ECMWF Report on ERS-2 RA for June 2000

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

By: Jean Bidlot

Date: 5 July 2000

Overview:

This month around 13550 observations arrived at ECMWF every 6 hours of which 77.7% passed the quality control. Data coverage was substantially reduced in one 6 hour time windows and no data were reported for the 17th 6UT and after 30th 6 UT (see figure 1). Note that we are talking about data which have arrived at ECMWF before they were needed for the operational data assimilation.

Backscatter:

ESR-2 $<\sigma_0>$ = 11.1dB (one broad peak around 11.1dB)

Wind Speed Comparison with ECMWF wind speeds (bias):

ERS-2 global: 0.509 m/s

ERS-2 northern hemisphere: -0.001 m/s

ERS-2 tropics: 0.459 m/s

ERS-2 southern hemisphere: 0.842m/s

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Wind Speed Comparison with buoy wind speeds (bias):

ERS-2 global: -0.22 m/s

ERS-2 northern hemisphere: -0.19 m/s

ERS-2 tropics: -0.43 m/s

Wave Height Comparison with ECMWF wave heights (bias):

ERS-2 global: 0.005 m (lowest waves measured: 0.6m)

ERS-2 northern hemisphere: 0.045 m

ERS-2 tropics: -0.040 m

ERS-2 southern hemisphere: 0.014 m

Wave Height Comparison with buoy wave heights (bias):

ERS-2 global: -0.01 m

ERS-2 northern hemisphere: -0.00 m

ERS-2 tropics: -0.14m

Remarks:

The wind speeds are still quite biases as can be seen in figures 13 and 26.

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

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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.

Figure captions:

Figure 1: Time series of data reception for ERS-2 Altimeter data for June 2000.

Figure 2: Distribution of the ERS-2 Altimeter Backscatter after QC for June 2000.

Figure 3: Distribution of the ERS-2 Altimeter wind speeds after QC for June 2000.

Figure 4: Distribution of the ERS-2 Altimeter wind speeds after along track averaging for June 2000.

Figure 5: Global distribution of ECMWF ocean surface wind speeds for June 2000.

Figure 6: Comparison of ECMWF wind speed results with ERS-2 Altimeter wind speed data for June 2000 (global).

Figure 7: Comparison of ECMWF wind speed results with ERS-2 Altimeter wind speed data for June 2000 (northern hemisphere)

Figure 8: Comparison of ECMWF wind speed results with ERS-2 Altimeter wind speed data for June 2000 (tropics)

Figure 9: Comparison of ECMWF wind speed results with ERS-2 Altimeter wind speed data for June 2000 (southern hemisphere)

Figure 10: Comparison of buoy wind speed observations with ERS-2 Altimeter wind speed data for June 2000 (global).

Figure 11: Comparison of buoy wind speed observations with ERS-2 Altimeter wind speed data for June 2000 (northern hemisphere).

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Figure 12: Comparison of buoy wind speed observations with ERS-2 Altimeter wind speed data for June 2000 (tropics).
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 2000.
Figure 15: Distribution of the ERS-2 Altimeter wave heights after along track averaging for June 2000.
Figure 16: Global distribution of ECMWF wave heights for June 2000.
Figure 17: Comparison of ECMWF wave height results with ERS-2 Altimeter wave height data for June 2000 (global).
Figure 18: Comparison of ECMWF wave height results with ERS-2 Altimeter wave height data for June 2000 (northern hemisphere)
Figure 19: Comparison of ECMWF wave height results with ERS-2 Altimeter wave height data for June 2000 (tropics)
Figure 20: Comparison of ECMWF wave height results with ERS-2 Altimeter wave height data for June 2000 (southern hemisphere)
Figure 21: Comparison of buoy wave height observations with ERS-2 Altimeter wave height data for June 2000 (global).
Figure 22: Comparison of buoy wave height observations with ERS-2 Altimeter wave height data for June 2000 (northern hemisphere).
Figure 23: Comparison of buoy wave height observations with ERS-2 Altimeter wave height data for June 2000 (tropics).
Figure 24: ERS-2 Altimeter wave heights: Timeseries of bias (ERS-2 - model) and scatter index (SI) for June 2000.
Figure 25: ERS-2 Altimeter wave heights: Timeseries of bias (ERS-2 - model) and scatter index (SI) from December 1996 to June 2000
Figure 26: ERS-2 Altimeter wind speeds: Timeseries of bias (ERS-2 - model) and scatter index (SI) from December 1996 to June 2000

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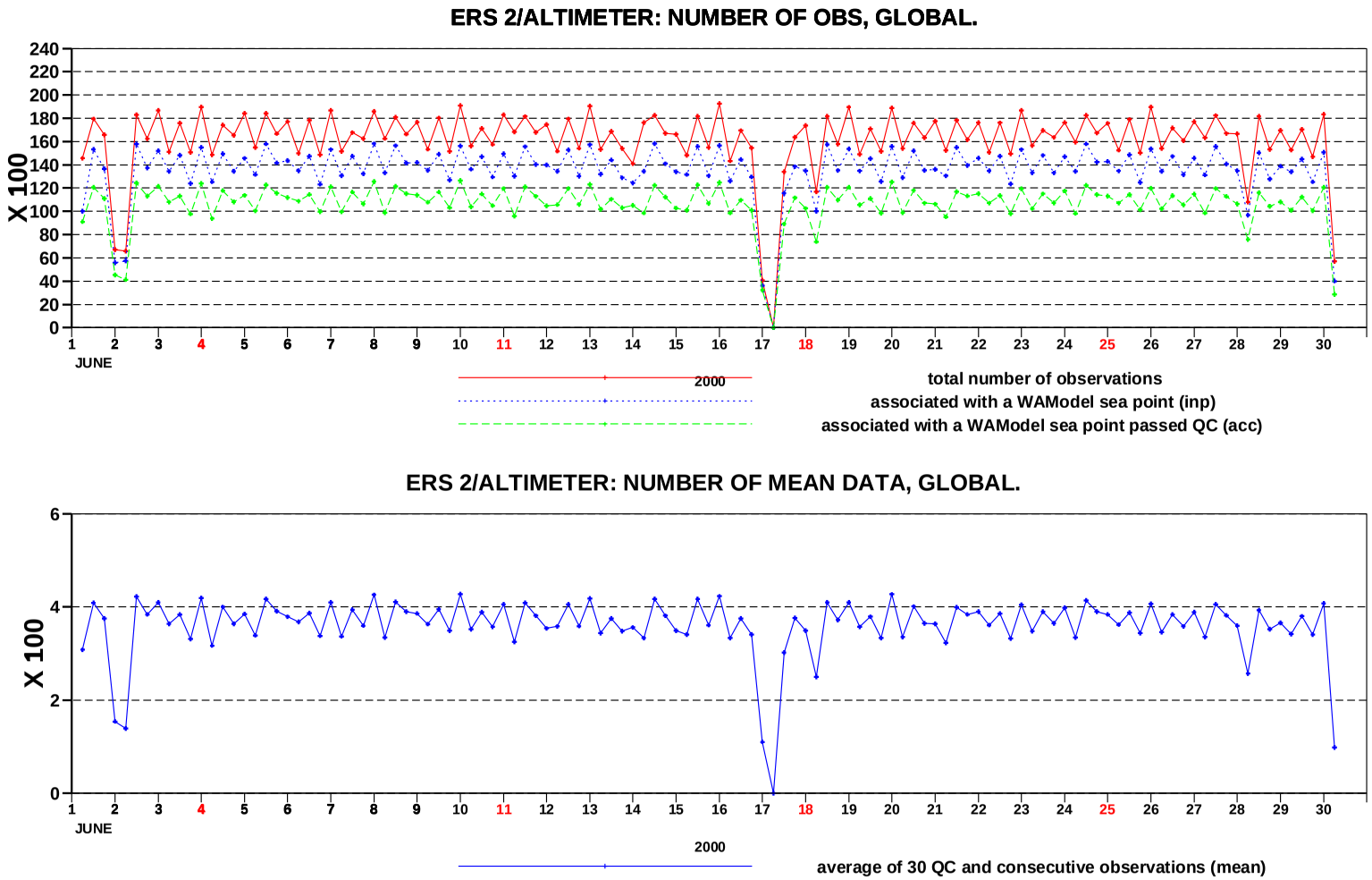


Figure 1: Time series of data reception for ERS-2 Altimeter data for June 2000

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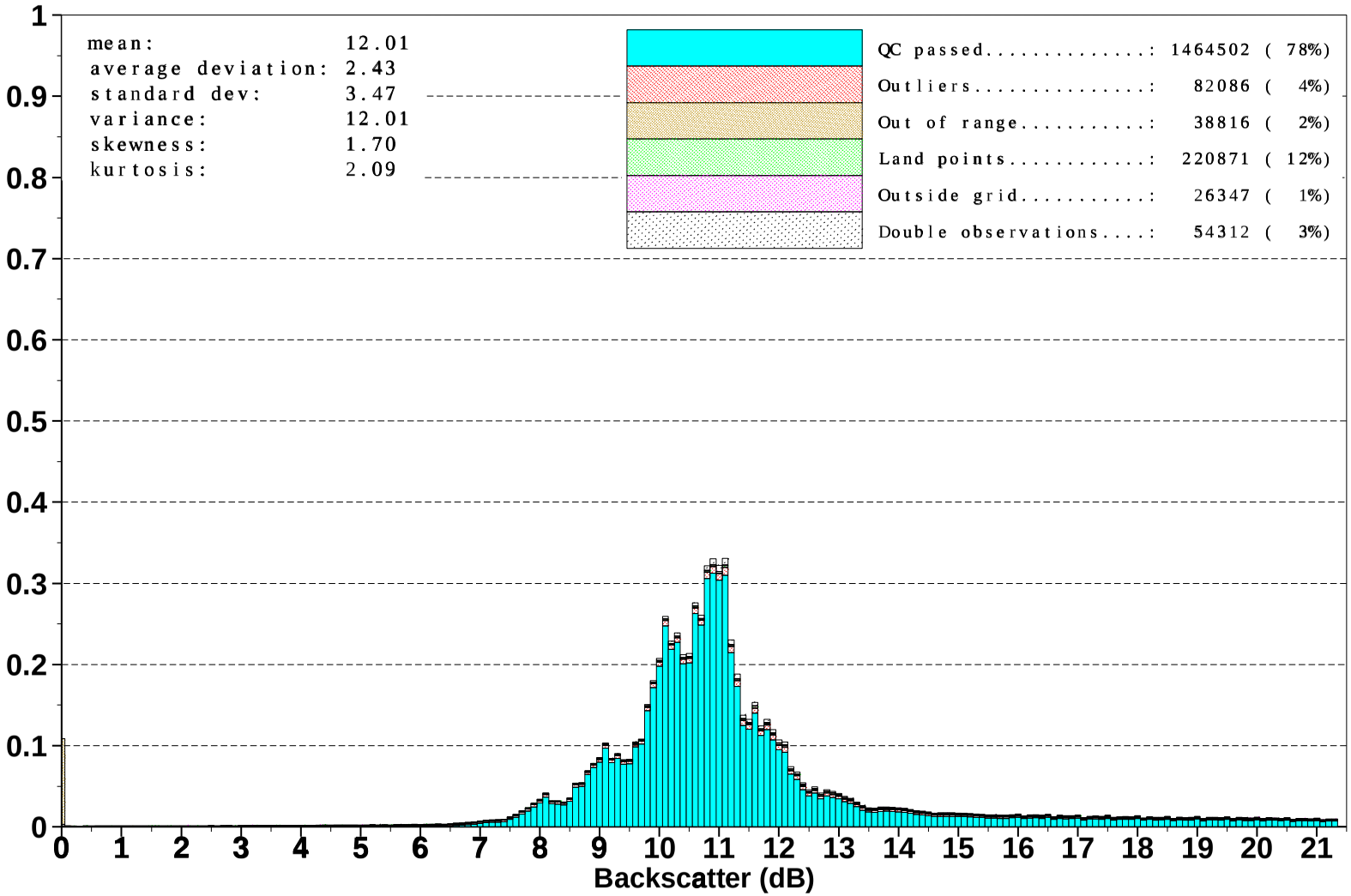


