ECMWF Report on ERS-2 RA for October 2001

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

By: *Saleh Abdalla*

Date: *6 November 2001*

Overview:

Based on the data received during the full month, on average, 15559 observations arrived at ECMWF every 6 hours of which 79.4% passed the quality control. The data coverage, which was rather good, can be seen in Figure 1. Data were missed for the '6-hour' time slots centred at 06:00 UTC on 13 and 29 October. Significant reduction of data reception occurred at the time slots centred at 12:00 on the 5th. and the 6th., 00:00 and 12:00 on the 13th., and 00:00 on the 29th., the 30th. and the 31st. 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 usual.

Backscatter:

ESR-2 $<\sigma_0>$ = 11.04 dB (with a main peak at 11.1 dB and a secondary peak at 10.5 dB)

Wind Speed Comparison with ECMWF wind speeds (bias):

ERS-2 global: 0.052 m/s

ERS-2 northern hemisphere: 0.015 m/s

ERS-2 tropics: -0.108 m/s

ERS-2 southern hemisphere: 0.198 m/s

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Wind Speed Comparison with buoy wind speeds (bias):

ERS-2 global: -0.660 m/s

ERS-2 northern hemisphere: -0.666 m/s

ERS-2 tropics: -0.542 m/s

Wave Height Comparison with ECMWF wave heights (bias):

ERS-2 global: -0.020 m (lowest waves measured: 0.6m)

ERS-2 northern hemisphere: 0.095 m

ERS-2 tropics: -0.071 m

ERS-2 southern hemisphere: -0.058 m

Wave Height Comparison with buoy wave heights (bias):

ERS-2 global: -0.13 m

ERS-2 northern hemisphere: -0.13 m

ERS-2 tropics: -0.17 m

Remarks:

- As was reported earlier, there are few outliers (RA values higher than model) in the scatter plot for the wave heights in the Northern Hemisphere and the Tropics (Figures 18 and 19). These outliers are due to some of the tropical cyclones,

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which was not resolved successfully by the ECMWF atmospheric model. Roughly speaking, a similar number of wind speed outliers can be attributed to the same cause. It should be stressed again that this can not explain most of the outliers in the wind scatter plots.

- Annalisa Martini of ESA has pointed out that “DES Sun-Blinding” phenomenon is responsible for the wind speed outliers. This phenomenon started to have more significant impact on the RA parameters since the start of gyro-less pilotting of the spacecraft. Indeed, several outliers are associated with this phenomenon during October 2001 (e.g. on the 19th. and the 21st.).
- Other than the above mentioned outliers, the quality of Altimeter data is as it used to be.

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 October 2001.
Figure 2: Distribution of the ERS-2 Altimeter Backscatter after QC for October 2001.
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Figure 22: Comparison of buoy wave height observations with ERS-2 Altimeter wave height data for October 2001 (northern hemisphere).
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Figure 24: ERS-2 Altimeter wave heights: Timeseries of bias (ERS-2 - model) and scatter index (SI) for October 2001.
Figure 25: ERS-2 Altimeter wave heights: Timeseries of bias (ERS-2 - model) and scatter index (SI) from December 1996 to October 2001
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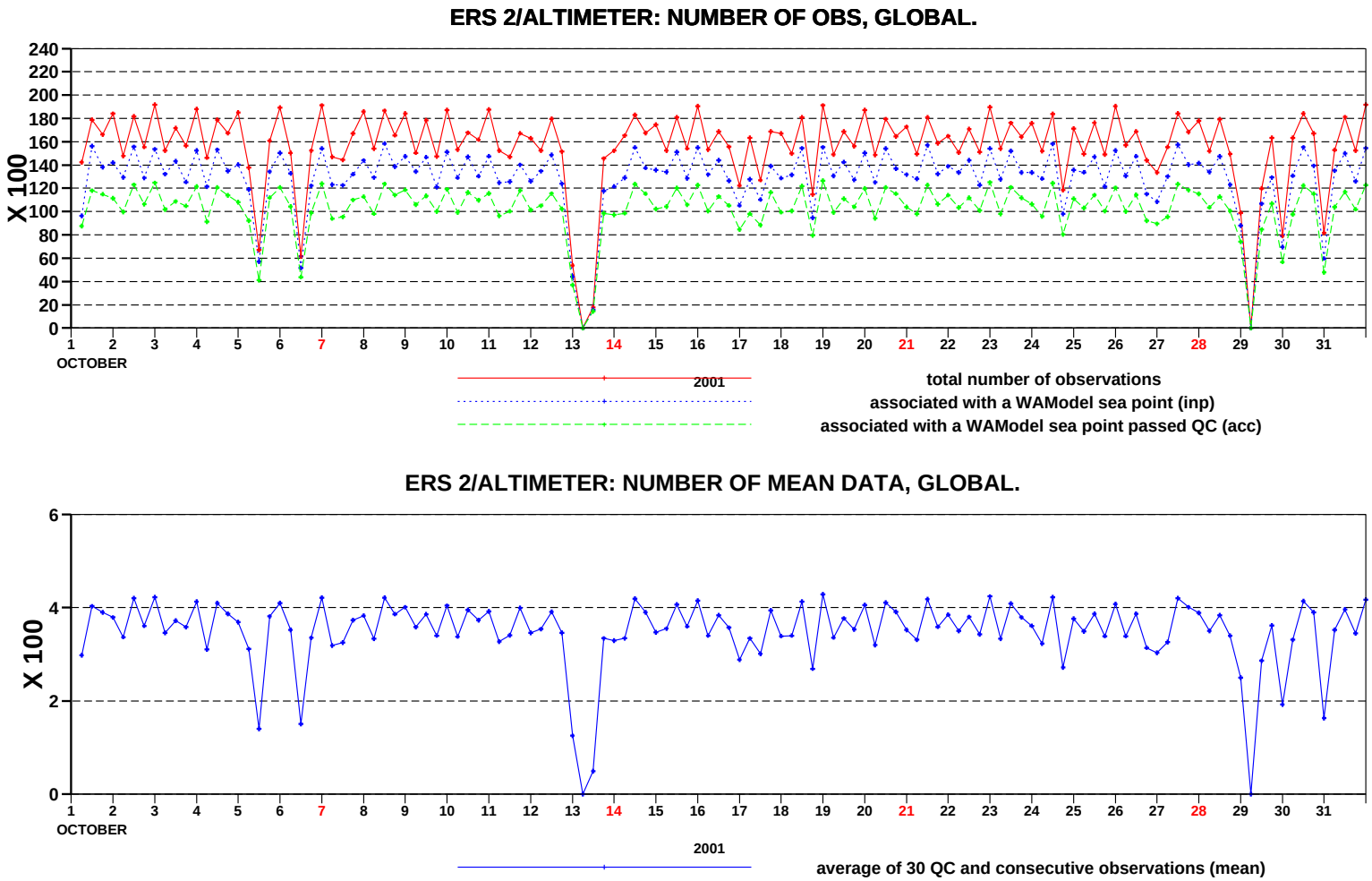


Figure 1: Time series of data reception for ERS-2 Altimeter data for October 2001

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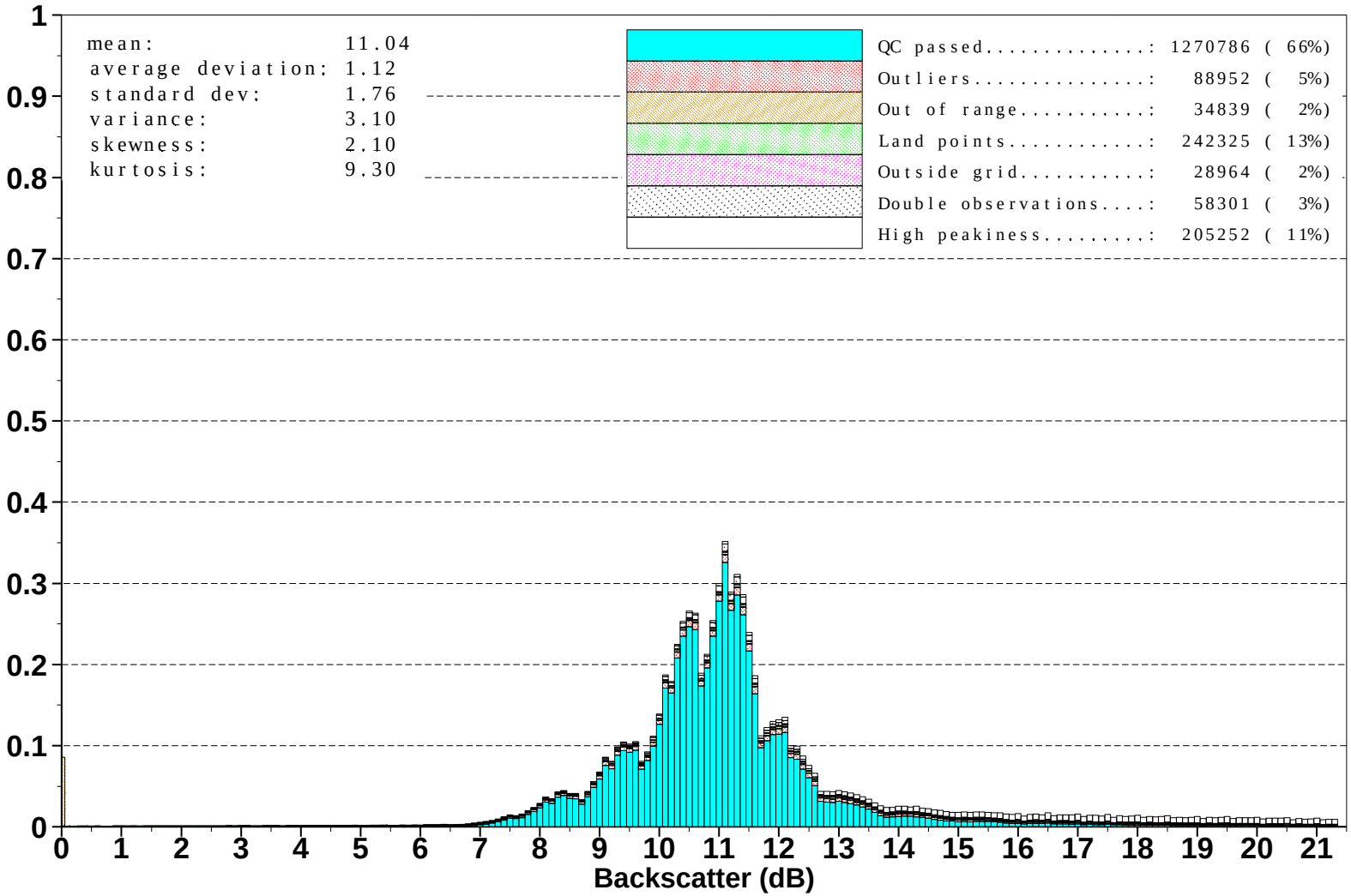


Figure 2: Distribution of the ERS-2 Altimeter backscatter after QC for October 2001

