ECMWF Report on ERS-2 RA for June 2006

Title: Report on ERS-2 Radar Altimeter wave height and wind speed data.

By: *Saleh Abdalla*

Date: *5 July 2006*

Overview:

Based on the data received at ECMWF during the whole month, on average, 5158 observations arrived at ECMWF every 6 hours of which 67.52% passed the quality control. As can be seen in Figure 1, there was no data during the 6-hour time window centred at 06:00 UTC on the 27th. of the month. Furthermore, there was significant reduction of data at several time windows. The current coverage of the data covers: the North Atlantic, the western coast of North America, the eastern coast of China and around Korea and Japan, and the Southern Ocean as can be seen in Figure 27. The quality of the received data is as good as usual.

Backscatter:

ESR-2 $<\sigma_0>$ = 11.66 dB (with one main peak at 11.4 dB and at least two secondary peaks 10.6 and 10.8 dB).

Wind Speed Comparison with ECMWF wind speeds (bias):

ERS-2 global: - 0.639 m/s

ERS-2 northern hemisphere: - 0.894 m/s

ERS-2 tropics: + 0.002 m/s

ERS-2 southern hemisphere: + 0.597 m/s

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Wind Speed Comparison with buoy wind speeds (bias):

ERS-2 global: - 1.185 m/s

ERS-2 northern hemisphere: - 1.148 m/s

ERS-2 tropics (Hawaii): *missing*

Wave Height Comparison with ECMWF wave heights (bias):

ERS-2 global: + 0.032 m (lowest waves measured: 0.6m)

ERS-2 northern hemisphere: +0.062 m

ERS-2 tropics: +0.003 m

ERS-2 southern hemisphere: - 0.201 m

Wave Height Comparison with buoy wave heights (bias):

ERS-2 global: + 0.062 m

ERS-2 northern hemisphere: + 0.048 m

ERS-2 tropics (Hawaii): *missing*

Remarks:

- The quality of Altimeter data, both wind speed and significant wave height, is as good as it used to be.
- Note that the large bias in both significant wave height and wind speed in the Southern Hemispheric extra tropics is due to the limited amount and coverage of the data.

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- According to ESA (EOHelp message of 4 July 2003), the recording capabilities of ERS-2 are declared permanently unavailable following the failure of the ERS-2 tape recorder on 22 June 2003. The ERS-2 tape recorders were used to record the ERS-2 Low Rate mission globally for a period of 8 years of continuous acquisition. The global coverage is, therefore, discontinued. The ERS-2 Low Rate mission will be continued within the visibility of ESA ground stations over Europe, North Atlantic, the Arctic and western North America. Coverage extended to include eastern coast of China and around Korea and Japan since 25 June 2005 and the Southern Ocean since 4 July 2005. Current coverage can be seen in Figure 27.
- Assimilation of ERS-2 RA wave heights into ECMWF wave model was stopped on 21st. of October 2003 and replaced by ENVISAT RA-2 Ku-band wave heights. Both instruments can not be assimilated at the same time as both satellites follow the same track with relatively short time separation (both can be assimilated safely if they were not so close).
- ENVISAT Ku-Band and Jason altimeter significant wave height data and ENVISAT ASAR Wave Mode Level 1b data are assimilated in the ECMWF wave model.
- There was no related ECMWF model changes this month (current operational cycle is CY30R1 since 1 February 2006).

Comparison Method:

The Altimeter wave height and wind speed data, as received by ECMWF from ESA through GTS, are the so-called fast delivery products. At ECMWF these data are subject to a quality control method, the details of which are described by Janssen et al. (1989) and Bauer et al. (1992). Consequently, superobservations are formed by averaging 30 consecutive data in order to match the spatial scales of the operational WAM model. Therefore, the collocation statistics are based on the comparison between these superobservations and operational wavemodel products.

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In addition, since also wave observations from buoys are received through the GTS, the Altimeter products are also compared against buoy observations. Again, in order to have matching scales, the buoy observations are averaged over a six hour time window. Apart from this, also a height correction is applied to the wind speed observations, since not all buoys observe the winds at the standard height of 10 m. A default observation height of 5 m is assumed, and when available the actual observation height is used. In order to interpolate from the observation height to the standard height a logarithmic wind profile with a roughness length as given by the Charnock relation is assumed, where the Charnock parameter is given the constant value of 0.018.

Figure captions:

Figure 1: Time series of data reception for ERS-2 Altimeter data for June 2006.

Figure 2: Distribution of the ERS-2 Altimeter Backscatter after QC for June 2006.

Figure 3: Distribution of the ERS-2 Altimeter wind speeds after QC for June 2006.

Figure 4: Distribution of the ERS-2 Altimeter wind speeds after along track averaging for June 2006.

Figure 5: Global distribution of ECMWF ocean surface wind speeds for June 2006.

Figure 6: Comparison of ECMWF wind speed results with ERS-2 Altimeter wind speed data for June 2006 (global).

Figure 7: Comparison of ECMWF wind speed results with ERS-2 Altimeter wind speed data for June 2006 (northern hemisphere)

Figure 8: Comparison of ECMWF wind speed results with ERS-2 Altimeter wind speed data for June 2006 (tropics)

Figure 9: Comparison of ECMWF wind speed results with ERS-2 Altimeter wind speed data for June 2006 (southern hemisphere)

Figure 10: Comparison of buoy wind speed observations with ERS-2 Altimeter wind speed data for June 2006 (global).

Figure 11: Comparison of buoy wind speed observations with ERS-2 Altimeter wind speed data for June 2006 (northern hemisphere).

Figure 12: Comparison of buoy wind speed observations with ERS-2 Altimeter wind speed data for June 2006 (hawaii).

Figure 13: ERS-2 Altimeter wind speeds: Timeseries of bias (ERS-2 - model) and scatter index (SI).

Figure 14: Distribution of the ERS-2 Altimeter wave heights after QC for June 2006.

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Figure 15: Distribution of the ERS-2 Altimeter wave heights after along track averaging for June 2006.
Figure 16: Global distribution of ECMWF wave heights for June 2006.
Figure 17: Comparison of ECMWF wave height results with ERS-2 Altimeter wave height data for June 2006 (global).
Figure 18: Comparison of ECMWF wave height results with ERS-2 Altimeter wave height data for June 2006 (northern hemisphere)
Figure 19: Comparison of ECMWF wave height results with ERS-2 Altimeter wave height data for June 2006 (tropics)
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Figure 24: ERS-2 Altimeter wave heights: Timeseries of bias (ERS-2 - model) and scatter index (SI) for June 2006.
Figure 25: ERS-2 Altimeter wave heights: Timeseries of bias (ERS-2 - model) and scatter index (SI) from December 1996 to June 2006.
Figure 26: ERS-2 Altimeter wind speeds: Timeseries of bias (ERS-2 - model) and scatter index (SI) from December 1996 to June 2006.
Figure 27: Significant wave height: Monthly mean difference of ERS-2 altimeter data minus wave model results for June 2006.

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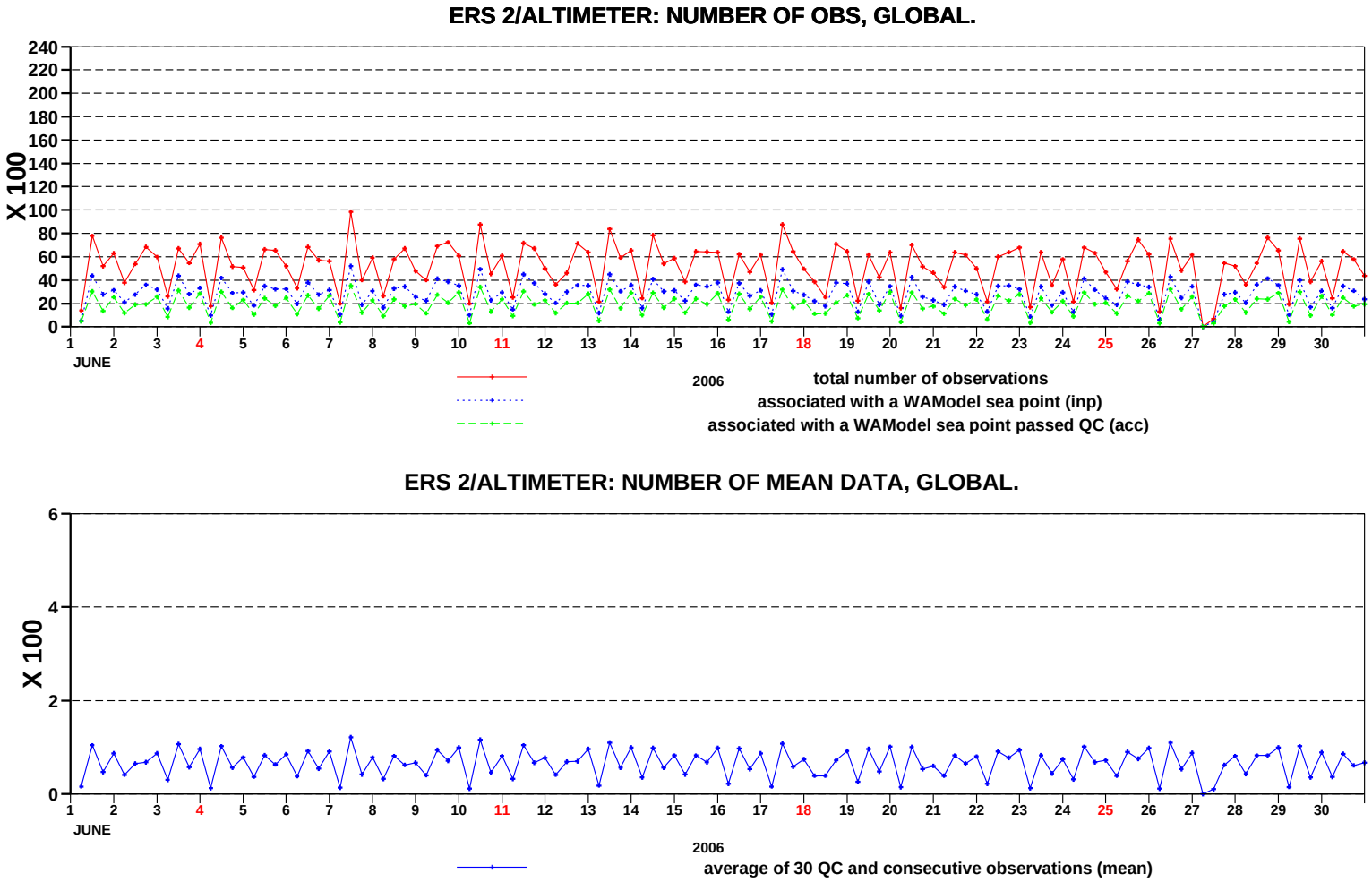


Figure 1:Time series of data reception for ERS-2 Altimeter data for June 2006

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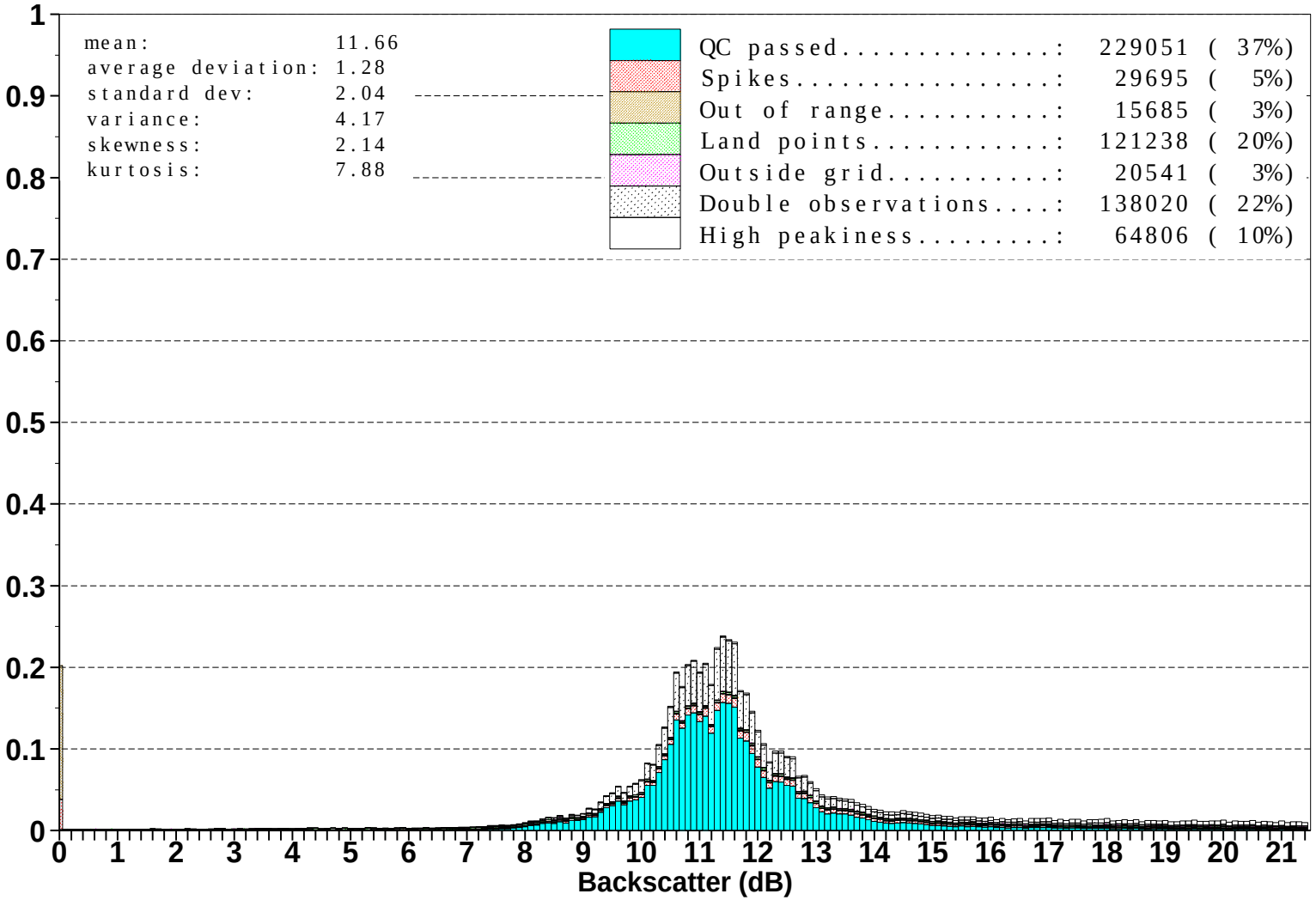


