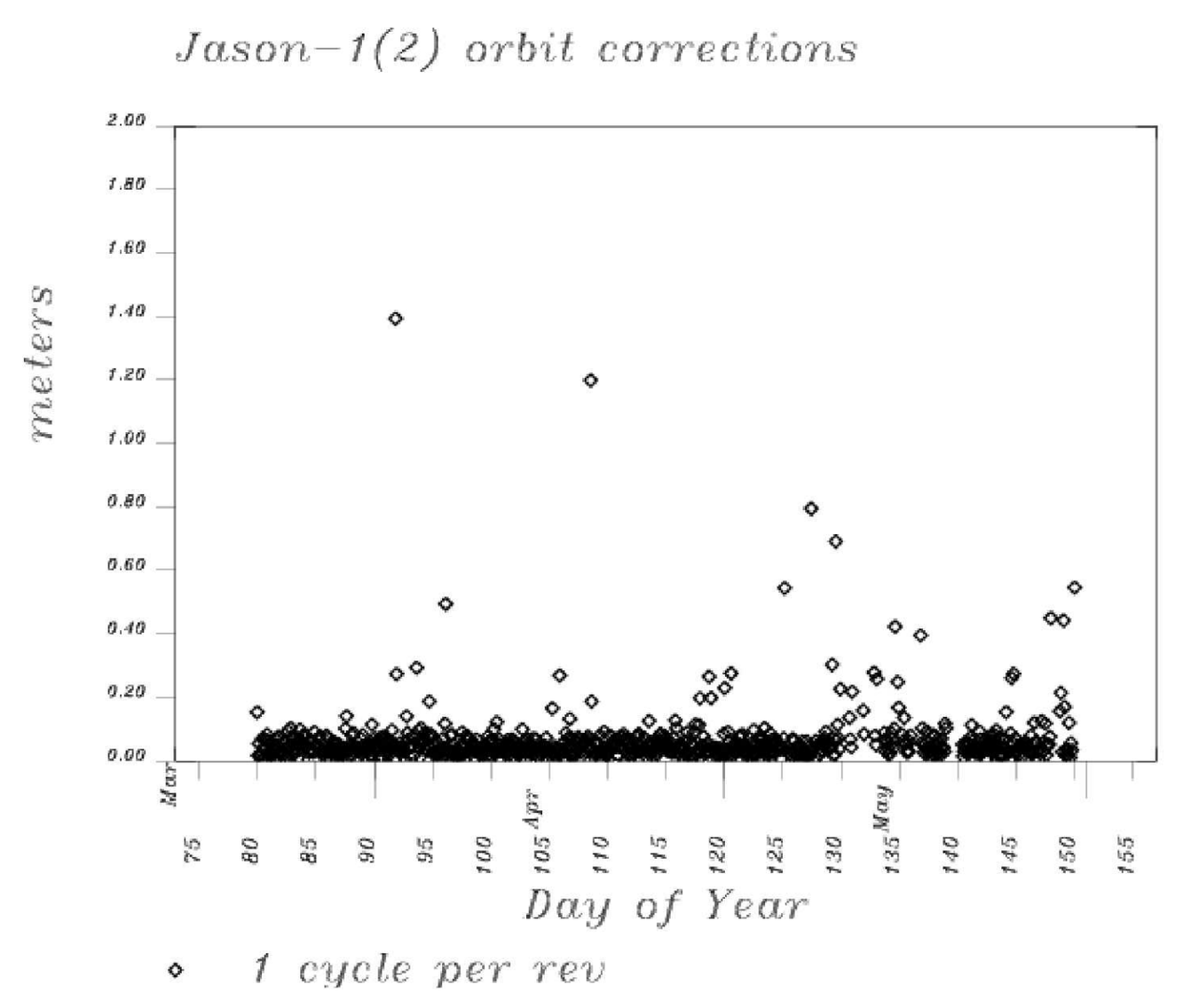
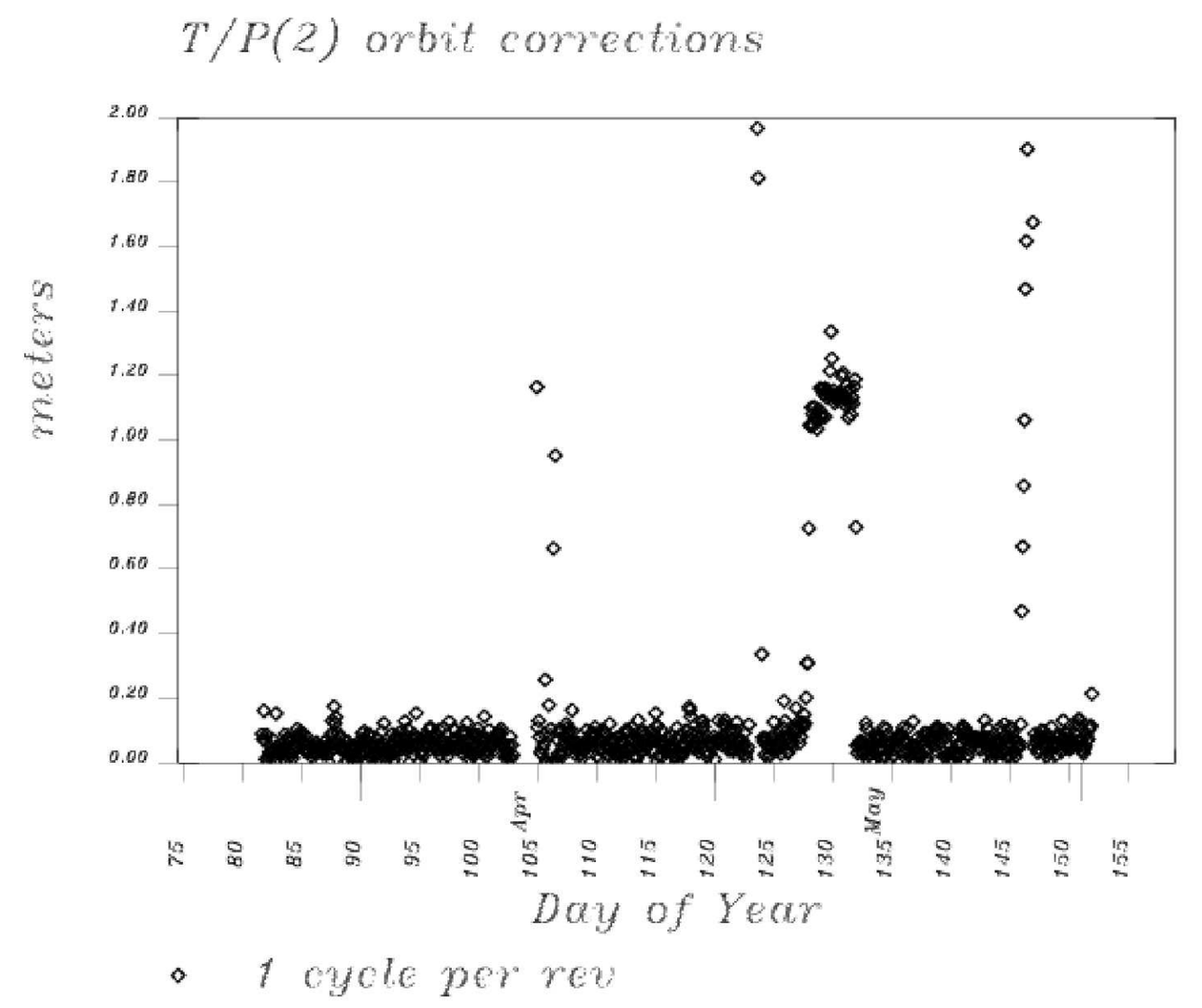
Introduction

Currently at the Naval Research Laboratory (NRL) and the Naval Oceanographic Office, TOPEX/Poseidon, ERS-2 and GFO satellite altimetry data are processed on a real time basis. With the beginning of the Jason-1 osdrs and igdrs these data sets were placed into an analagous processing stream at NRL so that they could be analyzed in the same manner. The techniques used in the real time processing are presented. Extensive analysis is performed on the data, both during and post processing. This allows problems in the Jason-1 data stream to be identified in a real time manner. These analyses demonstrate how much data is flagged as suspect in the processing, at what point it is is flagged, and for what reason. (Note, it was the result of this analysis that an error in the osdr was discovered and prevented proper processing of it. Initial analysis of this problem is included in this poster and prompted it's correction, which is being facilitated at the time of this writing.) Orbit solutions are the greatest source of error in real time altimeter products, and an orbit correction algorithm provides continuous analysis of orbit accuracy. Analysis of the final Jason-1 data sea surface height anomaly is made through examination of the crossover rm values, and collinear rms values in the case of TOPEX/Poseidon, both for each altimeter and between altimeters. The results of this processing are presented graphically on a daily basis on *The Real Time Ocean Environment* web site.

Data Processing and Dropped Points

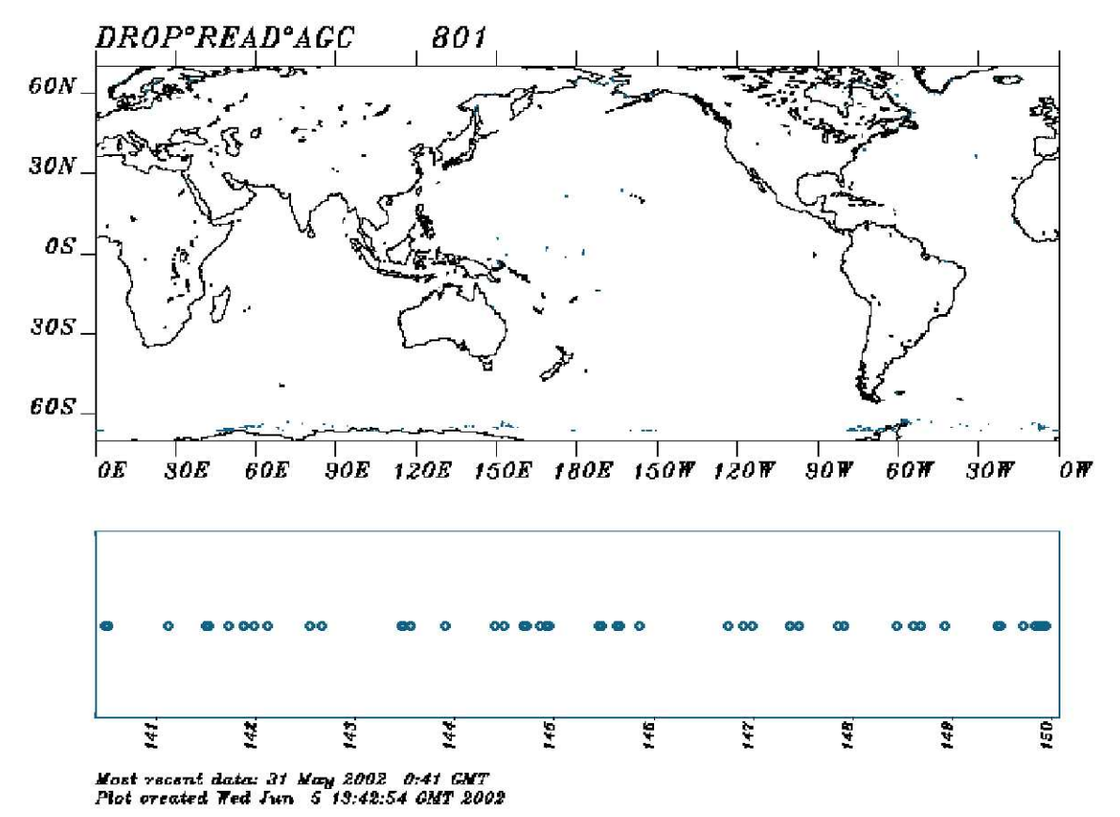
A number of processing steps are perfomed in converting the the raw altimetry data from the geophysical data records to a final sea surface height anomaly. Each step is briefly described below. In each of these steps certain points are determined to not be of scientific value and are subsequently flagged or "dropped" from further consideration. The following plots show in what part of the processing the Jason igdr data points were dropped and for what reason. The time period presented is the most current cycle (~10 days) of data. At the top of the plot the number of criteria is named and the numer of points flagged is given. Each plot indicates where the flagged data point is in space and time.