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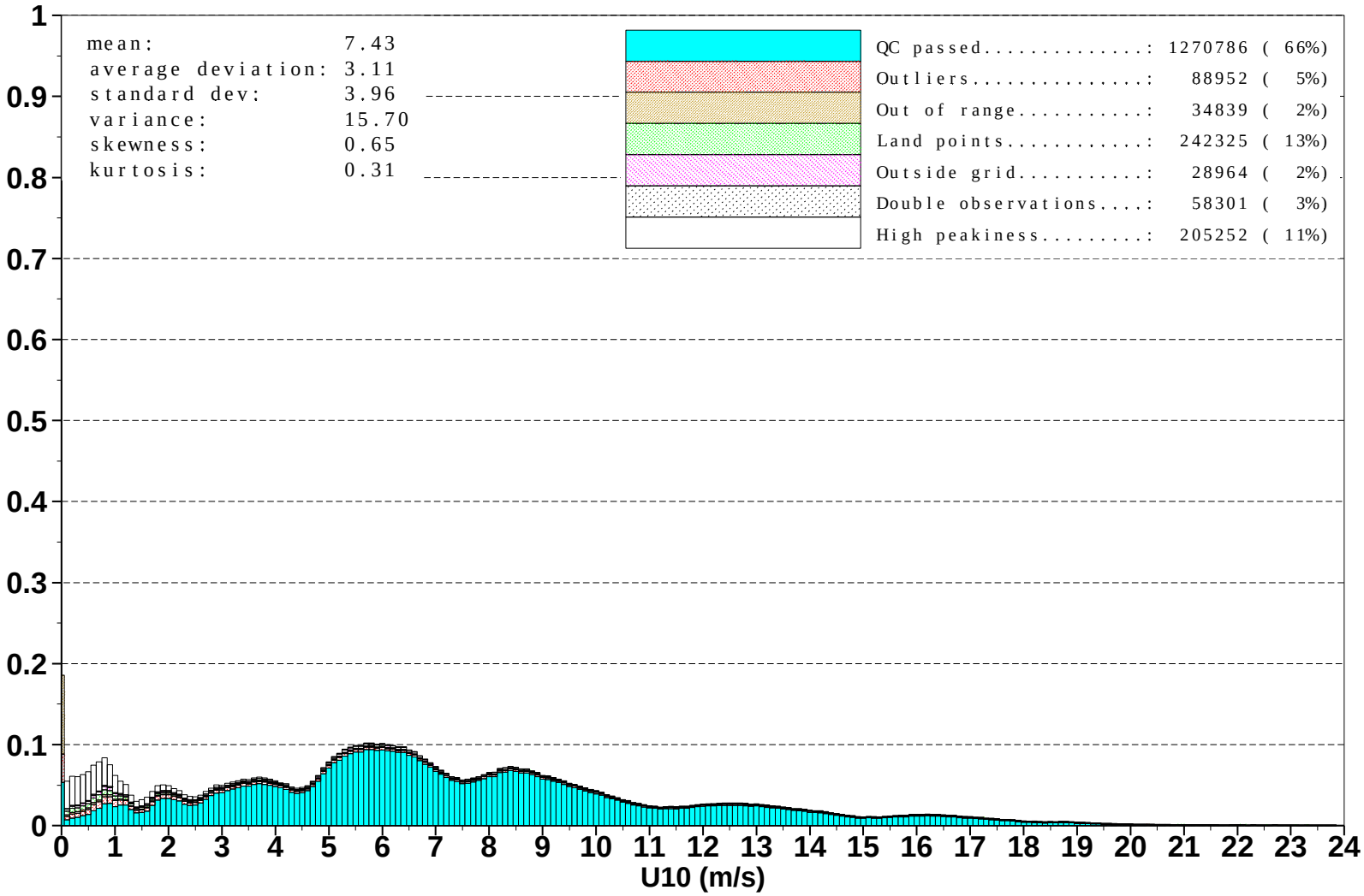


Figure 3: Distribution of the ERS-2 Altimeter wind speeds after QC for October 2001

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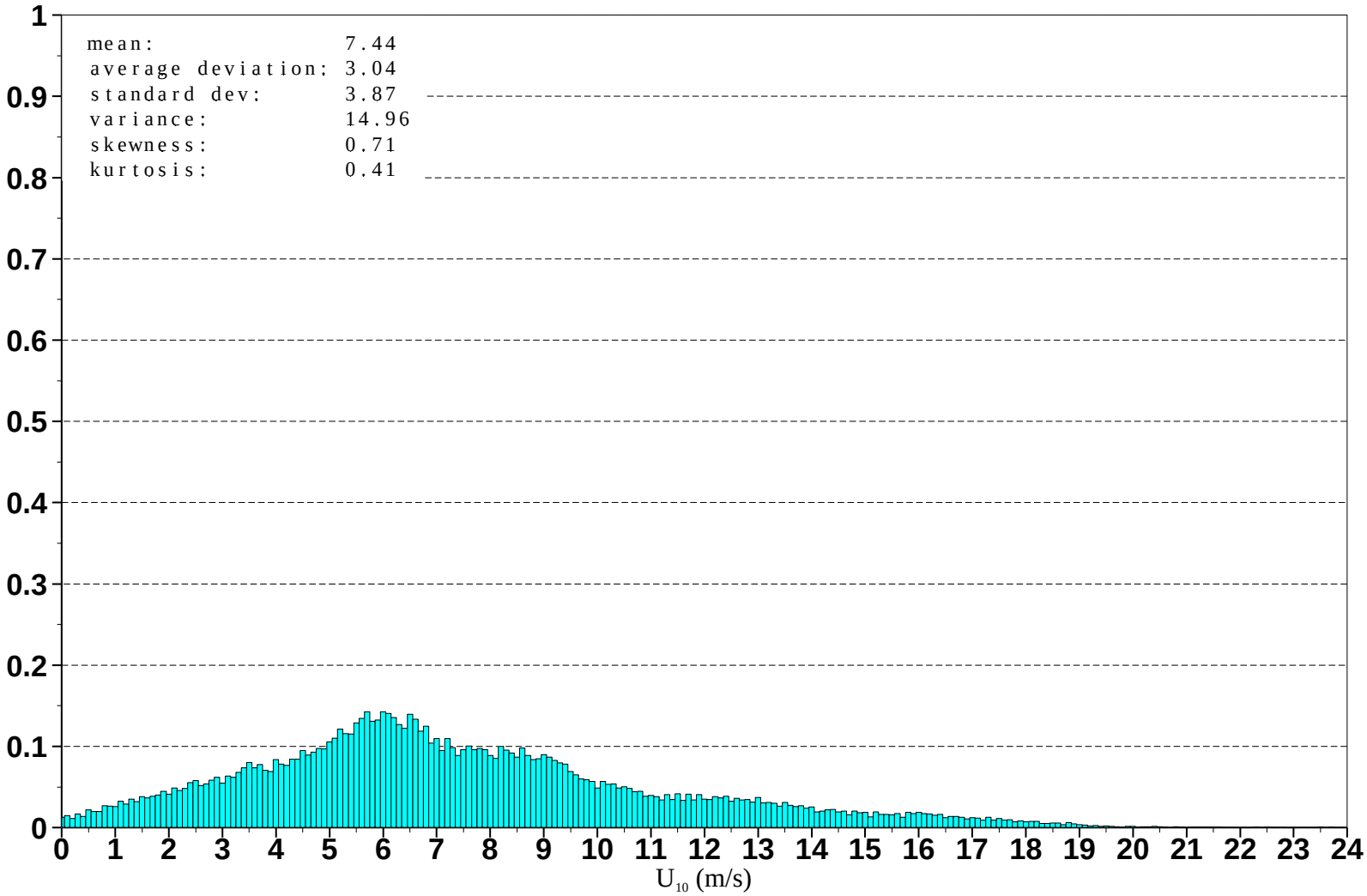


Figure 4: Distribution of ERS-2 Altimeter wind speeds after along track averaging for October 2001

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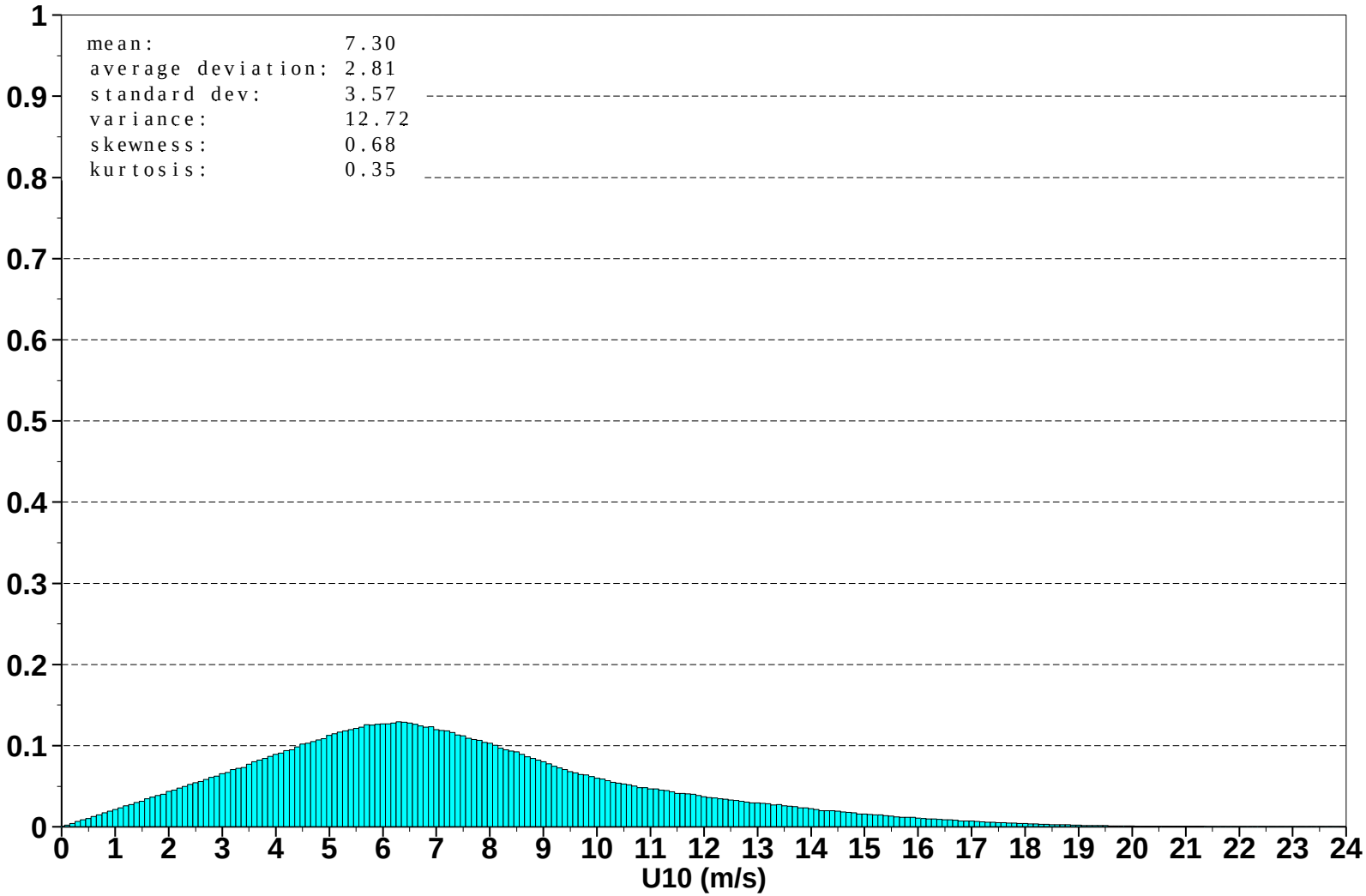
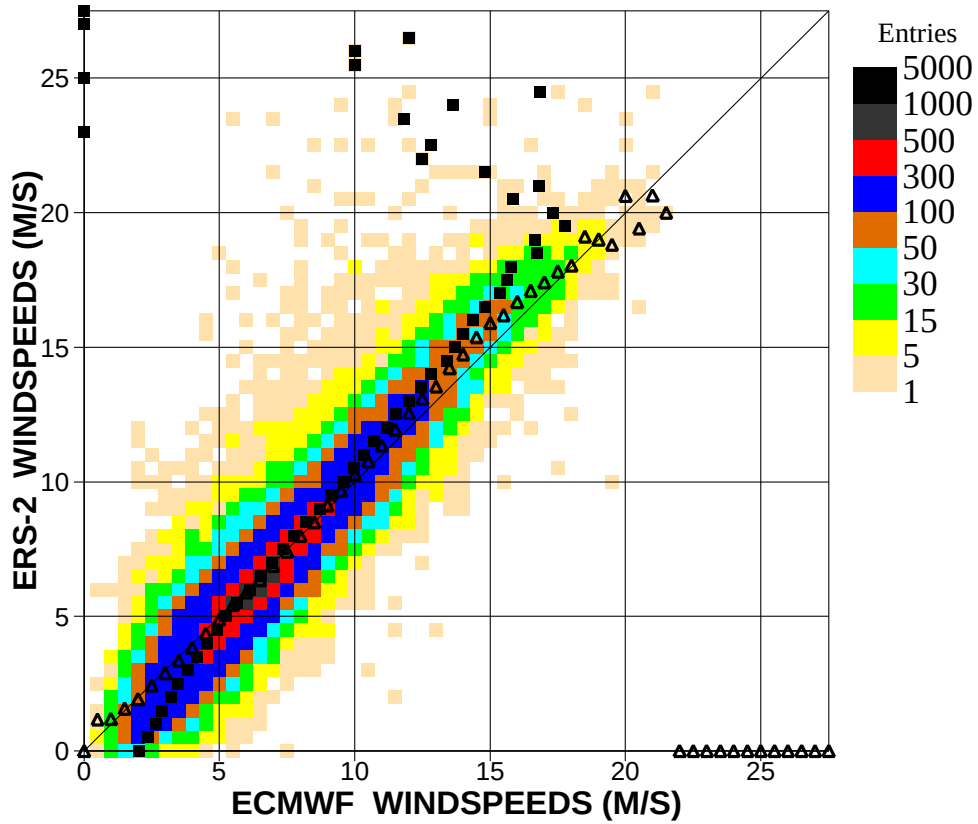