Figure 2: Distribution of the ERS-2 Altimeter backscatter after QC for June 2000

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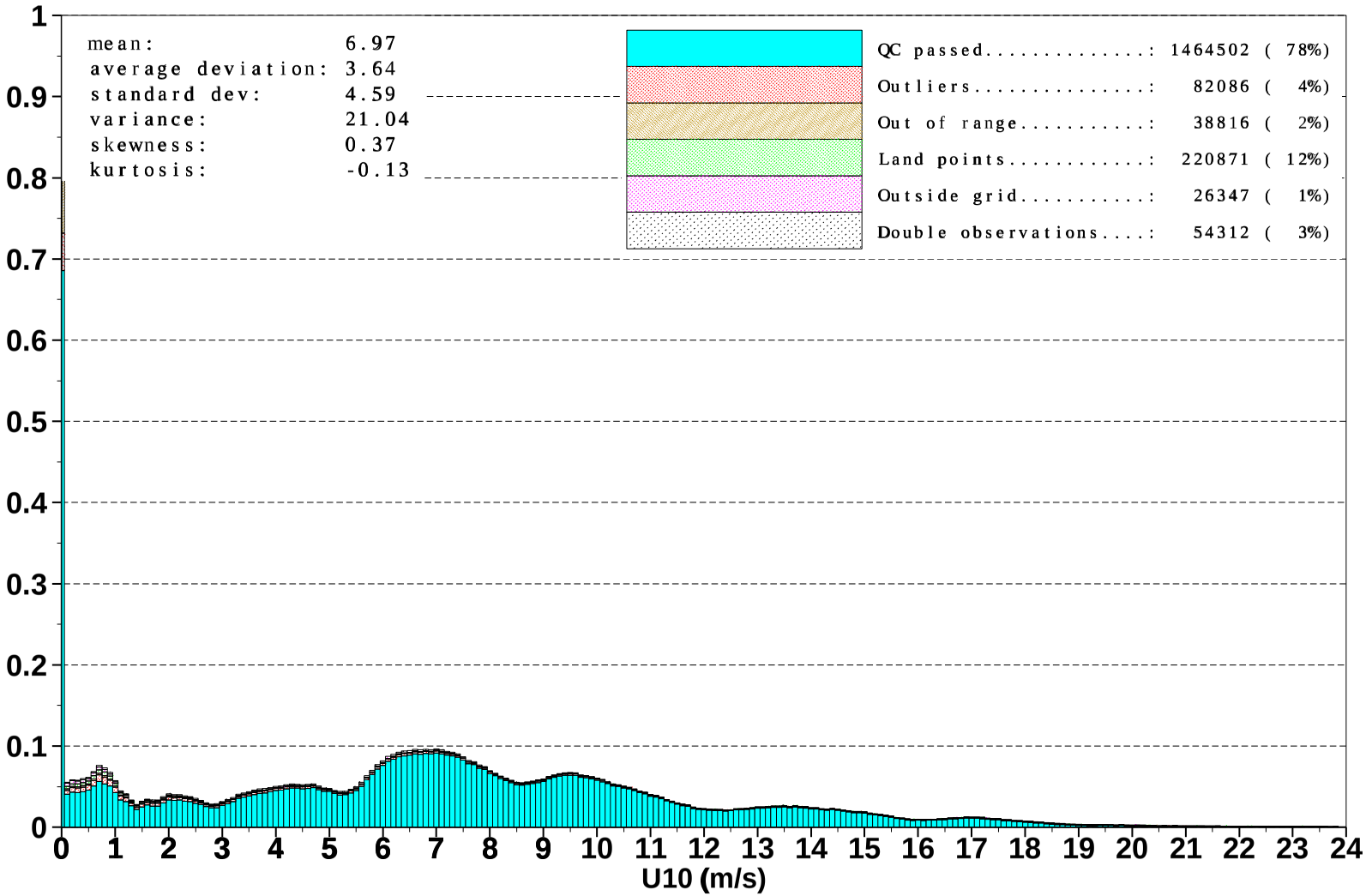


Figure 3: Distribution of the ERS-2 Altimeter wind speeds after QC for June 2000

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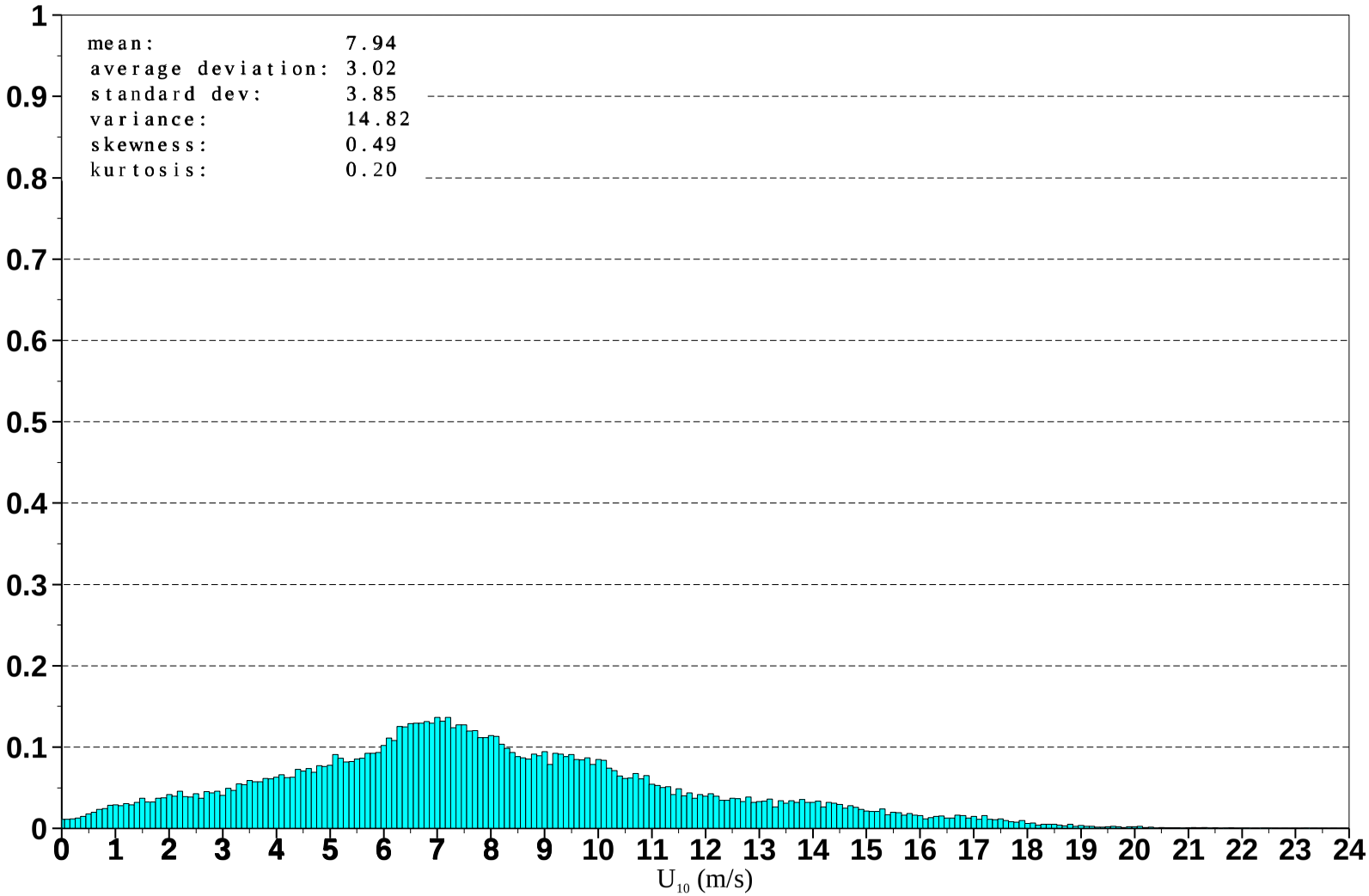


Figure 4: Distribution of ERS-2 Altimeter wind speeds after along track averaging for June 2000

