ECMWF Report on ERS-2 RA for June 2002

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

By: *Saleh Abdalla*

Date: *5 July 2002*

Overview:

Based on the data received during the full month, on average, 15863 observations arrived at ECMWF every 6 hours of which 80.2% passed the quality control. The data coverage, which was rather good, can be seen in Figure 1. There were periods of significant reduction in data reception on the first 5 days of the month. The ESA Earth Observation Missions Helpdesk Team announced the suspension of data transfer to the Gatineau receiving station during the period 31 May till 3 June (e-mail messages of the ESA Earth Observation Missions Helpdesk Team on June 3 and 13, 2002). Furthermore, data reception was significantly reduced at time slots centred at 00:00 on the 6th., the 10th., and the 26th. of the month. Note that we are talking about the raw data which have arrived at ECMWF before they were processed.

The quality of the received data is as good as used to be before January 2000.

Backscatter:

ESR-2 $<\sigma_0>$ = 11.03 dB (with double peaks at 10.6 dB and at 11.1 dB)

Wind Speed Comparison with ECMWF wind speeds (bias):

ERS-2 global: -0.012 m/s

ERS-2 northern hemisphere: -0.568 m/s

ERS-2 tropics: -0.014 m/s

ERS-2 southern hemisphere: 0.301 m/s

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Wind Speed Comparison with buoy wind speeds (bias):

ERS-2 global: -0.887 m/s

ERS-2 northern hemisphere: -0.876 m/s

ERS-2 tropics: -0.990 m/s

Wave Height Comparison with ECMWF wave heights (bias):

ERS-2 global: -0.031 m (lowest waves measured: 0.6m)

ERS-2 northern hemisphere: 0.013 m

ERS-2 tropics: -0.050 m

ERS-2 southern hemisphere: -0.043 m

Wave Height Comparison with buoy wave heights (bias):

ERS-2 global: -0.009 m

ERS-2 northern hemisphere: 0.004 m

ERS-2 tropics: -0.172 m

Remarks:

- The quality of Altimeter wave height and wind speed data are as good as they used to be. The wind speed data has experienced an improved quality after March 21, 2002 (after the recovery from the ERS- 2 anomaly of March 2002).

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Apparently, this can be attributed to the yaw control system which makes use of some of the data coming from SAR imagette processing. This yaw control system was implemented on March 4, 2002. The impact of this system on the wind speed quality was not felt earlier because of the anomaly which lasted about 2 weeks.

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.

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.

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Figure captions:

Figure 1: Time series of data reception for ERS-2 Altimeter data for June 2002.
Figure 2: Distribution of the ERS-2 Altimeter Backscatter after QC for June 2002.
Figure 3: Distribution of the ERS-2 Altimeter wind speeds after QC for June 2002.
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Figure 5: Global distribution of ECMWF ocean surface wind speeds for June 2002.
Figure 6: Comparison of ECMWF wind speed results with ERS-2 Altimeter wind speed data for June 2002 (global).
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Figure 21: Comparison of buoy wave height observations with ERS-2 Altimeter wave height data for June 2002 (global).
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Figure 23: Comparison of buoy wave height observations with ERS-2 Altimeter wave height data for June 2002 (tropics).

Figure 24: ERS-2 Altimeter wave heights: Timeseries of bias (ERS-2 - model) and scatter index (SI) for June 2002.

Figure 25: ERS-2 Altimeter wave heights: Timeseries of bias (ERS-2 - model) and scatter index (SI) from December 1996 to June 2002

Figure 26: ERS-2 Altimeter wind speeds: Timeseries of bias (ERS-2 - model) and scatter index (SI) from December 1996 to June 2002

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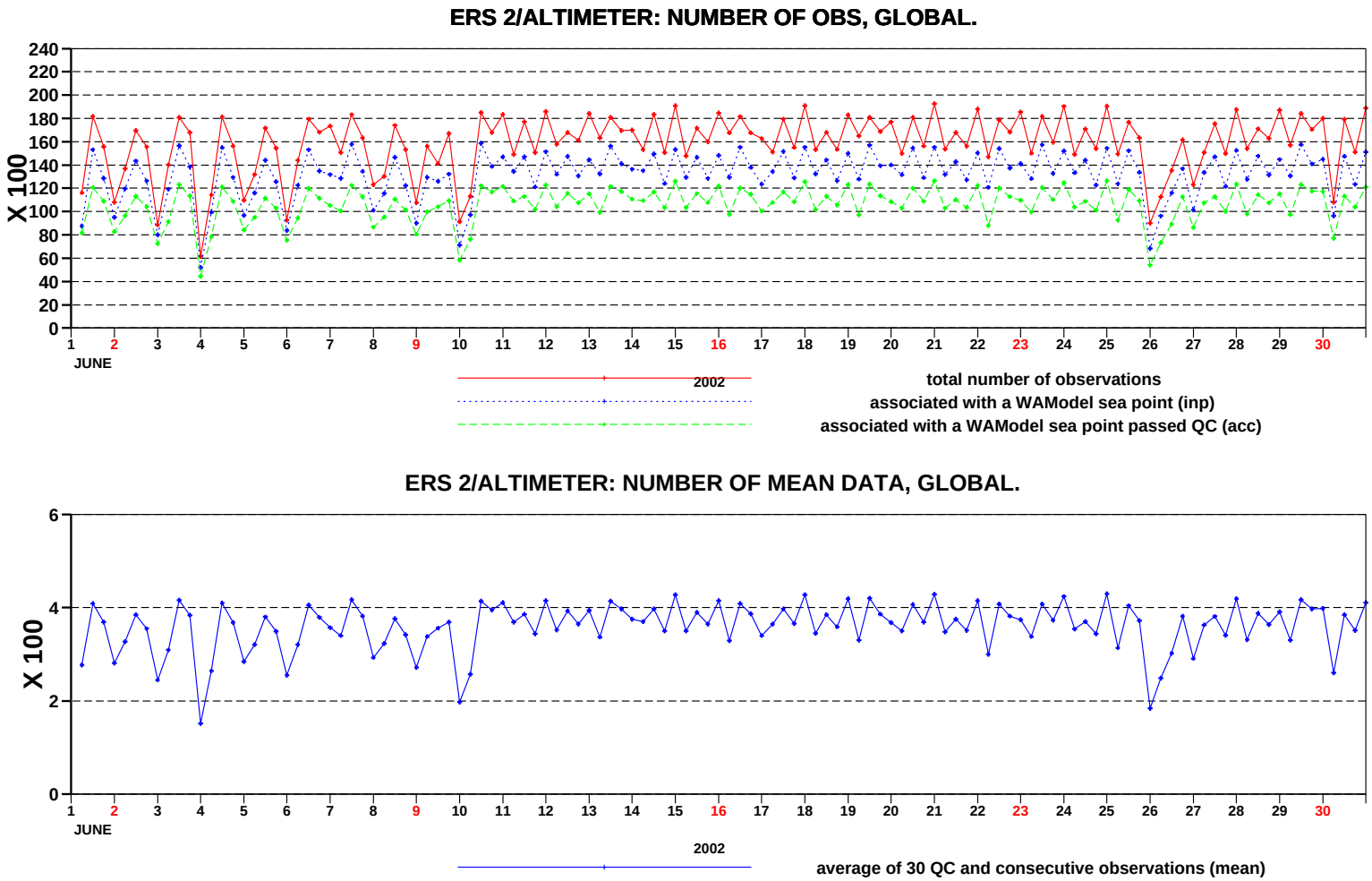


Figure 1: Time series of data reception for ERS-2 Altimeter data for June 2002

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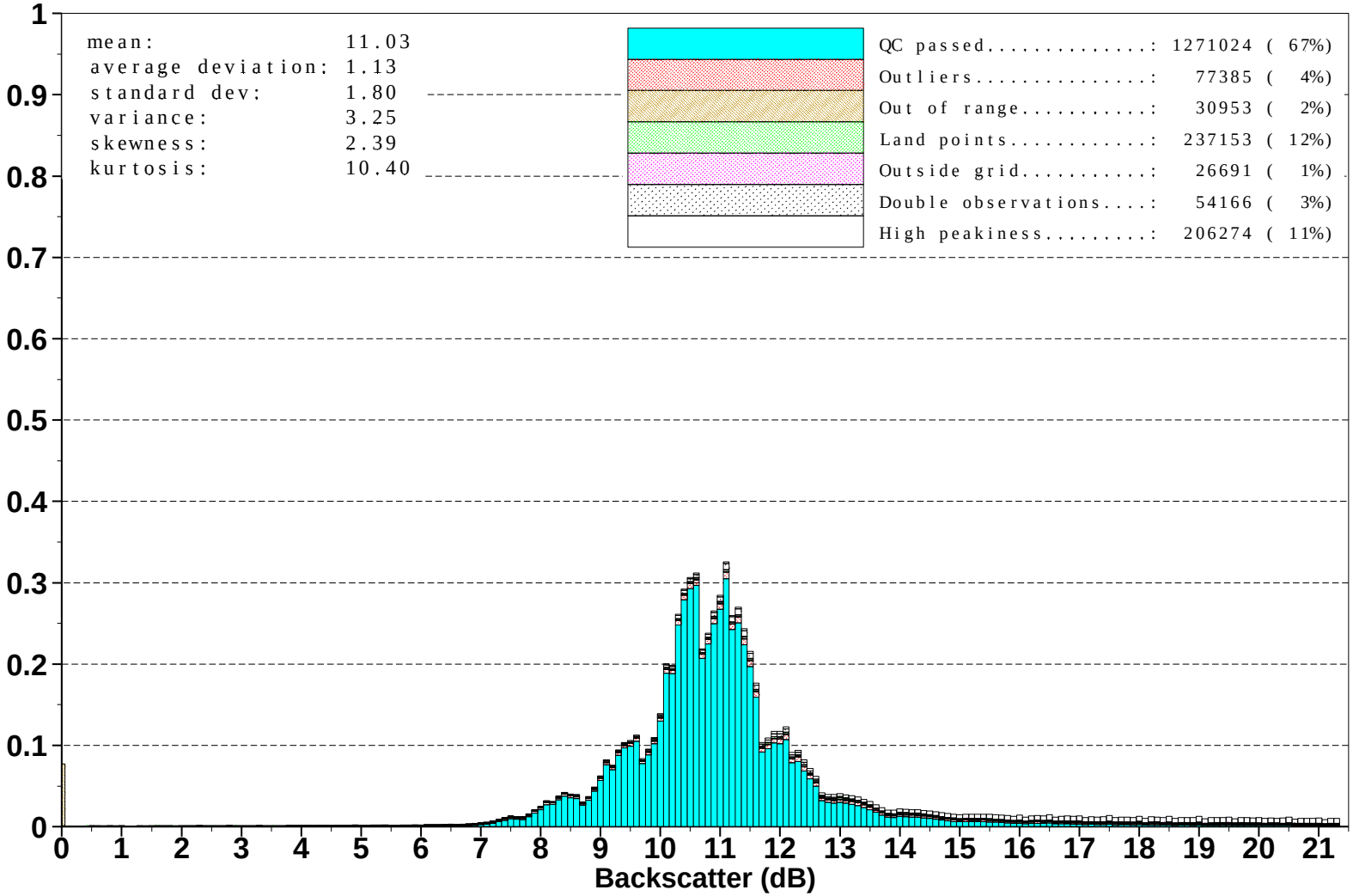