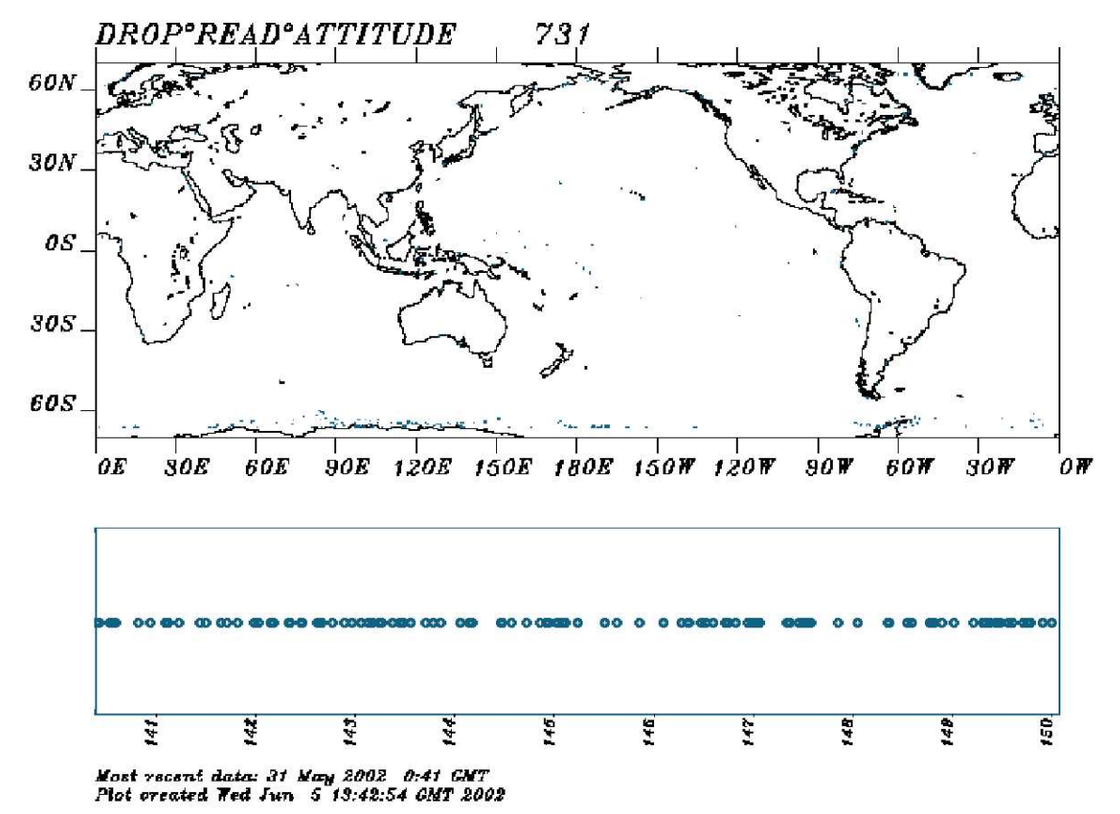


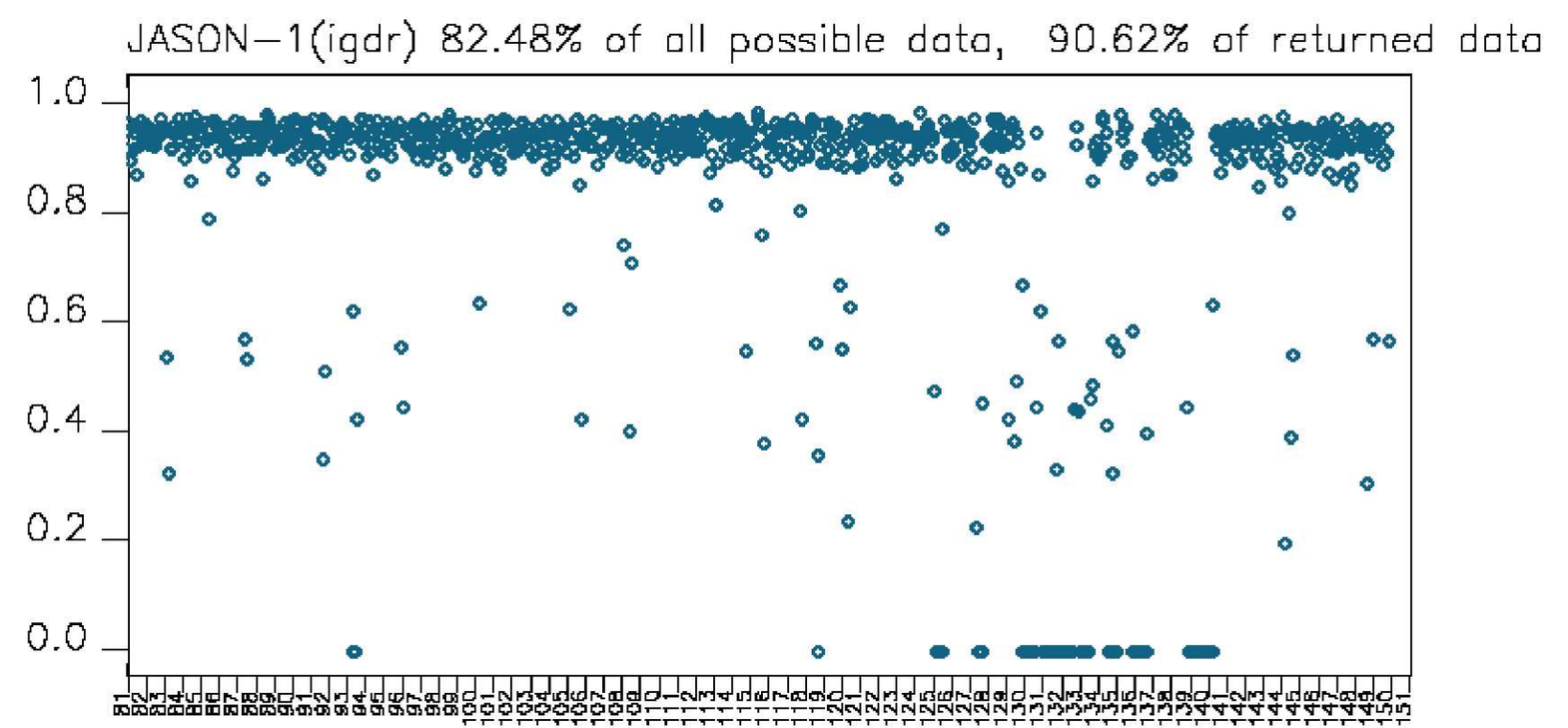


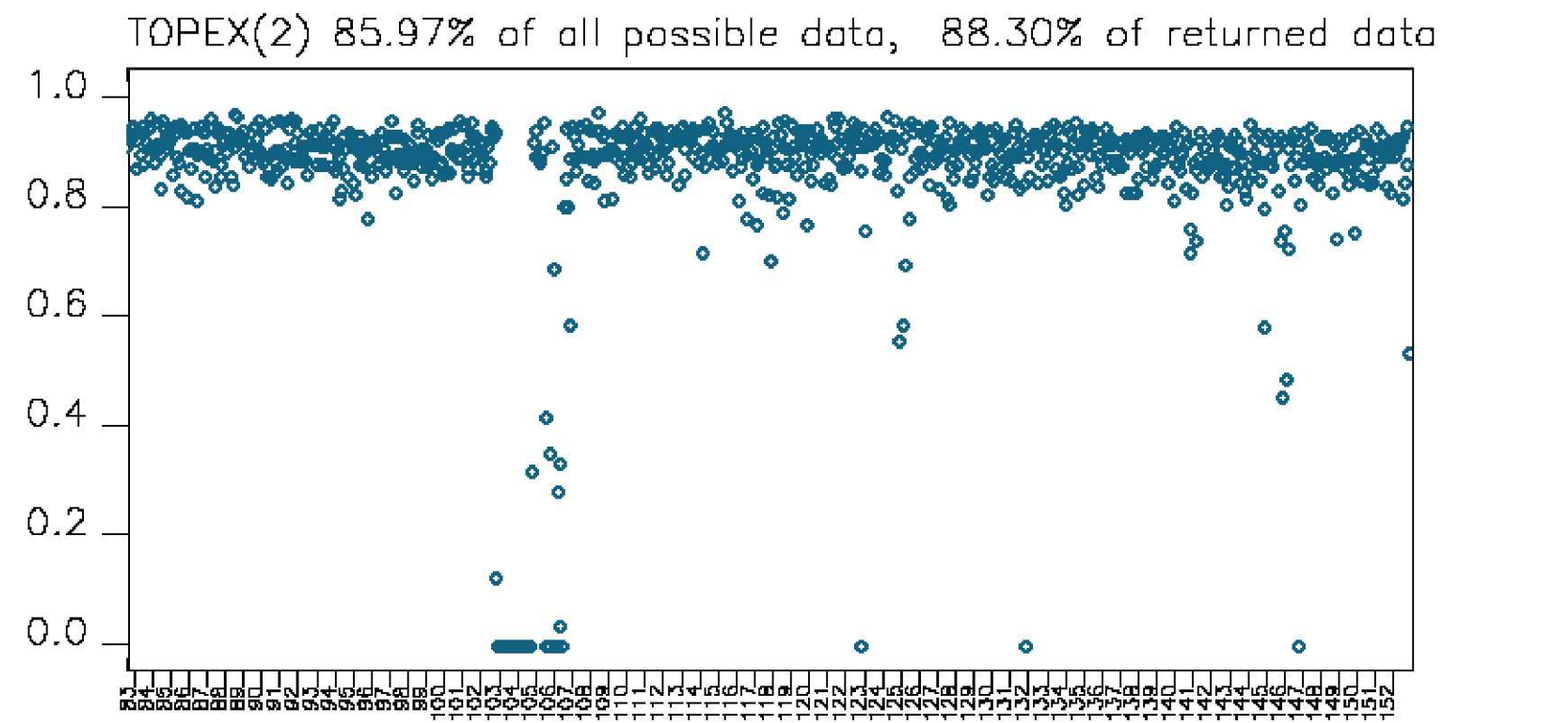
The plots above show the magnitudes of orbit error corrections applied to the altimetry data during processing. It is clearly shown that the orbit supplied on the Jason igdr are generally equivalent to that of the Topex/Poseidon (tpx2) orbit.

read: Data is read from the gdr and standard correction factors (e.g. inverse barometer, em bias, dry tropo, etc.) are applied. Points are flagged if certain physical parameters are outside prescribed bounds.