Figure 2: Distribution of the ERS-2 Altimeter backscatter after QC for June 2006

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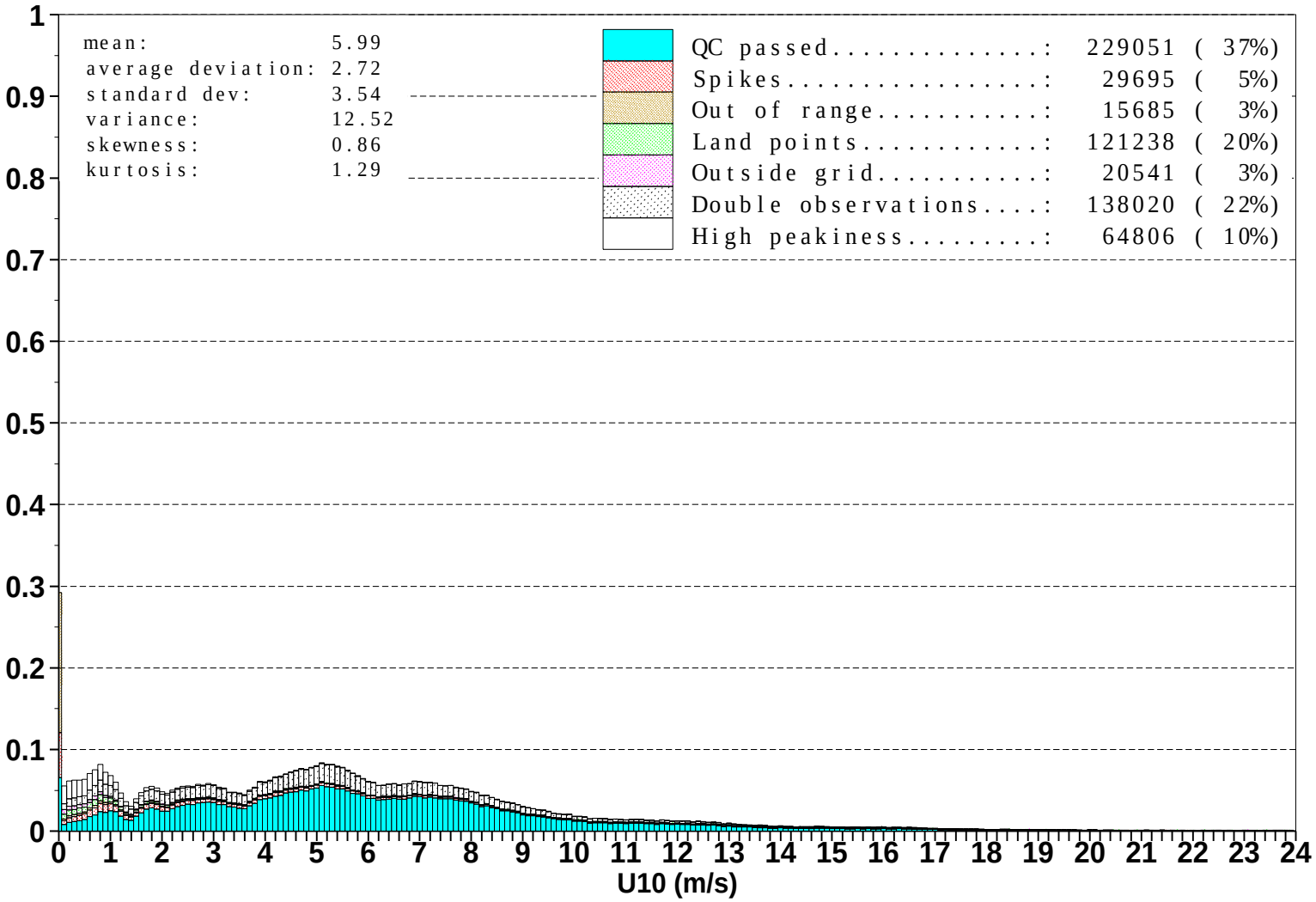


Figure 3: Distribution of the ERS-2 Altimeter wind speeds after QC for June 2006

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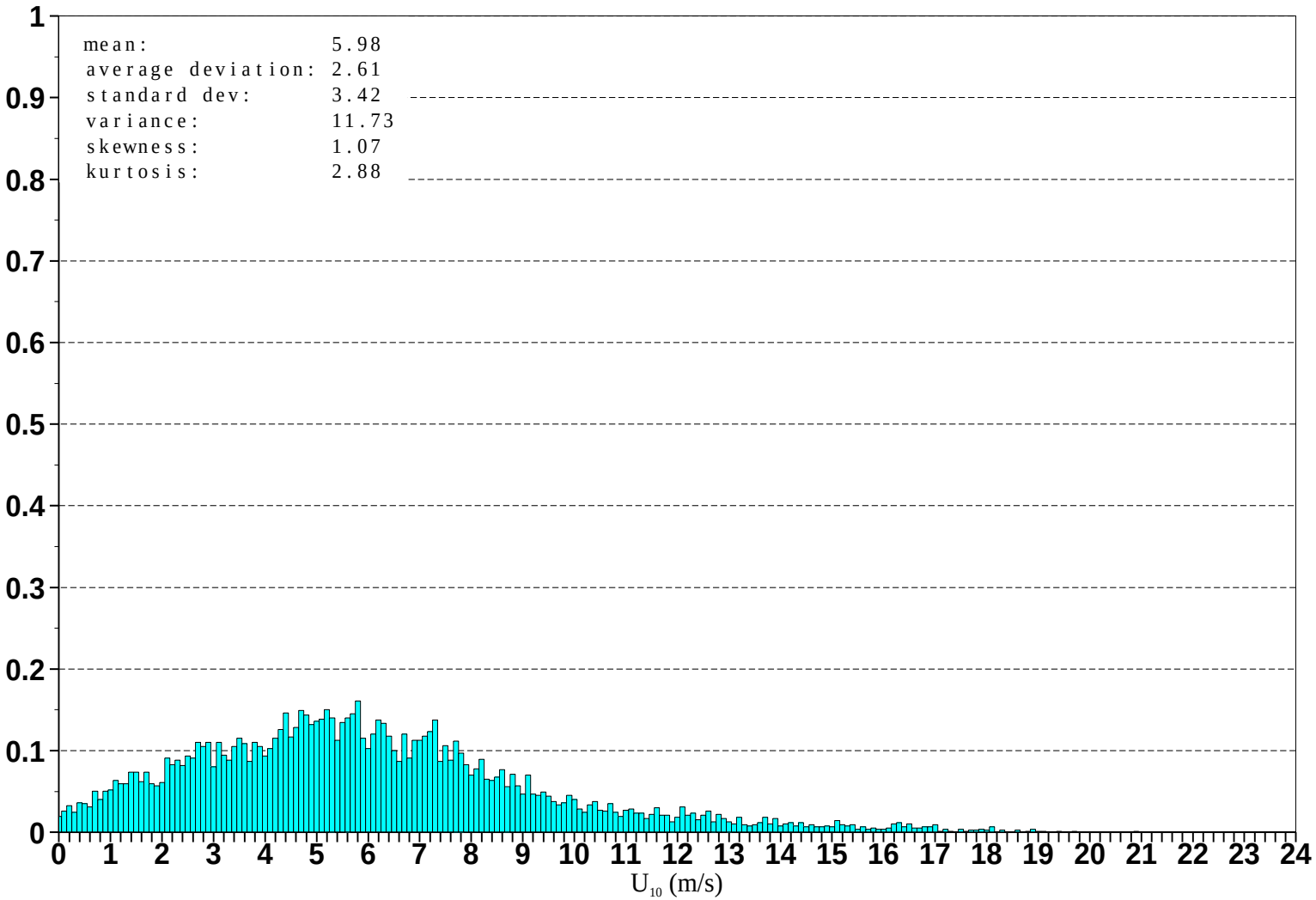


Figure 4: Distribution of ERS-2 Altimeter wind speeds after along track averaging for June 2006