Figure 2: Distribution of the ERS-2 Altimeter backscatter after QC for June 2002

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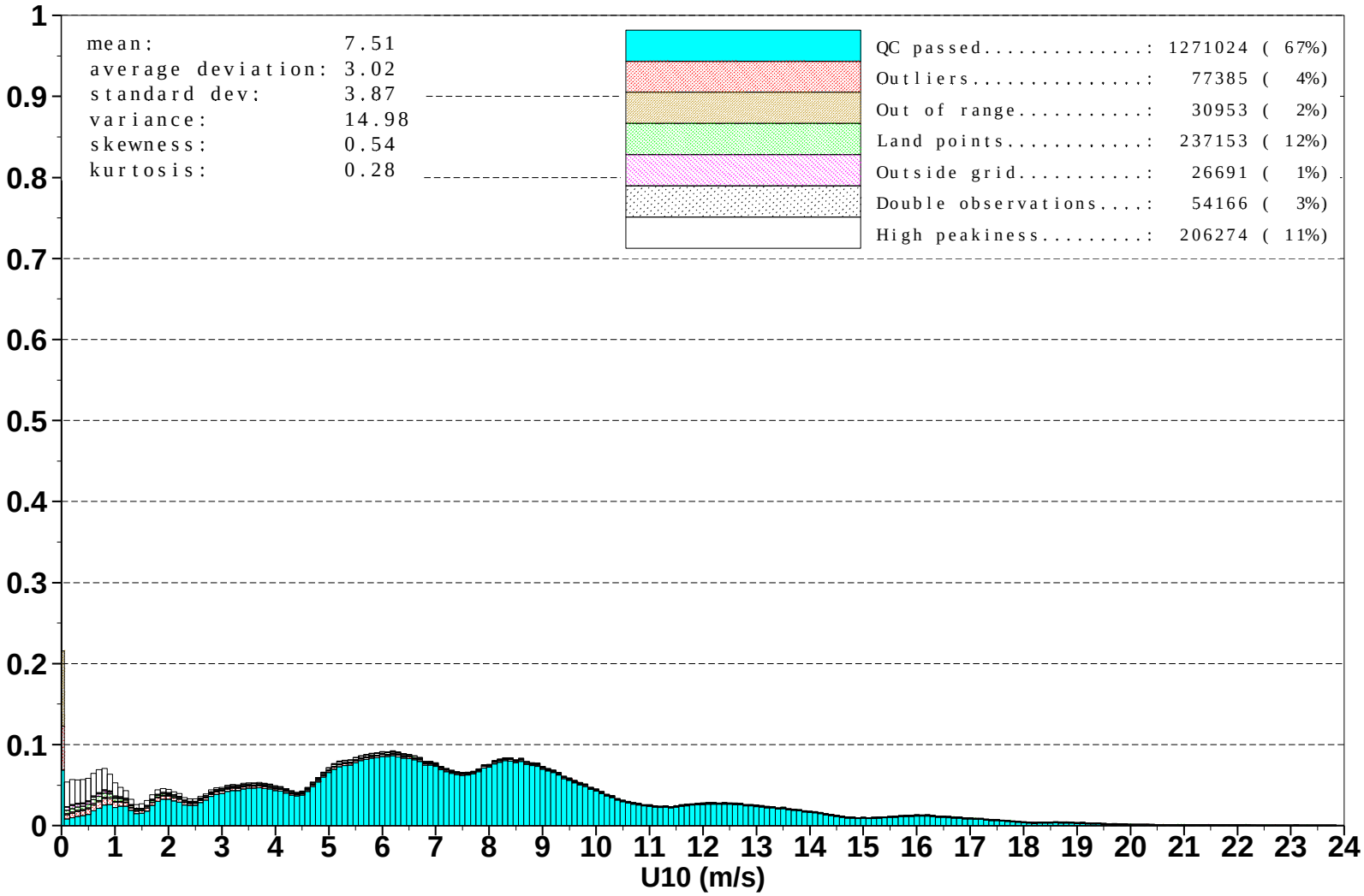


Figure 3: Distribution of the ERS-2 Altimeter wind speeds after QC for June 2002

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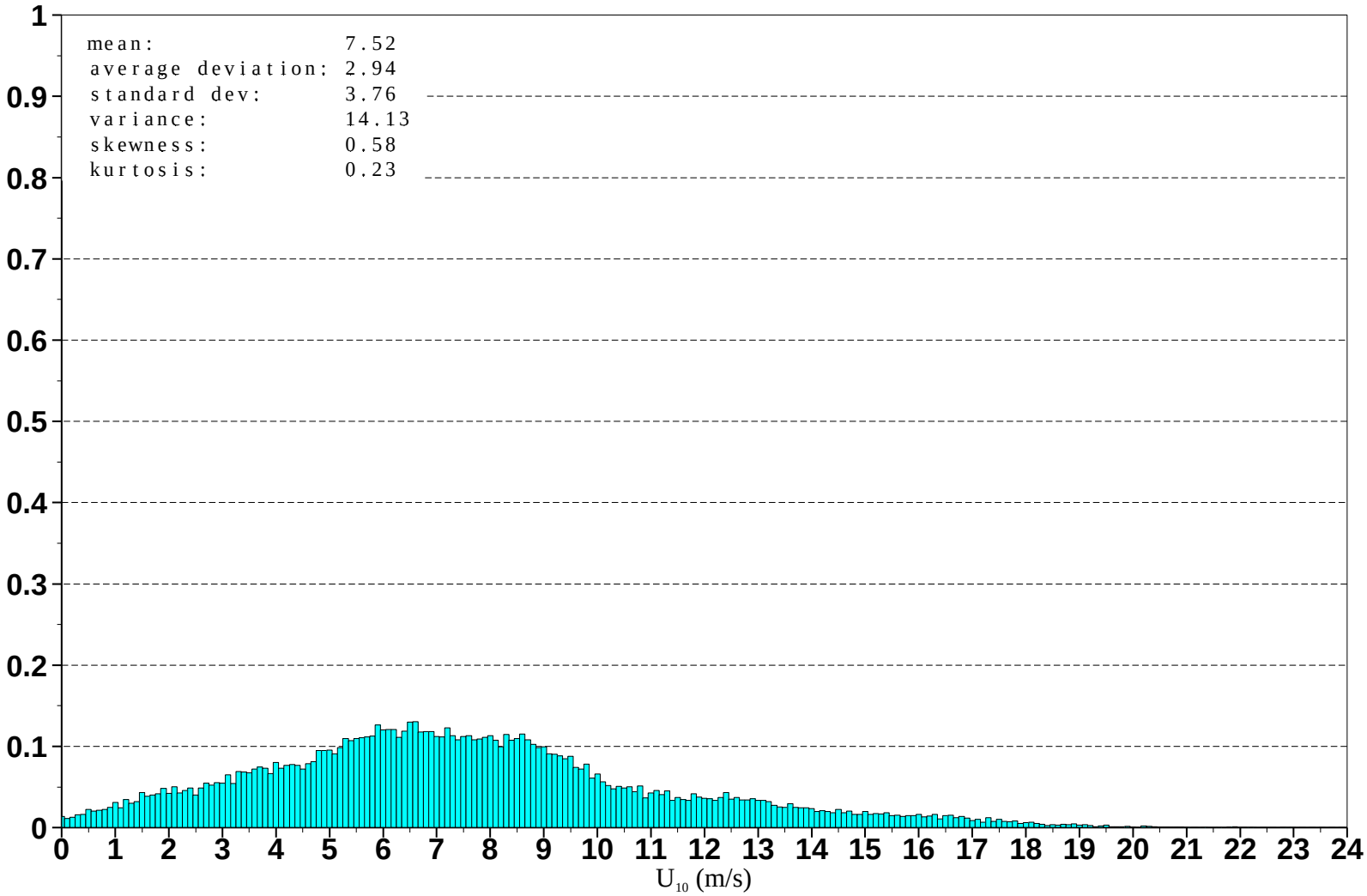


Figure 4: Distribution of ERS-2 Altimeter wind speeds after along track averaging for June 2002

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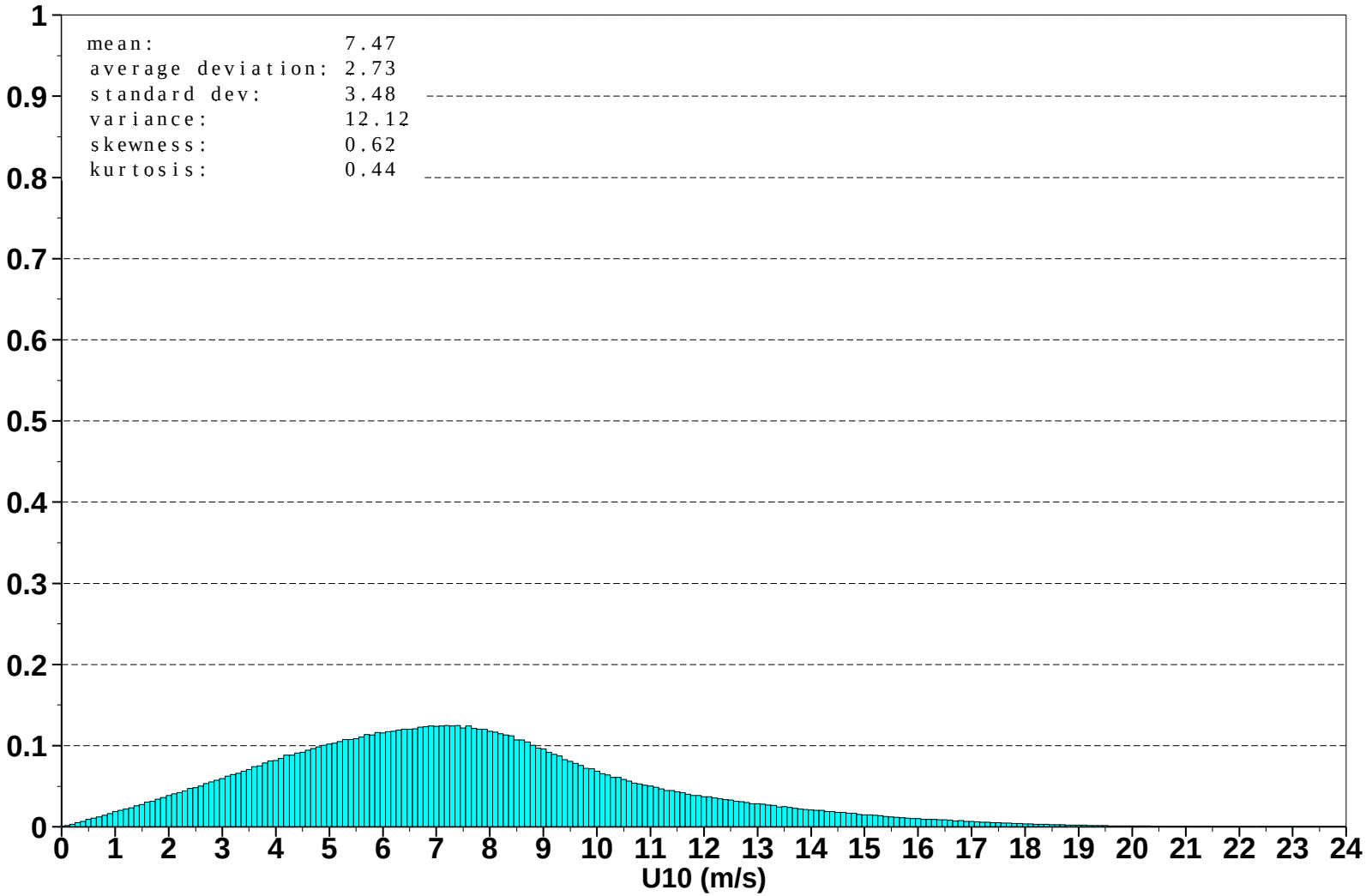
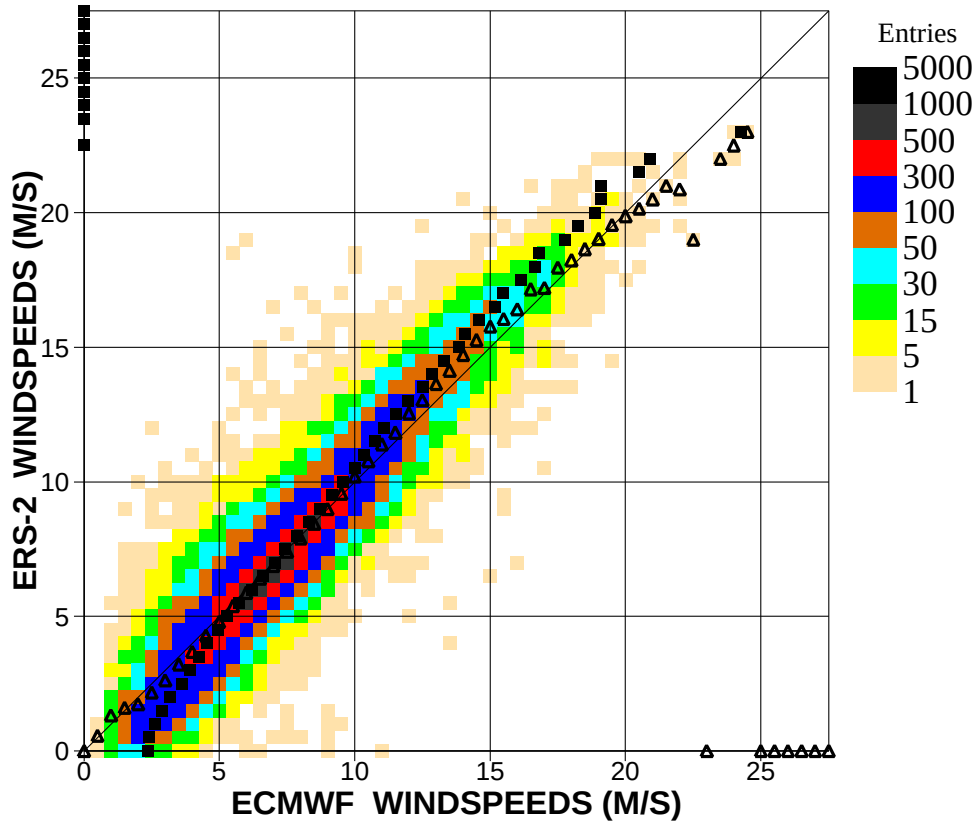