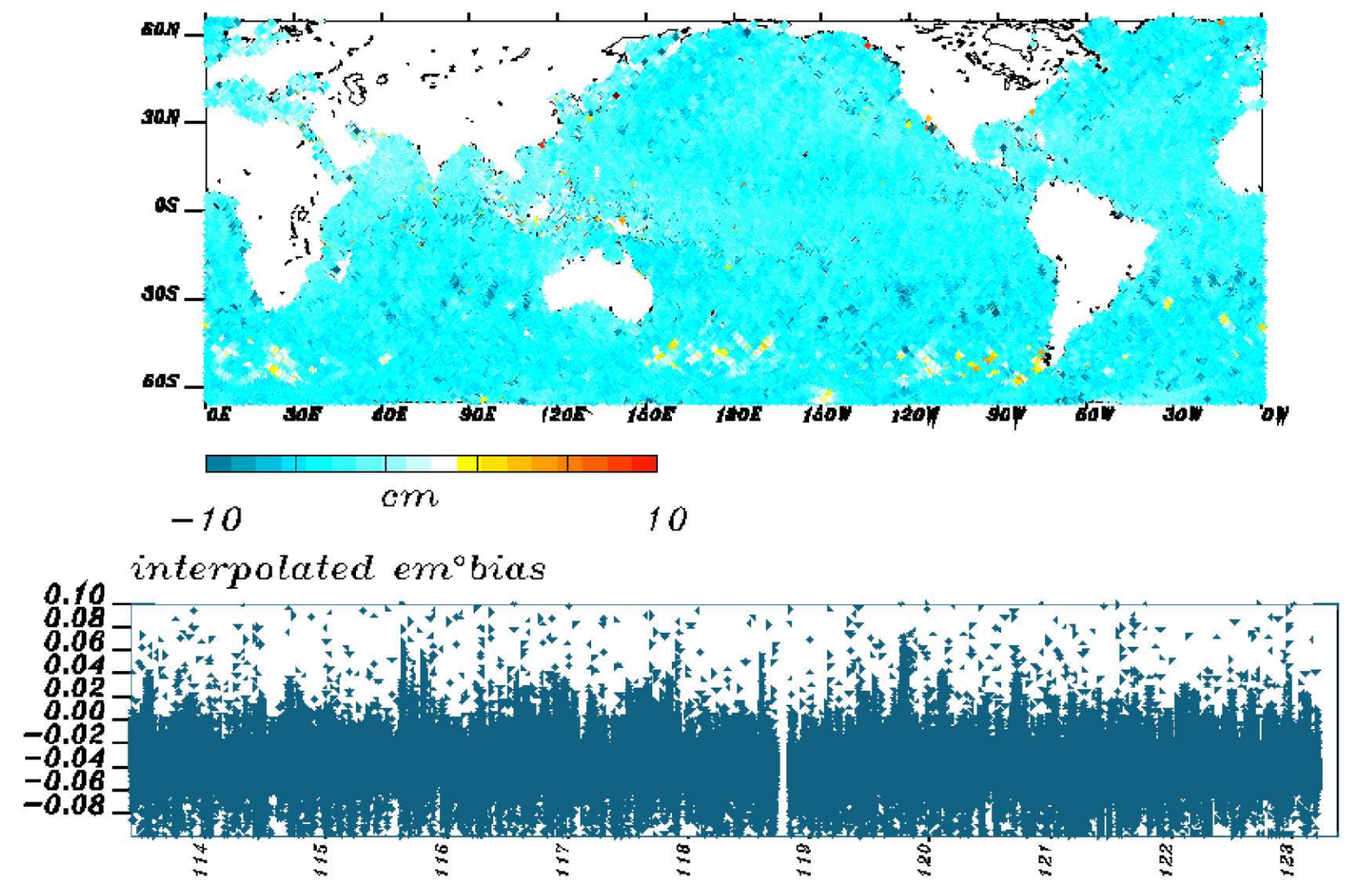


The plots above show the percent of data that was processed without being "flagged" or dropped within each track. The percent of returned data that contains valuable scientific information is comparable to that of Topex/Poseidon.

Jason-1 versus Topex/Poseidon

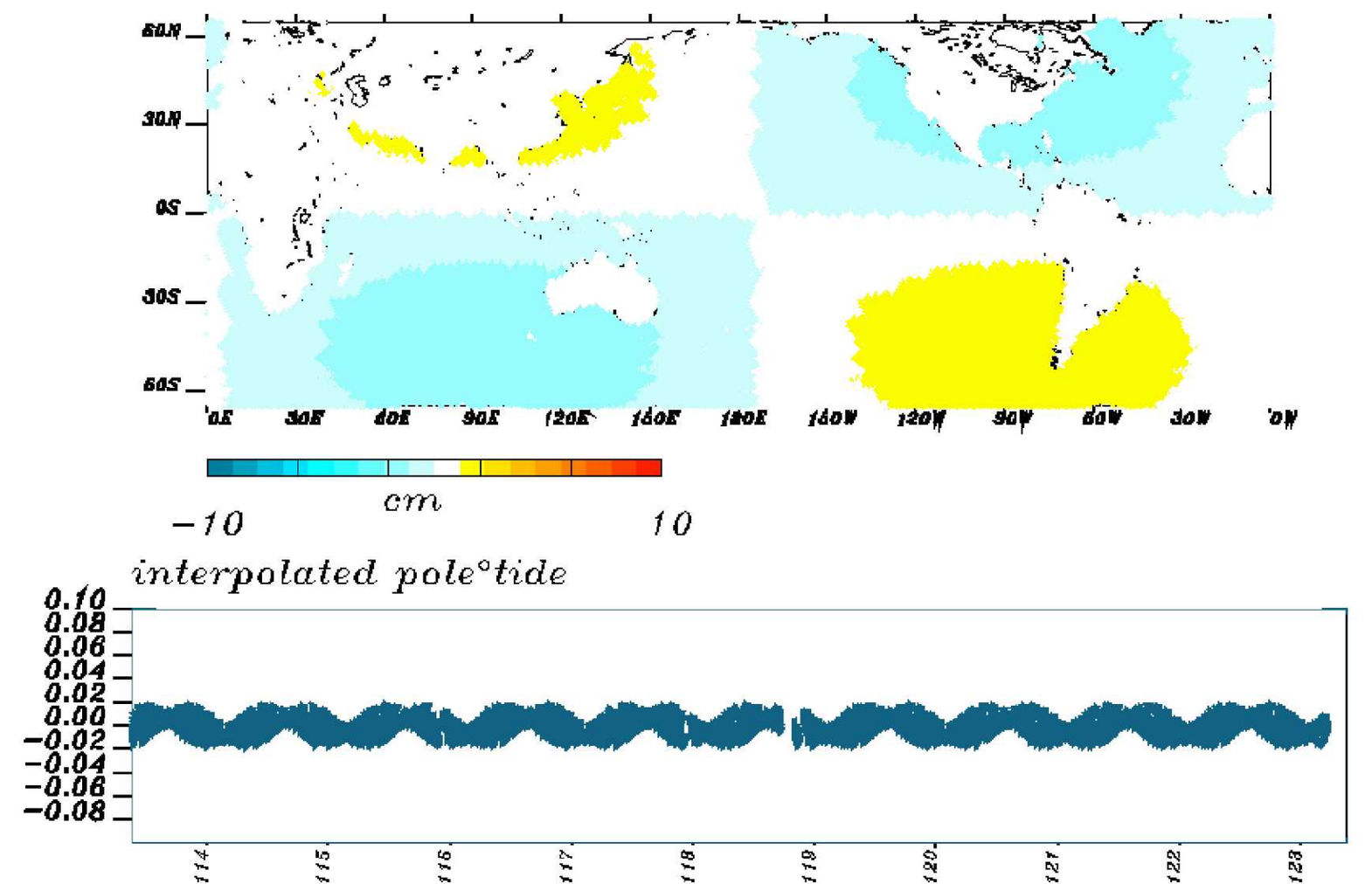
Collinear comparison of Jason and Topex

To gain a clearer understanding of the Jason data products it was decided to difference them along track with Topex data. This was done for both the height value and the seven major correction terms included on the gdr (these terms are listed in the table to the right). After initial processing problems with the osdr it was decided to also difference the Jason osdrs with the Jason igdrs. This was performed for each cycle for which data existed for all types. Plots were made of each cycle and a mean and rms were computed. The table of these values and plots of some interesting cases have been included here. Note, each plot contains one cycle of data. The scale on the spatial section of the plot is centimeters and is meters for the temporal section. The time axis of the plots is in julian days.



Jason igdr minus Topex em bias (cycle 11)

Adistinct three to four centimeter bias is exhibited both spatially and temporally. This behaviour is consistent across all cyles examined.

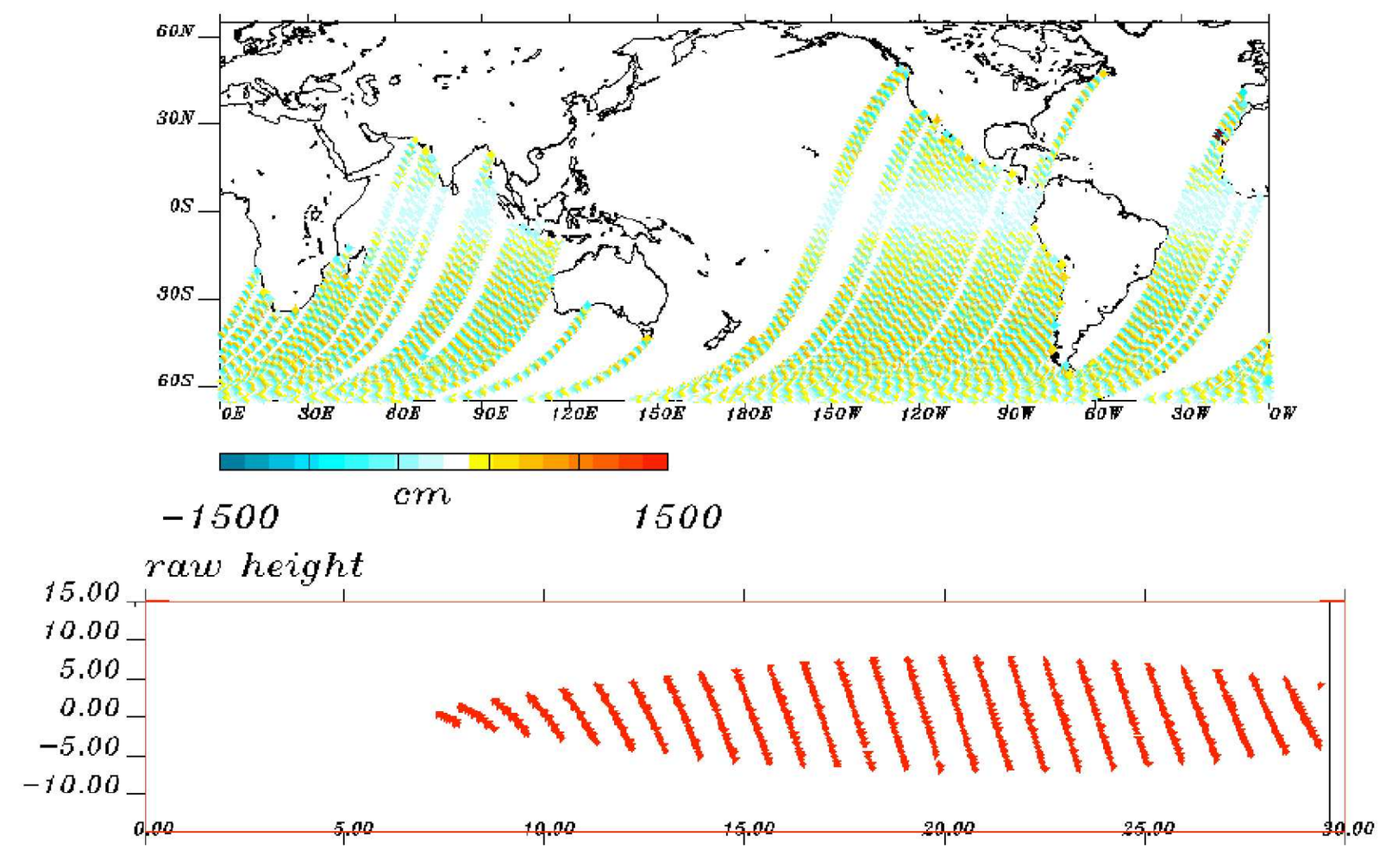


Jason igdr minus Topex pole tide (cycle 11)

A regional difference in the pole tide correction was seen that resulted in sinusoid-like difference in time. This behaviour is consistent across all cycles examined.