Figure 5: Global distribution of ECMWF ocean surface wind speeds for October 2001

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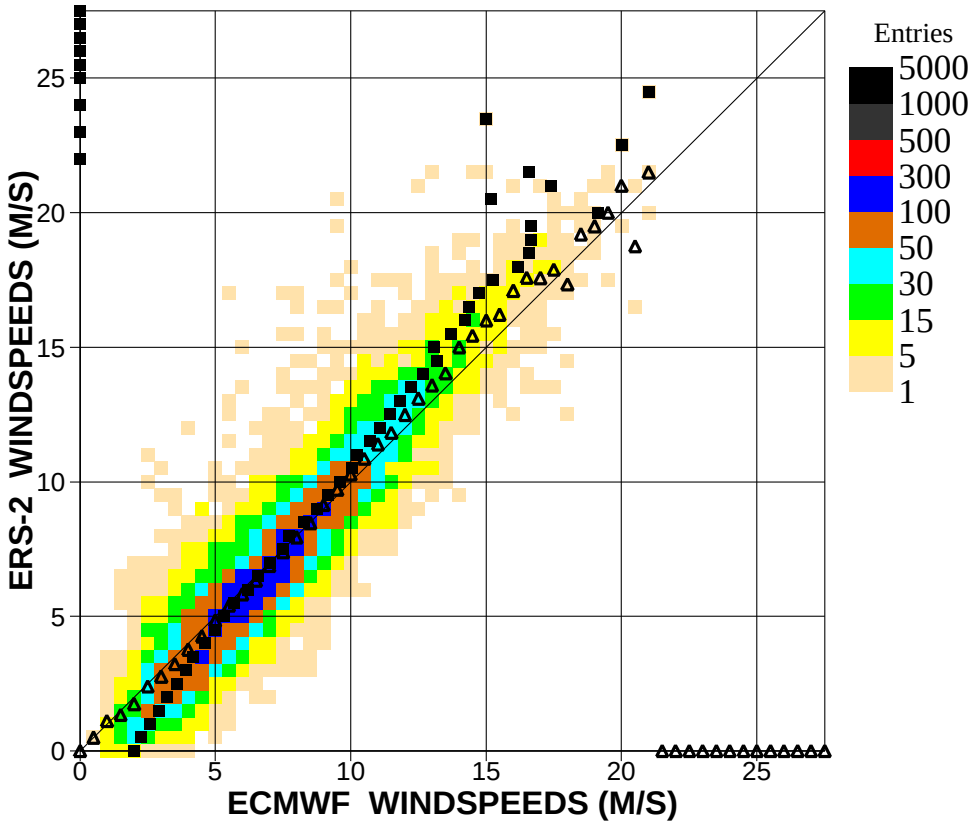
STATISTICS

ENTRIES	42886
MEAN ECMWF	7.3858
MEAN ERS-2	7.4376
BIAS (ERS-2 - ECMWF)	0.0518
STANDARD DEVIATION	1.4629
SCATTER INDEX	0.1981
CORRELATION	0.9276
SYMMETRIC SLOPE	1.0331(0.0021)
REGR. COEFFICIENT	1.0672(0.0021)
REGR. CONSTANT	-0.4446(0.0168)

Figure 6. Comparison of ECMWF wind speed results with ERS2 Altimeter wind speed data for October 2001 (global)

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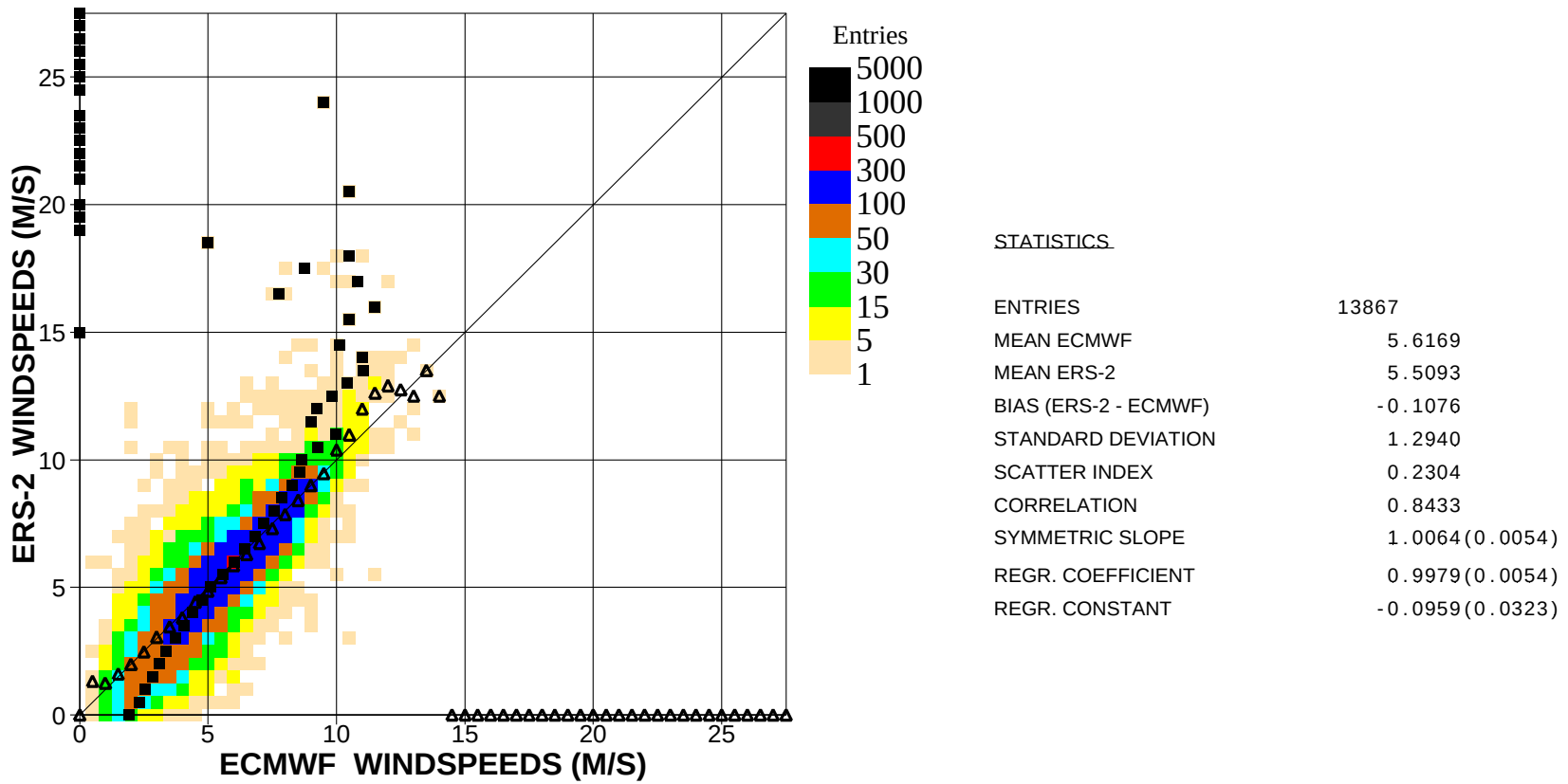
STATISTICS

ENTRIES	11807
MEAN ECMWF	7.3545
MEAN ERS-2	7.3695
BIAS (ERS-2 - ECMWF)	0.0150
STANDARD DEVIATION	1.4444
SCATTER INDEX	0.1964
CORRELATION	0.9260
SYMMETRIC SLOPE	1.0306(0.0041)
REGR. COEFFICIENT	1.0817(0.0041)
REGR. CONSTANT	-0.5857(0.0326)

Figure 7. Comparison of ECMWF wind speed results with ERS2 Altimeter wind speed data for October 2001 (n.hem.)

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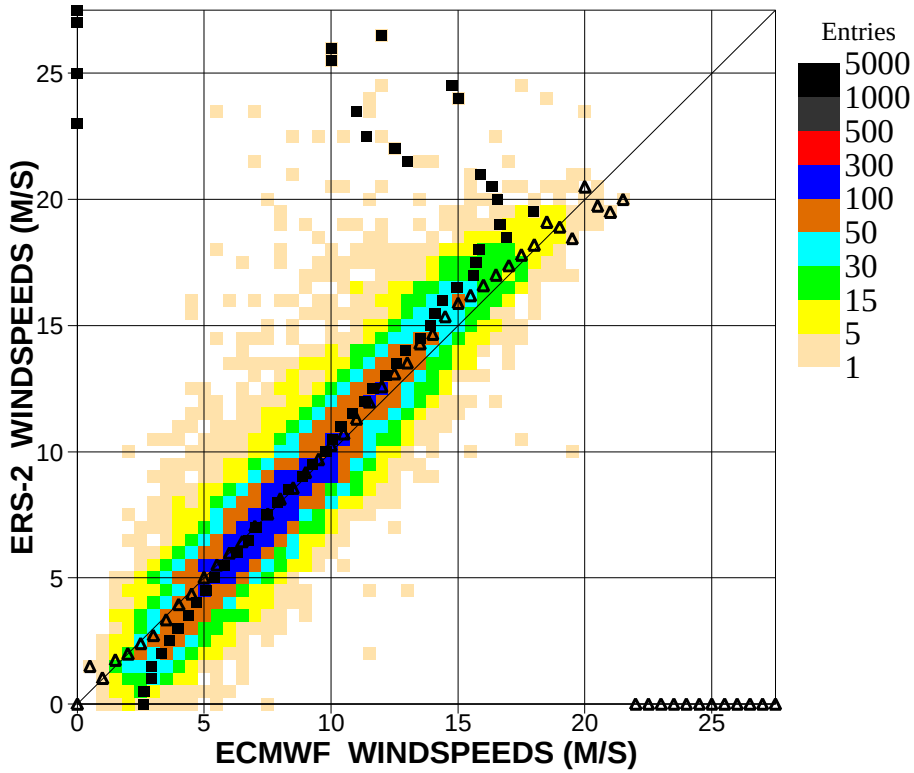
STATISTICS

ENTRIES	13867
MEAN ECMWF	5.6169
MEAN ERS-2	5.5093
BIAS (ERS-2 - ECMWF)	-0.1076
STANDARD DEVIATION	1.2940
SCATTER INDEX	0.2304
CORRELATION	0.8433
SYMMETRIC SLOPE	1.0064(0.0054)
REGR. COEFFICIENT	0.9979(0.0054)
REGR. CONSTANT	-0.0959(0.0323)

Figure 8. Comparison of ECMWF wind speed results with ERS2 Altimeter wind speed data for October 2001 (tropics)