Figure 5: Global distribution of ECMWF ocean surface wind speeds for June 2002

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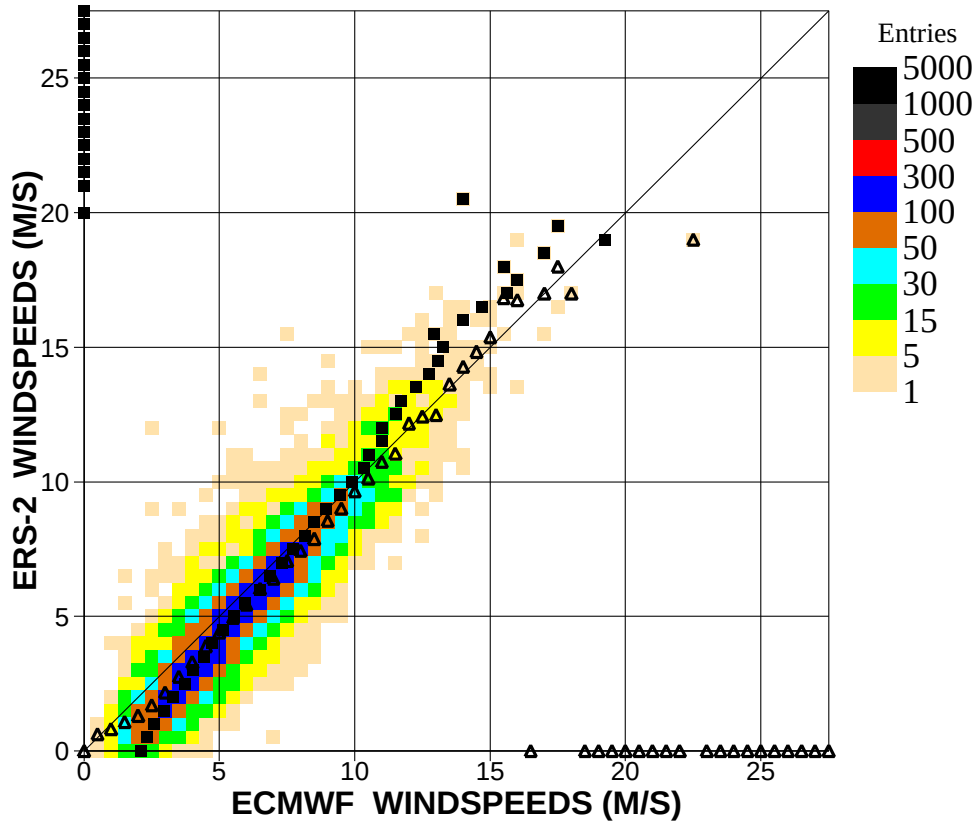
STATISTICS

ENTRIES	42849
MEAN ECMWF	7.5280
MEAN ERS-2	7.5156
BIAS (ERS-2 - ECMWF)	-0.0124
STANDARD DEVIATION	1.3225
SCATTER INDEX	0.1757
CORRELATION	0.9382
SYMMETRIC SLOPE	1.0230(0.0019)
REGR. COEFFICIENT	1.0731(0.0019)
REGR. CONSTANT	-0.5624(0.0157)

Figure 6. Comparison of ECMWF wind speed results with ERS2 Altimeter wind speed data for June 2002 (global)

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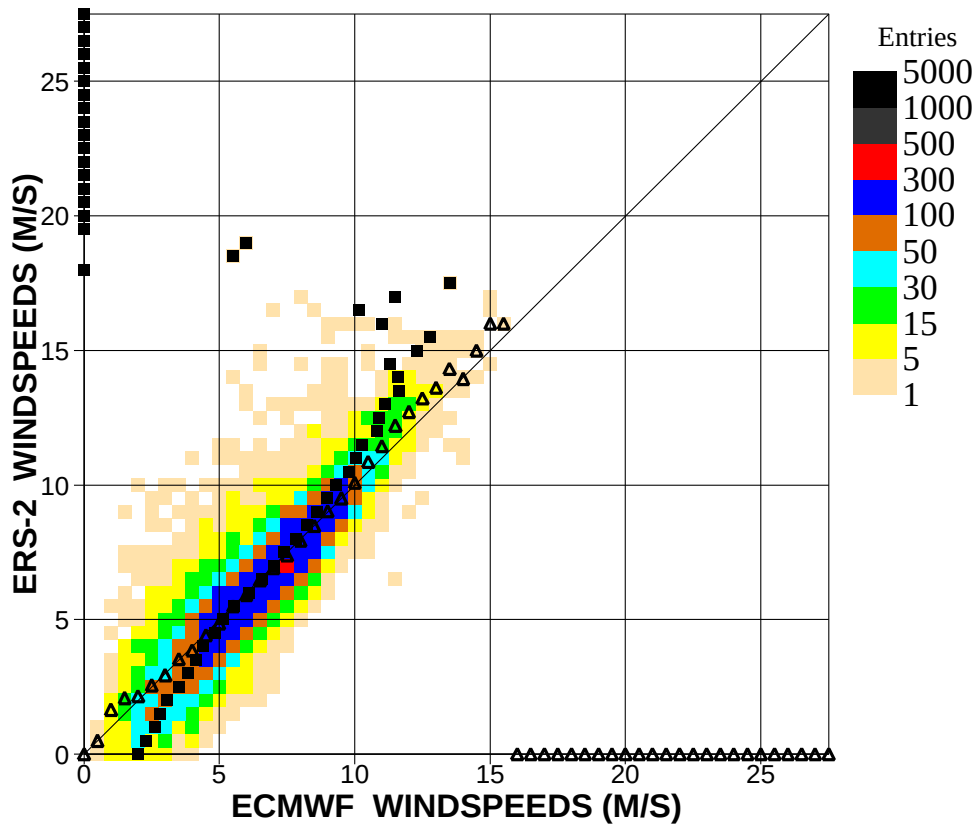
STATISTICS

ENTRIES	10658
MEAN ECMWF	6.0900
MEAN ERS-2	5.5225
BIAS (ERS-2 - ECMWF)	-0.5675
STANDARD DEVIATION	1.1870
SCATTER INDEX	0.1949
CORRELATION	0.9163
SYMMETRIC SLOPE	0.9468(0.0046)
REGR. COEFFICIENT	1.0492(0.0044)
REGR. CONSTANT	-0.8672(0.0294)

Figure 7. Comparison of ECMWF wind speed results with ERS2 Altimeter wind speed data for June 2002 (n.hem.)

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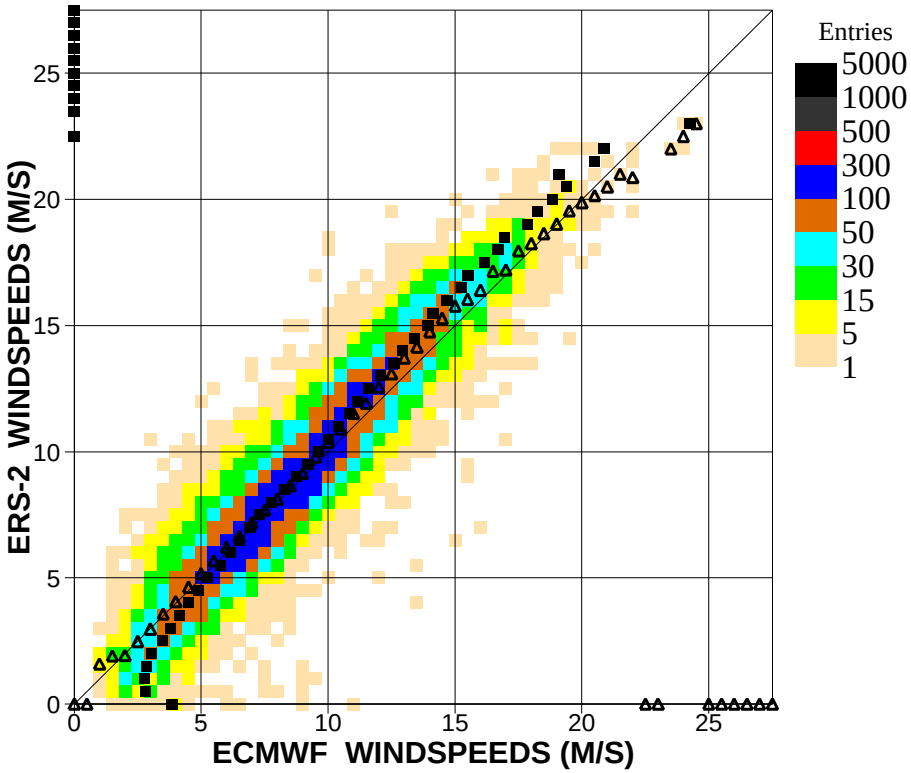
STATISTICS

ENTRIES	13741
MEAN ECMWF	6.5968
MEAN ERS-2	6.5831
BIAS (ERS-2 - ECMWF)	-0.0137
STANDARD DEVIATION	1.1898
SCATTER INDEX	0.1804
CORRELATION	0.8892
SYMMETRIC SLOPE	1.0150(0.0045)
REGR. COEFFICIENT	1.0226(0.0045)
REGR. CONSTANT	-0.1631(0.0313)

Figure 8. Comparison of ECMWF wind speed results with ERS2 Altimeter wind speed data for June 2002 (tropics)