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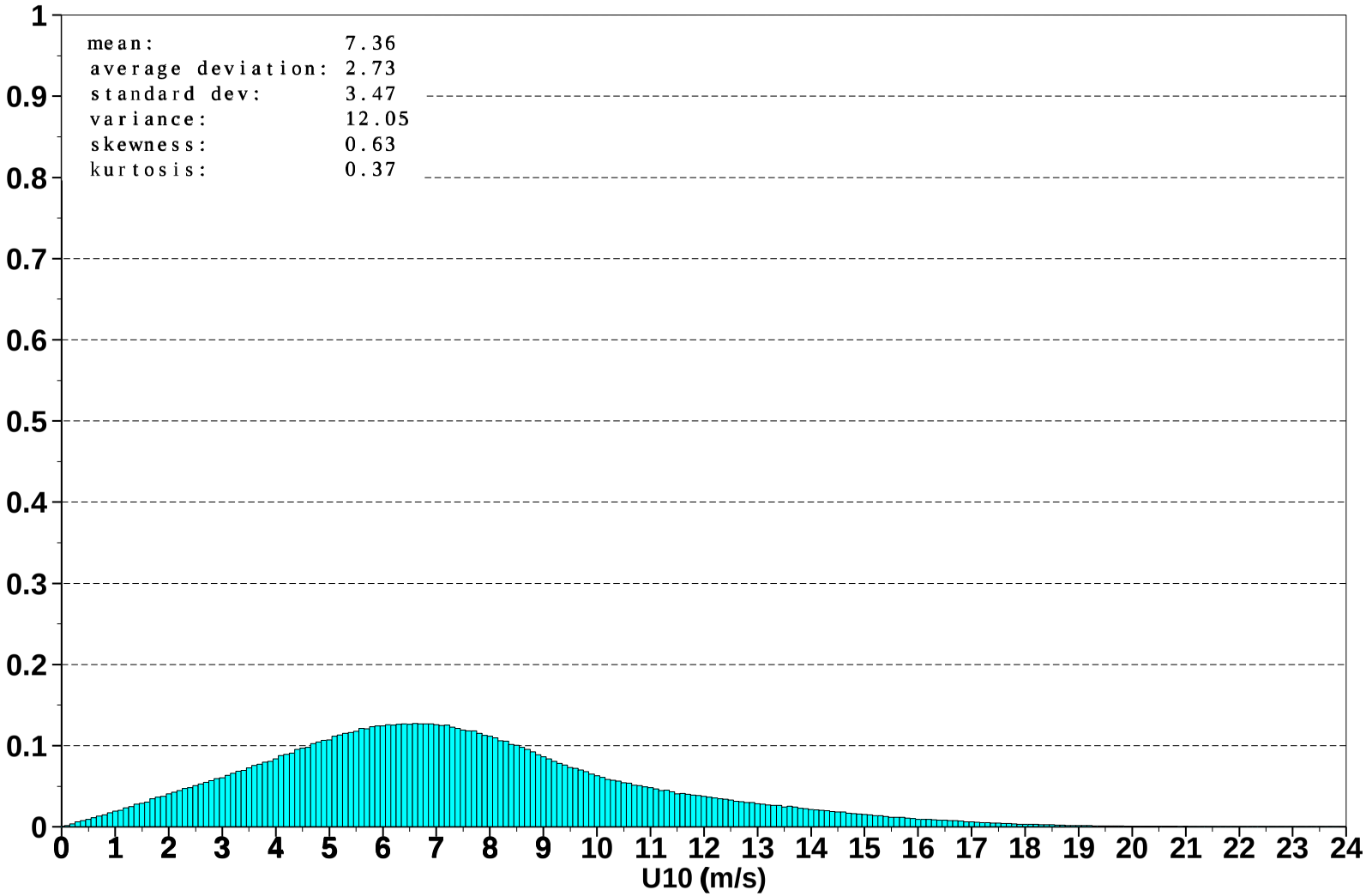
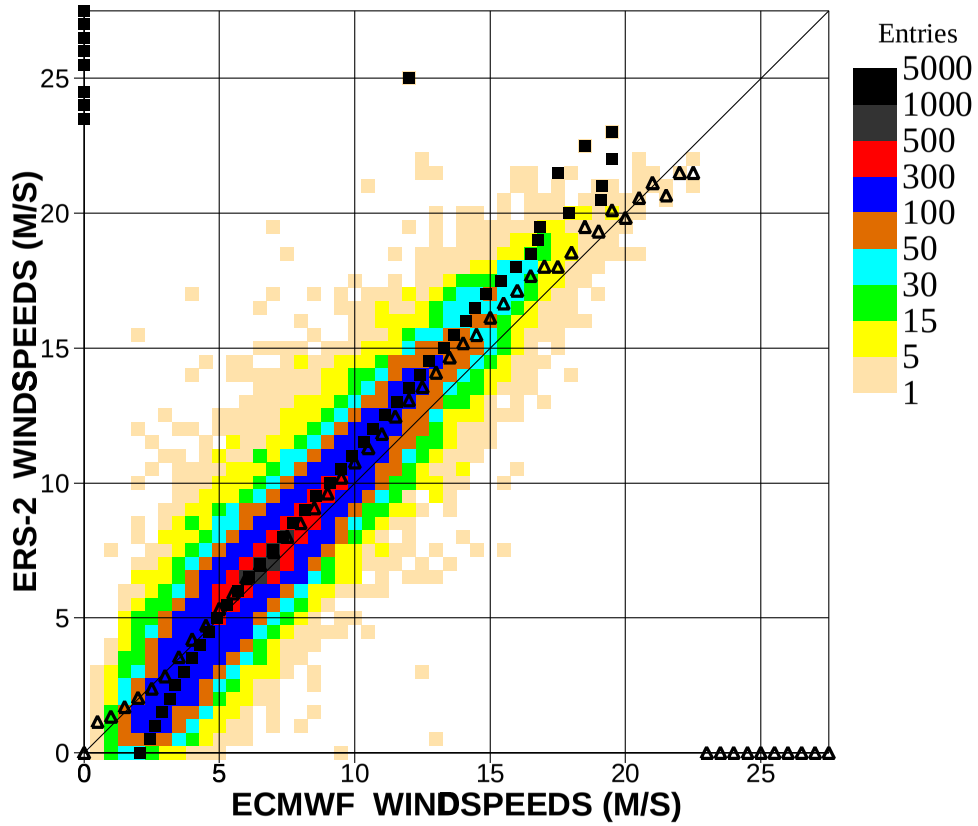


Figure 5: Global distribution of ECMWF ocean surface wind speeds for June 2000

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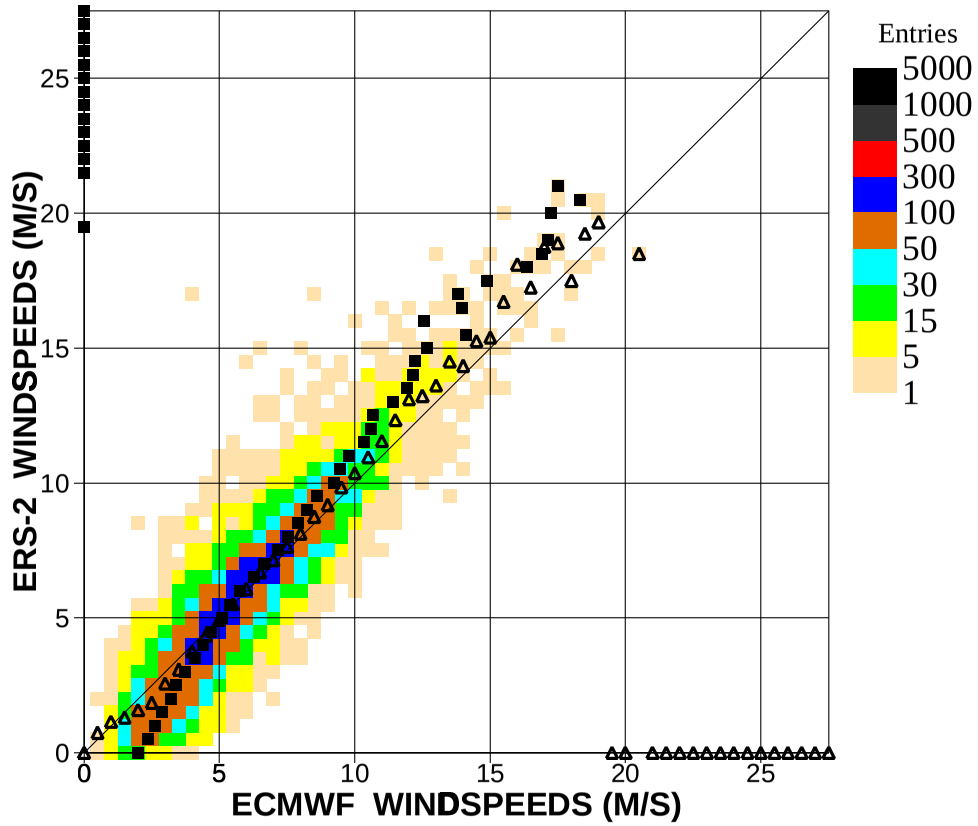
STATISTICS

ENTRIES	41754
MEAN ECMWF	7.4344
MEAN ERS-2	7.9429
BIAS (ERS-2 - ECMWF)	0.5085
STANDARD DEVIATION	1.4447
SCATTER INDEX	0.1943
CORRELATION	0.9302
SYMMETRIC SLOPE	1.0862(0.0021)
REGR. COEFFICIENT	1.0913(0.0021)
REGR. CONSTANT	-0.1703(0.0171)

Figure 6. Comparison of ECMWF wind speed results with ERS2 Altimeter wind speed data for June 2000 (global)

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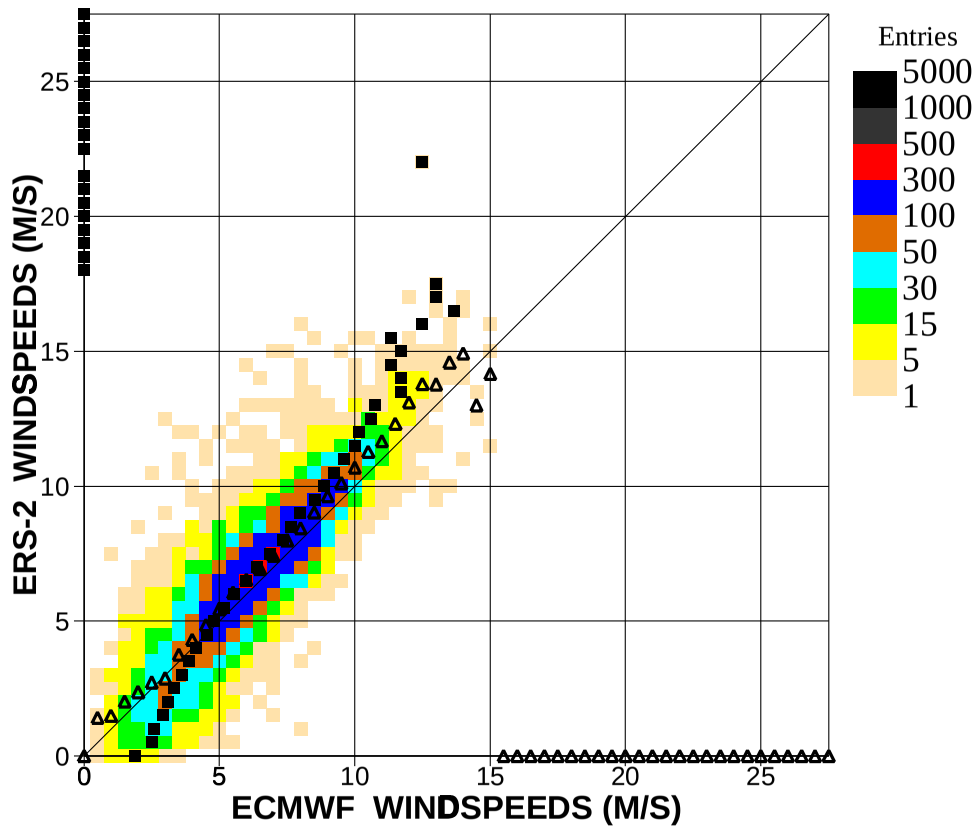


STATISTICS

ENTRIES	10568
MEAN ECMWF	5.9700
MEAN ERS-2	5.9686
BIAS (ERS-2 - ECMWF)	-0.0014
STANDARD DEVIATION	1.3560
SCATTER INDEX	0.2271
CORRELATION	0.9095
SYMMETRIC SLOPE	1.0389 (0.0051)
REGR. COEFFICIENT	1.1142 (0.0050)
REGR. CONSTANT	-0.6831 (0.0323)

Figure 7. Comparison of ECMWF wind speed results with ERS2 Altimeter wind speed data for June 2000 (n.hem.)