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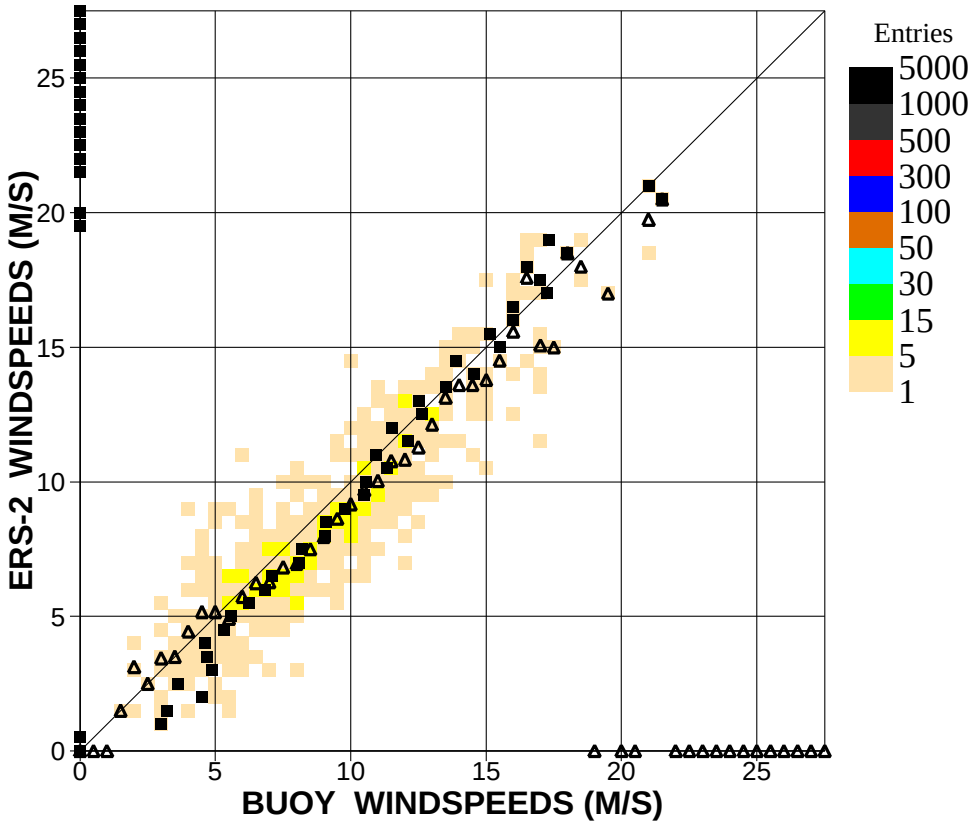


STATISTICS

ENTRIES	17574
MEAN ECMWF	8.7810
MEAN ERS-2	8.9793
BIAS (ERS-2 - ECMWF)	0.1983
STANDARD DEVIATION	1.5790
SCATTER INDEX	0.1798
CORRELATION	0.9269
SYMMETRIC SLOPE	1.0422(0.0033)
REGR. COEFFICIENT	1.0672(0.0033)
REGR. CONSTANT	-0.3917(0.0309)

Figure 9. Comparison of ECMWF wind speed results with ERS2 Altimeter wind speed data for October 2001 (s.hem.)

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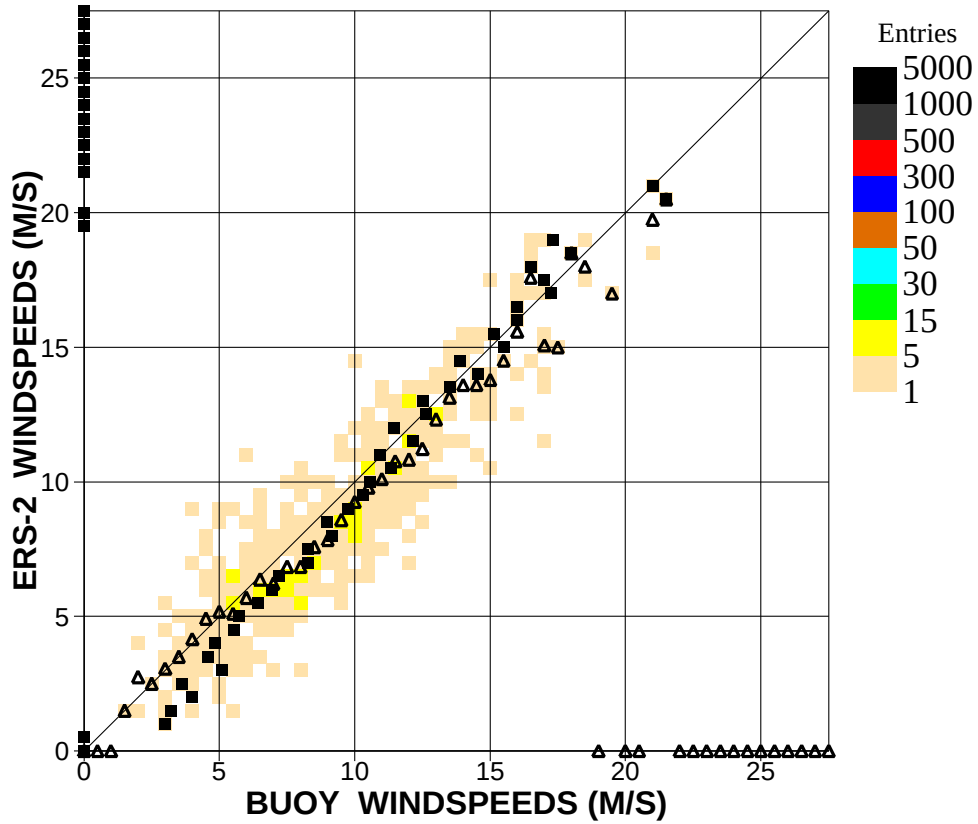


STATISTICS

ENTRIES	603	
MEAN BUOY	9.0937	
MEAN ERS-2	8.4337	
BIAS (ERS-2 - BUOY)	-0.6600	
STANDARD DEVIATION	1.5344	
SCATTER INDEX	0.1687	
CORRELATION	0.9030	
SYMMETRIC SLOPE	0.9391	(0.0179)
REGR. COEFFICIENT	0.9176	(0.0178)
REGR. CONSTANT	0.0892	(0.1732)

Figure 10. Comparison of buoy wind speed observations with ERS2 Altimeter wind speed data for October 2001 (global)

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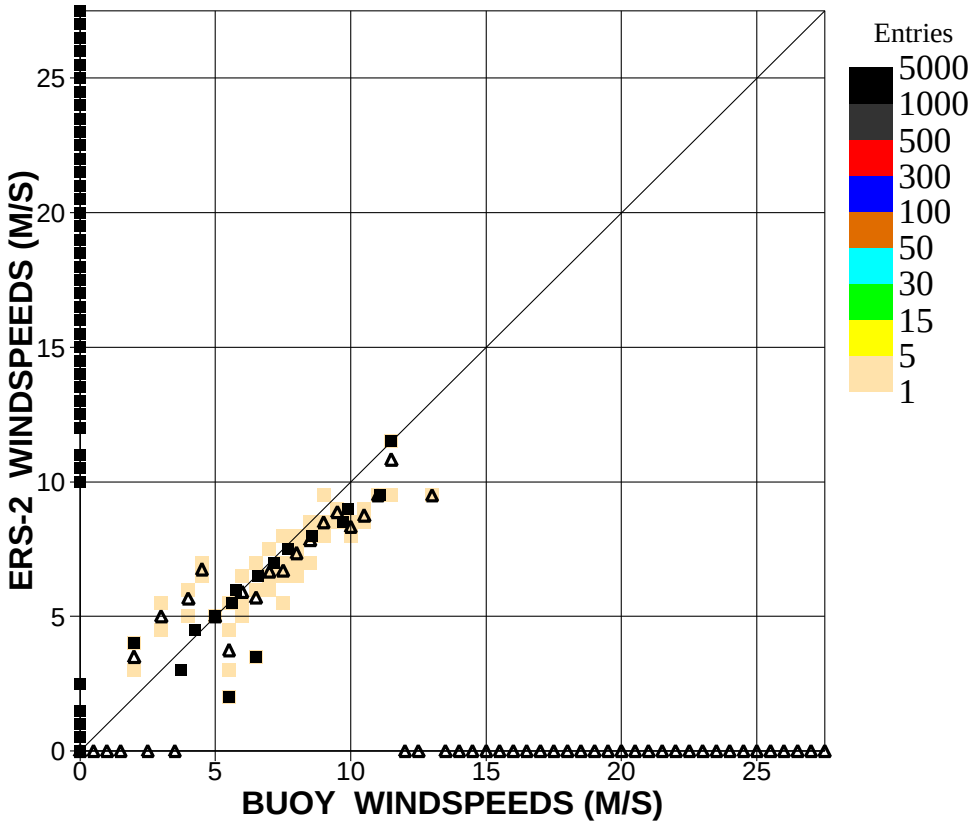


STATISTICS

ENTRIES	519	
MEAN BUOY	9.3086	
MEAN ERS-2	8.6426	
BIAS (ERS-2 - BUOY)	-0.6660	
STANDARD DEVIATION	1.5874	
SCATTER INDEX	0.1705	
CORRELATION	0.9040	
SYMMETRIC SLOPE	0.9419	(0.0194)
REGR. COEFFICIENT	0.9301	(0.0193)
REGR. CONSTANT	-0.0154	(0.1928)

Figure 11. Comparison of buoy wind speed observations with ERS2 Altimeter wind speed data for October 2001 (n.hem.)

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STATISTICS

ENTRIES	65	
MEAN BUOY	7.6131	
MEAN ERS-2	7.0708	
BIAS (ERS-2 - BUOY)	-0.5423	
STANDARD DEVIATION	1.2766	
SCATTER INDEX	0.1677	
CORRELATION	0.8544	
SYMMETRIC SLOPE	0.9176	(0.0603)
REGR. COEFFICIENT	0.6828	(0.0523)
REGR. CONSTANT	1.8729	(0.4180)

Figure 12. Comparison of buoy wind speed observations with ERS2 Altimeter wind speed data for October 2001 (hawaii)