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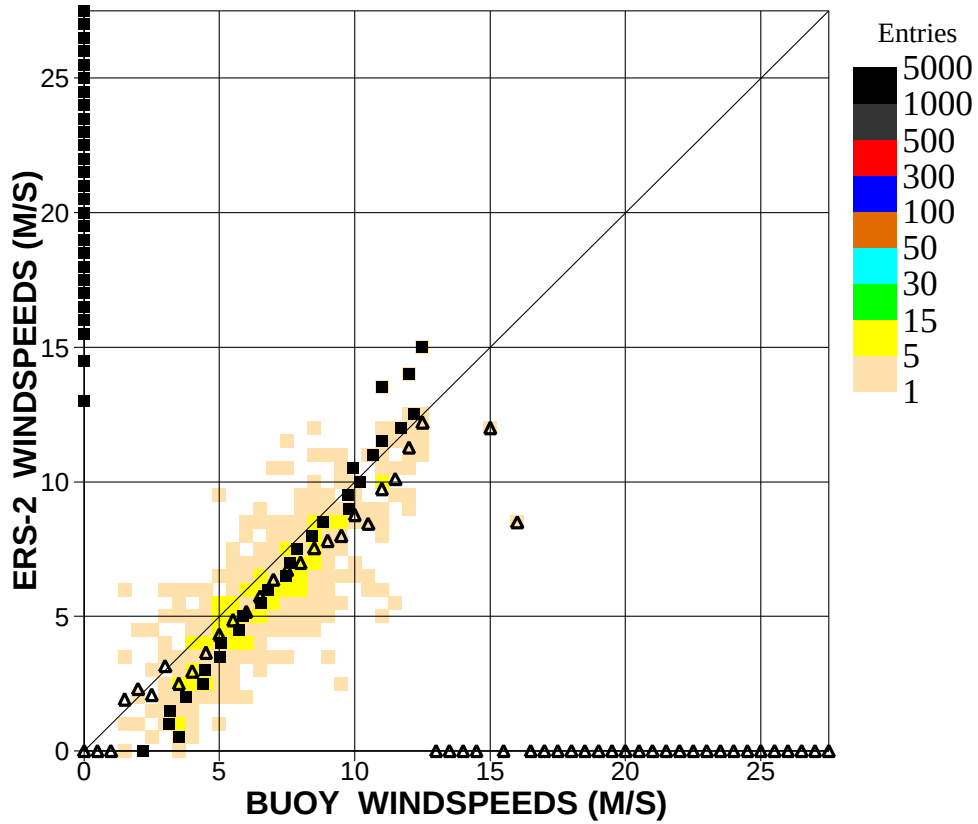


STATISTICS

ENTRIES	18775
MEAN ECMWF	9.0143
MEAN ERS-2	9.3152
BIAS (ERS-2 - ECMWF)	0.3009
STANDARD DEVIATION	1.3778
SCATTER INDEX	0.1529
CORRELATION	0.9412
SYMMETRIC SLOPE	1.0448(0.0028)
REGR. COEFFICIENT	1.0467(0.0027)
REGR. CONSTANT	-0.1202(0.0267)

Figure 9. Comparison of ECMWF wind speed results with ERS2 Altimeter wind speed data for June 2002 (s.hem.)

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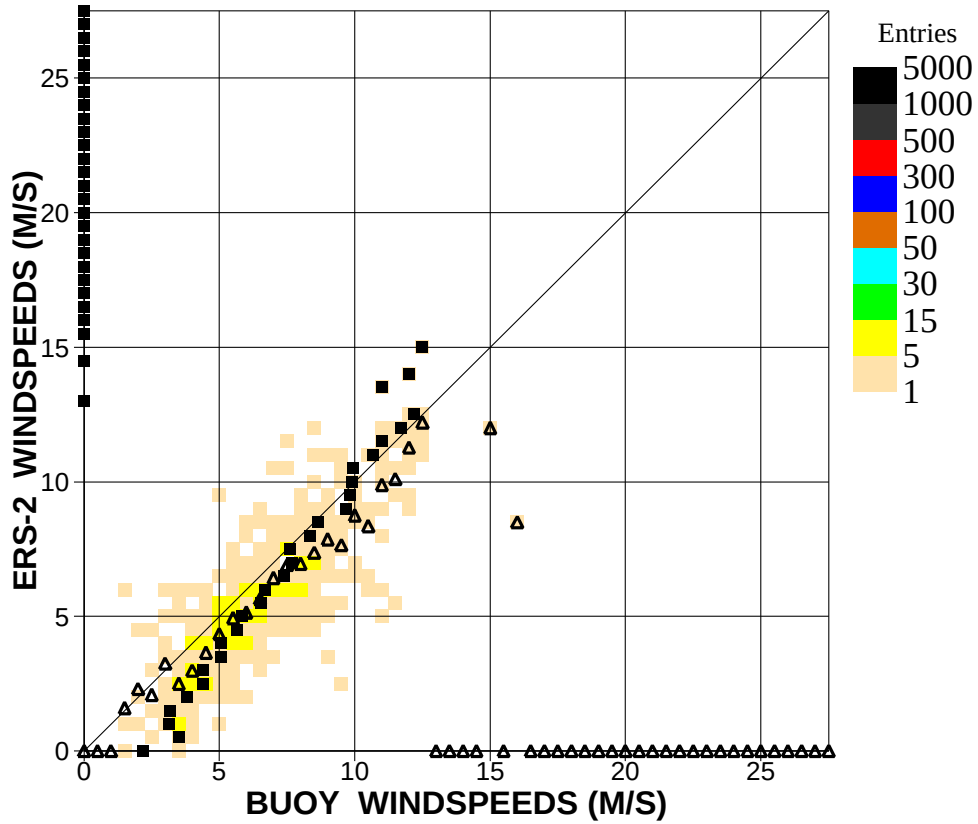


STATISTICS

ENTRIES	534	
MEAN BUOY	6.8769	
MEAN ERS-2	5.9899	
BIAS (ERS-2 - BUOY)	-0.8870	
STANDARD DEVIATION	1.5158	
SCATTER INDEX	0.2204	
CORRELATION	0.8354	
SYMMETRIC SLOPE	0.8978	(0.0258)
REGR. COEFFICIENT	0.8989	(0.0256)
REGR. CONSTANT	-0.1915	(0.1878)

Figure 10. Comparison of buoy wind speed observations with ERS2 Altimeter wind speed data for June 2002 (global)

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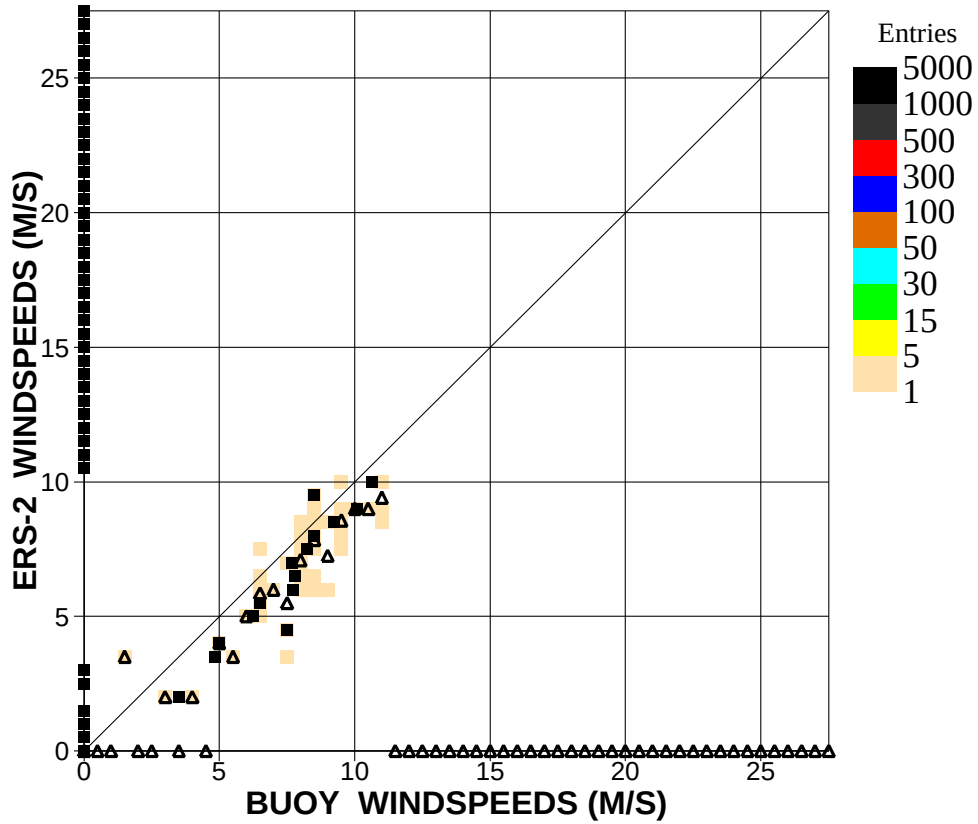
STATISTICS

ENTRIES	453	
MEAN BUOY	6.6854	
MEAN ERS-2	5.8093	
BIAS (ERS-2 - BUOY)	-0.8761	
STANDARD DEVIATION	1.5953	
SCATTER INDEX	0.2386	
CORRELATION	0.8295	
SYMMETRIC SLOPE	0.9001	(0.0288)
REGR. COEFFICIENT	0.8994	(0.0285)
REGR. CONSTANT	-0.2035	(0.2045)

Figure 11. Comparison of buoy wind speed observations with ERS2 Altimeter wind speed data for June 2002 (n.hem.)

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STATISTICS

ENTRIES	62	
MEAN BUOY	8.0492	
MEAN ERS-2	7.0597	
BIAS (ERS-2 - BUOY)	-0.9895	
STANDARD DEVIATION	0.9990	
SCATTER INDEX	0.1241	
CORRELATION	0.8614	
SYMMETRIC SLOPE	0.8849	(0.0671)
REGR. COEFFICIENT	0.8792	(0.0669)
REGR. CONSTANT	-0.0169	(0.5529)

Figure 12. Comparison of buoy wind speed observations with ERS2 Altimeter wind speed data for June 2002 (hawaii)

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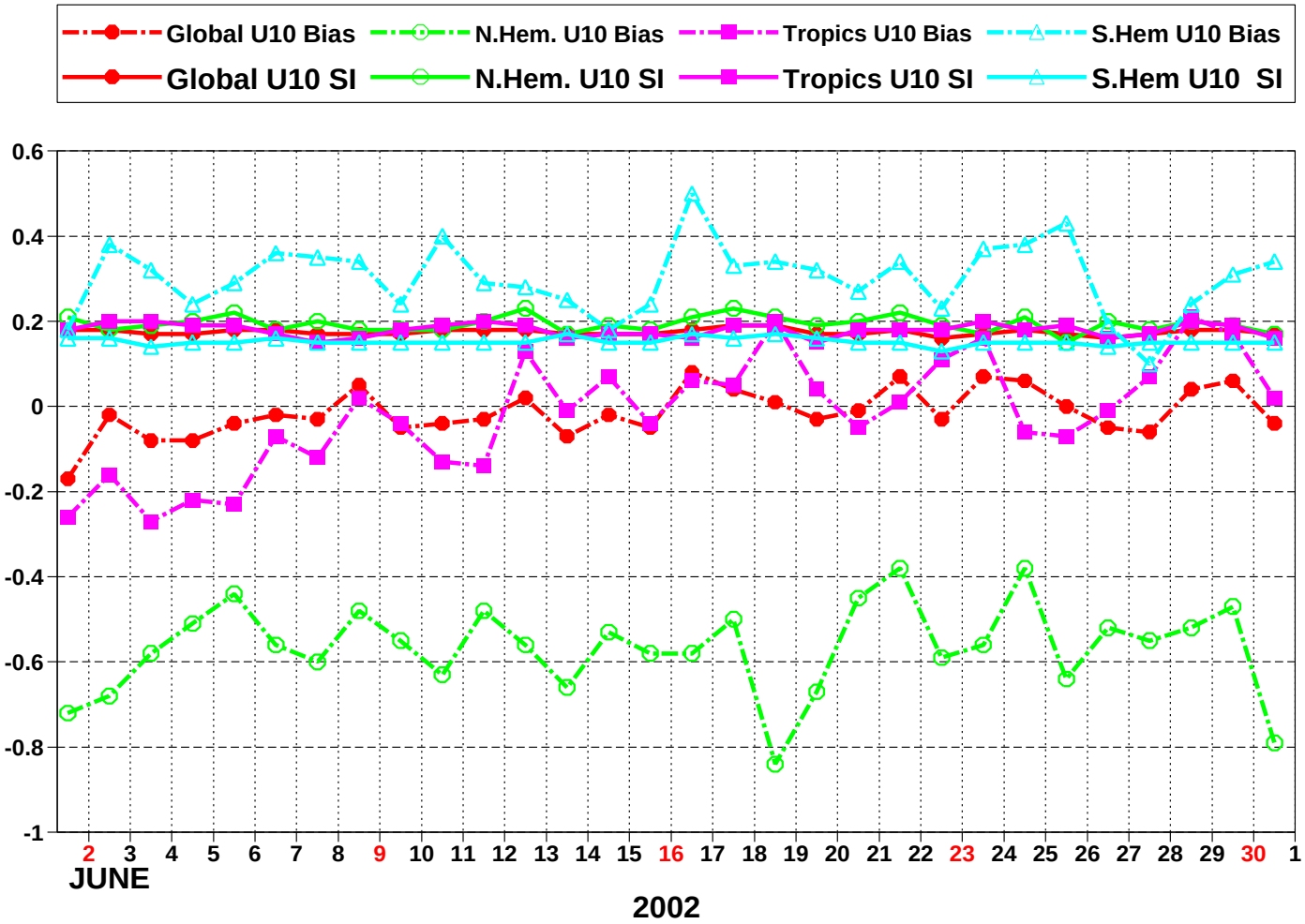