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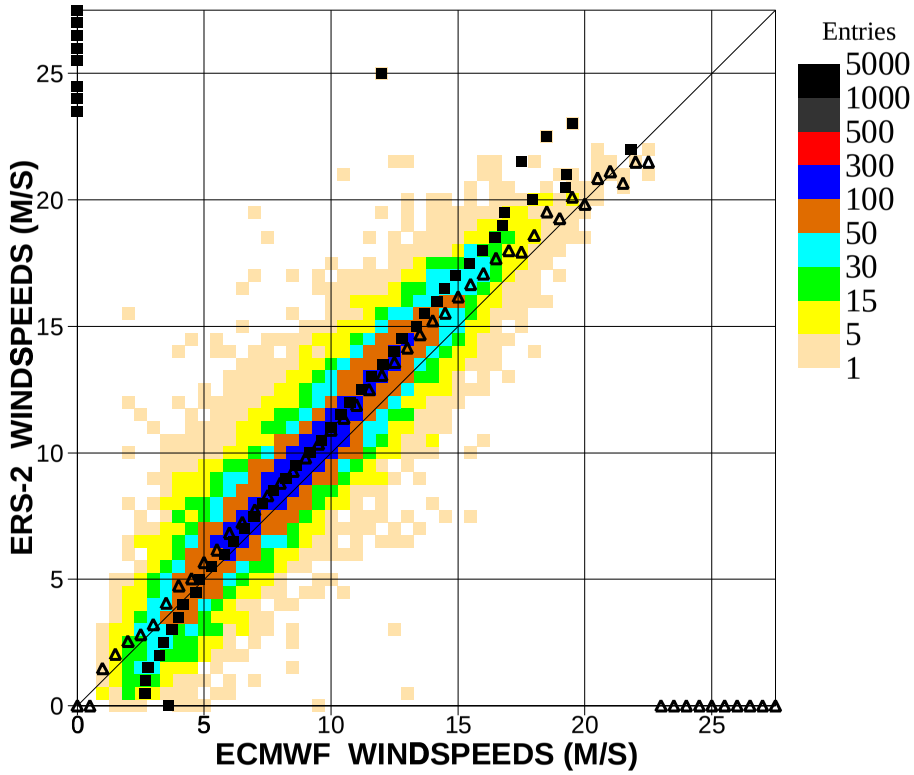
STATISTICS

ENTRIES	13512
MEAN ECMWF	6.3557
MEAN ERS-2	6.8150
BIAS (ERS-2 - ECMWF)	0.4593
STANDARD DEVIATION	1.2314
SCATTER INDEX	0.1938
CORRELATION	0.8803
SYMMETRIC SLOPE	1.0859(0.0049)
REGR. COEFFICIENT	1.0546(0.0049)
REGR. CONSTANT	0.1124(0.0328)

Figure 8. Comparison of ECMWF wind speed results with ERS2 Altimeter wind speed data for June 2000 (tropics)

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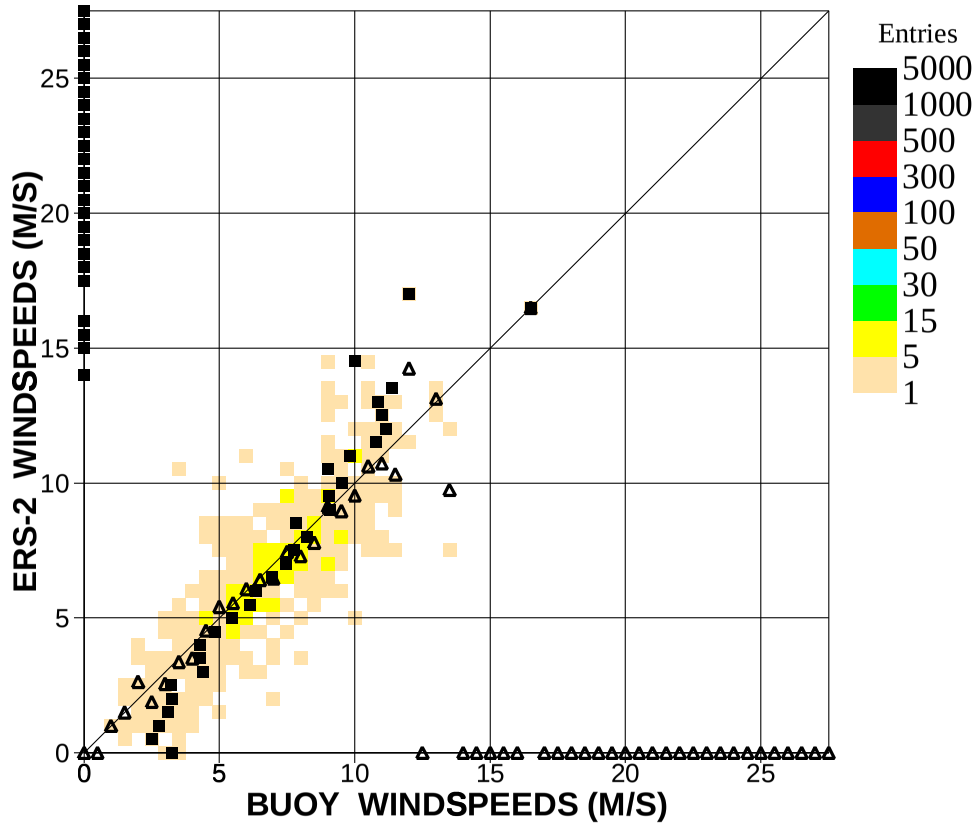


STATISTICS

ENTRIES	17985
MEAN ECMWF	9.0869
MEAN ERS-2	9.9286
BIAS (ERS-2 - ECMWF)	0.8417
STANDARD DEVIATION	1.5432
SCATTER INDEX	0.1698
CORRELATION	0.9255
SYMMETRIC SLOPE	1.0982(0.0032)
REGR. COEFFICIENT	1.0490(0.0032)
REGR. CONSTANT	0.3962(0.0312)

Figure 9. Comparison of ECMWF wind speed results with ERS2 Altimeter wind speed data for June 2000 (s.hem.)

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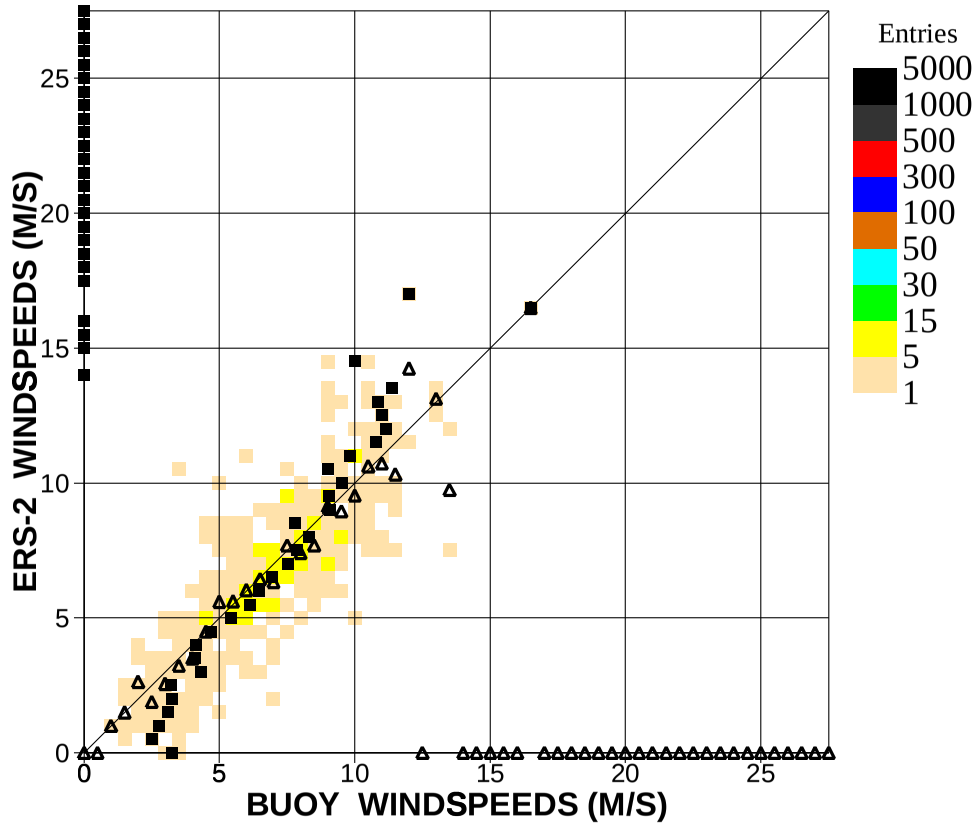


STATISTICS

ENTRIES	554	
MEAN BUOY	6.9306	
MEAN ERS-2	6.7108	
BIAS (ERS-2 - BUOY)	-0.2198	
STANDARD DEVIATION	1.5393	
SCATTER INDEX	0.2221	
CORRELATION	0.8416	
SYMMETRIC SLOPE	0.9888	(0.0262)
REGR. COEFFICIENT	0.9539	(0.0261)
REGR. CONSTANT	0.0999	(0.1920)

Figure 10. Comparison of buoy wind speed observations with ERS2 Altimeter wind speed data for June 2000 (global)