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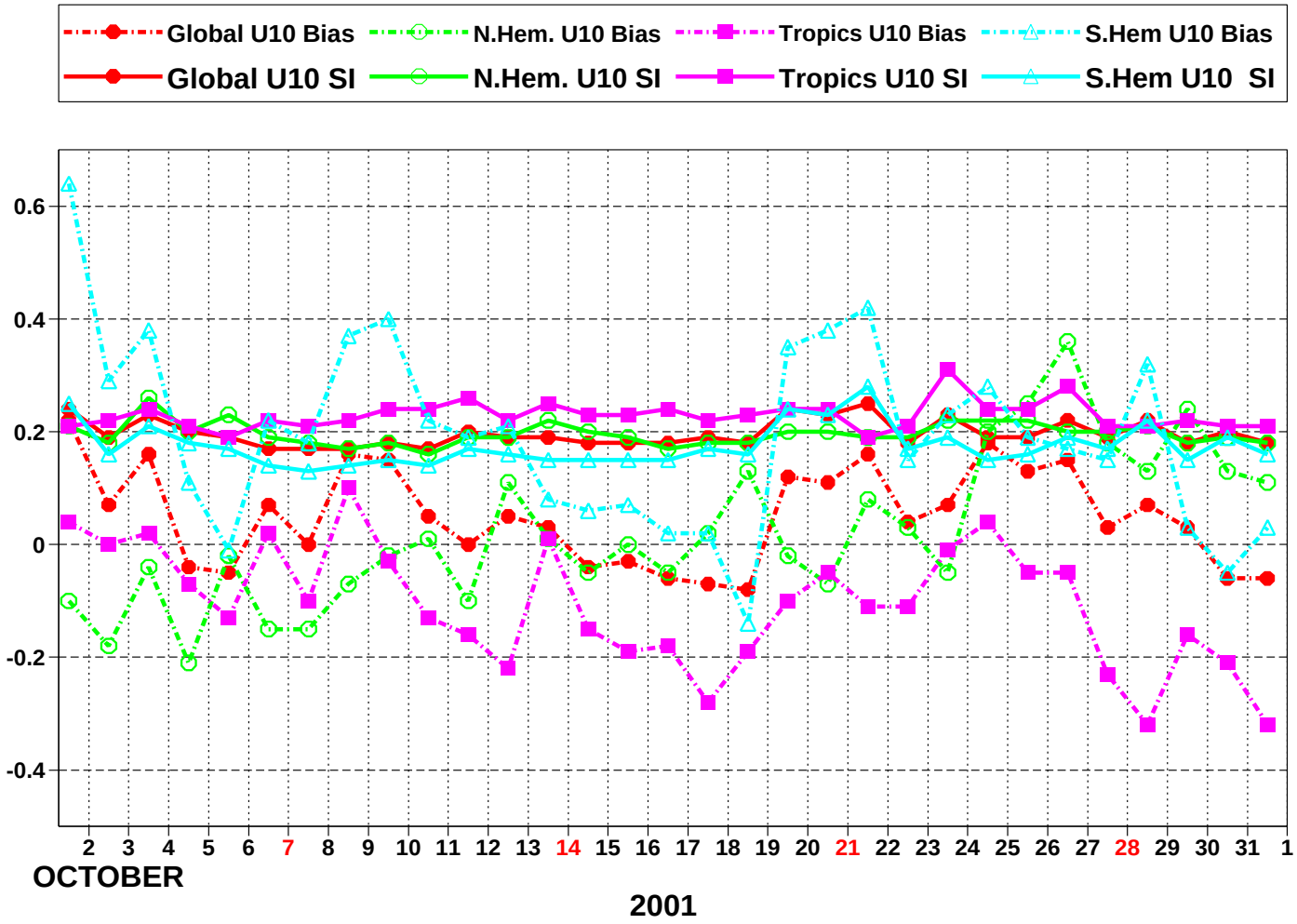


Figure 13: ERS-2 Altimeter wind speeds: Timeseries of bias (ERS-2 - model) and scatter index (SI)

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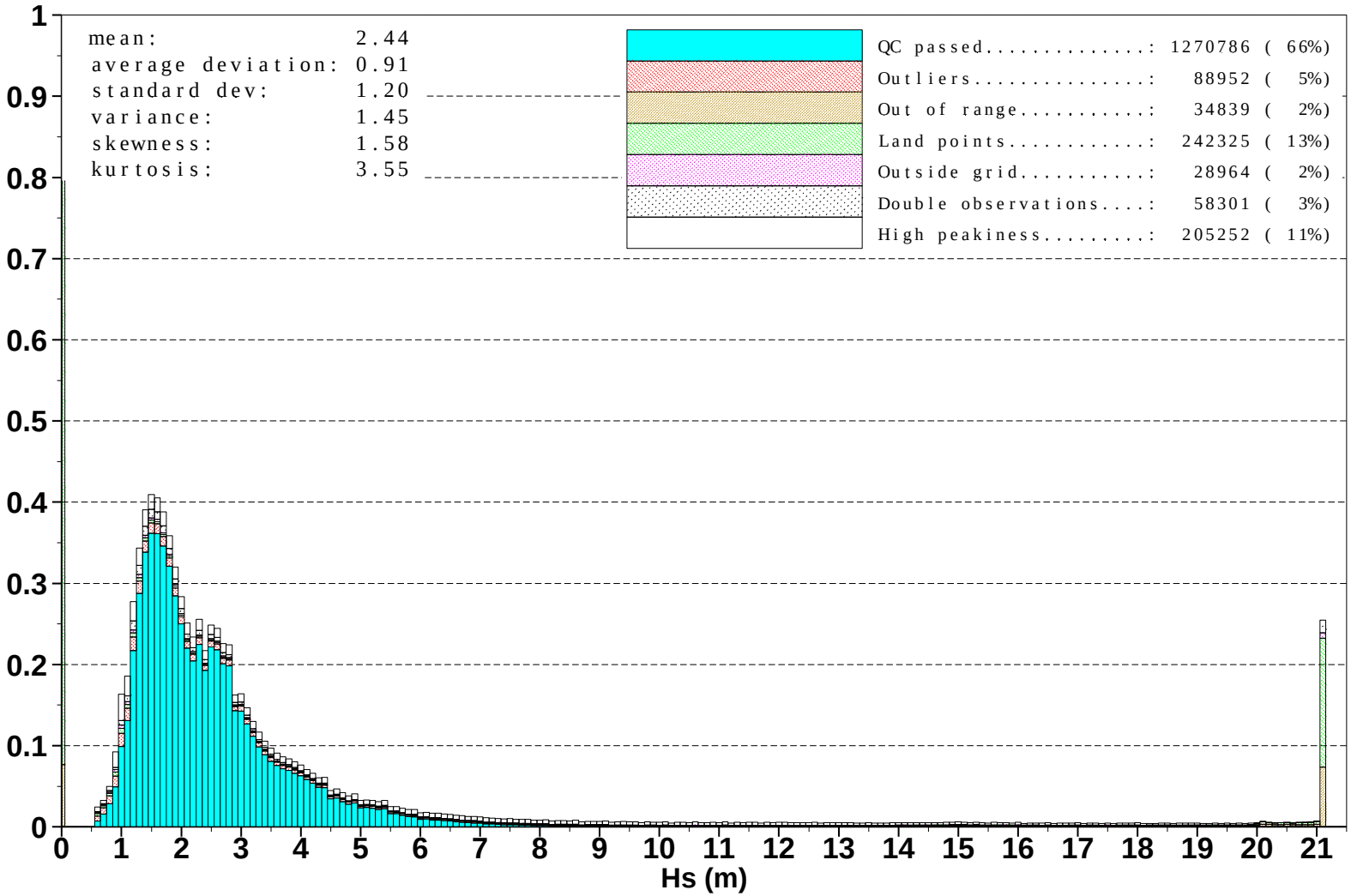


Figure 14: Distribution of the ERS-2 Altimeter wave heights after QC for October 2001

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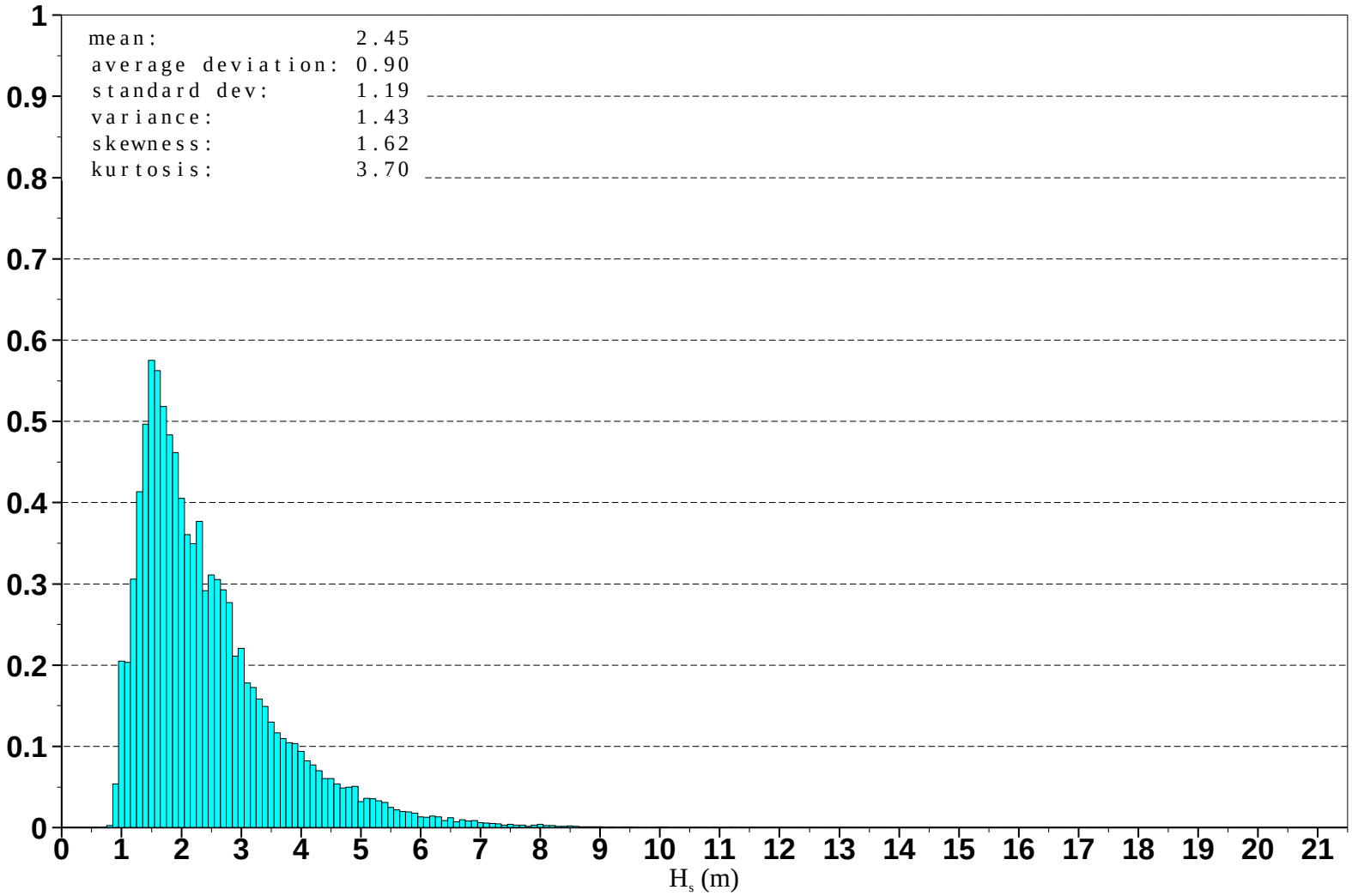


Figure 15: Distribution of ERS-2 Altimeter wave heights after along track averaging for October 2001