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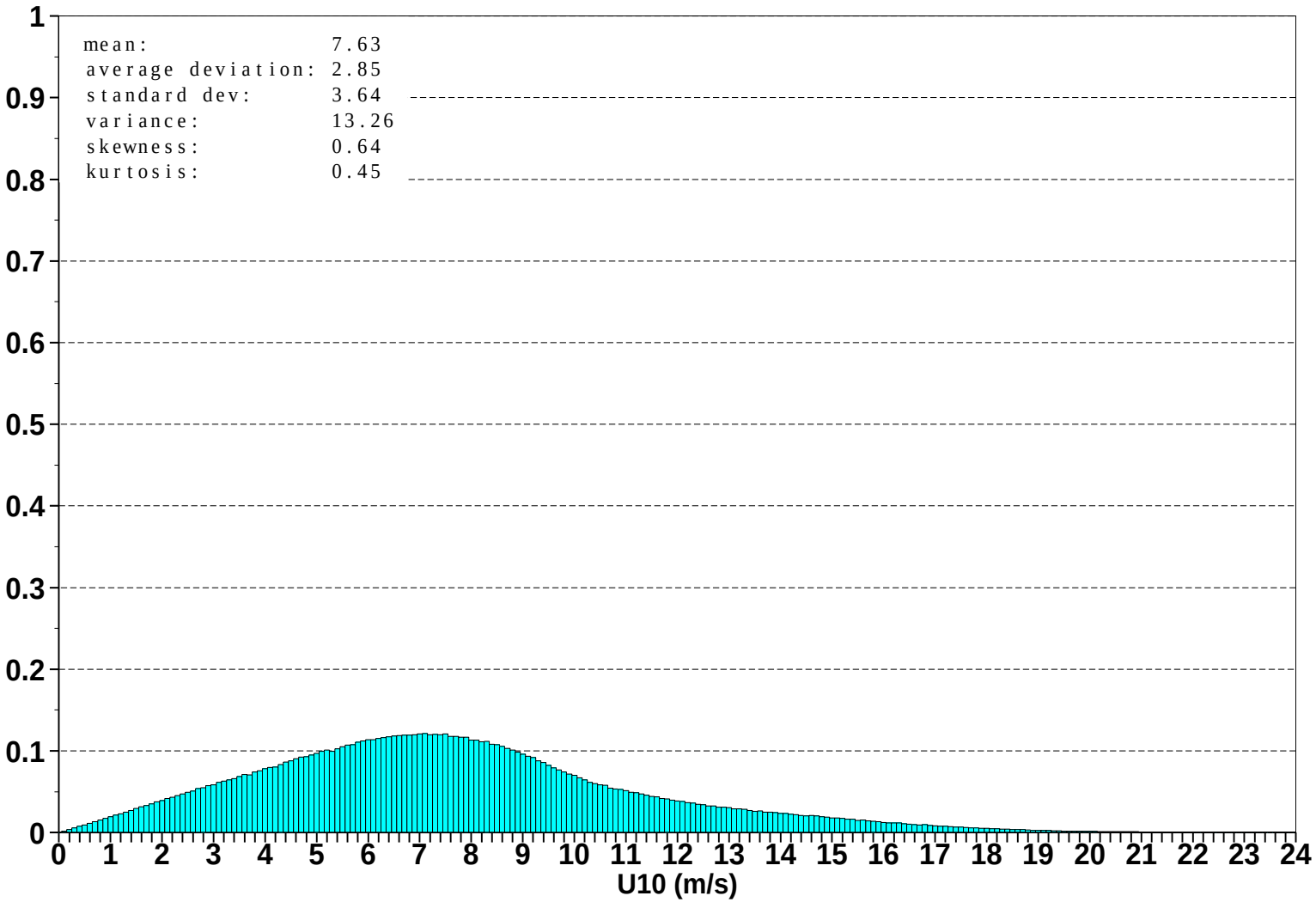
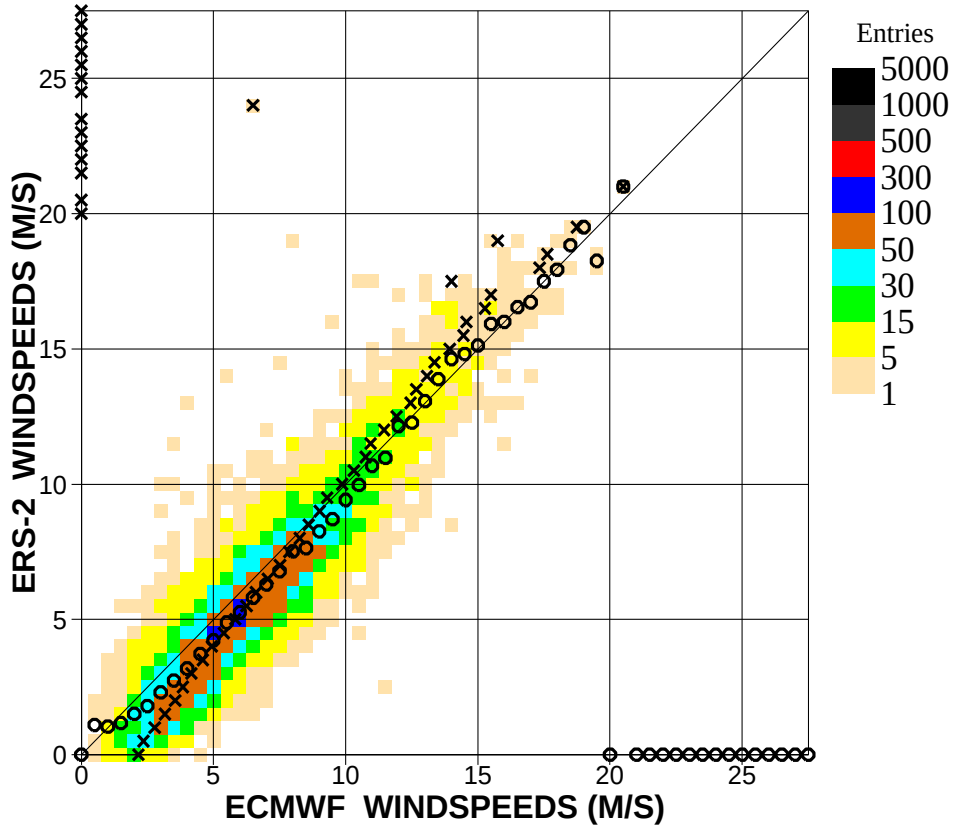


Figure 5: Global distribution of ECMWF ocean surface wind speeds for June 2006

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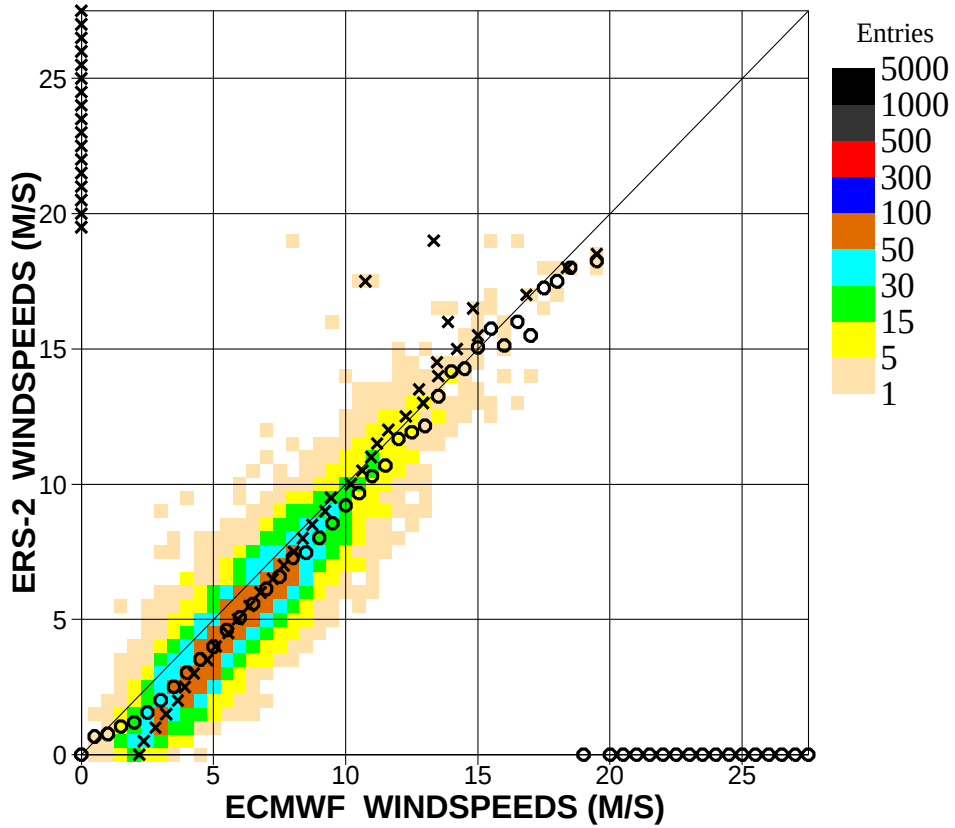
STATISTICS

ENTRIES	7719	
MEAN ECMWF	6.6172	
MEAN ERS-2	5.9785	
BIAS (ERS-2 - ECMWF)	-0.6388	
STANDARD DEVIATION	1.5035	
SCATTER INDEX	0.2272	
CORRELATION	0.8994	
SYMMETRIC SLOPE	0.9516	(0.0060)
REGR. COEFFICIENT	1.0482	(0.0058)
REGR. CONSTANT	-0.9575	(0.0420)

Figure 6. Comparison of ECMWF wind speed results with ERS2 Altimeter wind speed data for June 2006 (global)

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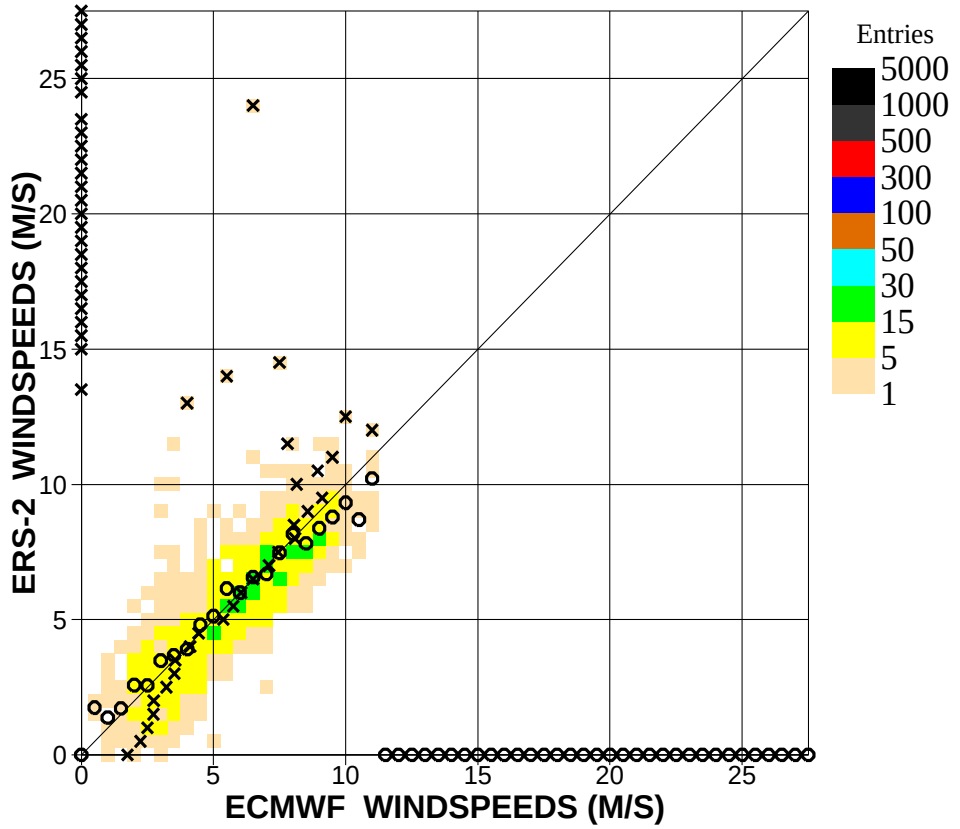


STATISTICS

ENTRIES	5963	
MEAN ECMWF	6.3326	
MEAN ERS-2	5.4389	
BIAS (ERS-2 - ECMWF)	-0.8937	
STANDARD DEVIATION	1.2133	
SCATTER INDEX	0.1916	
CORRELATION	0.9125	
SYMMETRIC SLOPE	0.9031	(0.0063)
REGR. COEFFICIENT	1.0273	(0.0060)
REGR. CONSTANT	-1.0663	(0.0409)

Figure 7. Comparison of ECMWF wind speed results with ERS2 Altimeter wind speed data for June 2006 (n.hem.)

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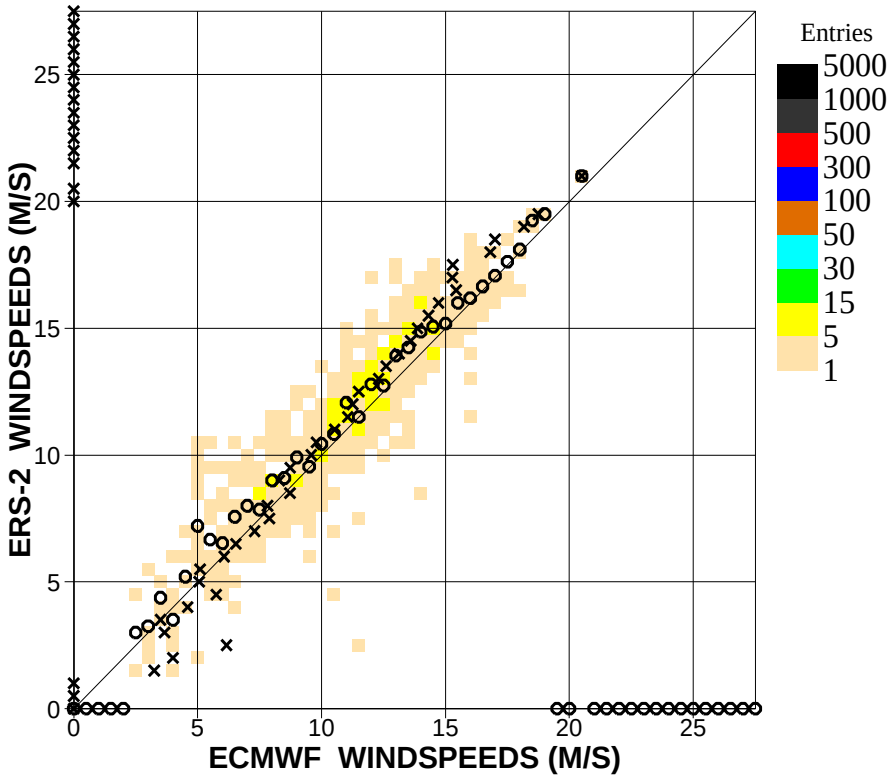
STATISTICS

ENTRIES	1182	
MEAN ECMWF	5.8229	
MEAN ERS-2	5.8247	
BIAS (ERS-2 - ECMWF)	0.0018	
STANDARD DEVIATION	2.1510	
SCATTER INDEX	0.3694	
CORRELATION	0.6774	
SYMMETRIC SLOPE	1.0425	(0.0282)
REGR. COEFFICIENT	0.8744	(0.0276)
REGR. CONSTANT	0.7330	(0.1725)

Figure 8. Comparison of ECMWF wind speed results with ERS2 Altimeter wind speed data for June 2006 (tropics)