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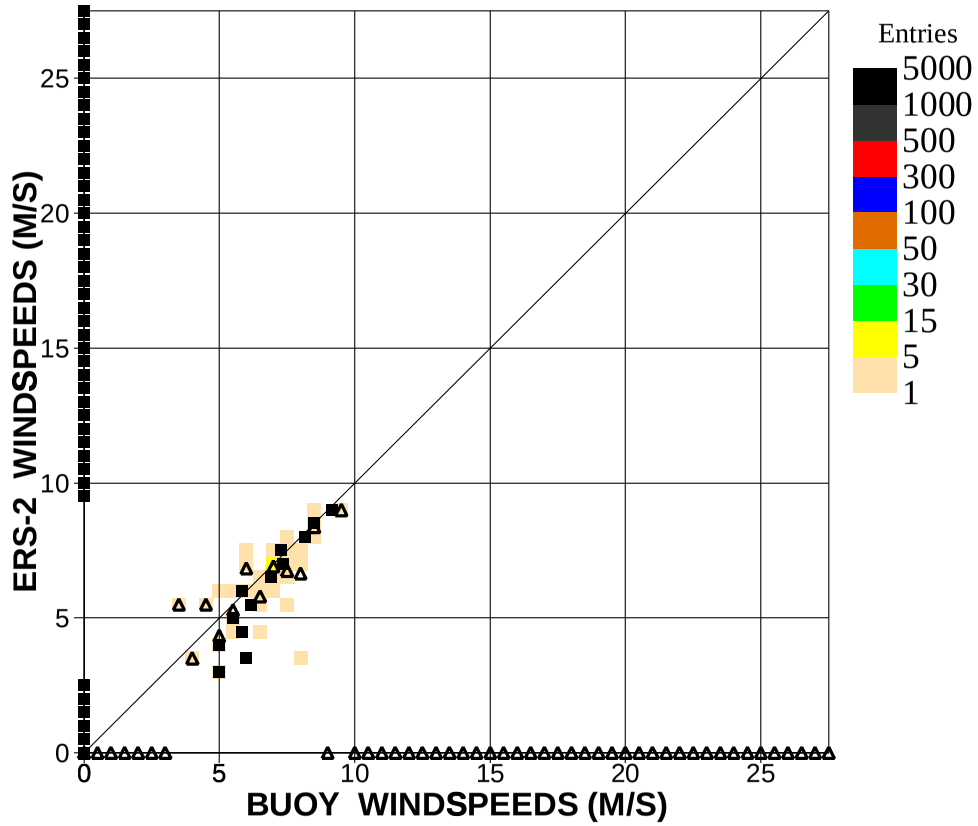


STATISTICS

ENTRIES	492	
MEAN BUOY	6.9404	
MEAN ERS-2	6.7441	
BIAS (ERS-2 - BUOY)	-0.1963	
STANDARD DEVIATION	1.5950	
SCATTER INDEX	0.2298	
CORRELATION	0.8449	
SYMMETRIC SLOPE	0.9934	(0.0276)
REGR. COEFFICIENT	0.9581	(0.0274)
REGR. CONSTANT	0.0946	(0.2033)

Figure 11. Comparison of buoy wind speed observations with ERS2 Altimeter wind speed data for June 2000 (n.hem.)

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STATISTICS

ENTRIES	56	
MEAN BUOY	6.8871	
MEAN ERS-2	6.4607	
BIAS (ERS-2 - BUOY)	-0.4264	
STANDARD DEVIATION	0.9918	
SCATTER INDEX	0.1440	
CORRELATION	0.7179	
SYMMETRIC SLOPE	0.9430	(0.1049)
REGR. COEFFICIENT	0.7751	(0.1023)
REGR. CONSTANT	1.1224	(0.7160)

Figure 12. Comparison of buoy wind speed observations with ERS2 Altimeter wind speed data for June 2000 (hawaii)

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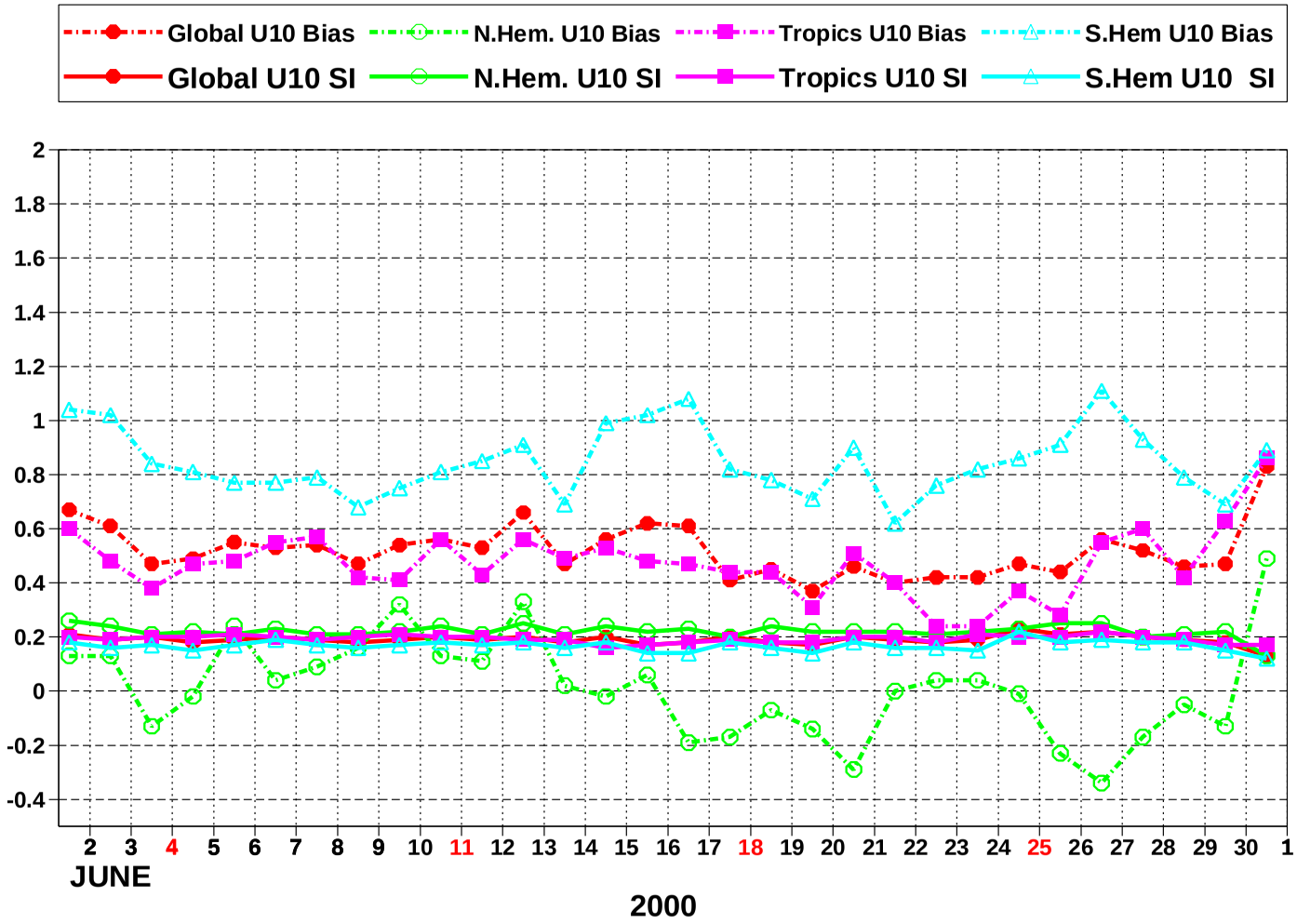


Figure 13: ERS-2 Altimeter wind speeds: Timeseries of bias (ERS-2 - model) and scatter index (SI)

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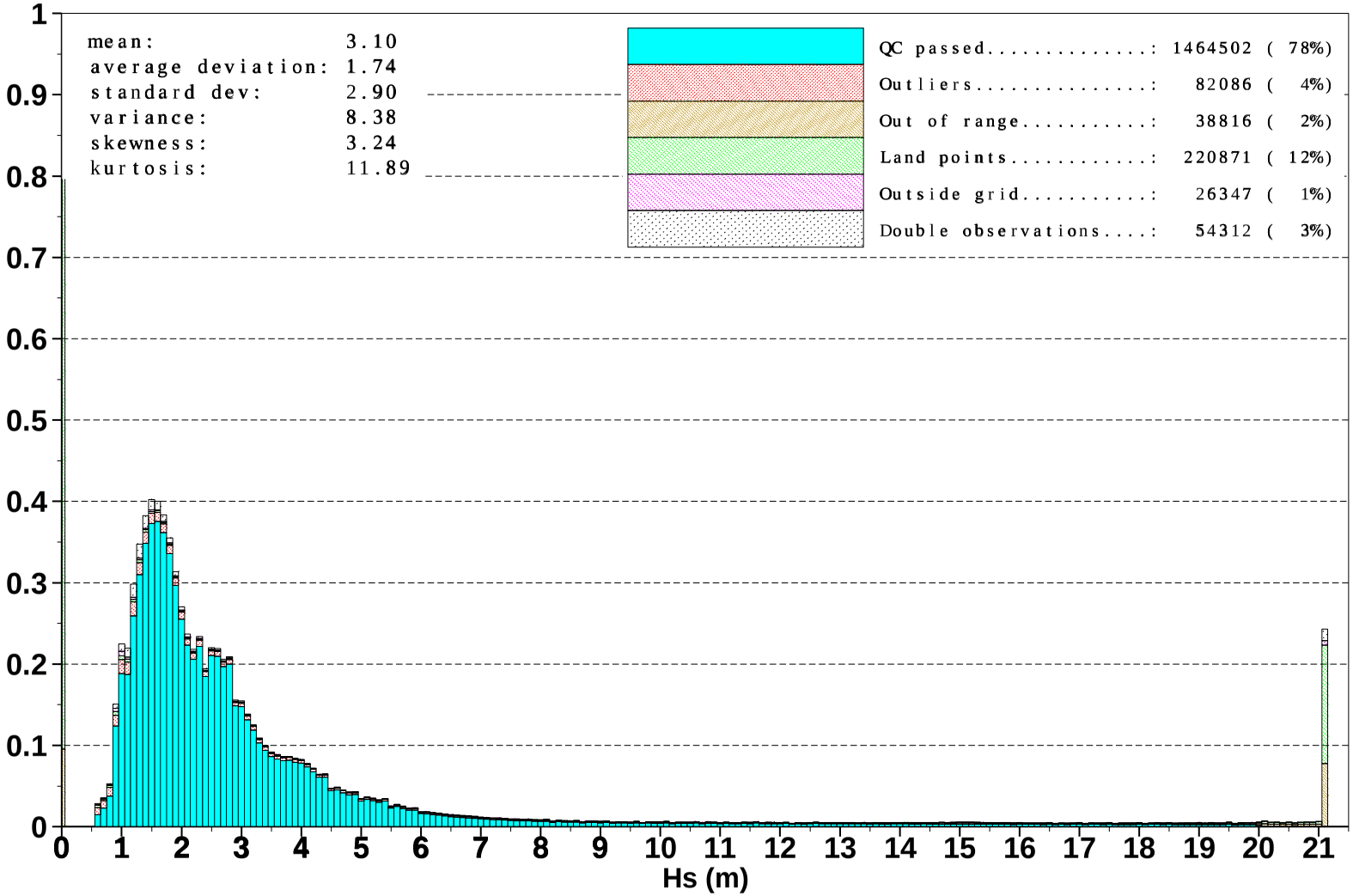