Figure 13: ERS-2 Altimeter wind speeds: Timeseries of bias (ERS-2 - model) and scatter index (SI)

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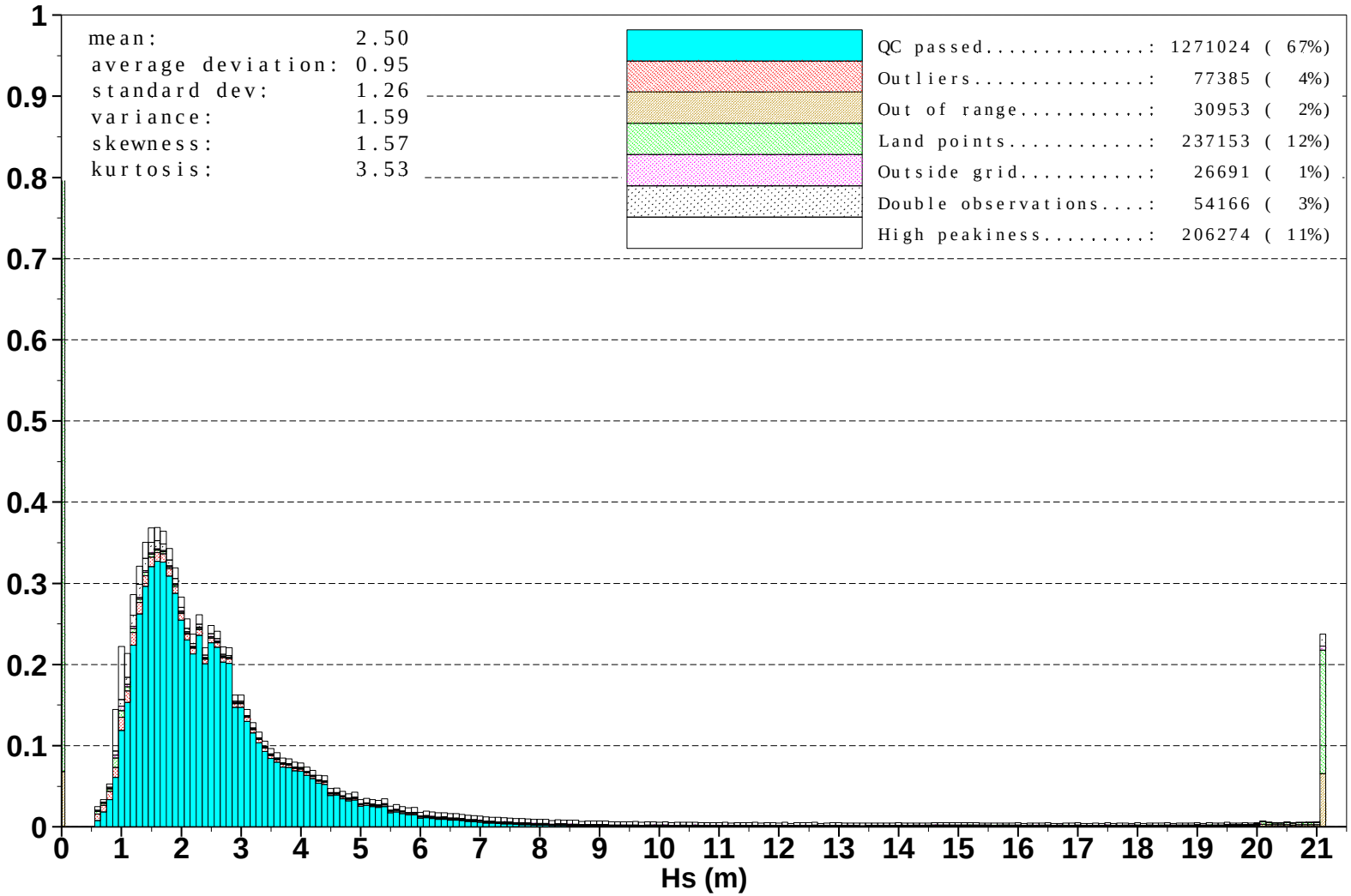


Figure 14: Distribution of the ERS-2 Altimeter wave heights after QC for June 2002

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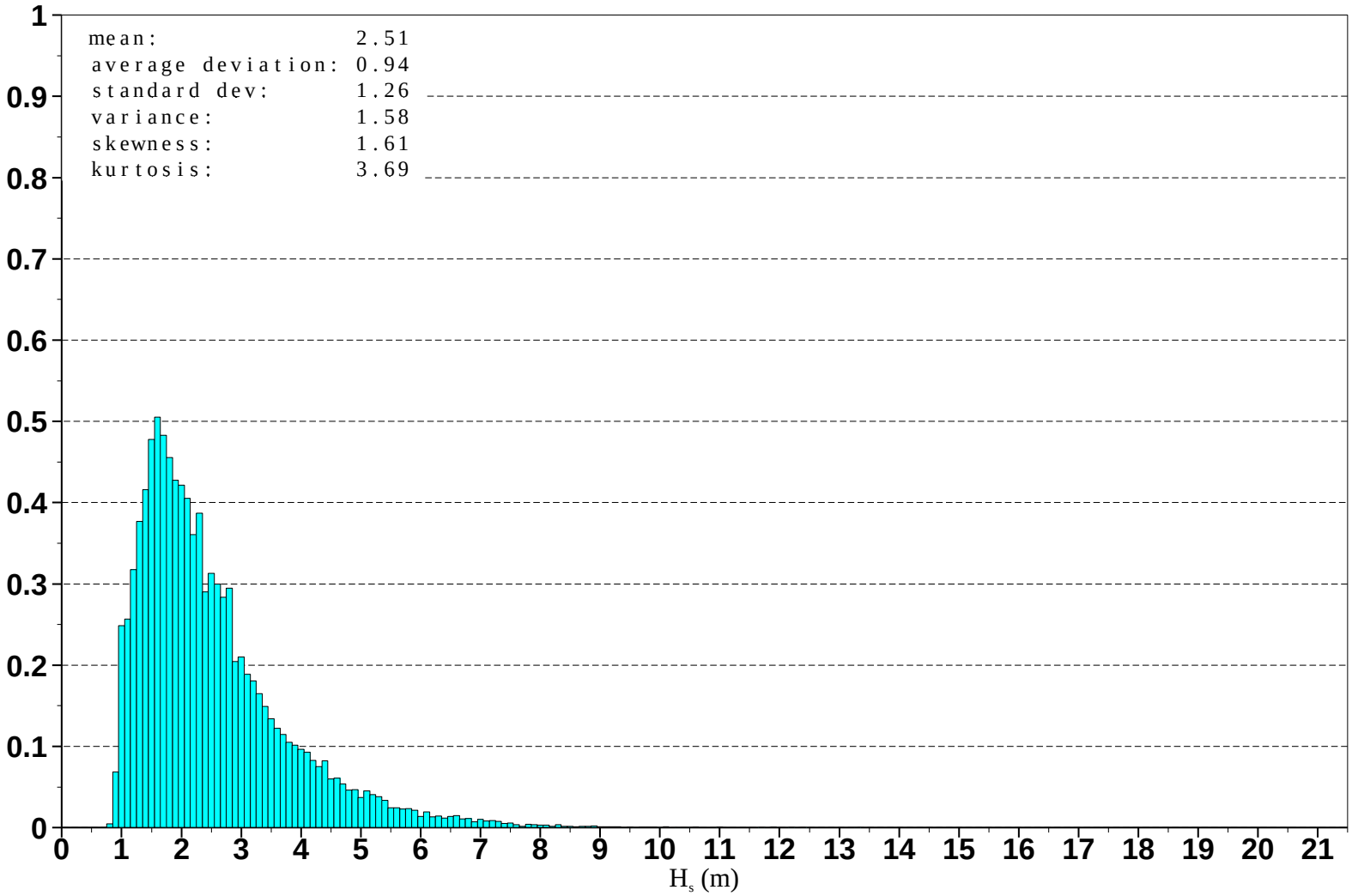


Figure 15: Distribution of ERS-2 Altimeter wave heights after along track averaging for June 2002