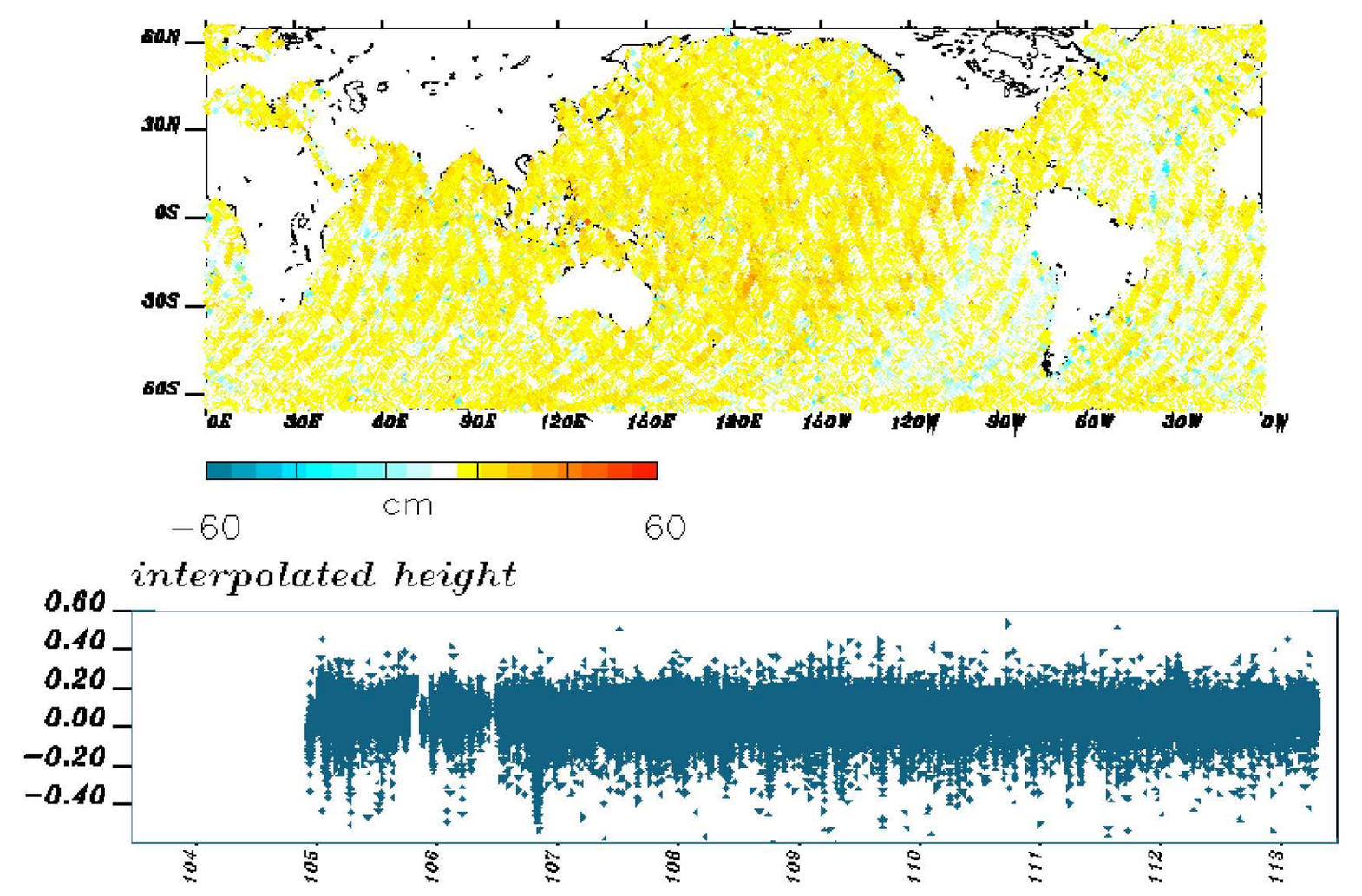
Cycle	Data types	-	height	wet tropo	dry tropo	inv barom	solid tide	iono	em bias	pole tide
8	igdr - tpx2	rms	5.07	0.70	0.44	1.91	0.07	1.78	1.34	0.85
		mean	6.37	0.66	-0.10	-0.45	-0.05	-0.11	-3.87	-0.08
	osdr - igdr	rms	448.6	-	0.45	1.96	0.00	13.63	2.78	N.A.
		mean	-21.2	-	0.07	0.31	0.00	-1.44	-0.27	N.A.
9	igdr - tpx2	rms	5.11	0.69	0.39	1.70	0.06	1.92	1.40	0.84
		mean	6.59	0.76	-0.14	-0.59	-0.03	-0.09	-3.87	-0.05
	osdr - igdr	rms	448.8	-	0.40	1.74	0.00	16.01	2.91	N.A.
		mean	-19.1	-	0.10	0.46	0.00	-1.46	-0.26	N.A.
10	igdr - tpx2	rms	5.66	0.64	0.39	1.69	0.06	1.96	1.41	0.81
		mean	6.74	0.80	-0.12	-0.53	0.02	0.08	-3.89	-0.09
	osdr - igdr	rms	460.8	-	0.41	1.80	0.00	18.6	3.17	N.A.
		mean	-18.0	-	0.09	0.41	0.00	-8.80	-0.32	N.A.
11	igdr - tpx2	rms	12.3	0.75	0.46	2.01	0.07	1.82	1.42	0.84
		mean	-0.73	0.74	-0.12	-0.51	0.06	0.38	-3.78	-0.08
	osdr - igdr	rms	466.8	-	0.47	2.05	0.00	5.71	3.11	N.A.
		mean	-15.3	-	0.09	0.41	0.00	-2.28	-0.39	N.A.
12	igdr - tpx2	rms	51.6	0.69	0.46	2.02	0.06	1.84	1.34	0.83
		mean	7.60	0.54	-0.12	-0.54	0.05	0.34	-3.79	-0.13
	osdr - igdr	rms	516.6	-	0.45	1.97	0.00	17.5	3.06	N.A.
		mean	-18.3	-	0.10	0.45	0.00	-2.67	-0.34	N.A.
13	igdr - tpx2	rms	5.35	0.97	0.45	1.98	0.06	1.69	1.37	0.82
		mean	5.68	0.13	-0.12	-0.53	0.01	0.35	-3.66	-0.10
	osdr - igdr	rms	508.2	-	0.44	1.92	0.00	18.4	3.08	N.A.
		mean	-17.7	-	0.11	0.48	0.00	-2.76	-0.37	N.A.
14	igdr - tpx2	rms	23.9	0.83	0.41	1.78	0.09	1.75	1.42	0.85
		mean	15.3	0.18	-0.11	-0.50	-0.05	0.36	-3.70	-0.05
	osdr - igdr	rms	518.9	-	0.39	1.71	0.00	15.0	3.13	N.A.
		mean	-26.9	-	0.09	0.39	0.00	-2.68	-0.47	N.A.

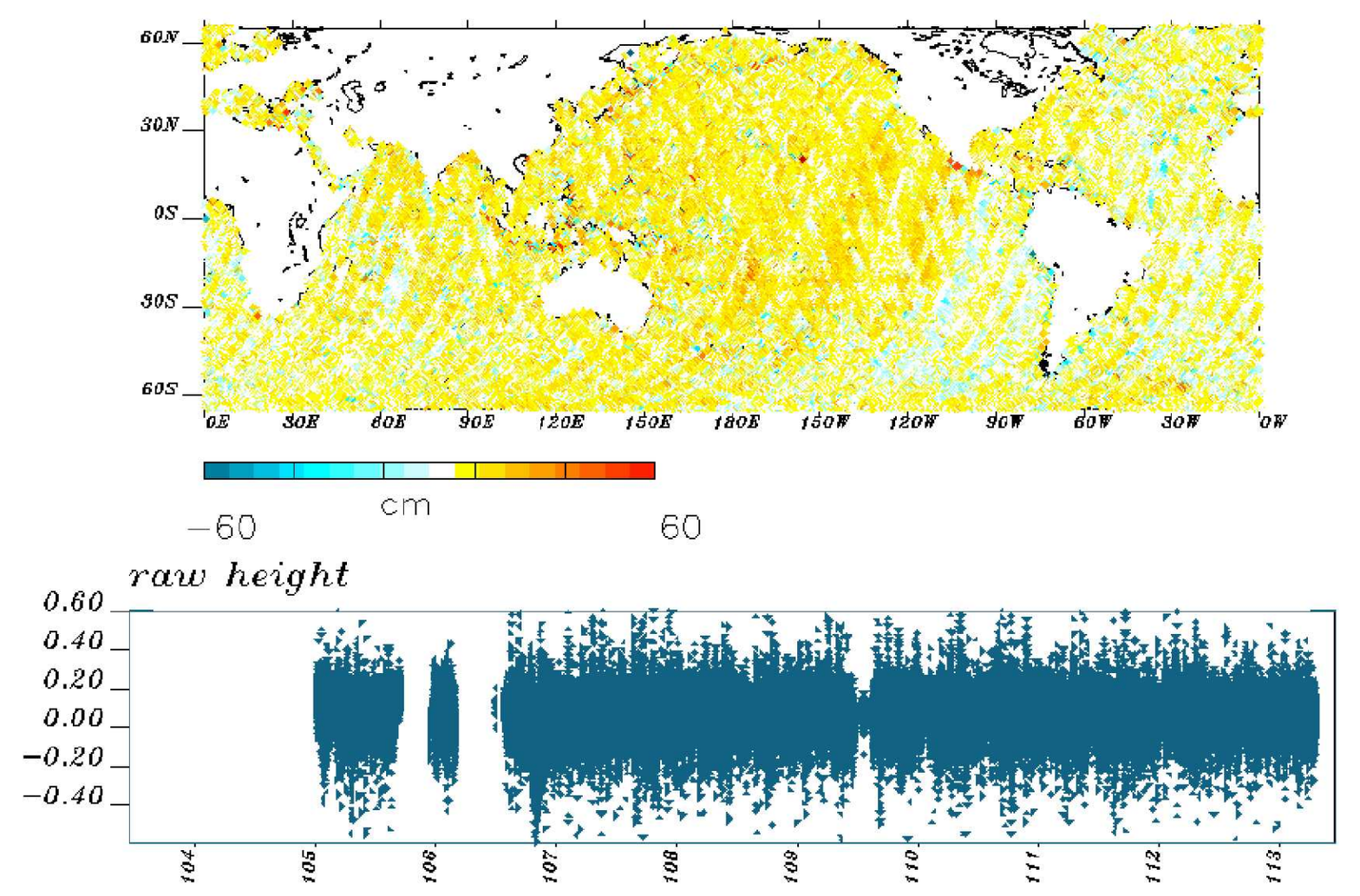
For each cycle of data that both Jason igdrs and osdrs exist the height and correction terms were differenced. The Jason igdrs were also differenced with Topex data. Note that all values were interpolated to the reference ground tracks before differencing. As graphically seen below, this reduces the noise associated with the rms values. A mean and rms were computed for each cycle and are presented in this chart. All values are in centimeters. Because the Jason osdr does not contain a pole tide or dry tropo correction value, statistics are not computed for the former and NOGAPS values are inserted for the latter. These statistics quickly demonstrated a large discrepancy in height values between the igdr and osdr. Also of note is an approximately 4 cm bias between the Jason and Topex em bias corrections.