Figure 14: Distribution of the ERS-2 Altimeter wave heights after QC for June 2000

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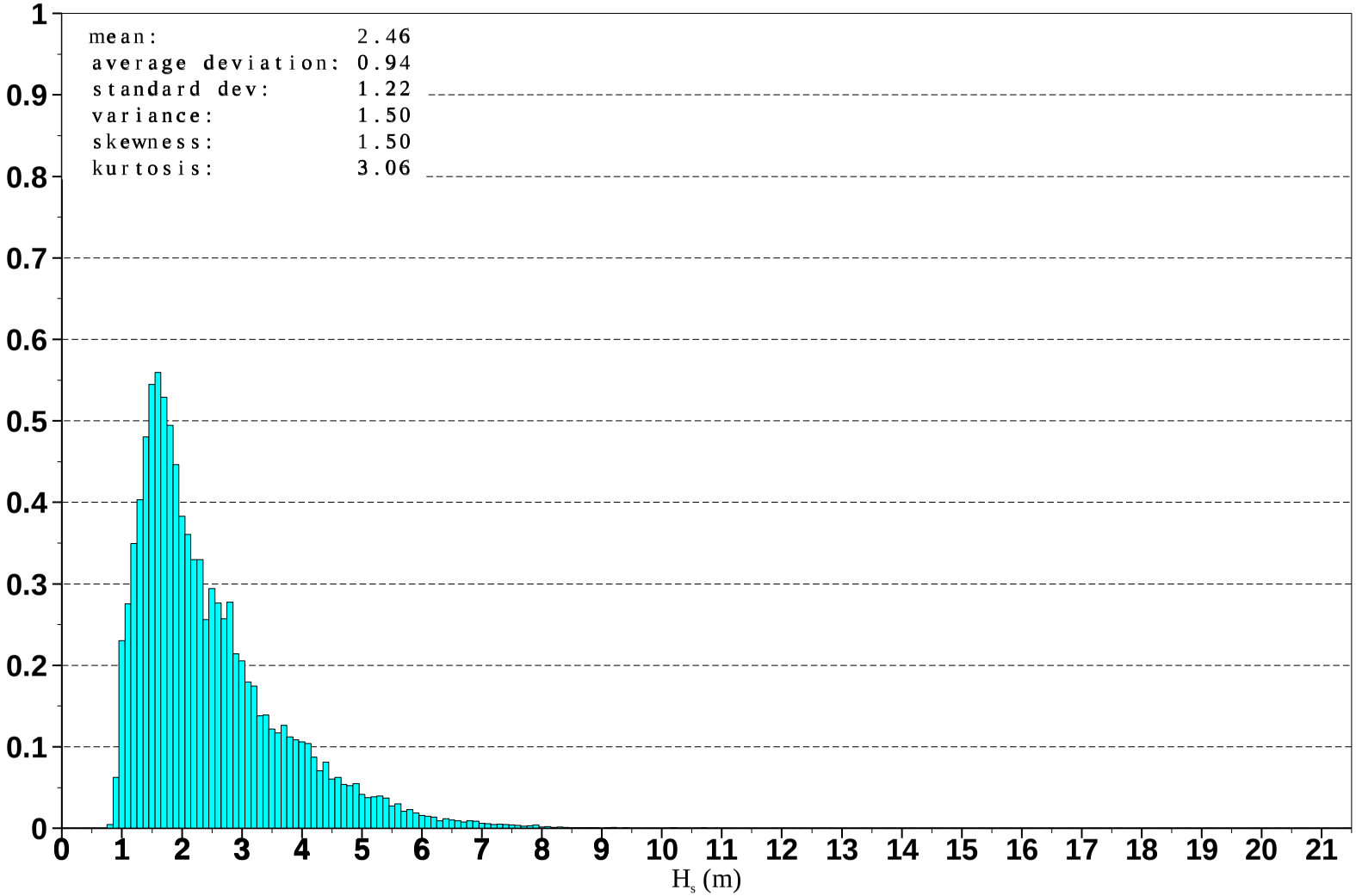


Figure 15: Distribution of ERS-2 Altimeter wave heights after along track averaging for June 2000

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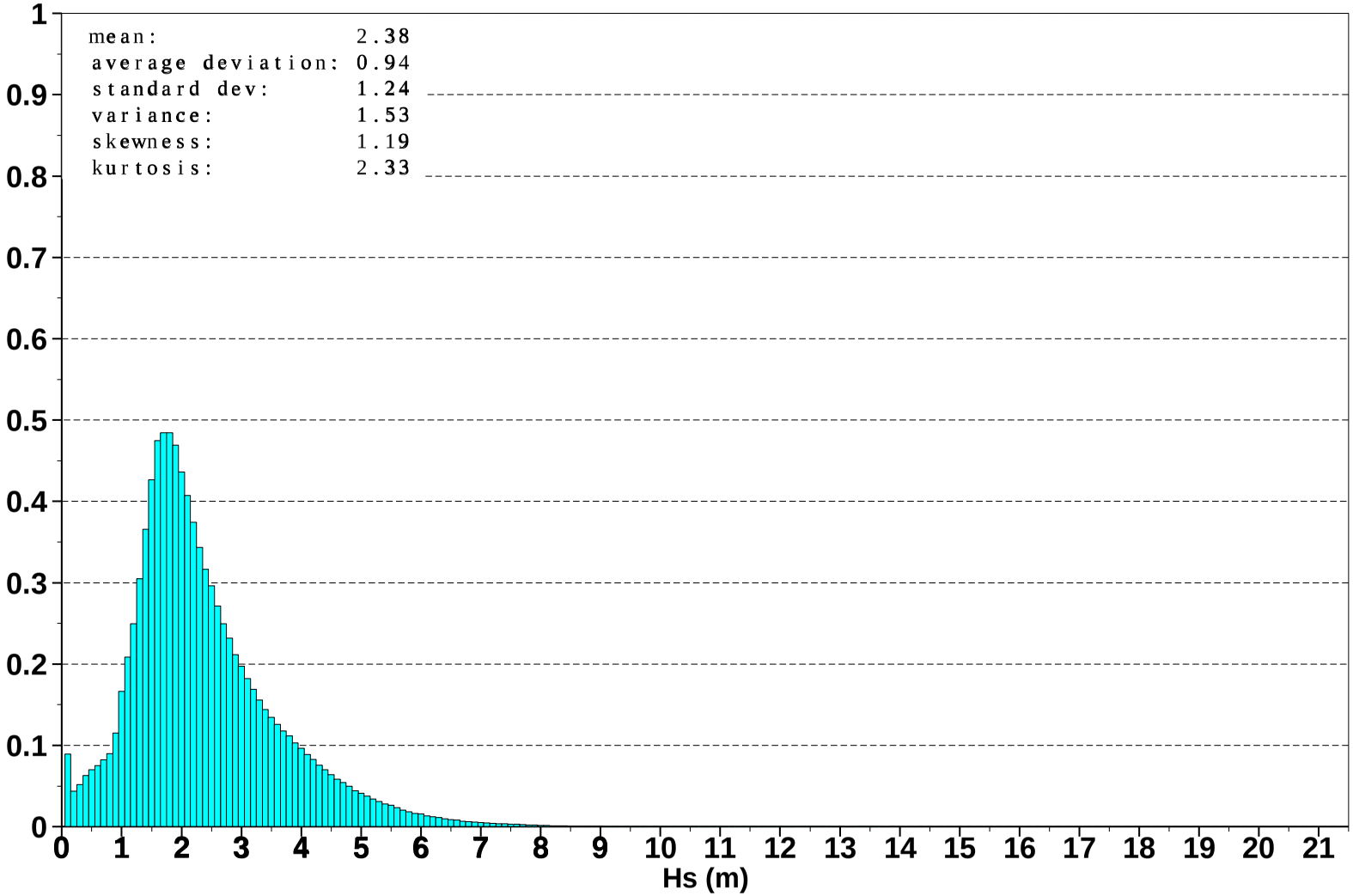
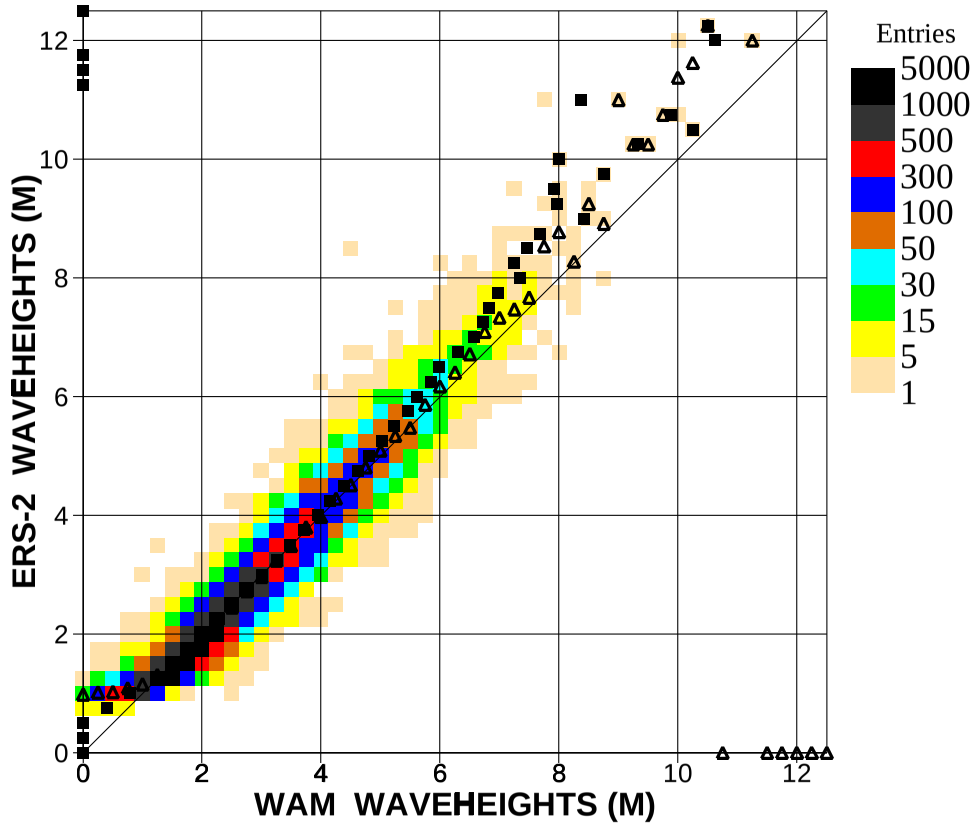