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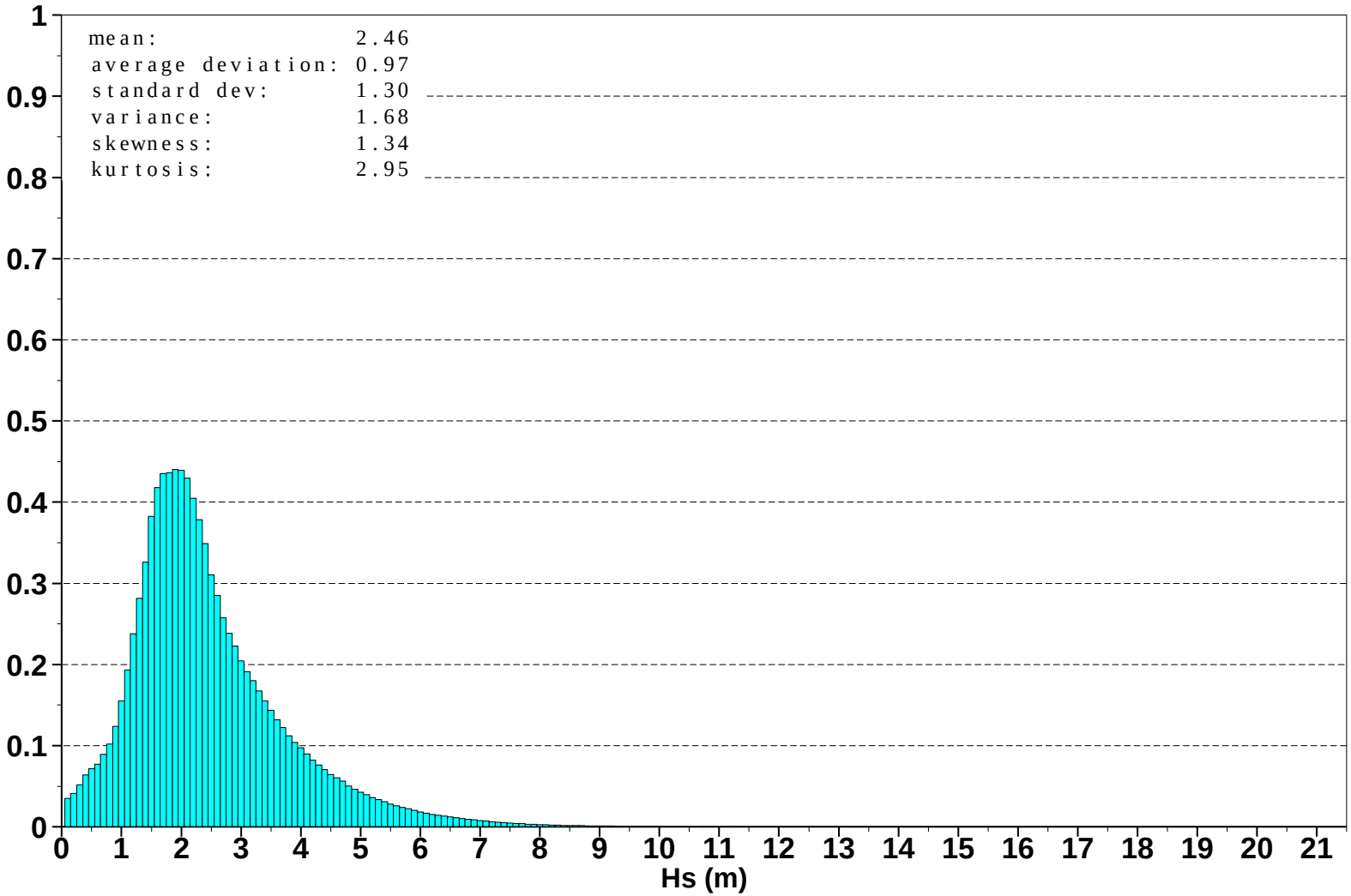
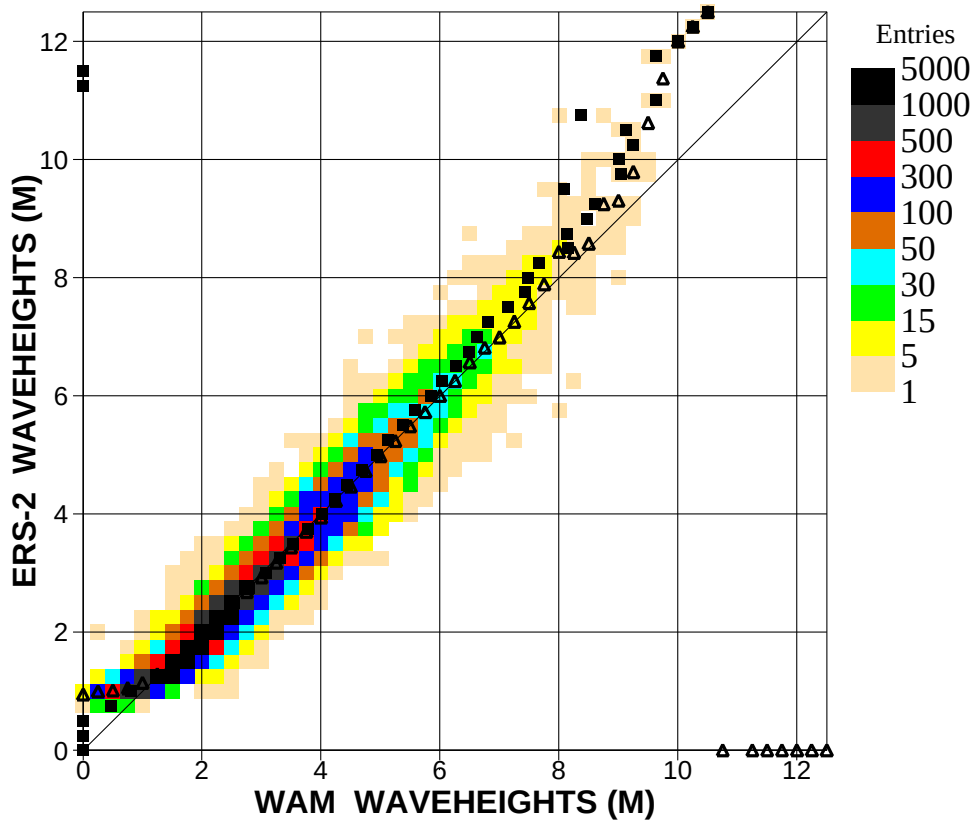


Figure 16: Global distribution of ECMWF wave heights for June 2002

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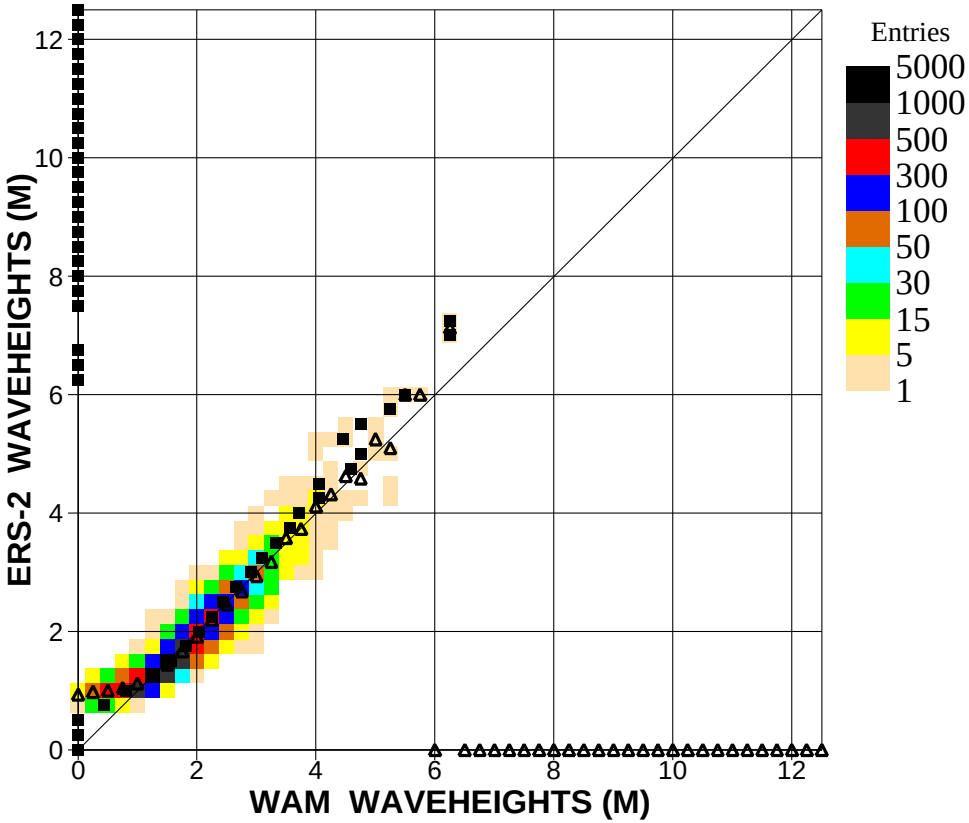


STATISTICS

ENTRIES	42849
MEAN WAM	2.5374
MEAN ERS-2	2.5065
BIAS (ERS-2 - WAM)	-0.0309
STANDARD DEVIATION	0.2794
SCATTER INDEX	0.1101
CORRELATION	0.9751
SYMMETRIC SLOPE	0.9923(0.0011)
REGR. COEFFICIENT	0.9857(0.0011)
REGR. CONSTANT	0.0053(0.0031)

Figure 17. Comparison of ECMWF wave height results with ERS2 Altimeter wave height data for June 2002 (global)

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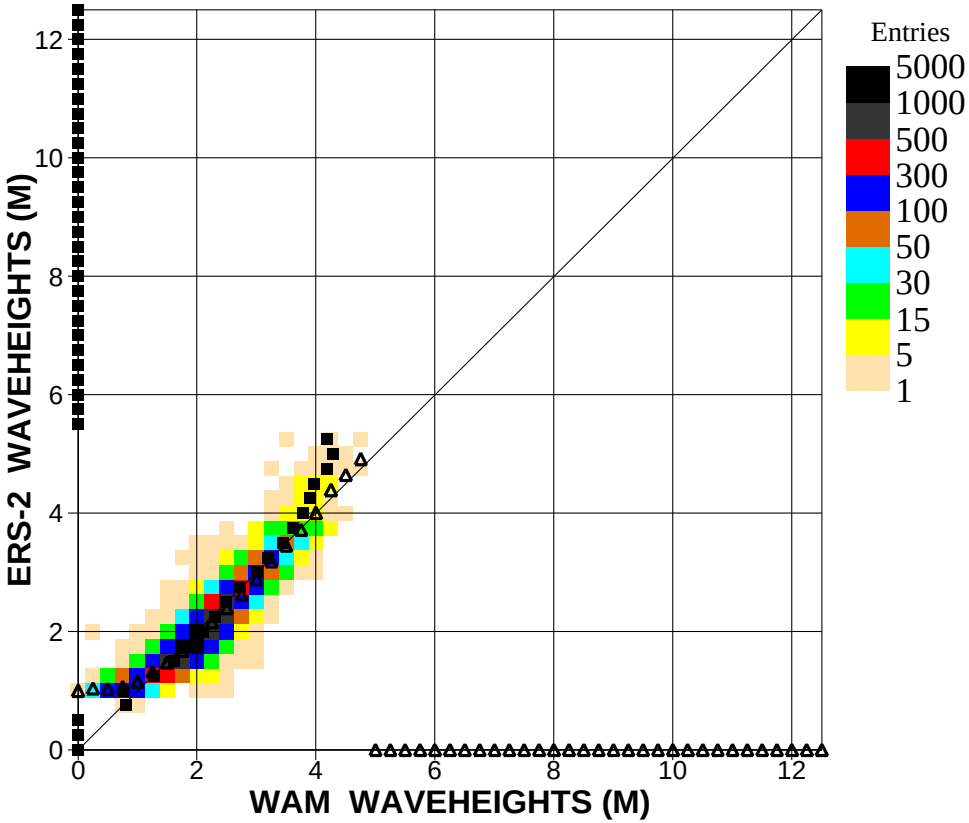


STATISTICS

ENTRIES	10658
MEAN WAM	1.6312
MEAN ERS-2	1.6442
BIAS (ERS-2 - WAM)	0.0130
STANDARD DEVIATION	0.2326
SCATTER INDEX	0.1426
CORRELATION	0.9314
SYMMETRIC SLOPE	0.9971(0.0035)
REGR. COEFFICIENT	0.8596(0.0033)
REGR. CONSTANT	0.2420(0.0057)

Figure 18. Comparison of ECMWF wave height results with ERS2 Altimeter wave height data for June 2002 (n.hem.)