Jason osdr minus igdr height

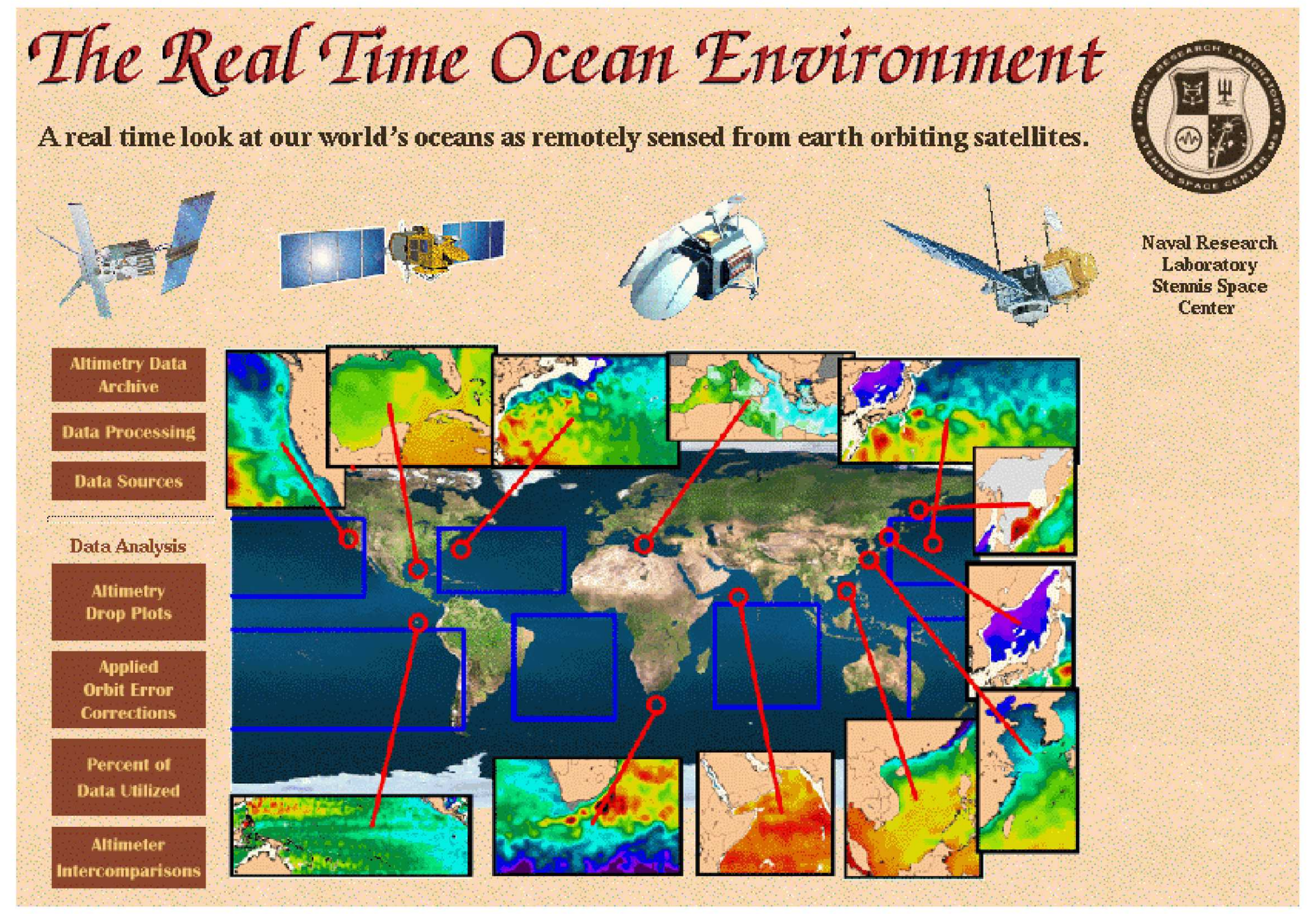
When the Jason osdrs were introduced to the real time processing stream the result was all the data was dropped with the majority being flagged in the *orbgdem* section of processing. The height and the correction fields were differenced with those on the igdr. The correction fields were found to be largely in agreement, but the height field showed a large mean difference and a huge rms value of over 4 metres. The plot above supports this value and shows a "sawtooth" shape. Note that the time scale is only 30 minutes and the large height range. This signal coupled with the quality seen in the igdr data gave strong indication that the error resided in the orbit field. These findings were passed along to other memers of the science working team and it was found that there was in fact an error in the orbit field. The error was not in the orbit solution, however, but was produced by an error in the orbit interpolation algorithm. This error is being corrected at the time this was written.





Jason igdr minus Topex height (cycle 10)

The plots above demonstrate how the difference seen in comparing the Jason igdr and Topex height data is reduced when all values are interpolated to the reference ground tracks. This technique subsequently was applied to all terms before differencing.