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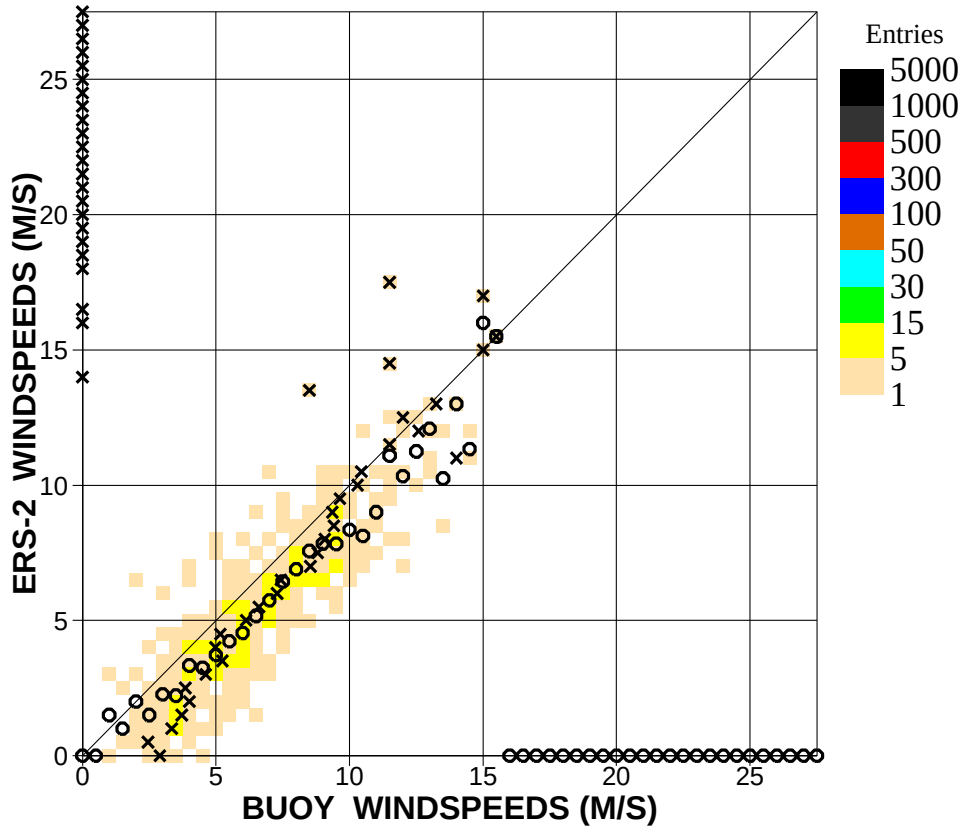


STATISTICS

ENTRIES	607	
MEAN ECMWF	10.9605	
MEAN ERS-2	11.5575	
BIAS (ERS-2 - ECMWF)	0.5970	
STANDARD DEVIATION	1.5383	
SCATTER INDEX	0.1404	
CORRELATION	0.9041	
SYMMETRIC SLOPE	1.0554	(0.0189)
REGR. COEFFICIENT	0.9625	(0.0185)
REGR. CONSTANT	1.0076	(0.2121)

Figure 9. Comparison of ECMWF wind speed results with ERS2 Altimeter wind speed data for June 2006 (s.hem.)

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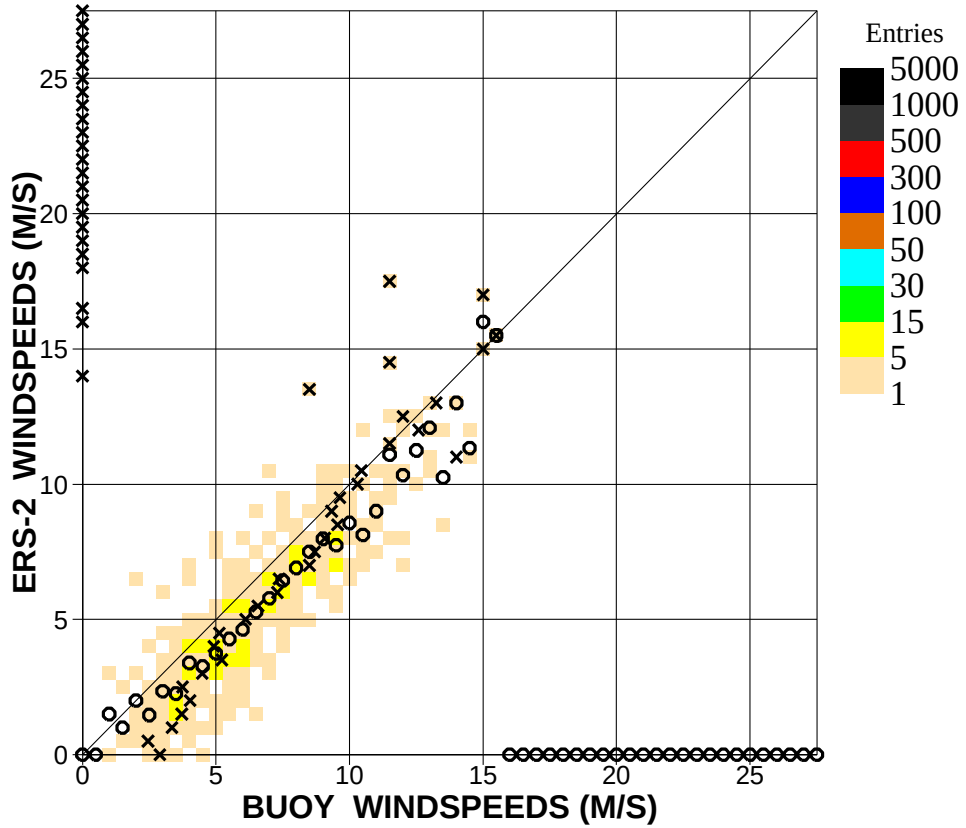
STATISTICS

ENTRIES	482	
MEAN BUOY	6.7055	
MEAN ERS-2	5.5207	
BIAS (ERS-2 - BUOY)	-1.1848	
STANDARD DEVIATION	1.4717	
SCATTER INDEX	0.2195	
CORRELATION	0.8741	
SYMMETRIC SLOPE	0.8648	(0.0244)
REGR. COEFFICIENT	0.9369	(0.0238)
REGR. CONSTANT	-0.7618	(0.1728)

Figure 10. Comparison of buoy wind speed observations with ERS2 Altimeter wind speed data for June 2006 (global)

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STATISTICS

ENTRIES	441	
MEAN BUOY	6.7179	
MEAN ERS-2	5.5698	
BIAS (ERS-2 - BUOY)	-1.1480	
STANDARD DEVIATION	1.5062	
SCATTER INDEX	0.2242	
CORRELATION	0.8730	
SYMMETRIC SLOPE	0.8705	(0.0255)
REGR. COEFFICIENT	0.9349	(0.0249)
REGR. CONSTANT	-0.7104	(0.1820)

Figure 11. Comparison of buoy wind speed observations with ERS2 Altimeter wind speed data for June 2006 (n.hem.)

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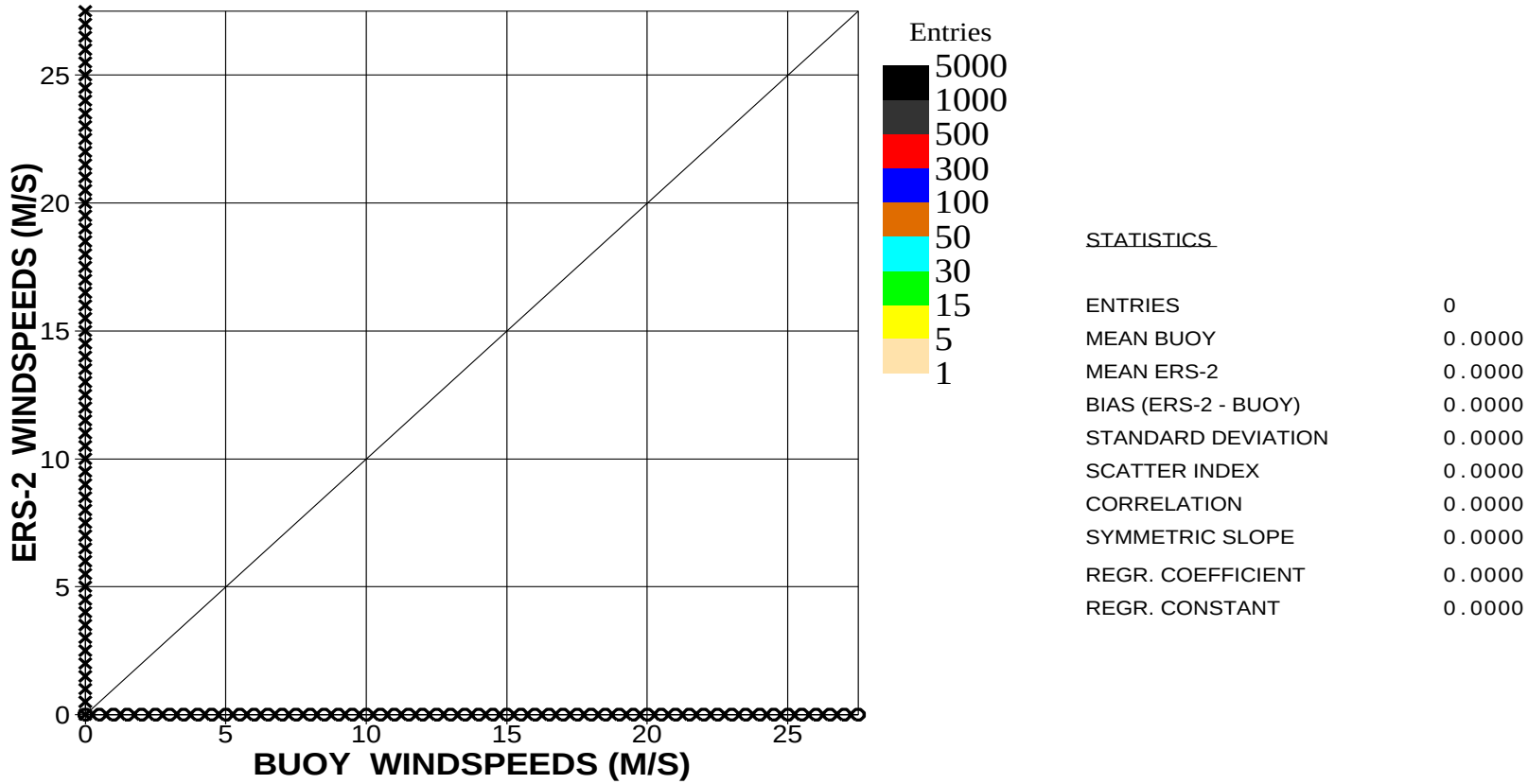


Figure 12. Comparison of buoy wind speed observations with ERS2 Altimeter wind speed data for June 2006 (hawaii)

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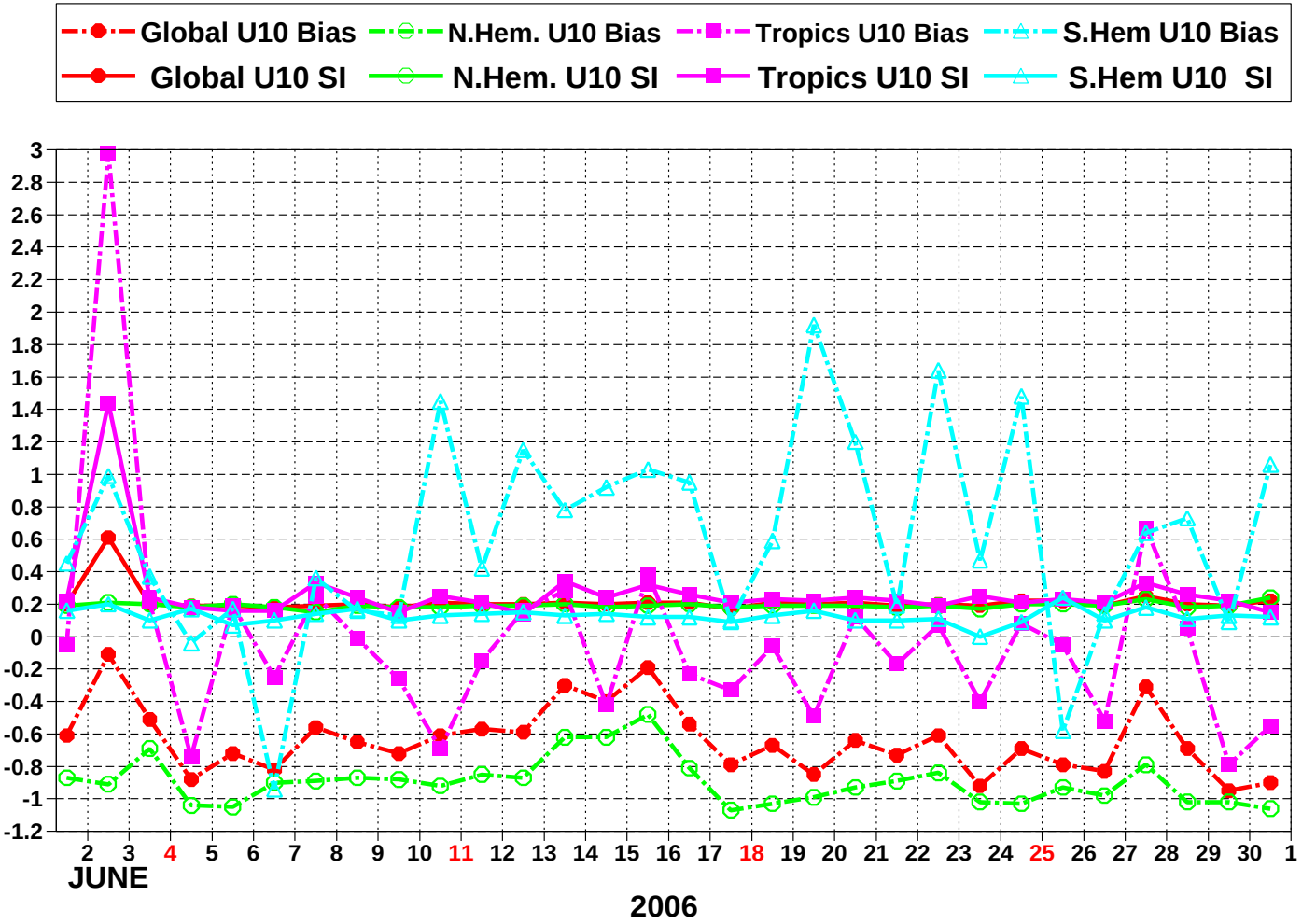