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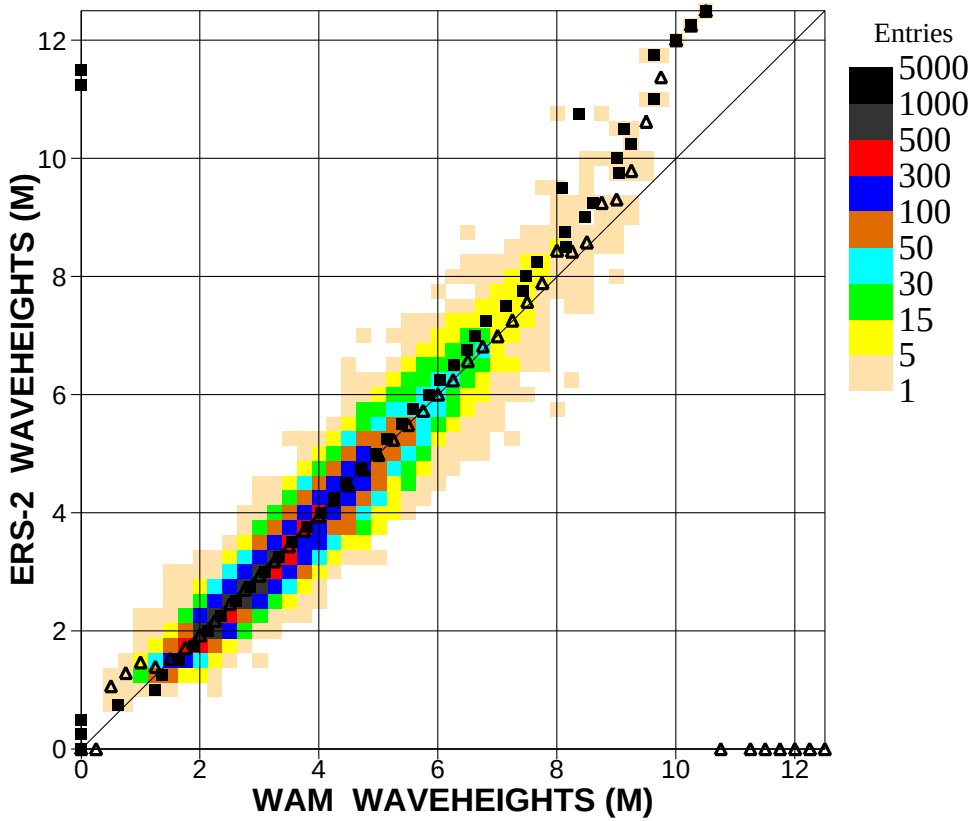
STATISTICS

ENTRIES	13741
MEAN WAM	2.0314
MEAN ERS-2	1.9818
BIAS (ERS-2 - WAM)	-0.0496
STANDARD DEVIATION	0.2237
SCATTER INDEX	0.1101
CORRELATION	0.9298
SYMMETRIC SLOPE	0.9749(0.0031)
REGR. COEFFICIENT	0.8994(0.0030)
REGR. CONSTANT	0.1549(0.0064)

Figure 19. Comparison of ECMWF wave height results with ERS2 Altimeter wave height data for June 2002 (tropics)

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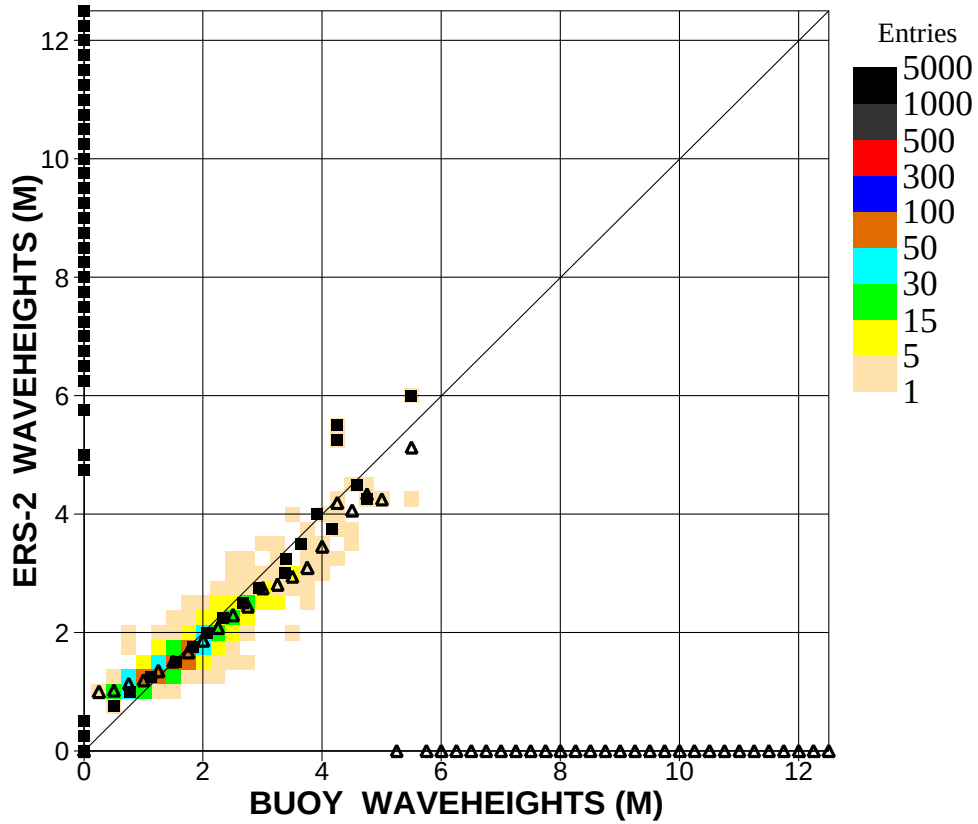


STATISTICS

ENTRIES	18775
MEAN WAM	3.4149
MEAN ERS-2	3.3724
BIAS (ERS-2 - WAM)	-0.0425
STANDARD DEVIATION	0.3319
SCATTER INDEX	0.0972
CORRELATION	0.9691
SYMMETRIC SLOPE	0.9959(0.0019)
REGR. COEFFICIENT	1.0213(0.0019)
REGR. CONSTANT	-0.1154(0.0069)

Figure 20. Comparison of ECMWF wave height results with ERS2 Altimeter wave height data for June 2002 (s.hem.)

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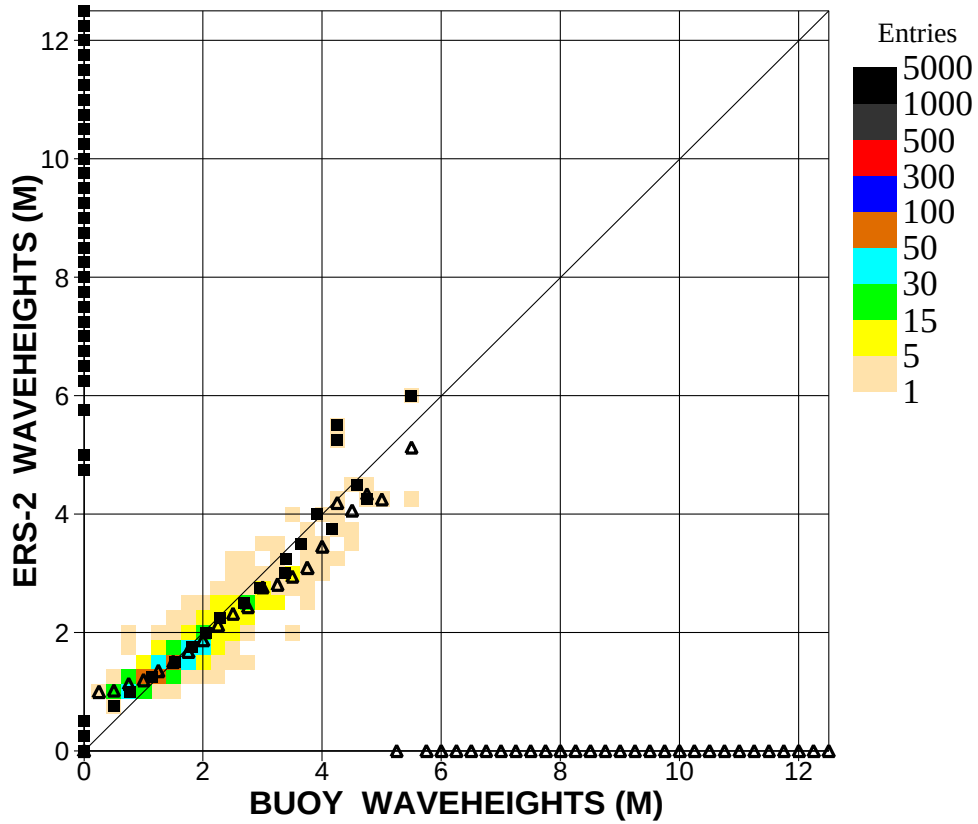
STATISTICS

ENTRIES	865	
MEAN BUOY	1.7568	
MEAN ERS-2	1.7478	
BIAS (ERS-2 - BUOY)	-0.0089	
STANDARD DEVIATION	0.3130	
SCATTER INDEX	0.1781	
CORRELATION	0.9297	
SYMMETRIC SLOPE	0.9658	(0.0126)
REGR. COEFFICIENT	0.7586	(0.0102)
REGR. CONSTANT	0.4151	(0.0198)

Figure 21. Comparison of buoy wave height observations with ERS2 Altimeter wave height data for June 2002 (global)

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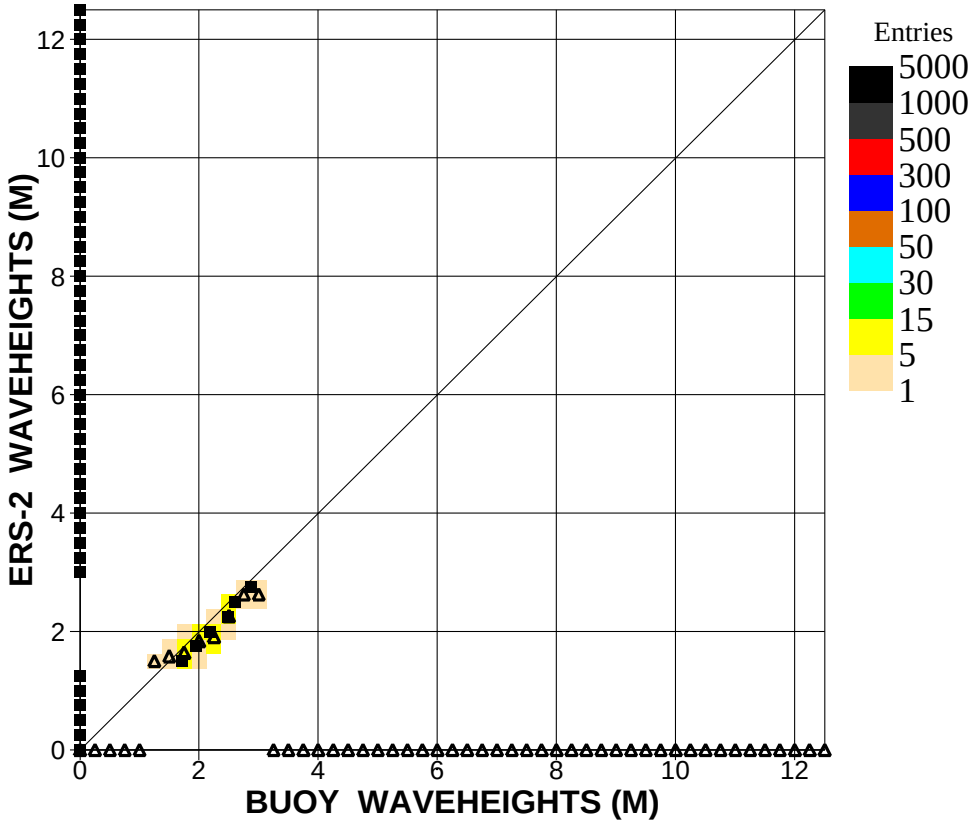


STATISTICS

ENTRIES	781	
MEAN BUOY	1.7293	
MEAN ERS-2	1.7332	
BIAS (ERS-2 - BUOY)	0.0040	
STANDARD DEVIATION	0.3198	
SCATTER INDEX	0.1849	
CORRELATION	0.9303	
SYMMETRIC SLOPE	0.9705	(0.0133)
REGR. COEFFICIENT	0.7631	(0.0108)
REGR. CONSTANT	0.4137	(0.0207)

Figure 22. Comparison of buoy wave height observations with ERS2 Altimeter wave height data for June 2002 (n.hem.)