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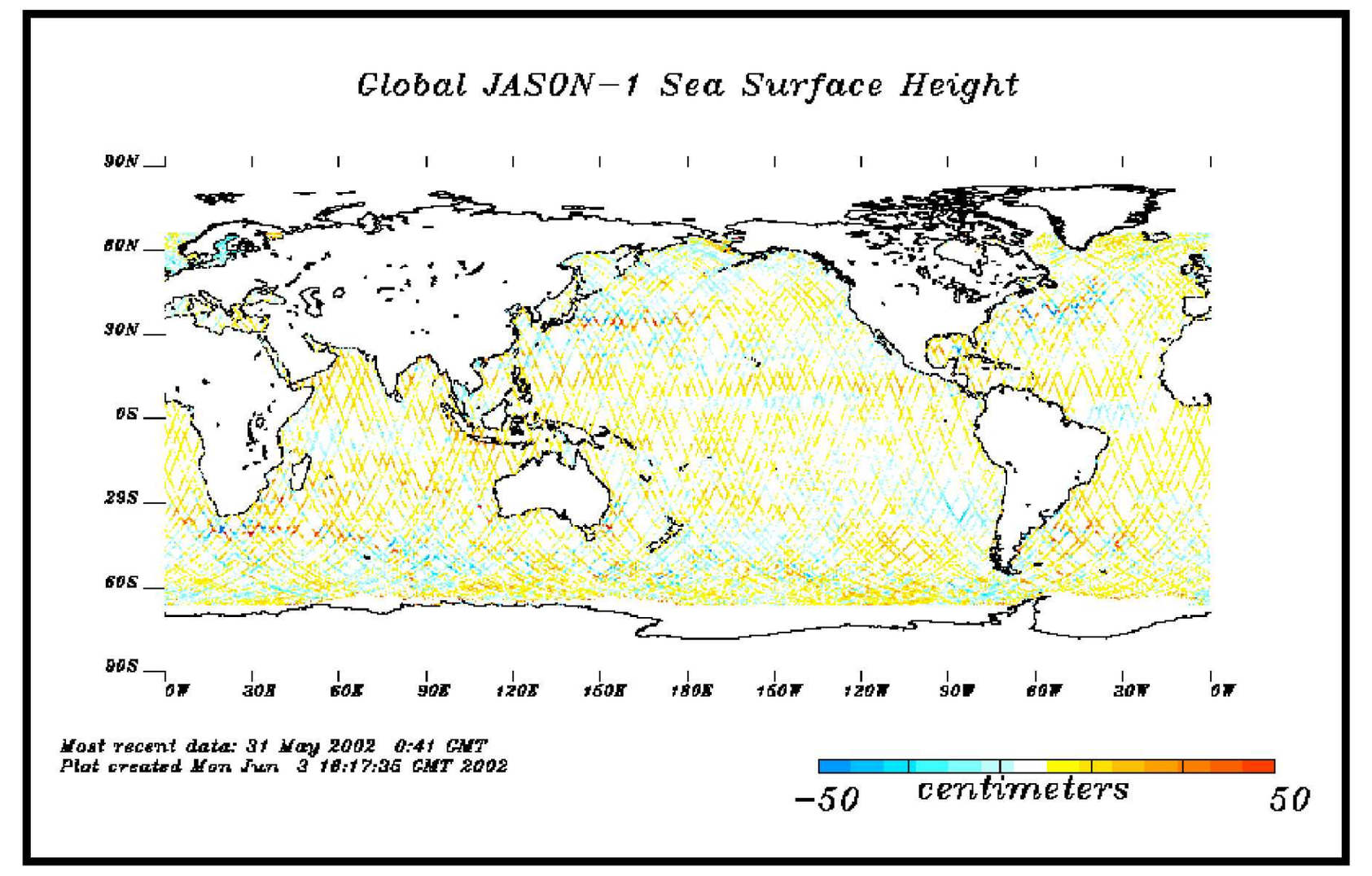
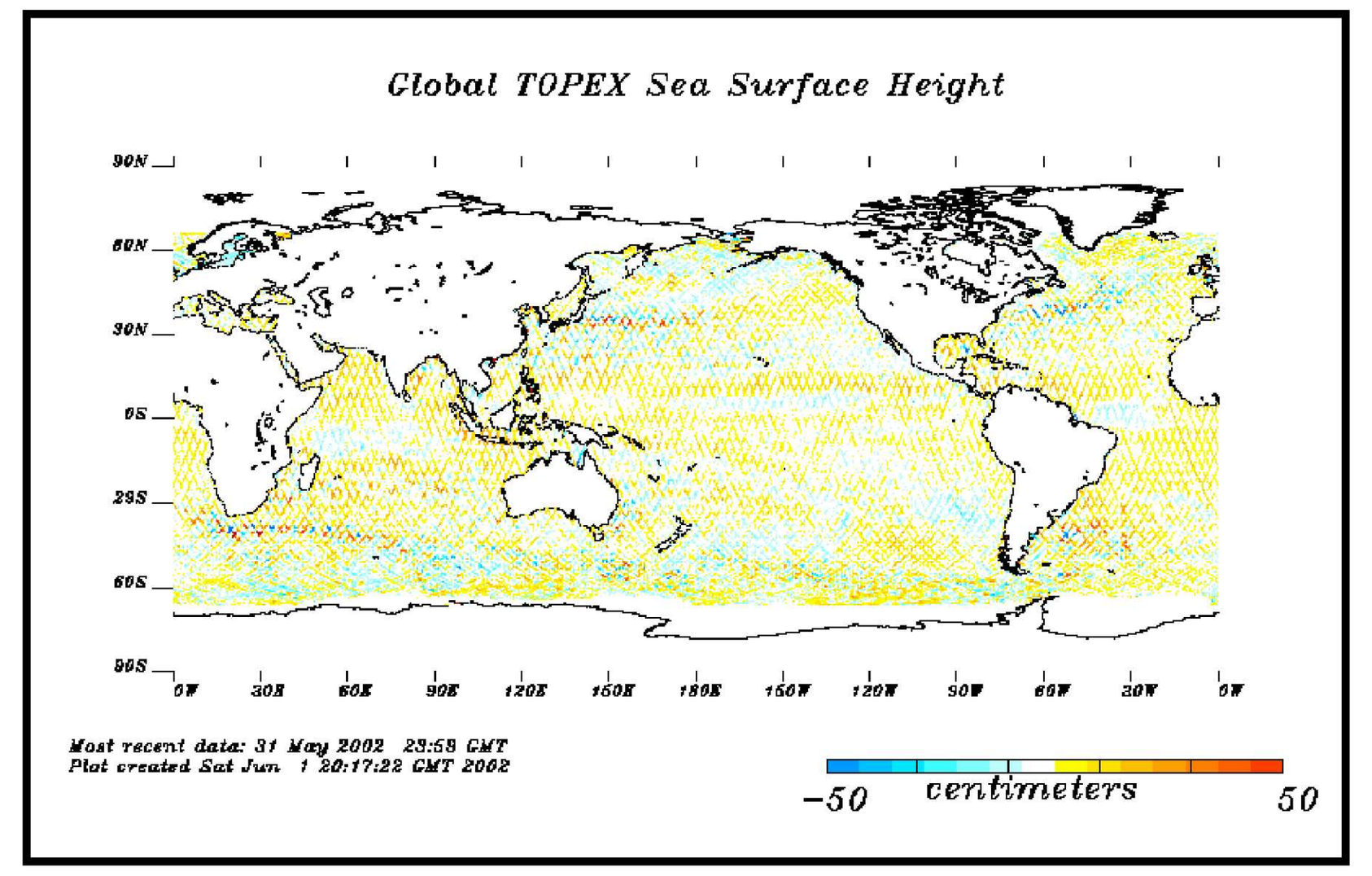
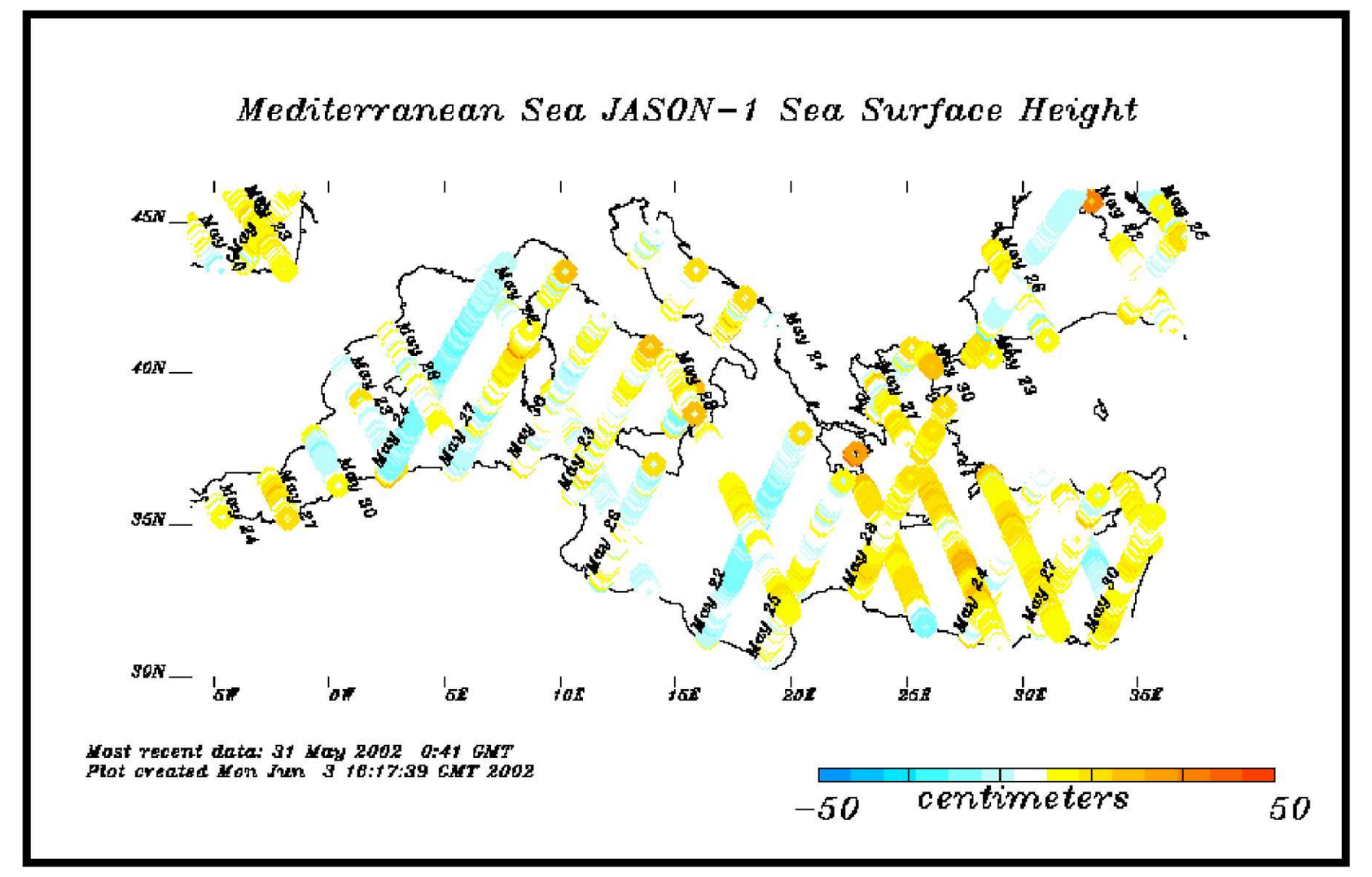
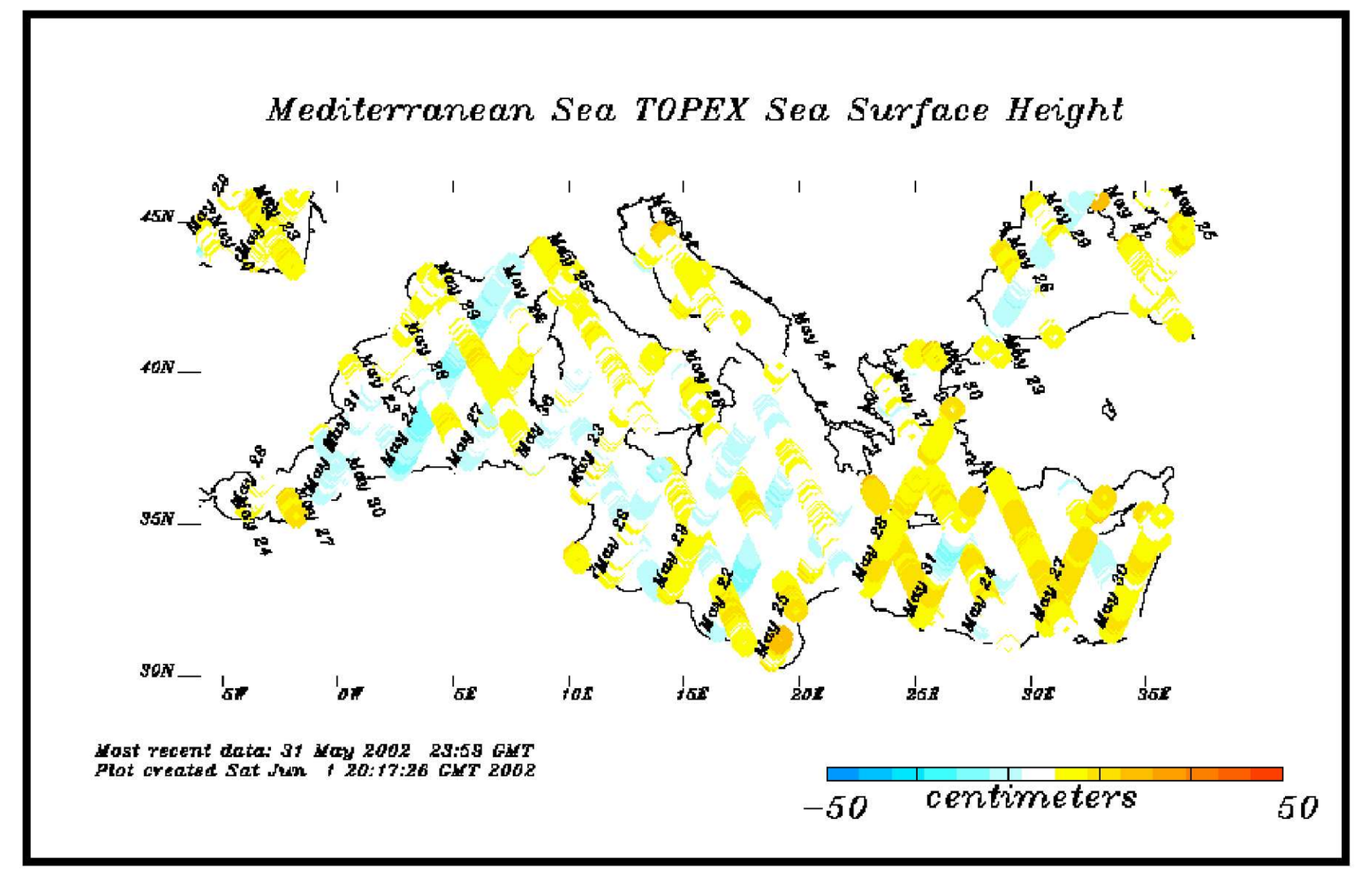