Figure 13: ERS-2 Altimeter wind speeds: Timeseries of bias (ERS-2 - model) and scatter index (SI)

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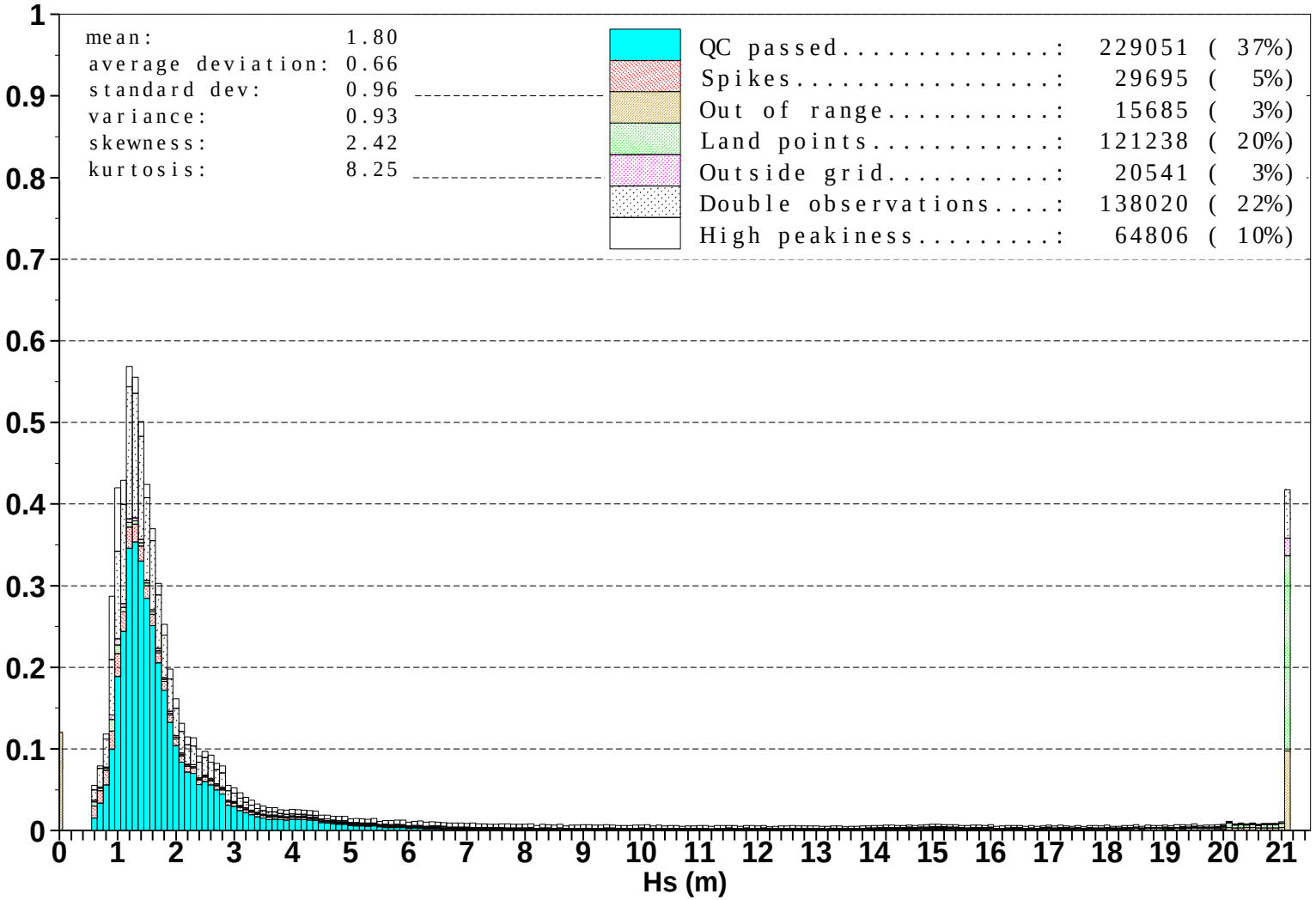


Figure 14: Distribution of the ERS-2 Altimeter wave heights after QC for June 2006

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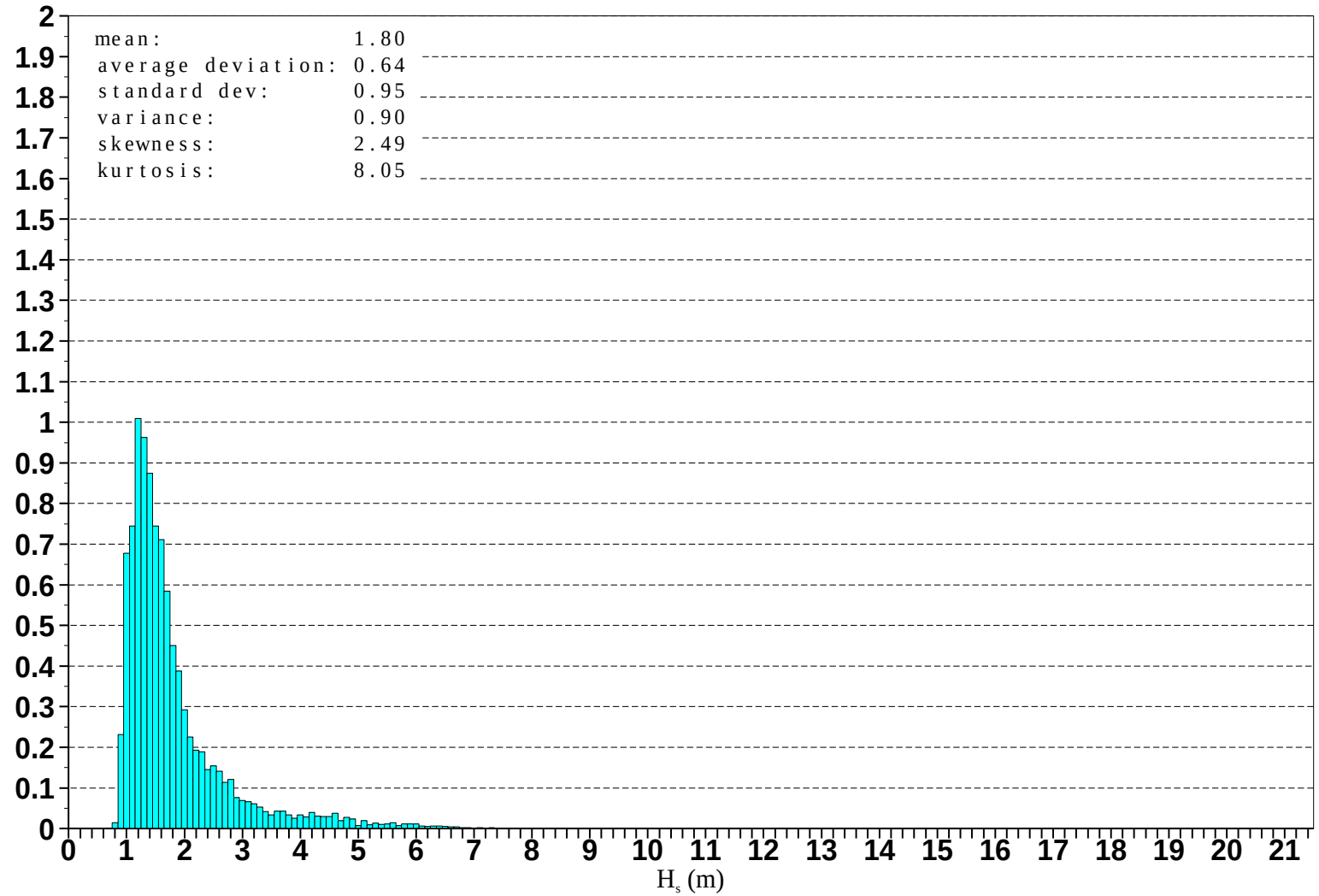


Figure 15: Distribution of ERS-2 Altimeter wave heights after along track averaging for June 2006

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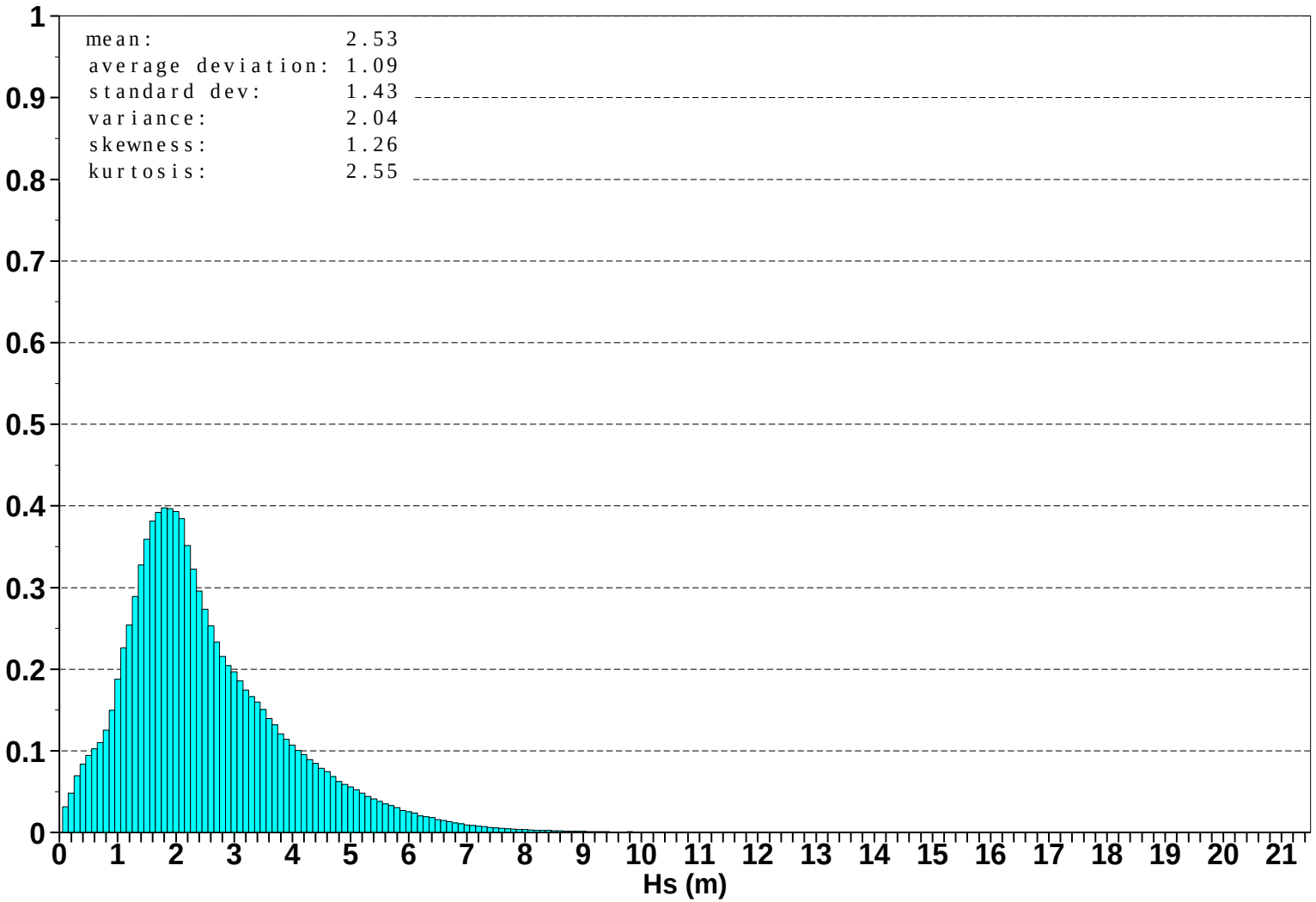
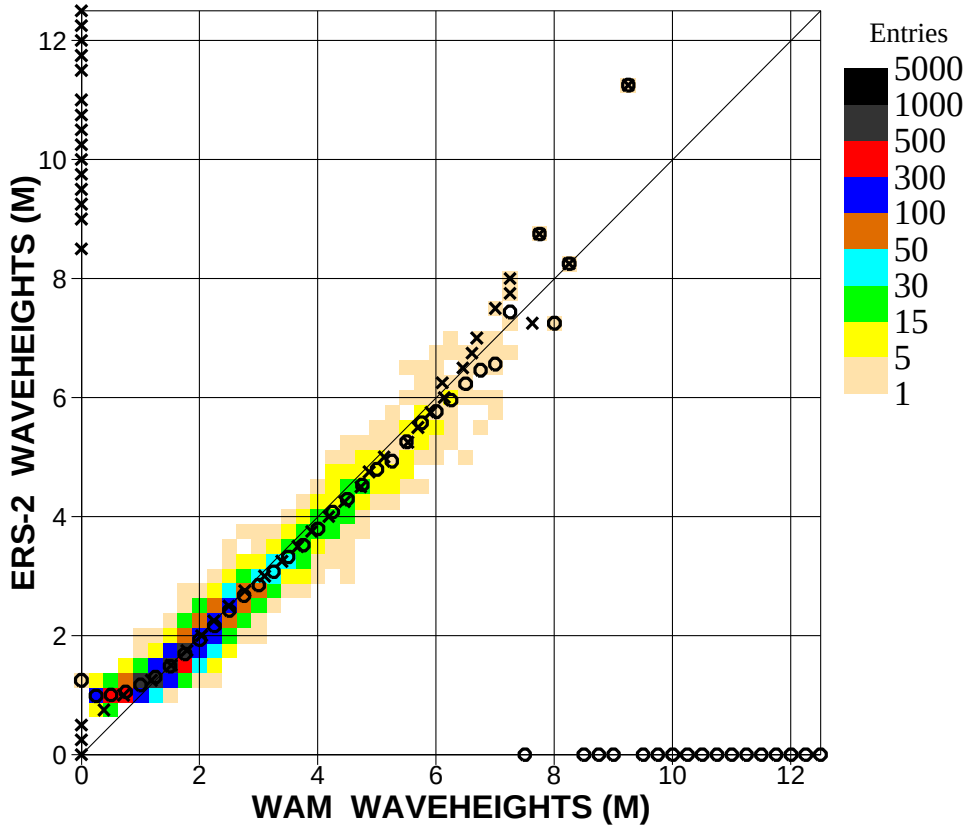