Figure 16: Global distribution of ECMWF wave heights for June 2000

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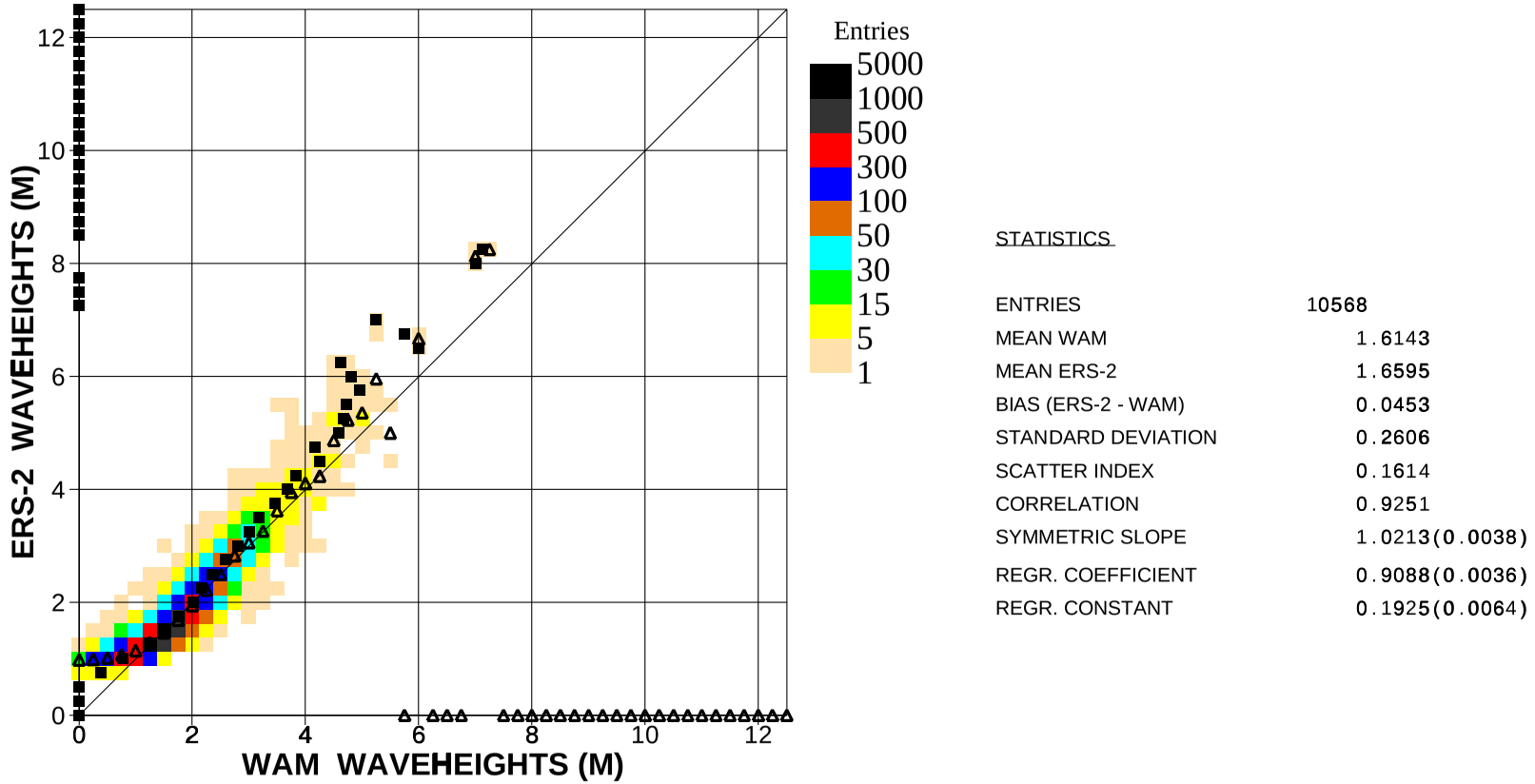


STATISTICS

ENTRIES	41754
MEAN WAM	2.4552
MEAN ERS-2	2.4599
BIAS (ERS-2 - WAM)	0.0047
STANDARD DEVIATION	0.3008
SCATTER INDEX	0.1225
CORRELATION	0.9694
SYMMETRIC SLOPE	1.0071(0.0012)
REGR. COEFFICIENT	0.9973(0.0012)
REGR. CONSTANT	0.0114(0.0034)

Figure 17. Comparison of ECMWF wave height results with ERS2 Altimeter wave height data for June 2000 (global)

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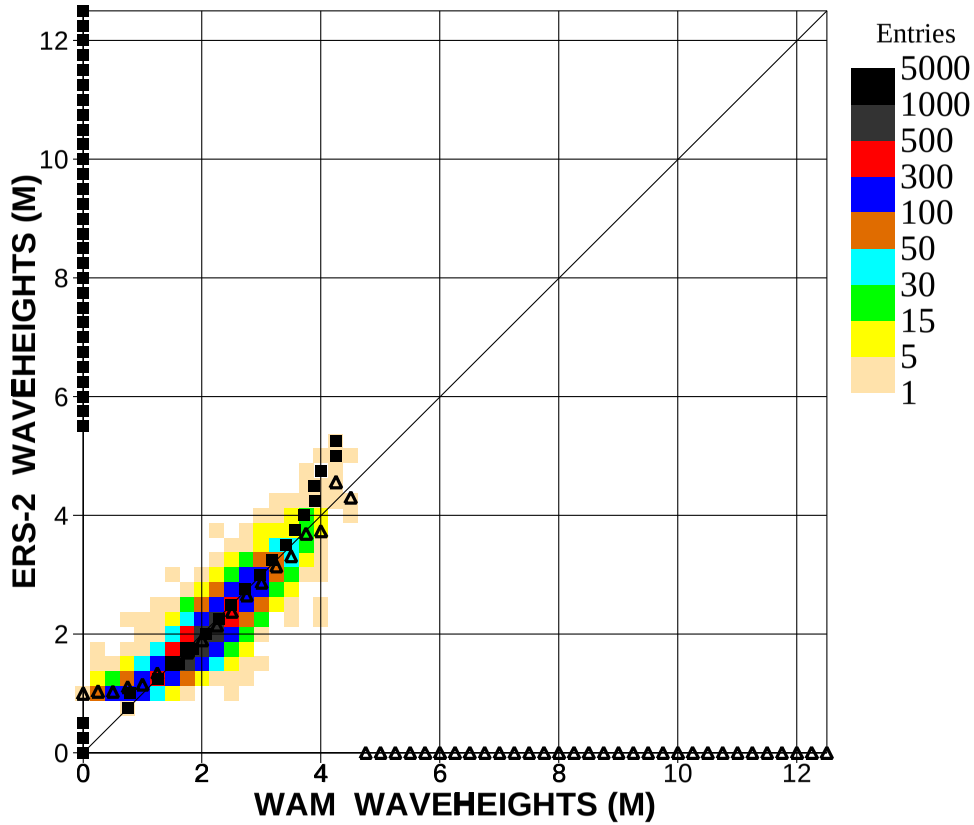


STATISTICS

ENTRIES	10568
MEAN WAM	1.6143
MEAN ERS-2	1.6595
BIAS (ERS-2 - WAM)	0.0453
STANDARD DEVIATION	0.2606
SCATTER INDEX	0.1614
CORRELATION	0.9251
SYMMETRIC SLOPE	1.0213(0.0038)
REGR. COEFFICIENT	0.9088(0.0036)
REGR. CONSTANT	0.1925(0.0064)

Figure 18. Comparison of ECMWF wave height results with ERS2 Altimeter wave height data for June 2000 (n.hem.)

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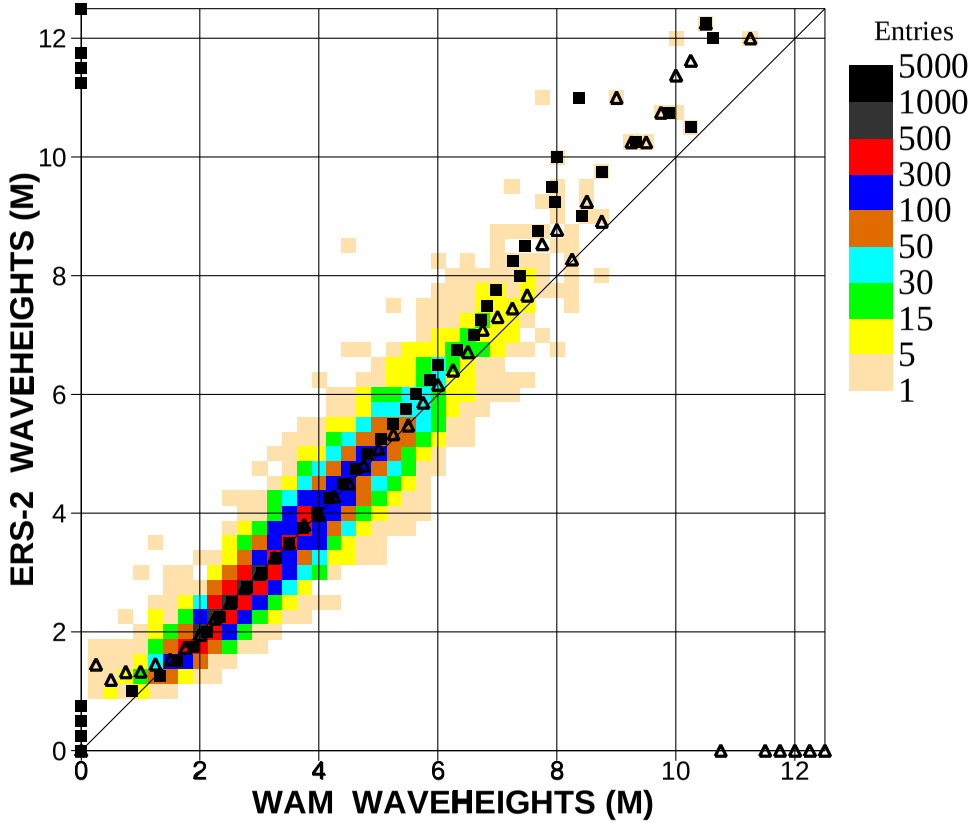