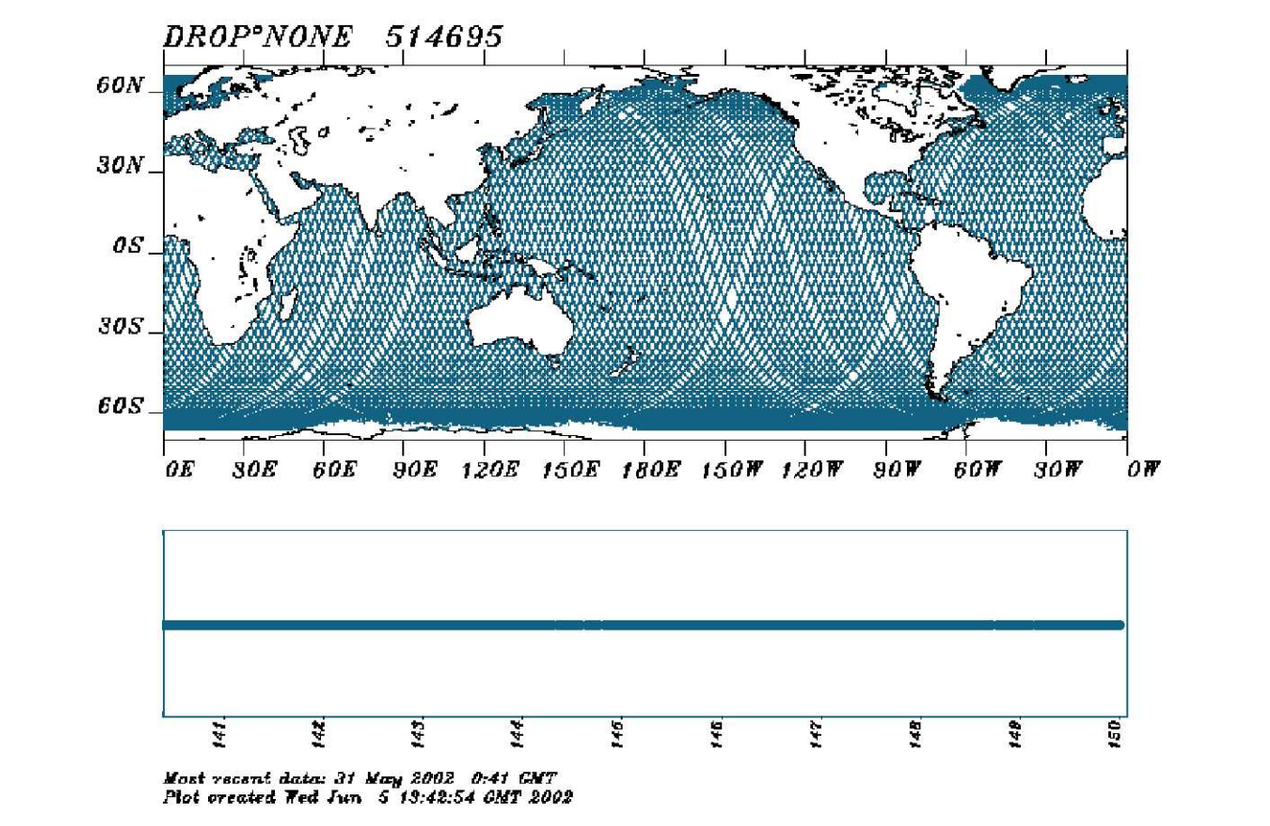


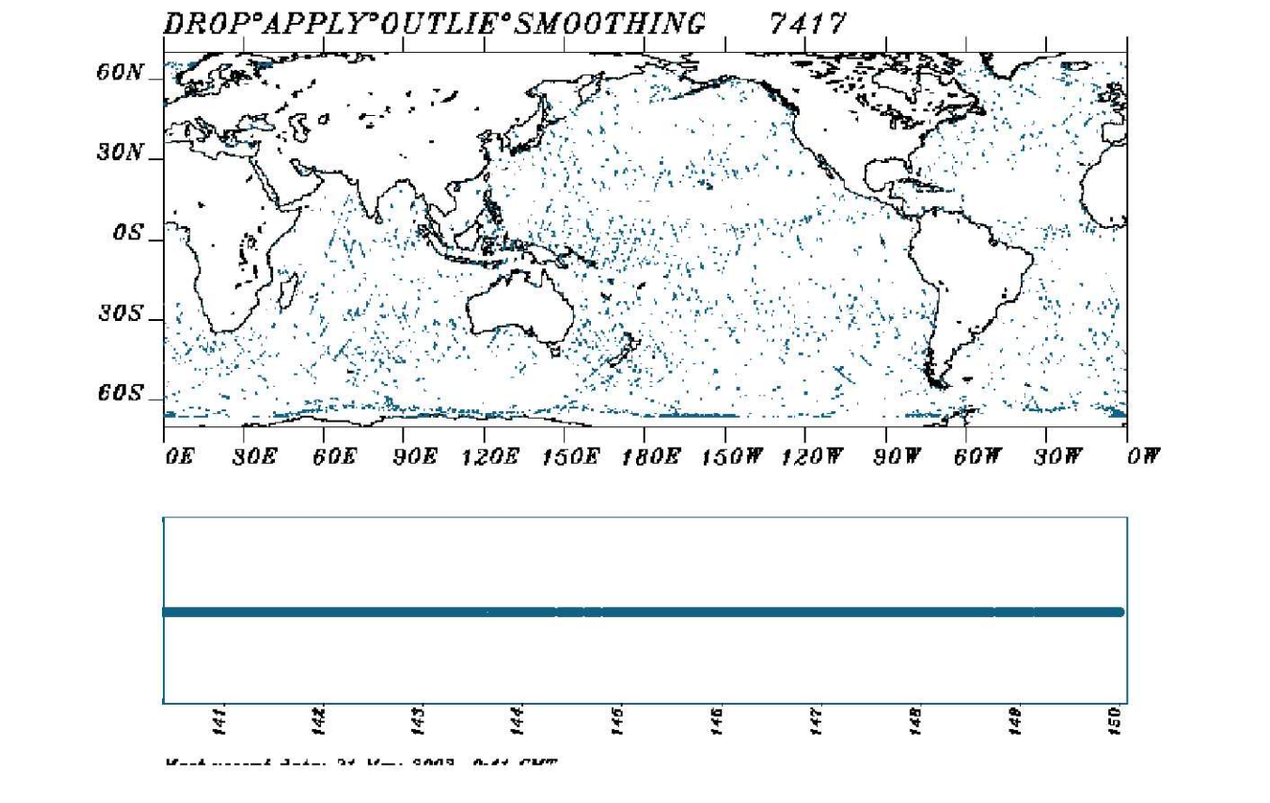


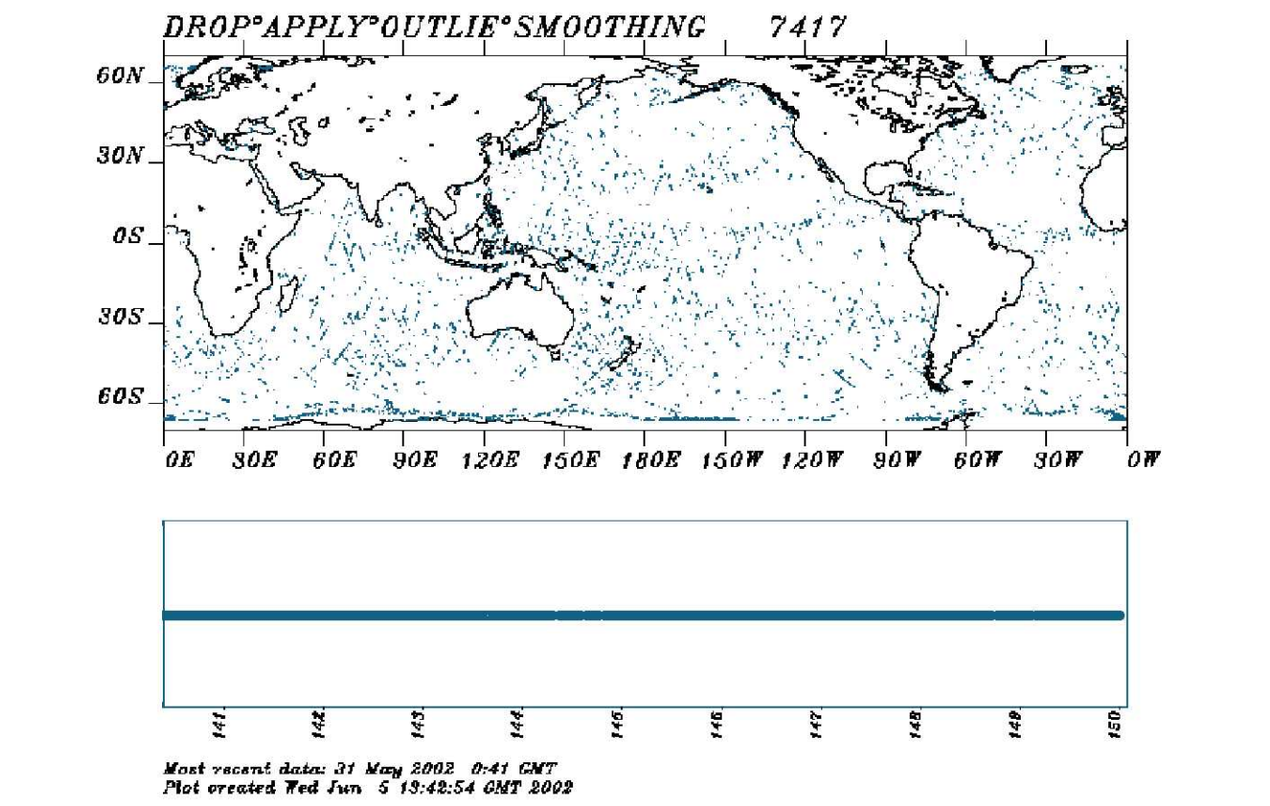
The sea surface height anomaly values are plotted along track for the Mediterranean Sea and globally. Plots are given for the most recent cycle of data for both Topex and Jason so that the very positive comparison can be seen.

	JASON-1	TOPEX	ERS-2	GFO
JASON-1	8.5712 (8.4882)	8.1721 (8.1055)	10.1552 (10.0214)	9.8809 (9.7823)
TOPEX	8.2662 (8.2361)	7.1581 (7.1342)	9.2603 (9.1546)	9.0484 (9.0046)
ERS-2	9.7505 (9.6504)	8.8992 (8.7796)	10.7336 (10.2616)	10.5491 (10.418)
GFO	9.5717 (9.4918)	8.815 (8.7519)	10.7342 (10.5981)	9.3225 (9.2032)

Processed sea surface height anomaly data for various altimeters are differenced at the points at which their ground tracks cross. From these differences rms values are computed and presented in the tables below. Only the nearest points in time at each crossover are evaluated. (i.e. If one of these points contains bad data the next nearest point is not evaluated.) All measurements are in centimeters. The first number given represents the value found using all data while the value in parentheses indicates only data bounded by +/-65 degrees latitude.