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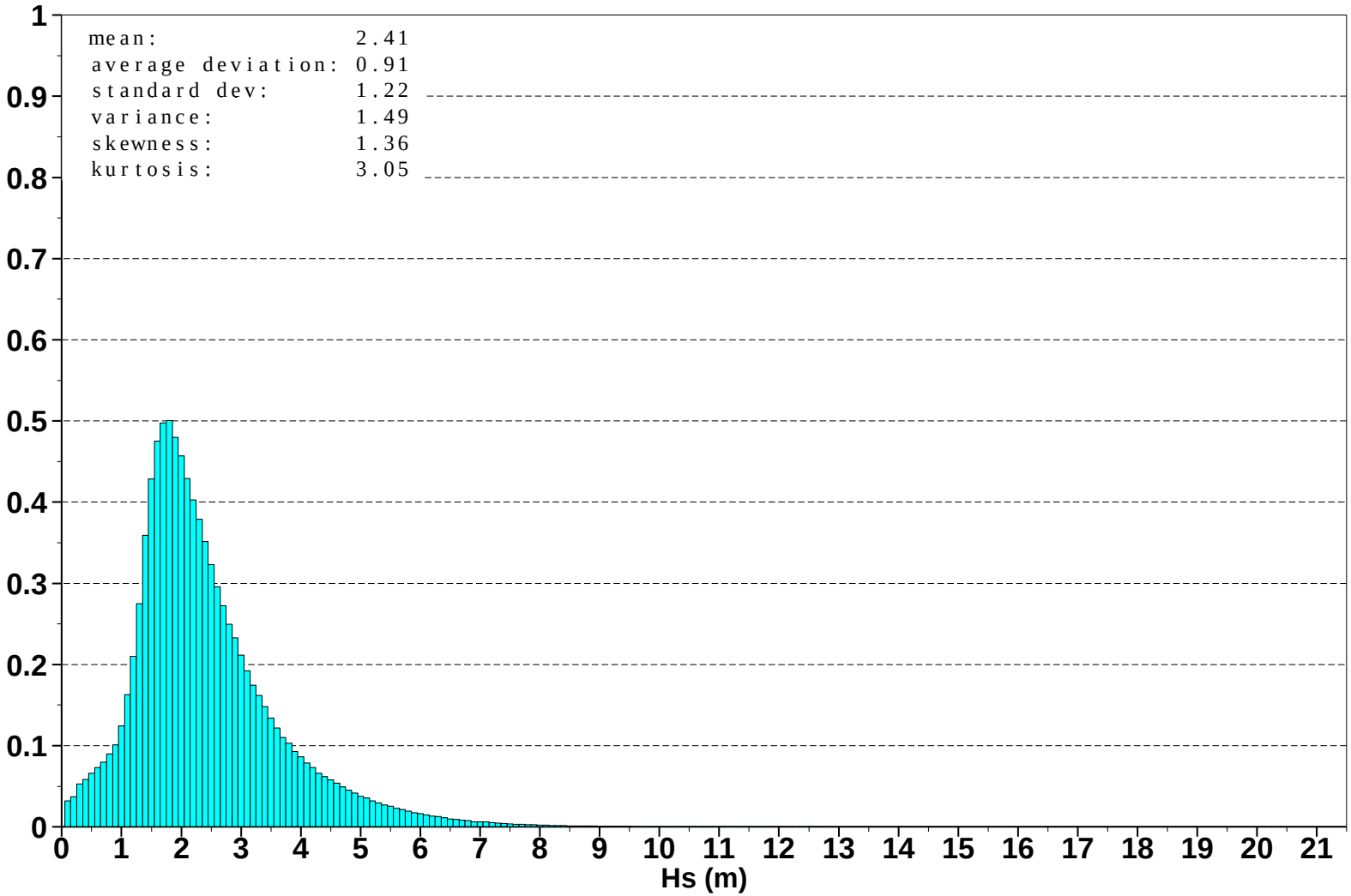
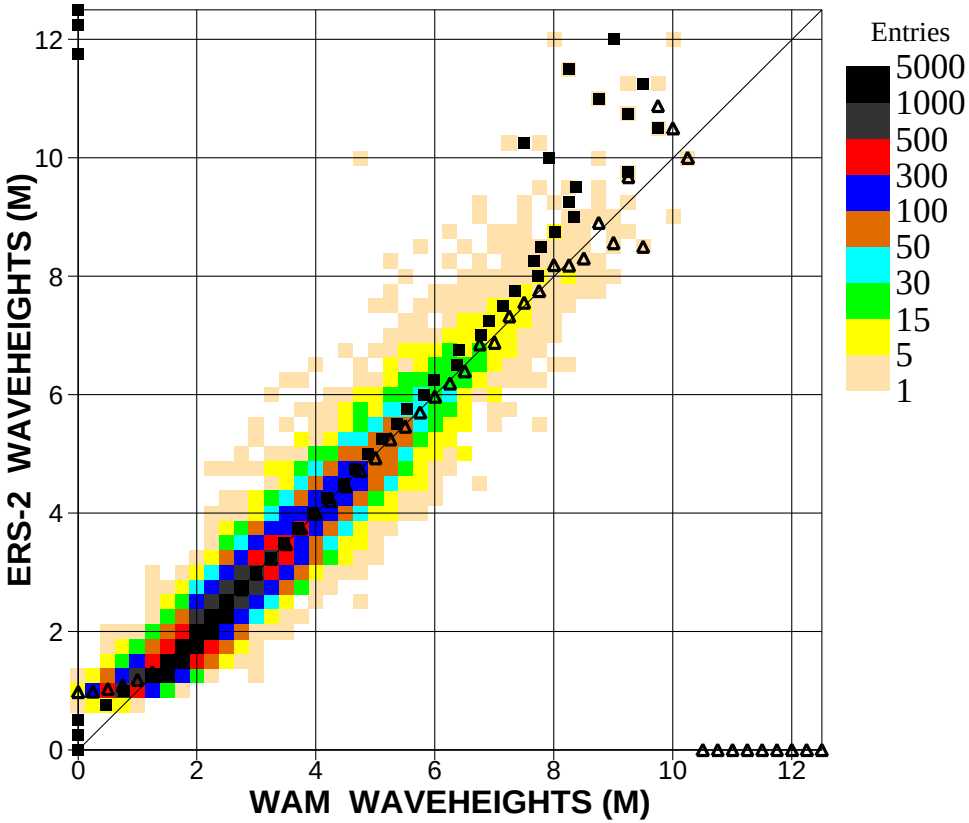


Figure 16: Global distribution of ECMWF wave heights for October 2001

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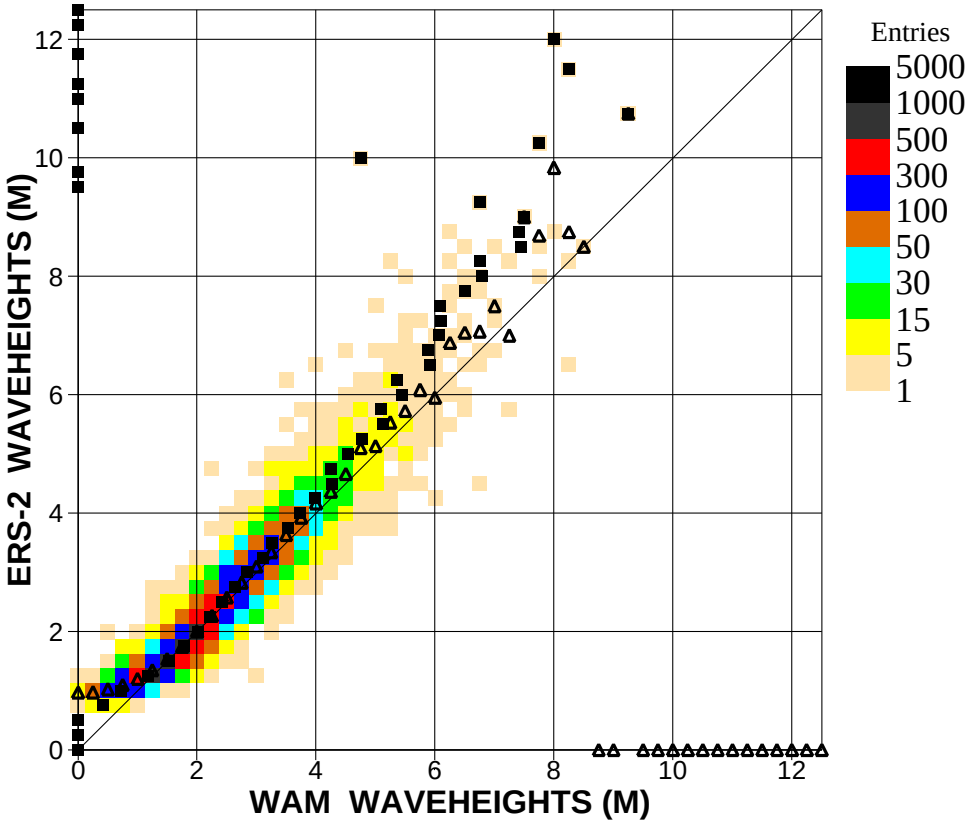


STATISTICS

ENTRIES	42886
MEAN WAM	2.4687
MEAN ERS-2	2.4483
BIAS (ERS-2 - WAM)	-0.0203
STANDARD DEVIATION	0.3079
SCATTER INDEX	0.1247
CORRELATION	0.9664
SYMMETRIC SLOPE	0.9958(0.0013)
REGR. COEFFICIENT	0.9791(0.0013)
REGR. CONSTANT	0.0313(0.0034)

Figure 17. Comparison of ECMWF wave height results with ERS2 Altimeter wave height data for October 2001 (global)

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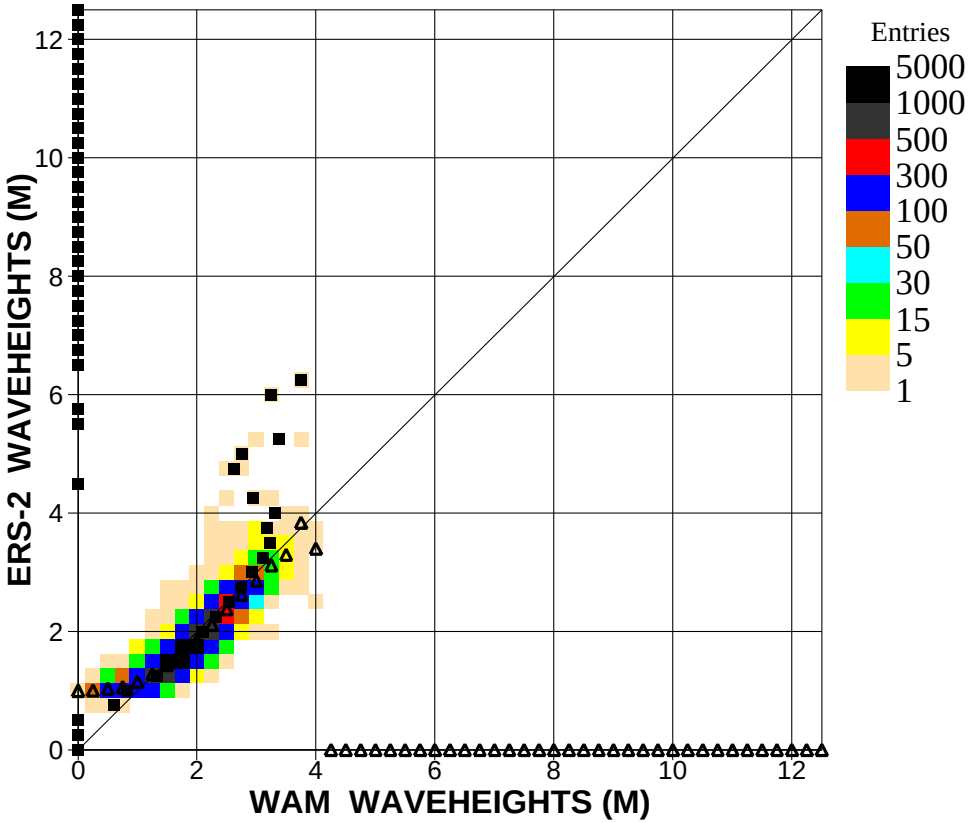


STATISTICS

ENTRIES	11807
MEAN WAM	2.1936
MEAN ERS-2	2.2886
BIAS (ERS-2 - WAM)	0.0950
STANDARD DEVIATION	0.3346
SCATTER INDEX	0.1525
CORRELATION	0.9495
SYMMETRIC SLOPE	1.0438(0.0031)
REGR. COEFFICIENT	0.9936(0.0030)
REGR. CONSTANT	0.1091(0.0073)

Figure 18. Comparison of ECMWF wave height results with ERS2 Altimeter wave height data for October 2001 (n.hem.)