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STATISTICS

ENTRIES	64	
MEAN BUOY	2.1504	
MEAN ERS-2	1.9780	
BIAS (ERS-2 - BUOY)	-0.1724	
STANDARD DEVIATION	0.1754	
SCATTER INDEX	0.0816	
CORRELATION	0.9032	
SYMMETRIC SLOPE	0.9177	(0.0502)
REGR. COEFFICIENT	0.7719	(0.0466)
REGR. CONSTANT	0.3181	(0.1019)

Figure 23. Comparison of buoy wave height observations with ERS2 Altimeter wave height data for June 2002 (hawaii)

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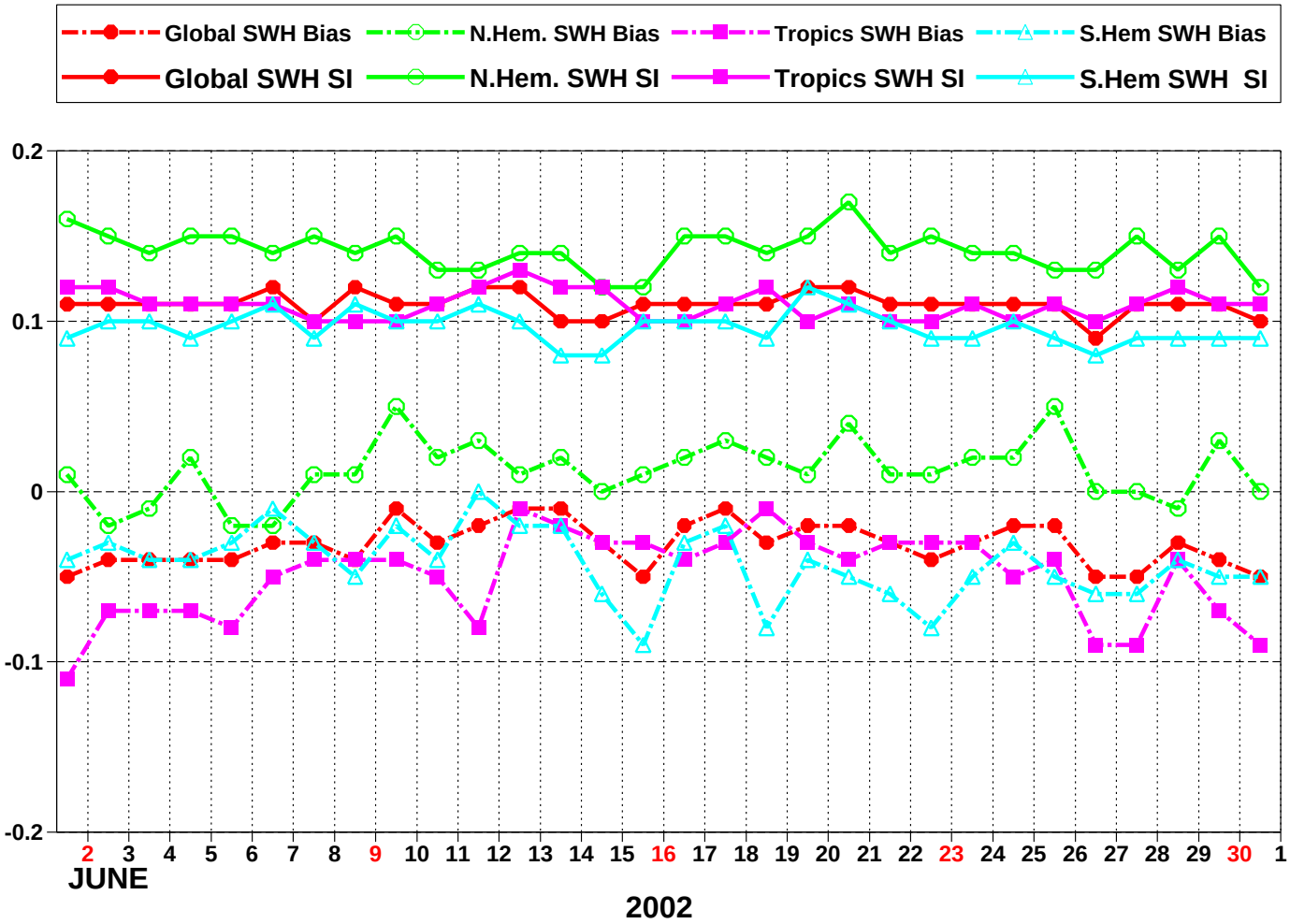


Figure 24: ERS-2 Altimeter wave heights: Timeseries of bias (ERS-2 - model) and scatter index (SI)

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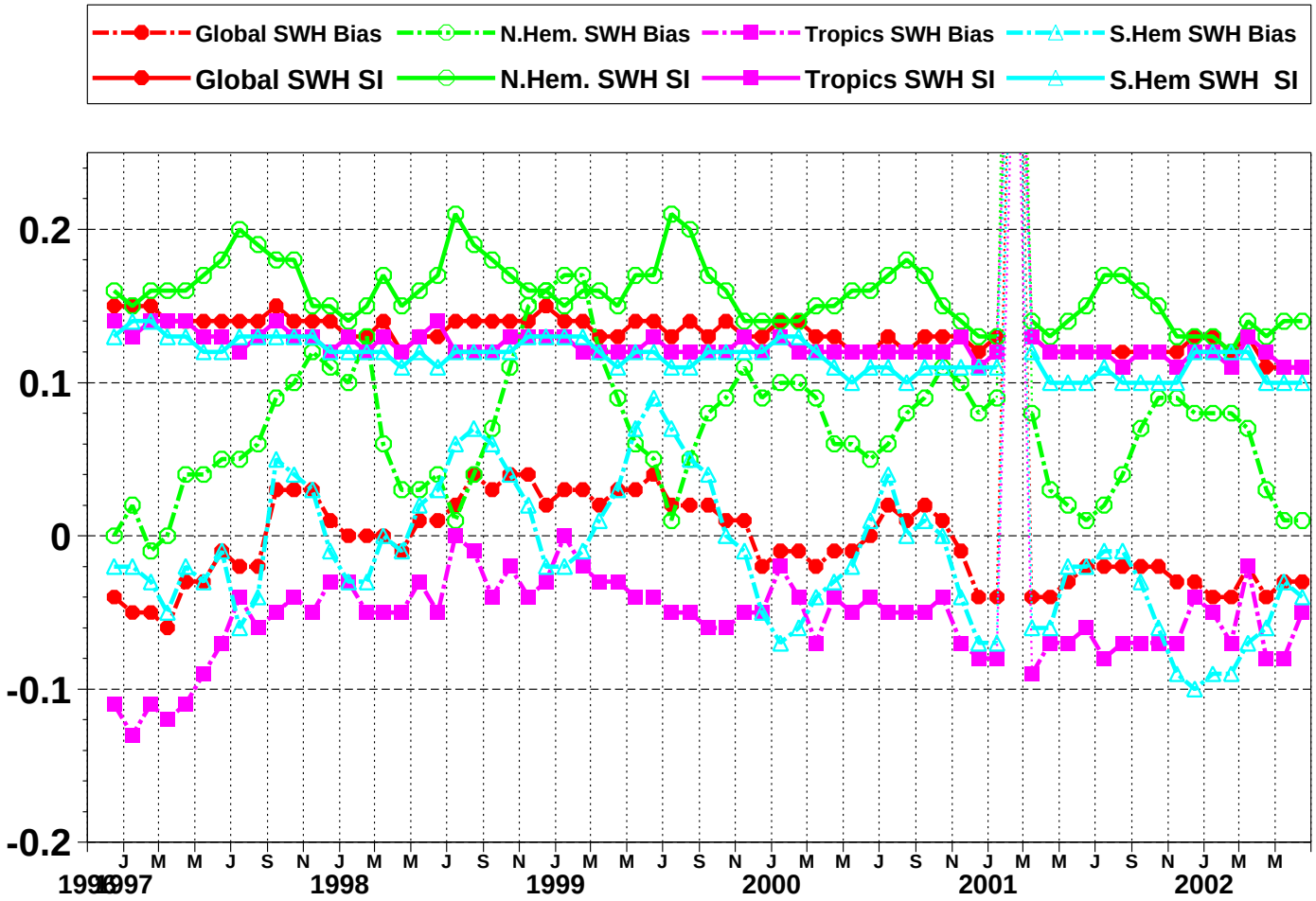


Figure 25: ERS-2 Altimeter wave heights: Timeseries of bias (ERS-2 - model) and scatter index (SI)

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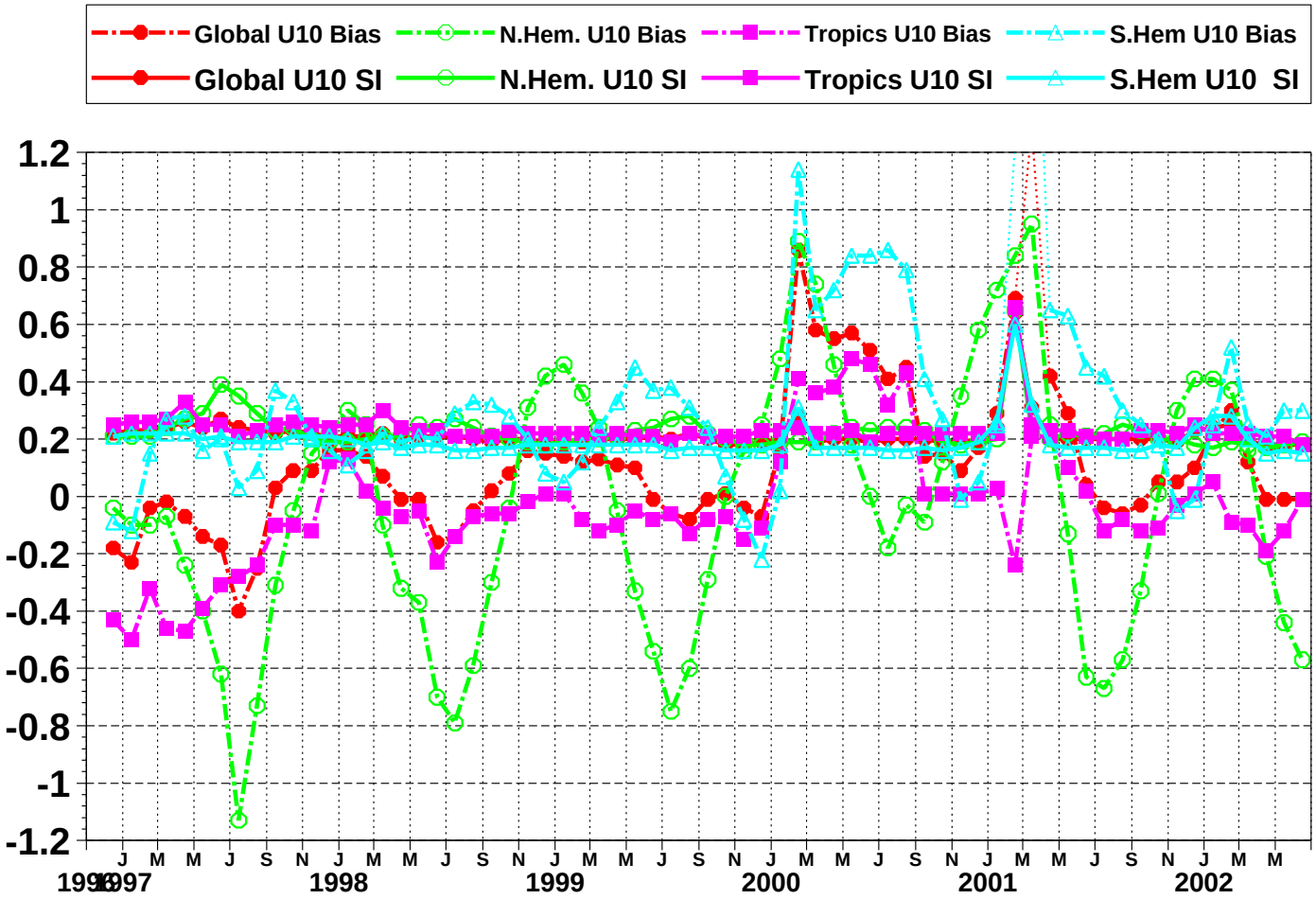


Figure 26: ERS-2 Altimeter wind speeds: Timeseries of bias (ERS-2 - model) and scatter index (SI)

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