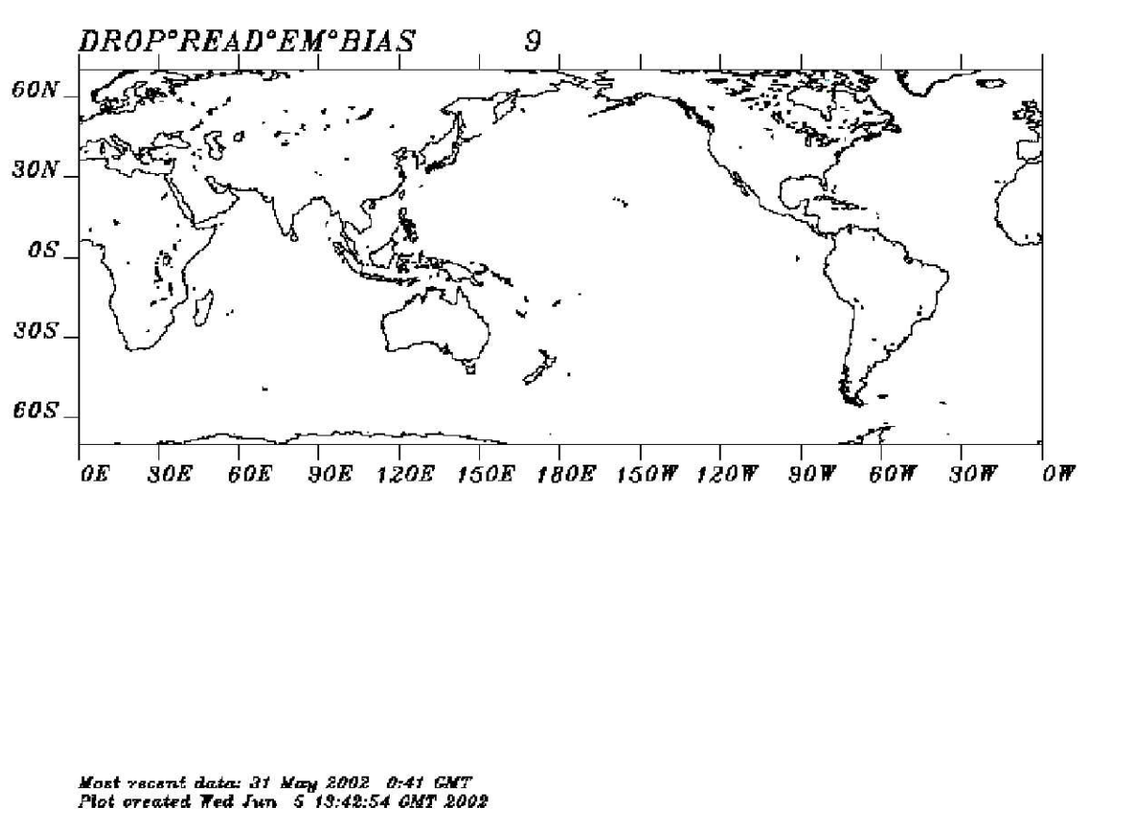


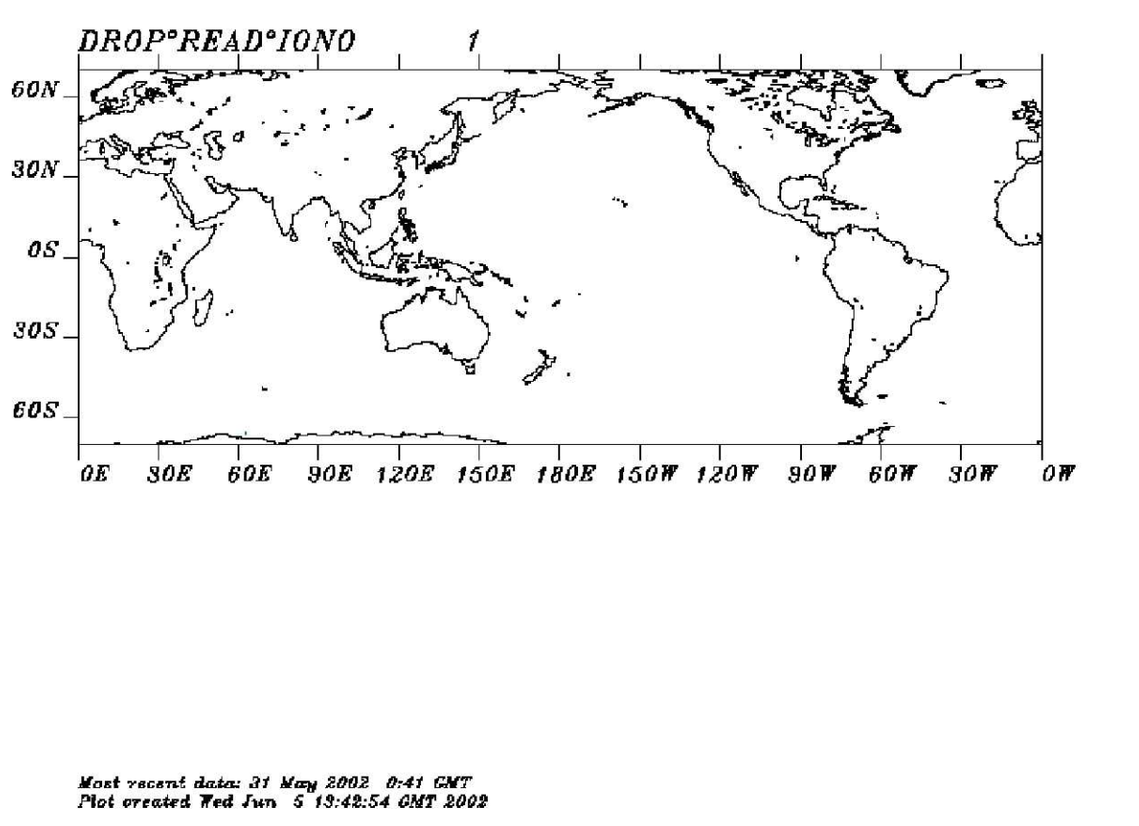


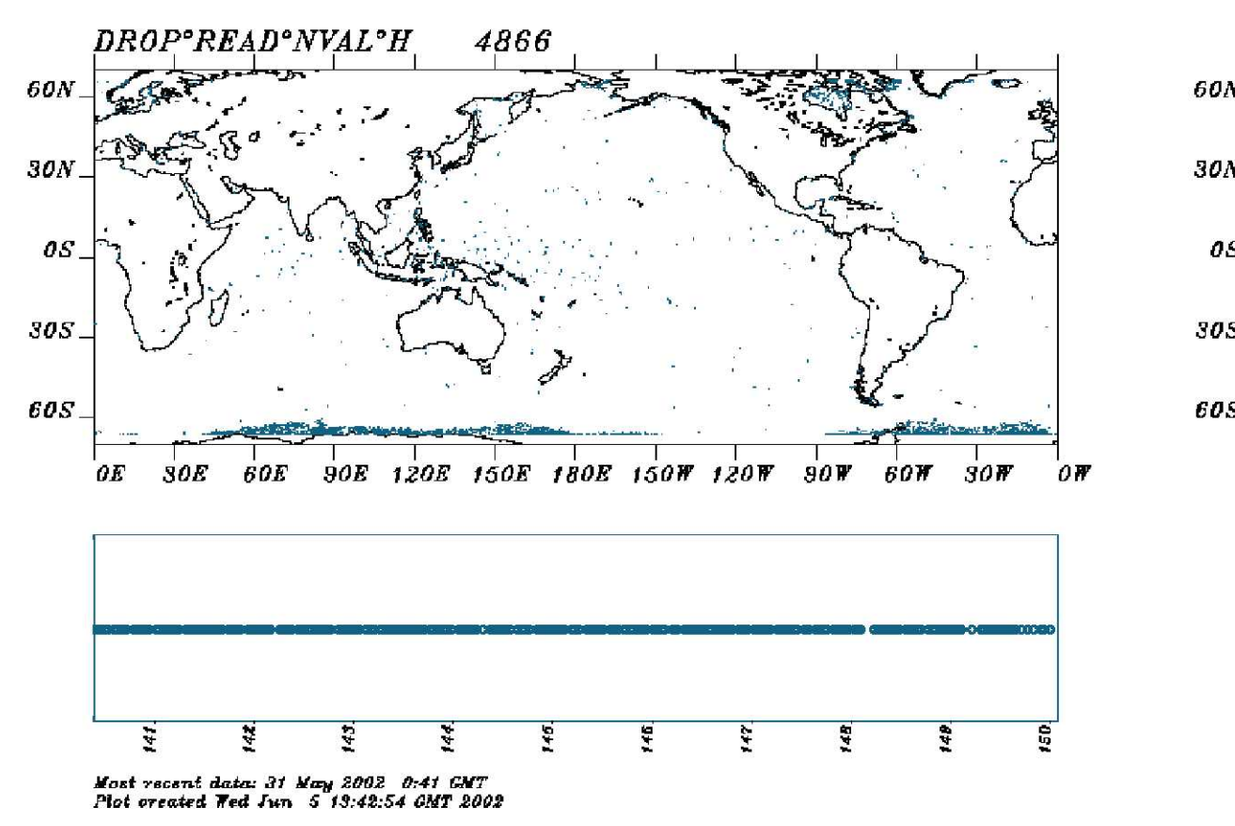
apply: Additional tidal corrections are removed as well the mean being removed from the height value. Extensive "outlier" detection is performed using a number of filters

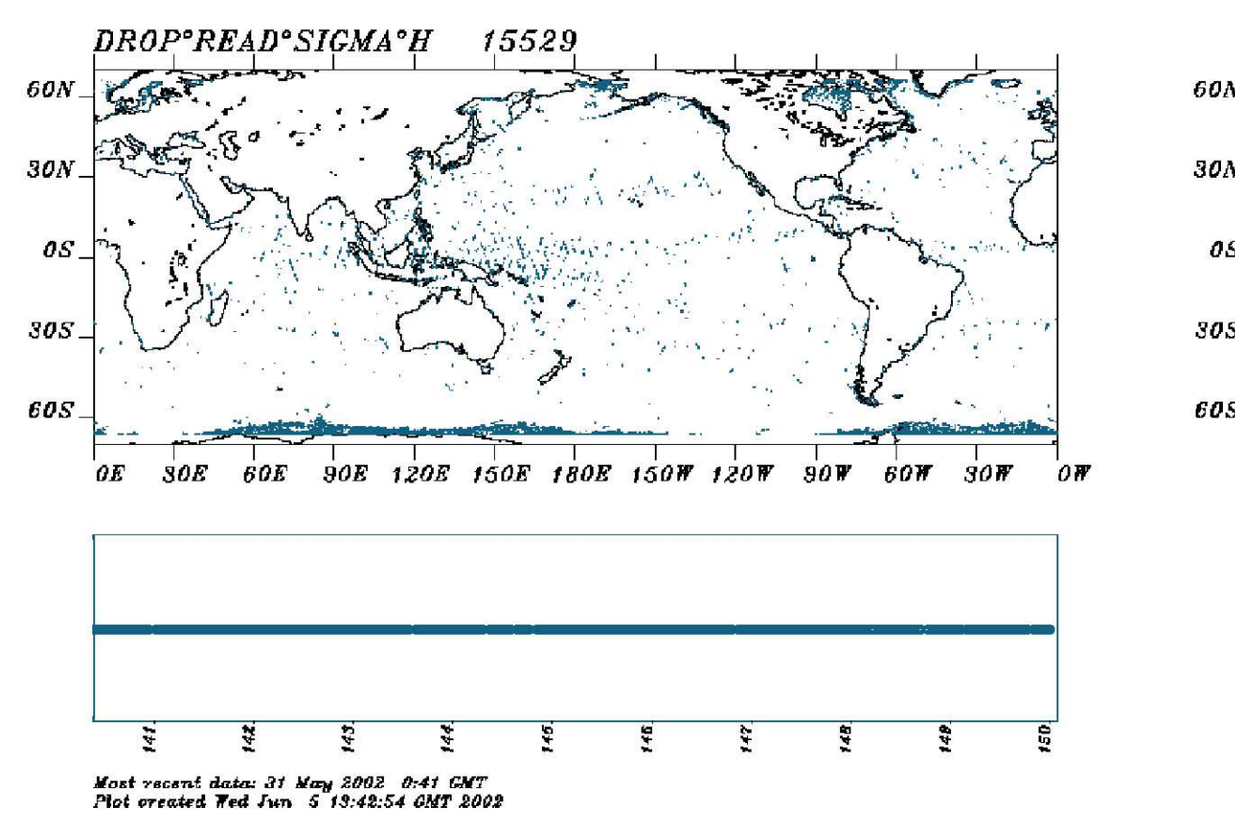
orbgdem: A once per revolution sinusoid fit is computed along each track and based on this an orbit correction factor is applied to the height value. No points were flagged in the processing of this Jason data.

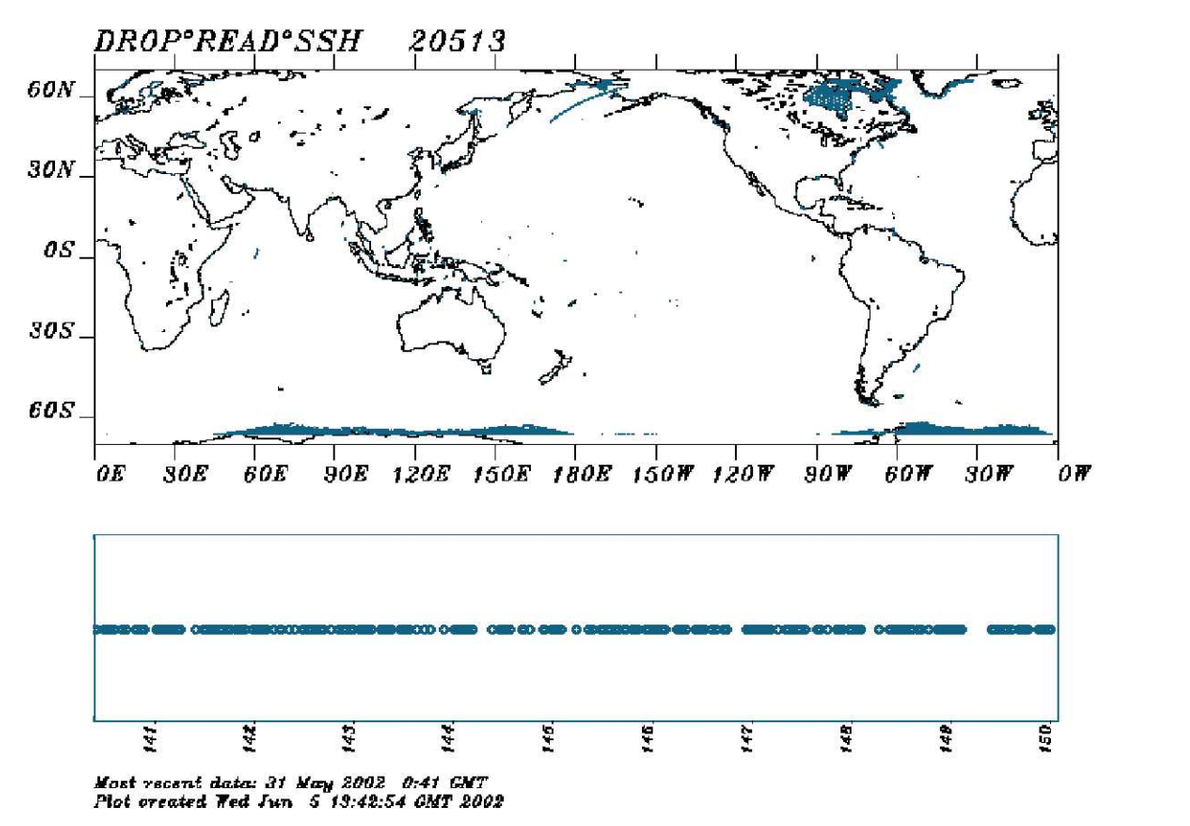
aptide: An ocean, long period, and load tide are computed using the *gotoo.2* tide model and removed from the height value at each point. No points are flagged in this step.











interp: Data points are interpolated to reference ground tracks. Geoid gradient coefficients are used to improve this process.