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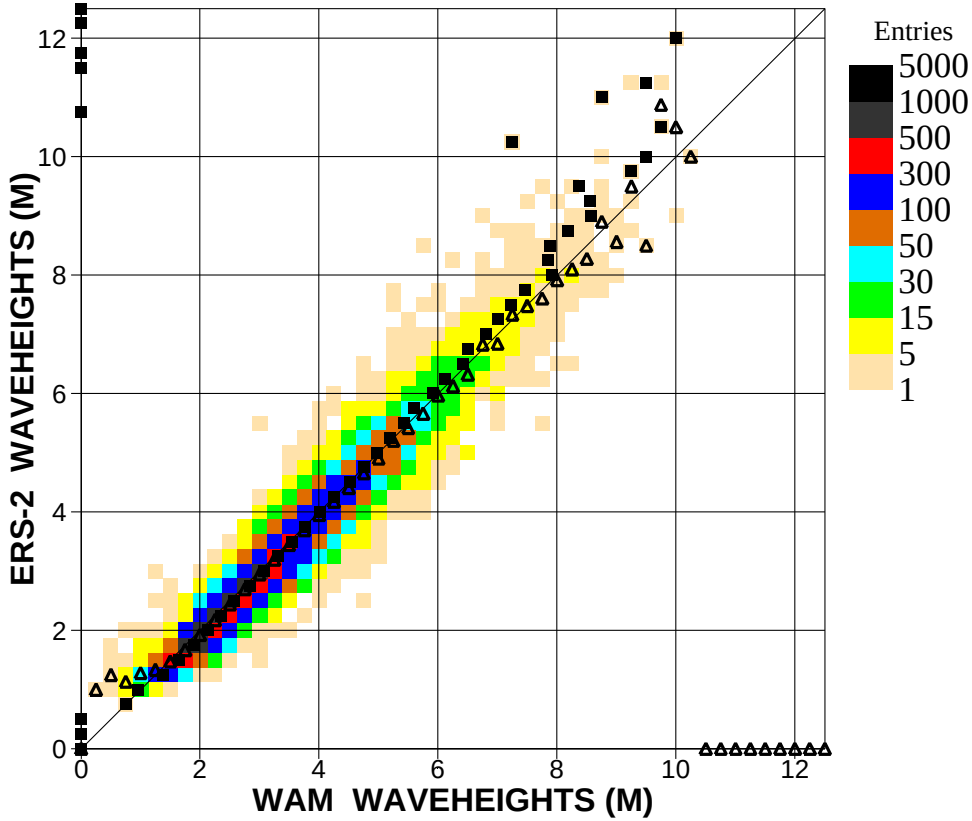


STATISTICS

ENTRIES	13867
MEAN WAM	1.8197
MEAN ERS-2	1.7492
BIAS (ERS-2 - WAM)	-0.0705
STANDARD DEVIATION	0.2235
SCATTER INDEX	0.1228
CORRELATION	0.9080
SYMMETRIC SLOPE	0.9578(0.0034)
REGR. COEFFICIENT	0.8318(0.0033)
REGR. CONSTANT	0.2355(0.0062)

Figure 19. Comparison of ECMWF wave height results with ERS2 Altimeter wave height data for October 2001 (tropics)

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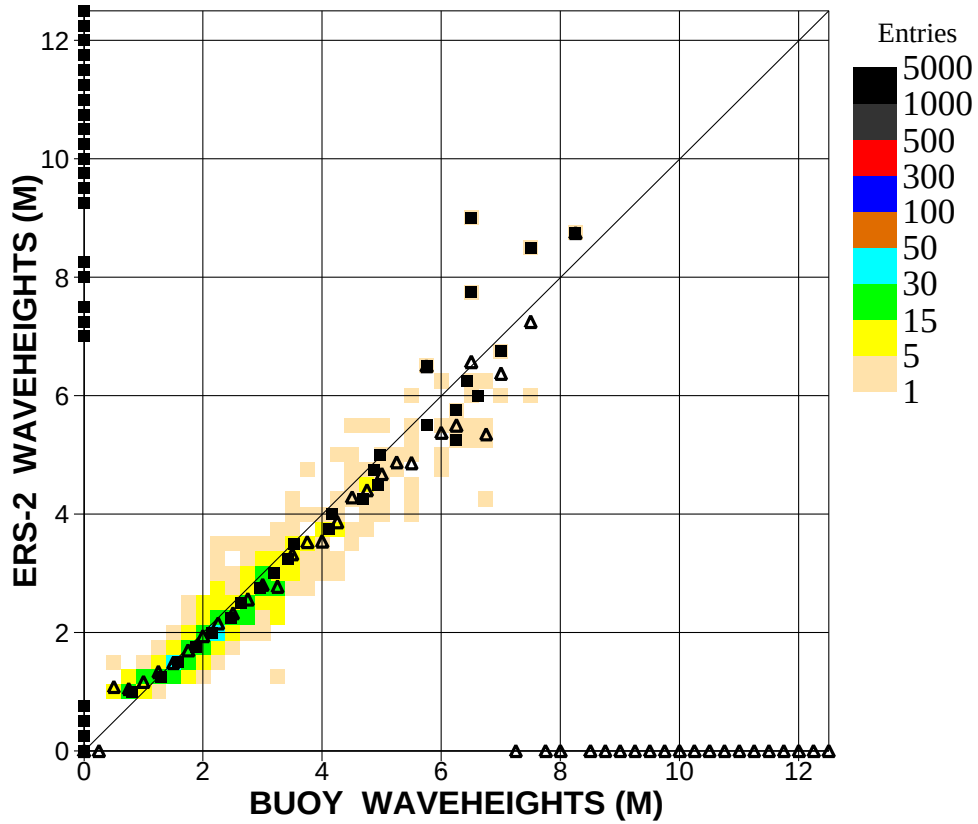


STATISTICS

ENTRIES	17574
MEAN WAM	3.1555
MEAN ERS-2	3.0971
BIAS (ERS-2 - WAM)	-0.0584
STANDARD DEVIATION	0.3246
SCATTER INDEX	0.1029
CORRELATION	0.9689
SYMMETRIC SLOPE	0.9881(0.0019)
REGR. COEFFICIENT	0.9953(0.0019)
REGR. CONSTANT	-0.0437(0.0065)

Figure 20. Comparison of ECMWF wave height results with ERS2 Altimeter wave height data for October 2001 (s.hem.)

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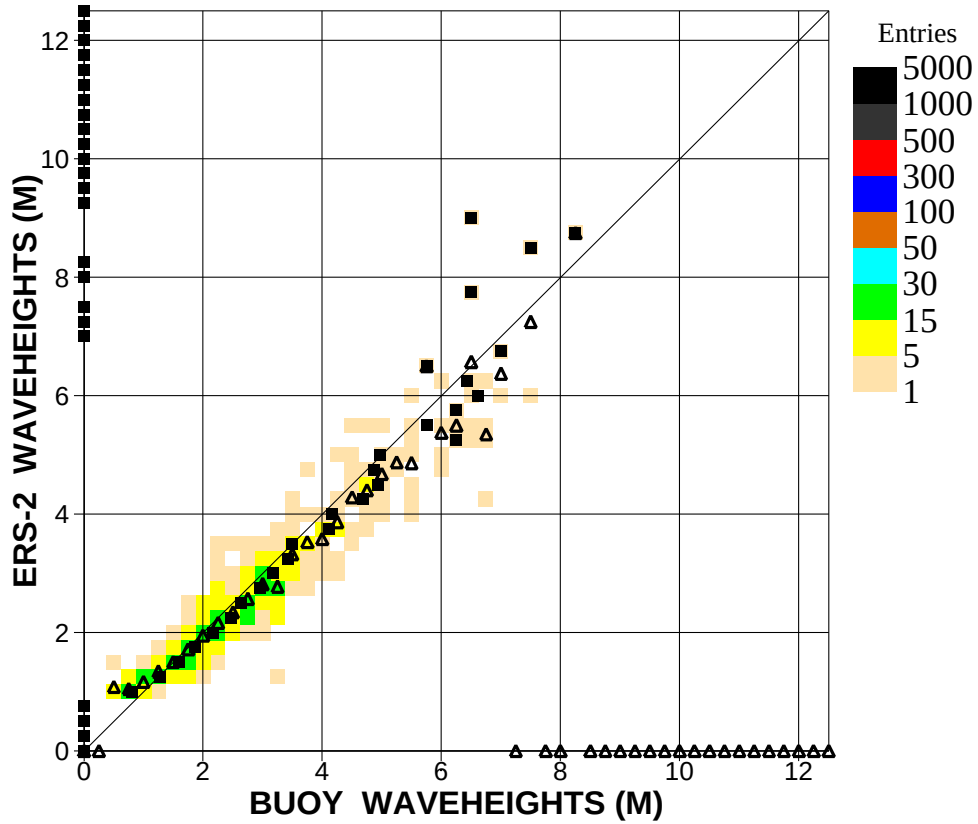


STATISTICS

ENTRIES	769	
MEAN BUOY	2.6211	
MEAN ERS-2	2.4862	
BIAS (ERS-2 - BUOY)	-0.1349	
STANDARD DEVIATION	0.4051	
SCATTER INDEX	0.1546	
CORRELATION	0.9499	
SYMMETRIC SLOPE	0.9411	(0.0107)
REGR. COEFFICIENT	0.8641	(0.0103)
REGR. CONSTANT	0.2214	(0.0300)

Figure 21. Comparison of buoy wave height observations with ERS2 Altimeter wave height data for October 2001 (global)

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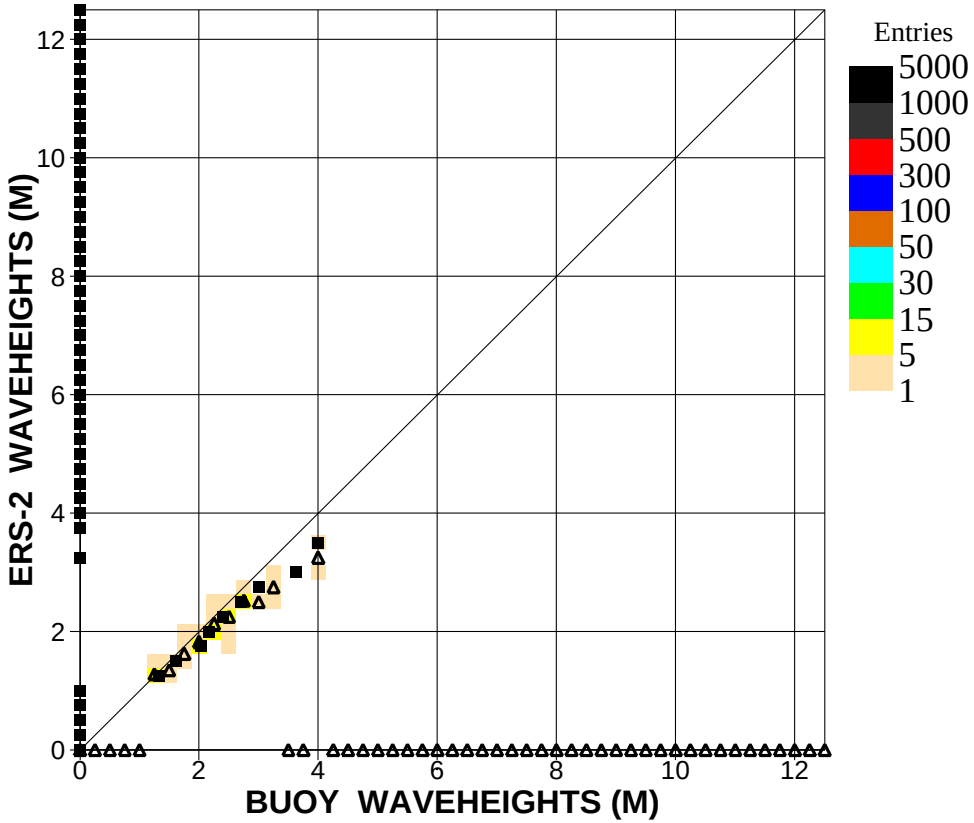


STATISTICS

ENTRIES	679	
MEAN BUOY	2.6861	
MEAN ERS-2	2.5522	
BIAS (ERS-2 - BUOY)	-0.1339	
STANDARD DEVIATION	0.4233	
SCATTER INDEX	0.1576	
CORRELATION	0.9492	
SYMMETRIC SLOPE	0.9424	(0.0114)
REGR. COEFFICIENT	0.8642	(0.0110)
REGR. CONSTANT	0.2309	(0.0330)

Figure 22. Comparison of buoy wave height observations with ERS2 Altimeter wave height data for October 2001 (n.hem.)