Figure 16: Global distribution of ECMWF wave heights for June 2006

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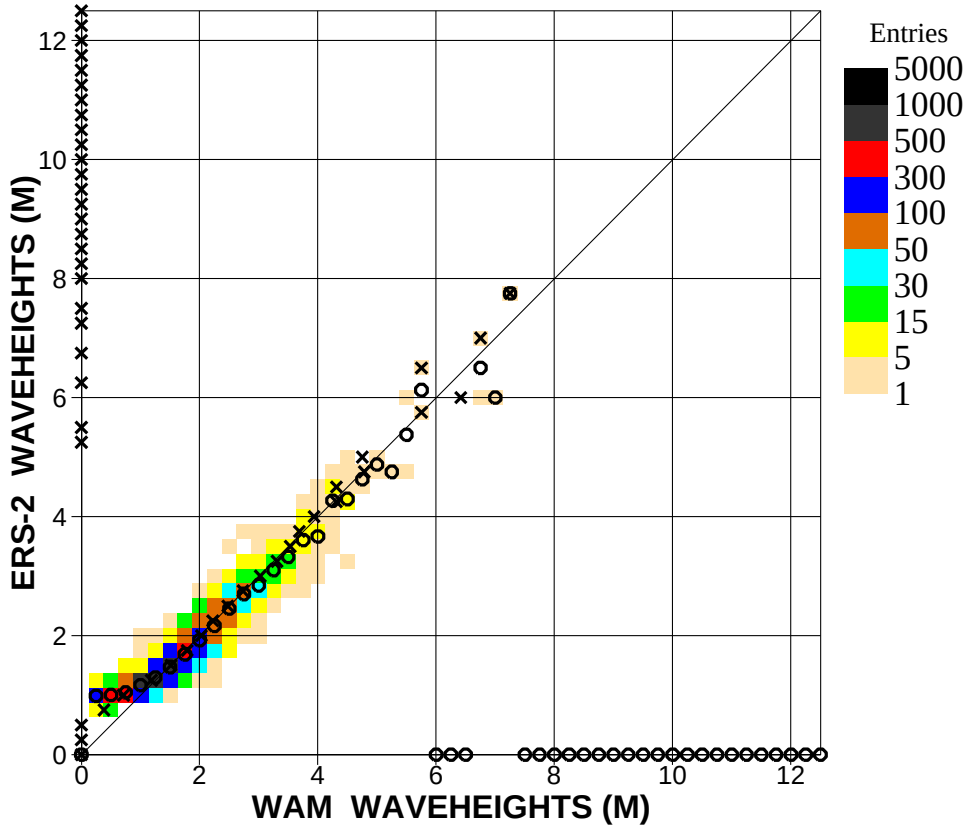


STATISTICS

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MEAN WAM	1.7725	
MEAN ERS-2	1.8047	
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STANDARD DEVIATION	0.2545	
SCATTER INDEX	0.1436	
CORRELATION	0.9731	
SYMMETRIC SLOPE	0.9887	(0.0027)
REGR. COEFFICIENT	0.8760	(0.0024)
REGR. CONSTANT	0.2519	(0.0049)

Figure 17. Comparison of ECMWF wave height results with ERS2 Altimeter wave height data for June 2006 (global)

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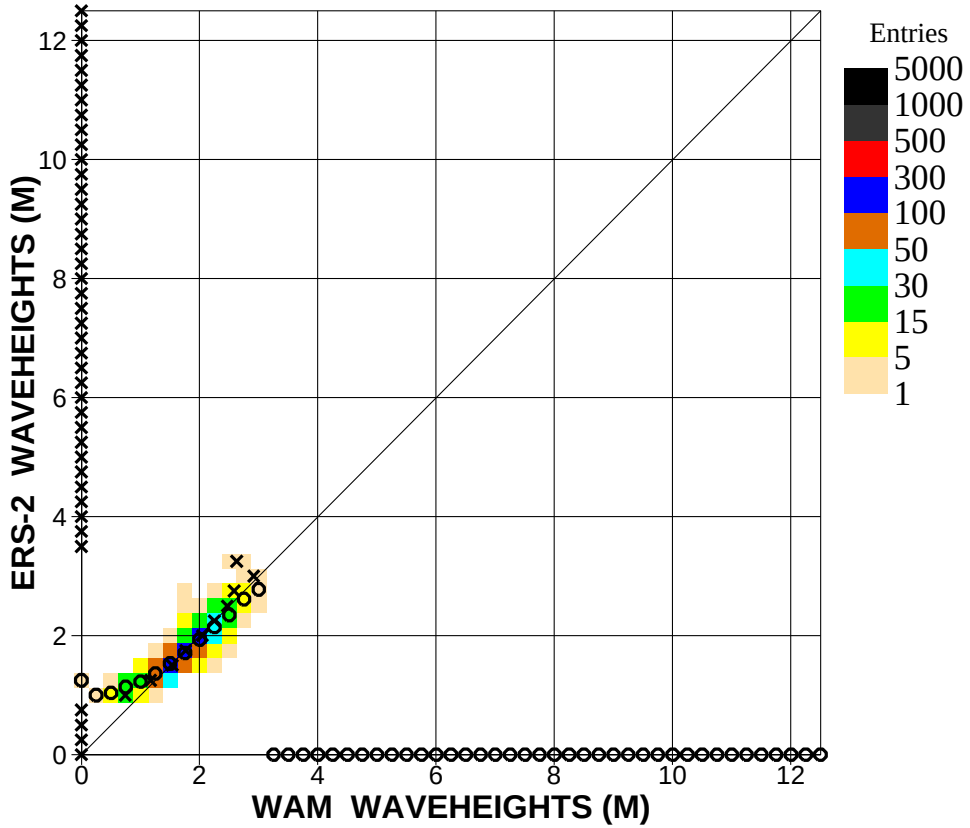


STATISTICS

ENTRIES	5963	
MEAN WAM	1.5151	
MEAN ERS-2	1.5770	
BIAS (ERS-2 - WAM)	0.0618	
STANDARD DEVIATION	0.2391	
SCATTER INDEX	0.1578	
CORRELATION	0.9474	
SYMMETRIC SLOPE	1.0089	(0.0045)
REGR. COEFFICIENT	0.8064	(0.0035)
REGR. CONSTANT	0.3552	(0.0059)

Figure 18. Comparison of ECMWF wave height results with ERS2 Altimeter wave height data for June 2006 (n.hem.)

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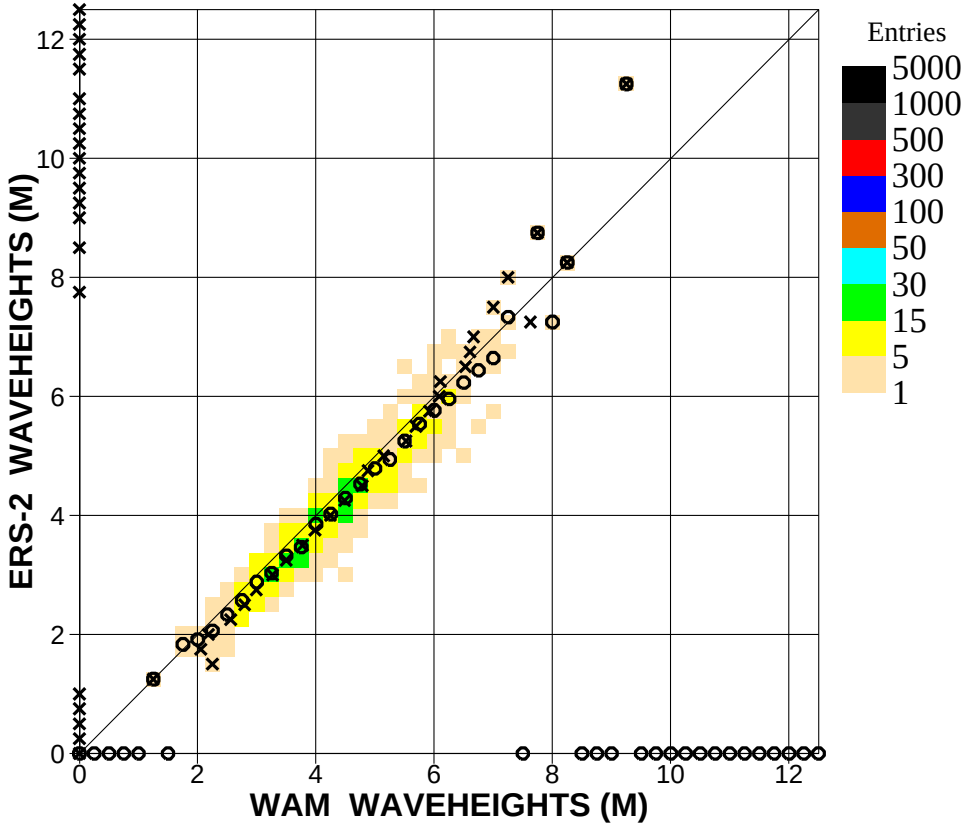


STATISTICS

ENTRIES	1182	
MEAN WAM	1.7339	
MEAN ERS-2	1.7366	
BIAS (ERS-2 - WAM)	0.0028	
STANDARD DEVIATION	0.2007	
SCATTER INDEX	0.1157	
CORRELATION	0.8993	
SYMMETRIC SLOPE	0.9920	(0.0128)
REGR. COEFFICIENT	0.7550	(0.0107)
REGR. CONSTANT	0.4275	(0.0192)

Figure 19. Comparison of ECMWF wave height results with ERS2 Altimeter wave height data for June 2006 (tropics)