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STATISTICS

ENTRIES	70	
MEAN BUOY	2.2275	
MEAN ERS-2	2.0529	
BIAS (ERS-2 - BUOY)	-0.1746	
STANDARD DEVIATION	0.2270	
SCATTER INDEX	0.1019	
CORRELATION	0.9486	
SYMMETRIC SLOPE	0.9121	(0.0365)
REGR. COEFFICIENT	0.7448	(0.0301)
REGR. CONSTANT	0.3939	(0.0697)

Figure 23. Comparison of buoy wave height observations with ERS2 Altimeter wave height data for October 2001 (hawaii)

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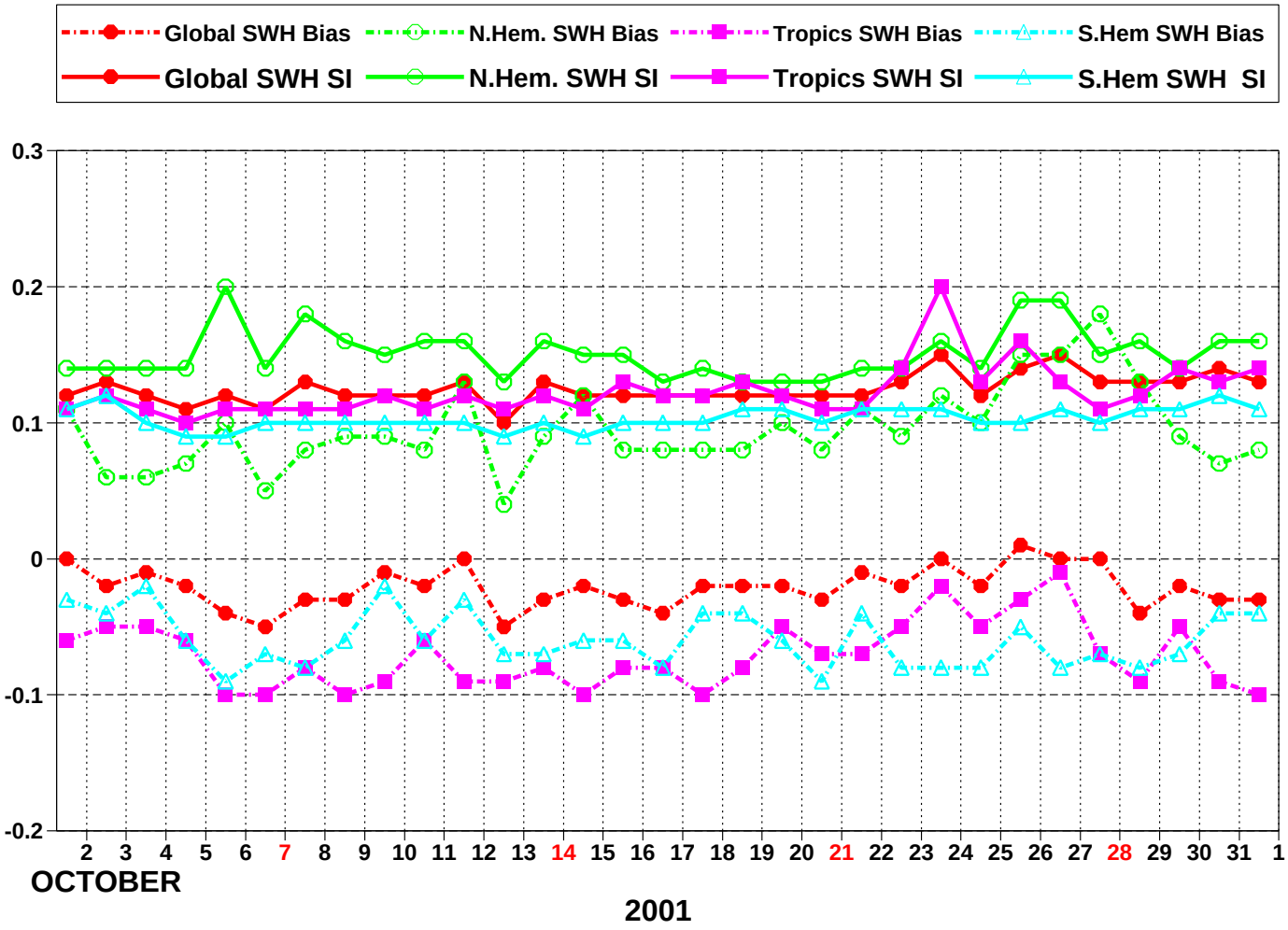


Figure 24: ERS-2 Altimeter wave heights: Timeseries of bias (ERS-2 - model) and scatter index (SI)

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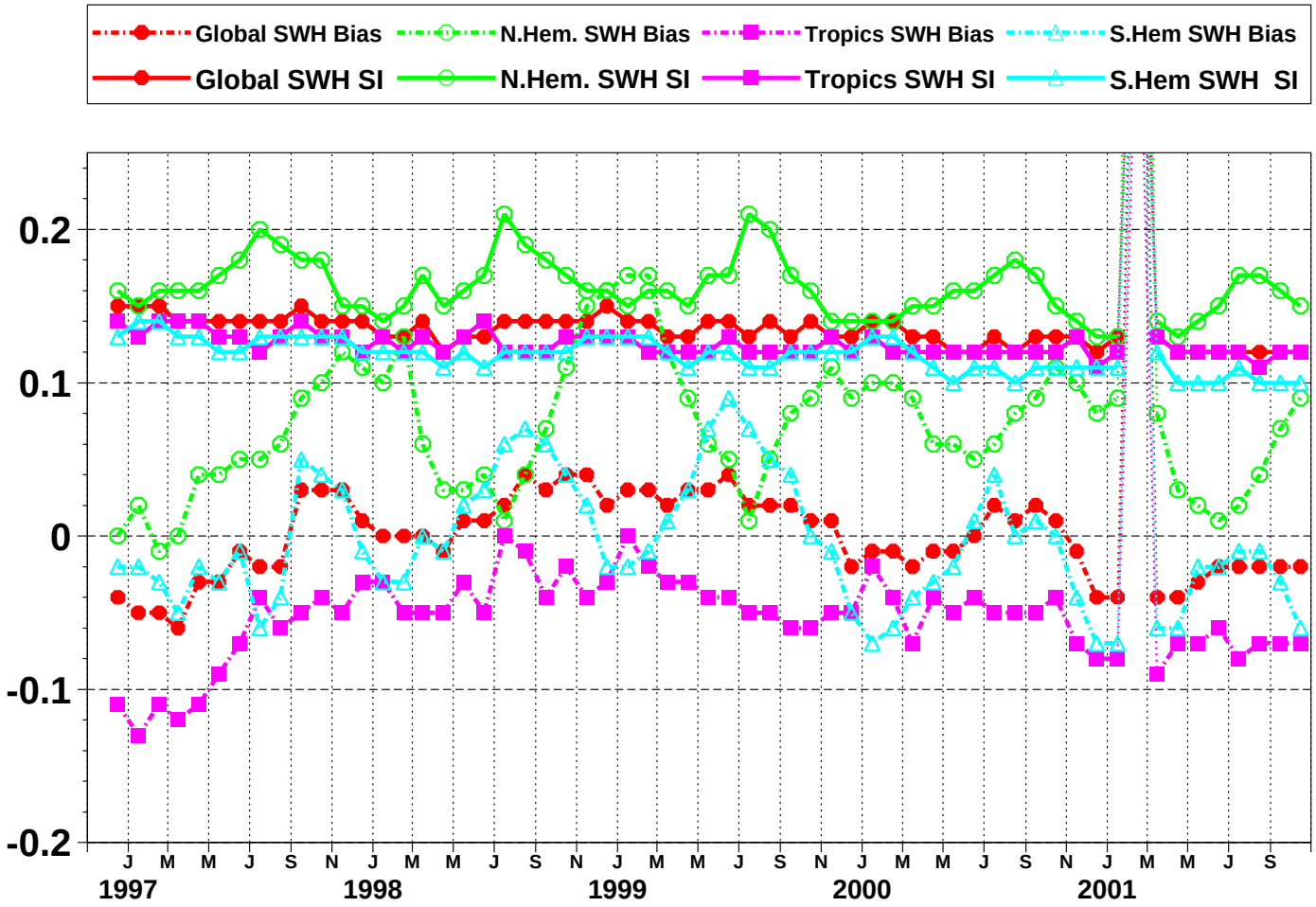


Figure 25: ERS-2 Altimeter wave heights: Timeseries of bias (ERS-2 - model) and scatter index (SI)

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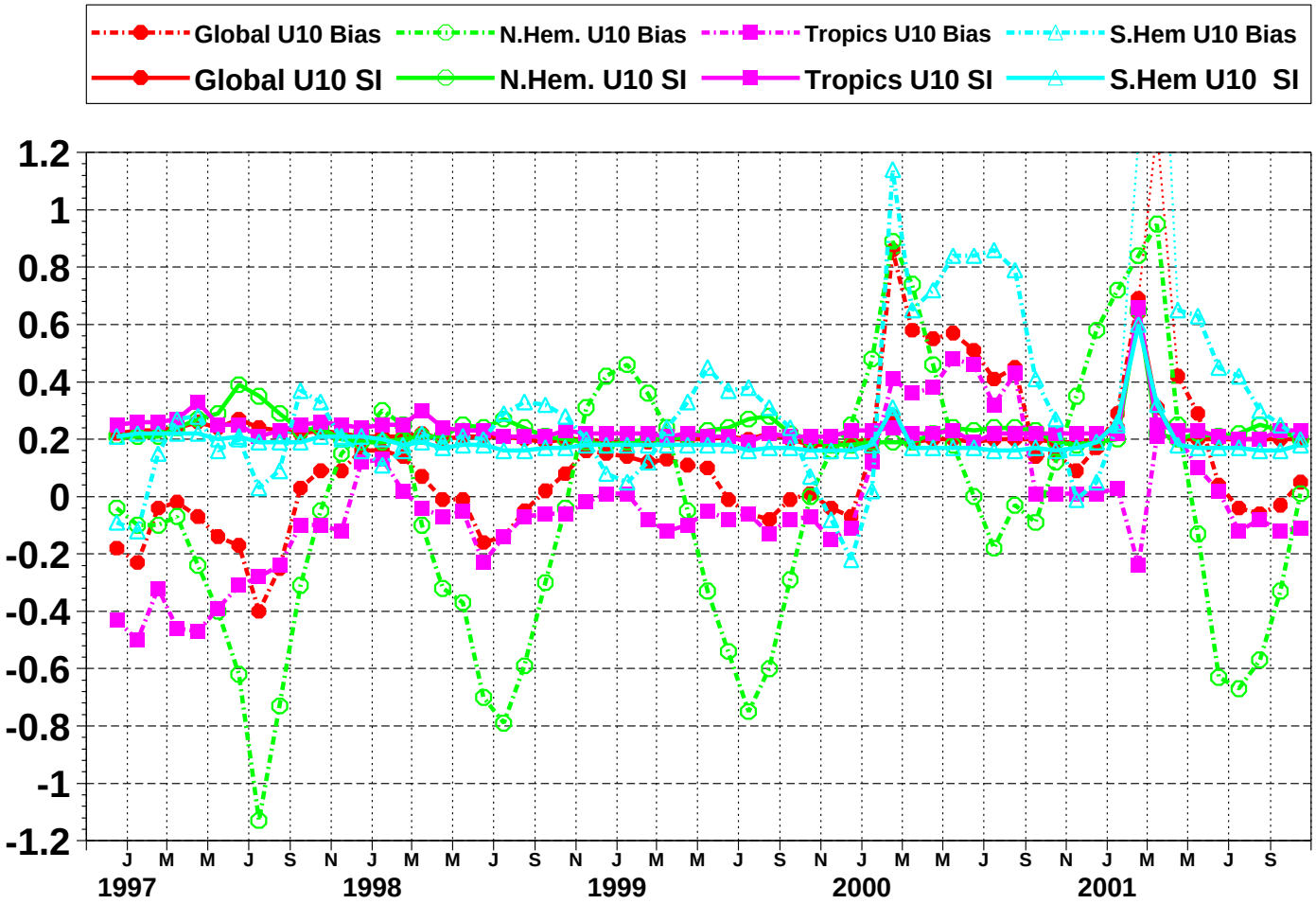


Figure 26: ERS-2 Altimeter wind speeds: Timeseries of bias (ERS-2 - model) and scatter index (SI)

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