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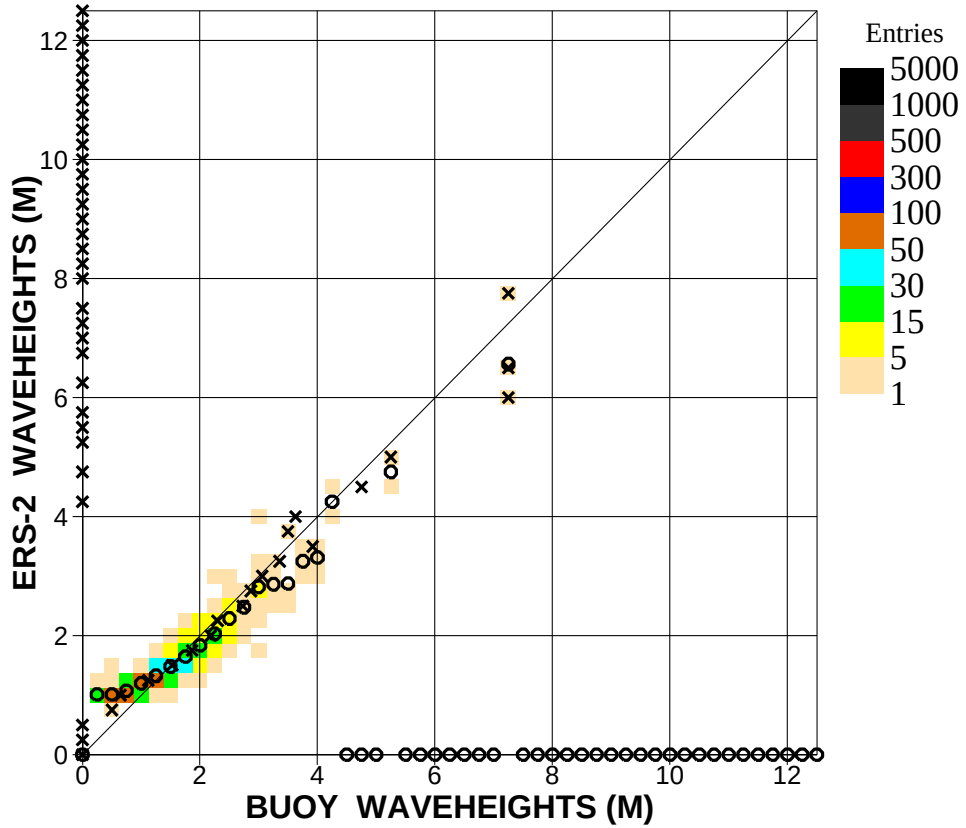


STATISTICS

ENTRIES	607	
MEAN WAM	4.3616	
MEAN ERS-2	4.1602	
BIAS (ERS-2 - WAM)	-0.2014	
STANDARD DEVIATION	0.3493	
SCATTER INDEX	0.0801	
CORRELATION	0.9572	
SYMMETRIC SLOPE	0.9598	(0.0124)
REGR. COEFFICIENT	0.9959	(0.0122)
REGR. CONSTANT	-0.1833	(0.0553)

Figure 20. Comparison of ECMWF wave height results with ERS2 Altimeter wave height data for June 2006 (s.hem.)

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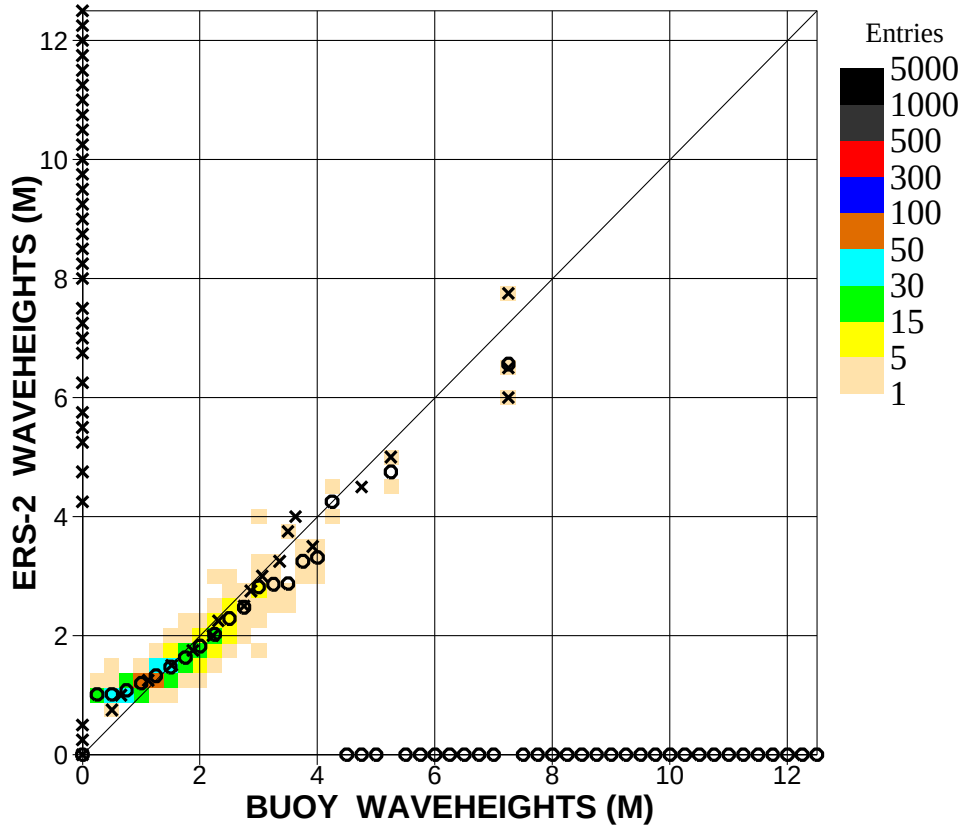


STATISTICS

ENTRIES	713	
MEAN BUOY	1.5143	
MEAN ERS-2	1.5764	
BIAS (ERS-2 - BUOY)	0.0620	
STANDARD DEVIATION	0.3376	
SCATTER INDEX	0.2230	
CORRELATION	0.9453	
SYMMETRIC SLOPE	0.9761	(0.0139)
REGR. COEFFICIENT	0.7248	(0.0094)
REGR. CONSTANT	0.4788	(0.0166)

Figure 21. Comparison of buoy wave height observations with ERS2 Altimeter wave height data for June 2006 (global)

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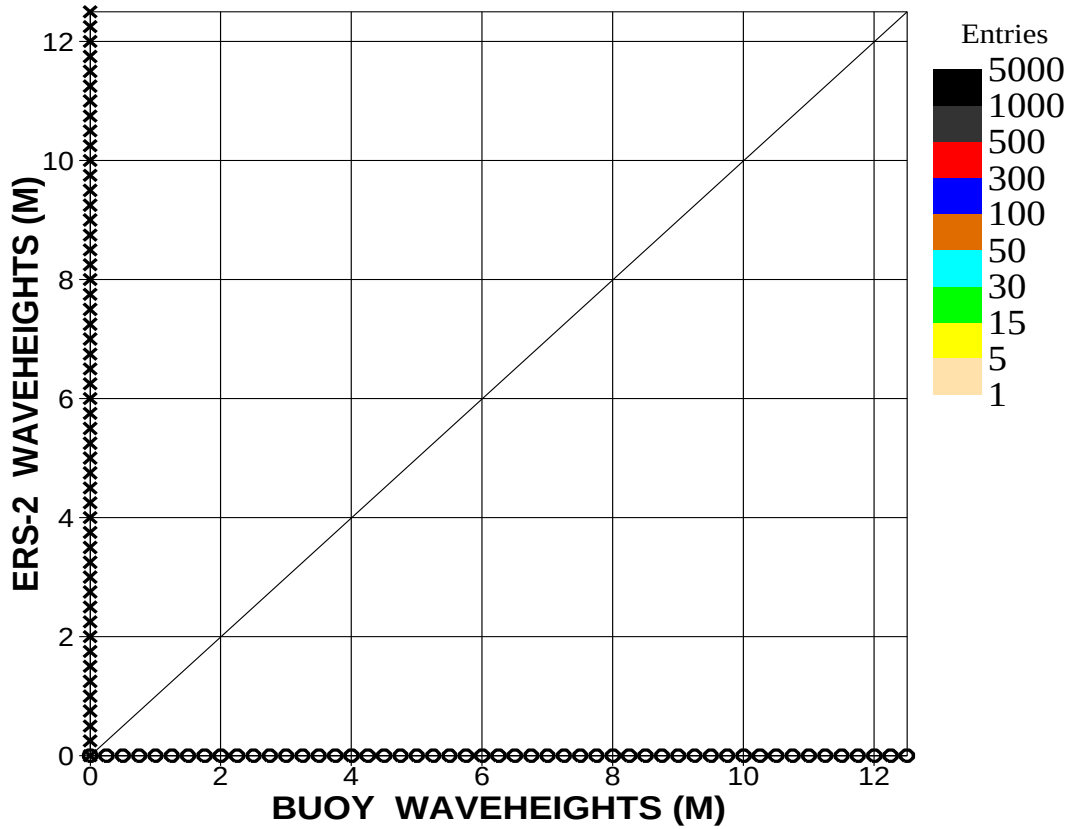


STATISTICS

ENTRIES	660	
MEAN BUOY	1.5487	
MEAN ERS-2	1.5962	
BIAS (ERS-2 - BUOY)	0.0475	
STANDARD DEVIATION	0.3405	
SCATTER INDEX	0.2198	
CORRELATION	0.9453	
SYMMETRIC SLOPE	0.9697	(0.0141)
REGR. COEFFICIENT	0.7293	(0.0098)
REGR. CONSTANT	0.4667	(0.0177)

Figure 22. Comparison of buoy wave height observations with ERS2 Altimeter wave height data for June 2006 (n.hem.)

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STATISTICS

ENTRIES	0
MEAN BUOY	0.0000
MEAN ERS-2	0.0000
BIAS (ERS-2 - BUOY)	0.0000
STANDARD DEVIATION	0.0000
SCATTER INDEX	0.0000
CORRELATION	0.0000
SYMMETRIC SLOPE	0.0000
REGR. COEFFICIENT	0.0000
REGR. CONSTANT	0.0000

Figure 23. Comparison of buoy wave height observations with ERS2 Altimeter wave height data for June 2006 (hawaii)

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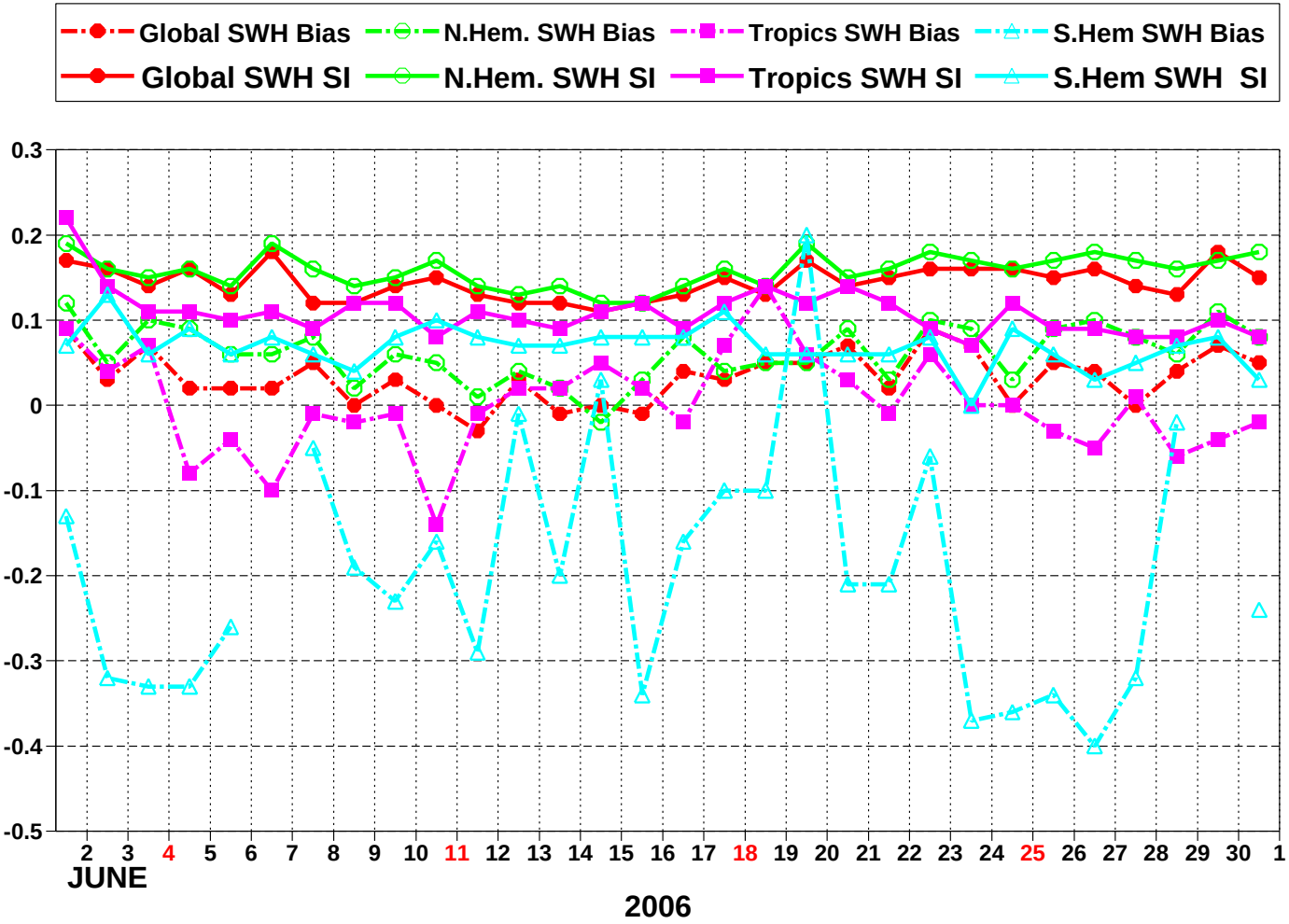


Figure 24: ERS-2 Altimeter wave heights: Timeseries of bias (ERS-2 - model) and scatter index (SI)

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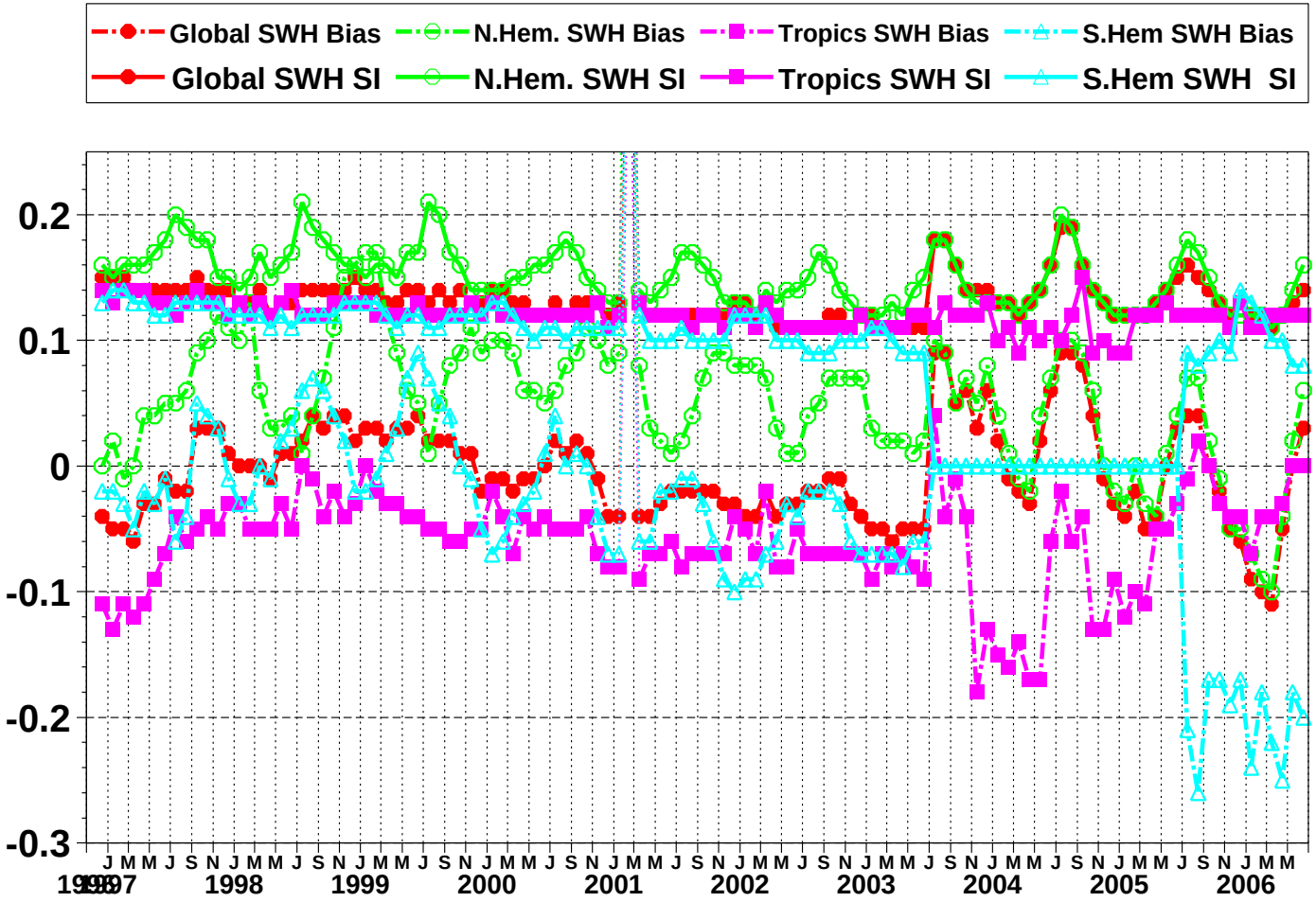


Figure 25: ERS-2 Altimeter wave heights: Timeseries of bias (ERS-2 - model) and scatter index (SI)

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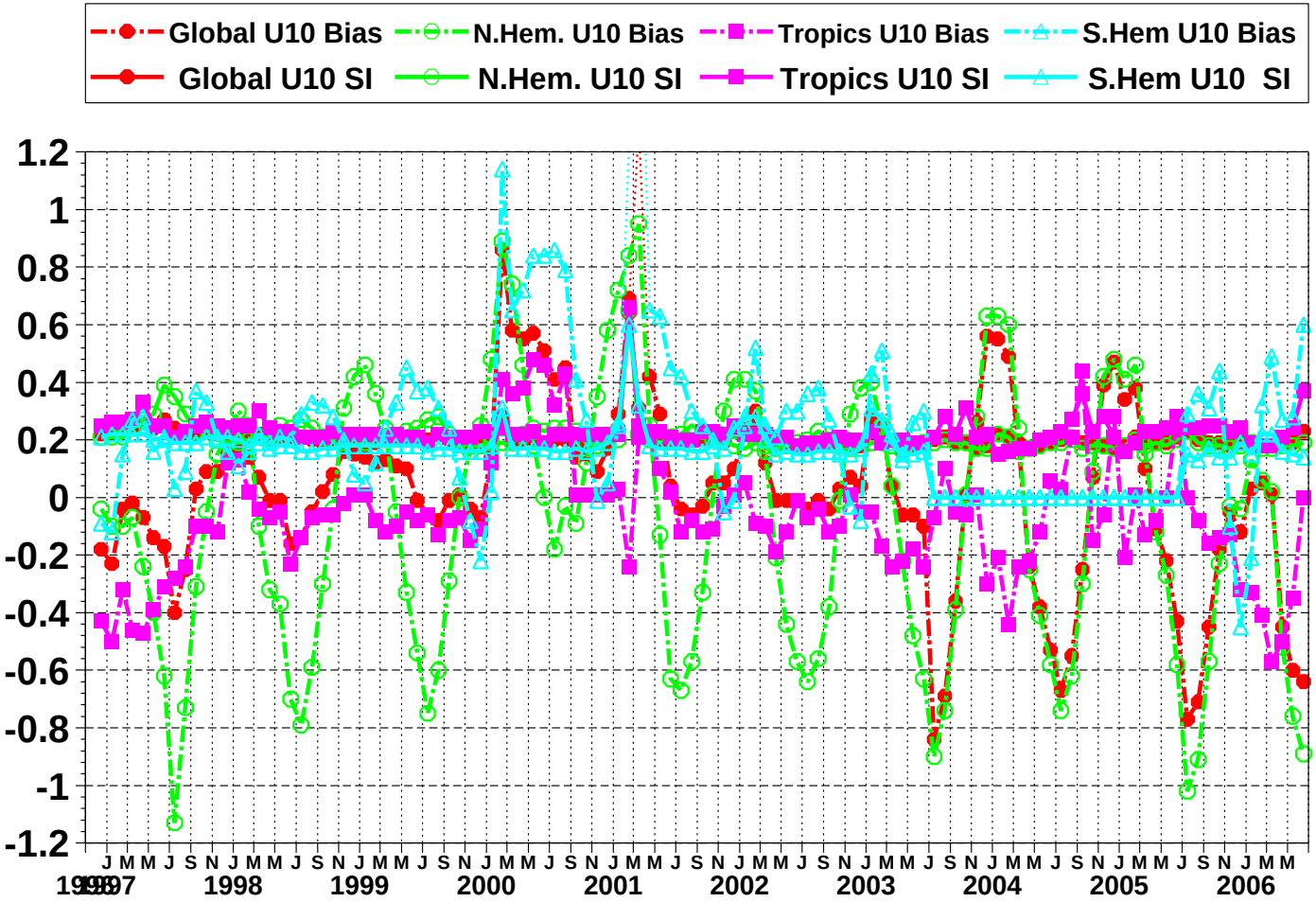


Figure 26: ERS-2 Altimeter wind speeds: Timeseries of bias (ERS-2 - model) and scatter index (SI)

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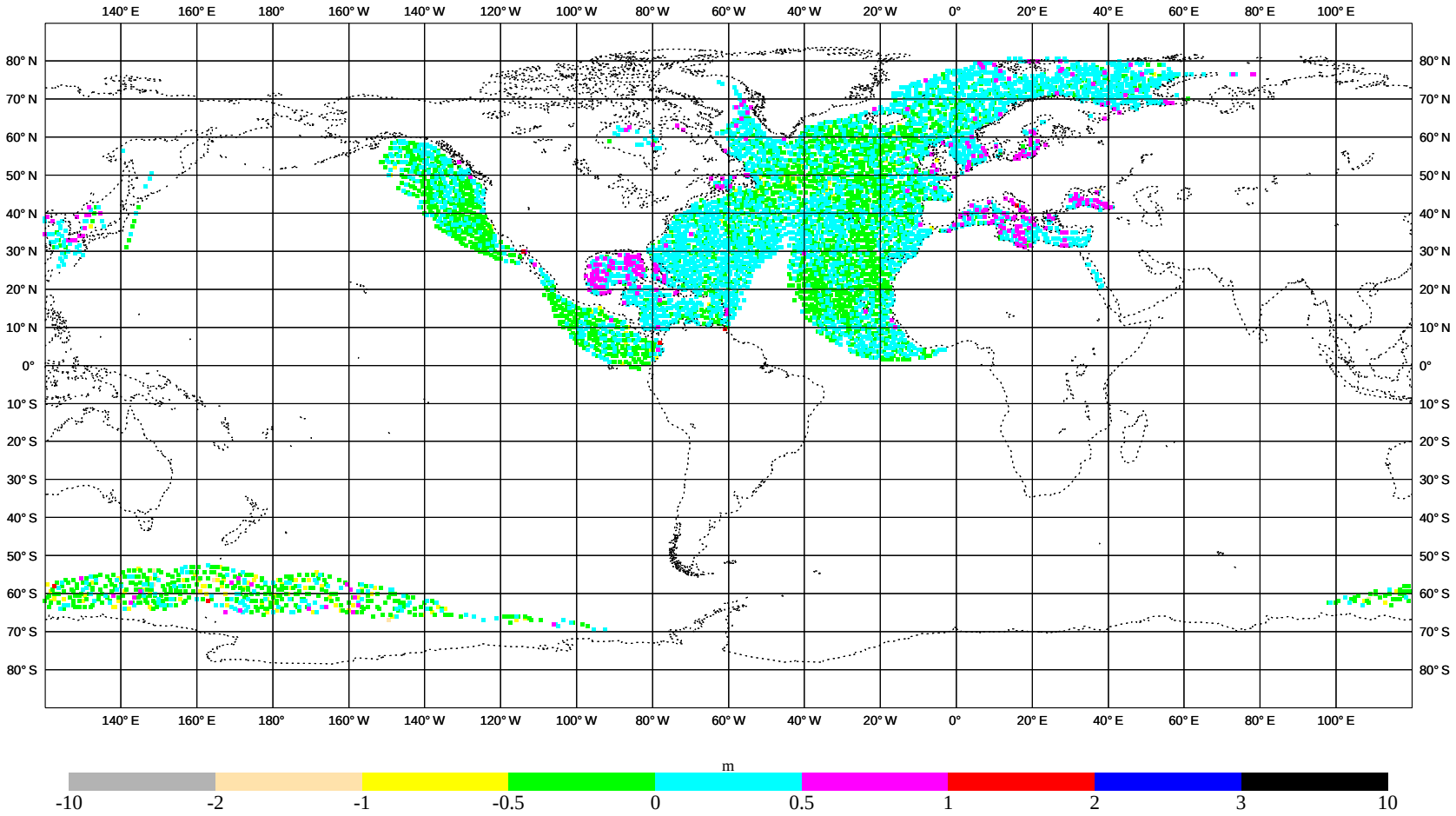


Figure 27: Significant wave height: Monthly mean difference of ERS-2 altimeter data minus wave model results for June 2006.

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