STATISTICS

ENTRIES	13512
MEAN WAM	1.9581
MEAN ERS-2	1.9185
BIAS (ERS-2 - WAM)	-0.0396
STANDARD DEVIATION	0.2442
SCATTER INDEX	0.1247
CORRELATION	0.9129
SYMMETRIC SLOPE	0.9761(0.0035)
REGR. COEFFICIENT	0.8541(0.0033)
REGR. CONSTANT	0.2461(0.0067)

Figure 19. Comparison of ECMWF wave height results with ERS2 Altimeter wave height data for June 2000 (tropics)

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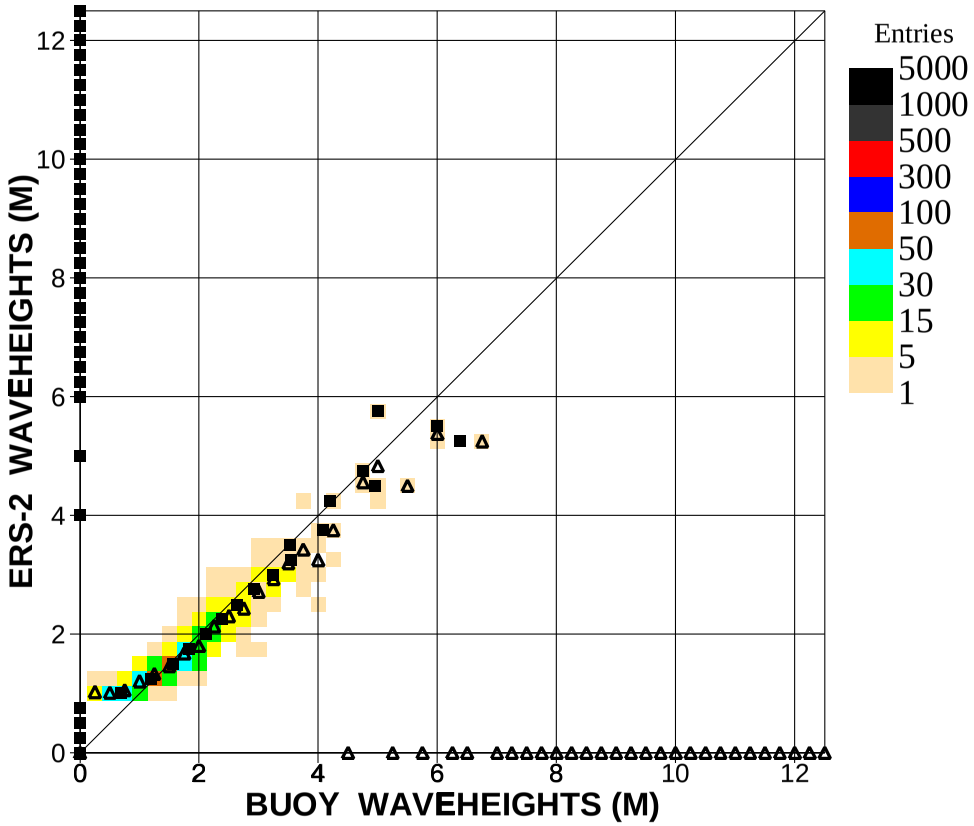


STATISTICS

ENTRIES	17985
MEAN WAM	3.3151
MEAN ERS-2	3.3290
BIAS (ERS-2 - WAM)	0.0139
STANDARD DEVIATION	0.3517
SCATTER INDEX	0.1061
CORRELATION	0.9623
SYMMETRIC SLOPE	1.0126(0.0022)
REGR. COEFFICIENT	1.0352(0.0022)
REGR. CONSTANT	-0.1027(0.0077)

Figure 20. Comparison of ECMWF wave height results with ERS2 Altimeter wave height data for June 2000 (s.hem.)

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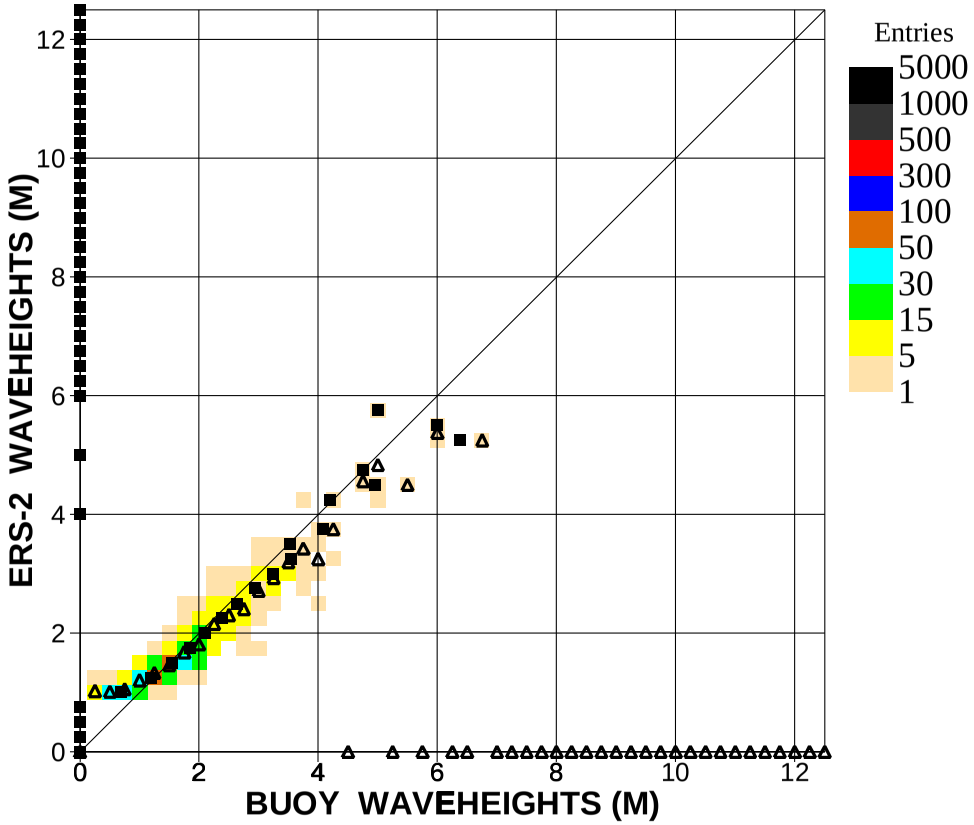


STATISTICS

ENTRIES	731	
MEAN BUOY	1.7326	
MEAN ERS-2	1.7220	
BIAS (ERS-2 - BUOY)	-0.0106	
STANDARD DEVIATION	0.3171	
SCATTER INDEX	0.1830	
CORRELATION	0.9472	
SYMMETRIC SLOPE	0.9558	(0.0124)
REGR. COEFFICIENT	0.7547	(0.0095)
REGR. CONSTANT	0.4145	(0.0185)

Figure 21. Comparison of buoy wave height observations with ERS2 Altimeter wave height data for June 2000 (global)

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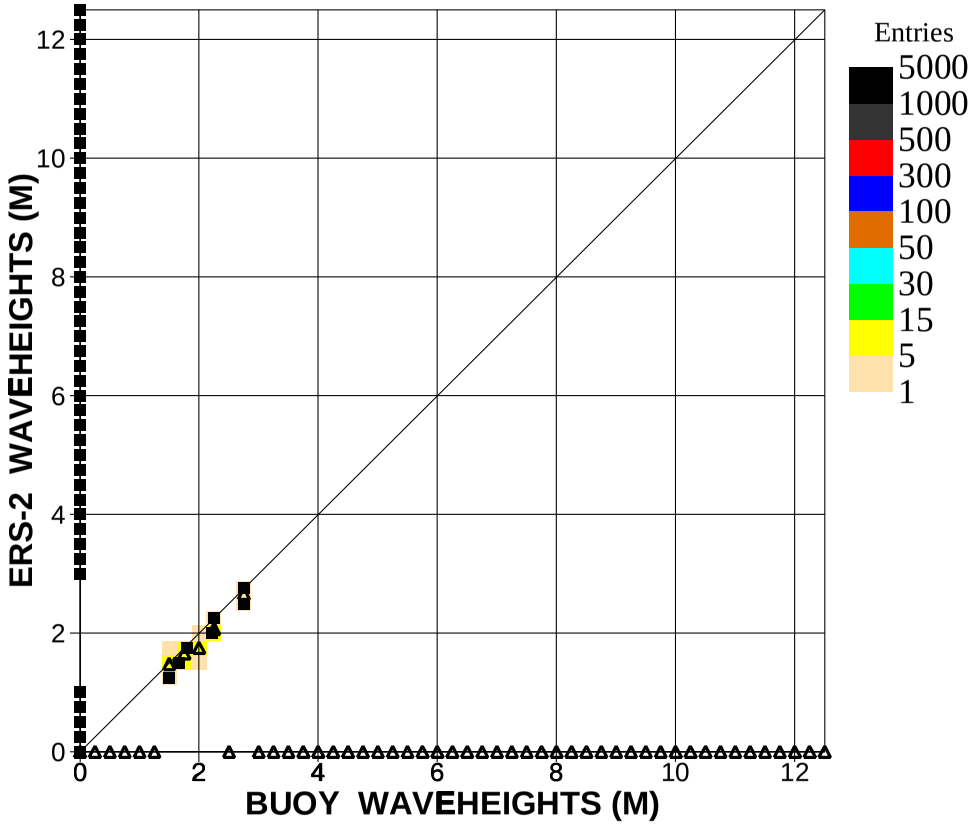


STATISTICS

ENTRIES	666	
MEAN BUOY	1.7214	
MEAN ERS-2	1.7209	
BIAS (ERS-2 - BUOY)	-0.0005	
STANDARD DEVIATION	0.3269	
SCATTER INDEX	0.1899	
CORRELATION	0.9483	
SYMMETRIC SLOPE	0.9577	(0.0129)
REGR. COEFFICIENT	0.7553	(0.0098)
REGR. CONSTANT	0.4208	(0.0192)

Figure 22. Comparison of buoy wave height observations with ERS2 Altimeter wave height data for June 2000 (n.hem.)

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STATISTICS

ENTRIES	59	
MEAN BUOY	1.9059	
MEAN ERS-2	1.7702	
BIAS (ERS-2 - BUOY)	-0.1357	
STANDARD DEVIATION	0.1215	
SCATTER INDEX	0.0638	
CORRELATION	0.9278	
SYMMETRIC SLOPE	0.9302	(0.0484)
REGR. COEFFICIENT	0.9078	(0.0483)
REGR. CONSTANT	0.0400	(0.0934)

Figure 23. Comparison of buoy wave height observations with ERS2 Altimeter wave height data for June 2000 (hawaii)

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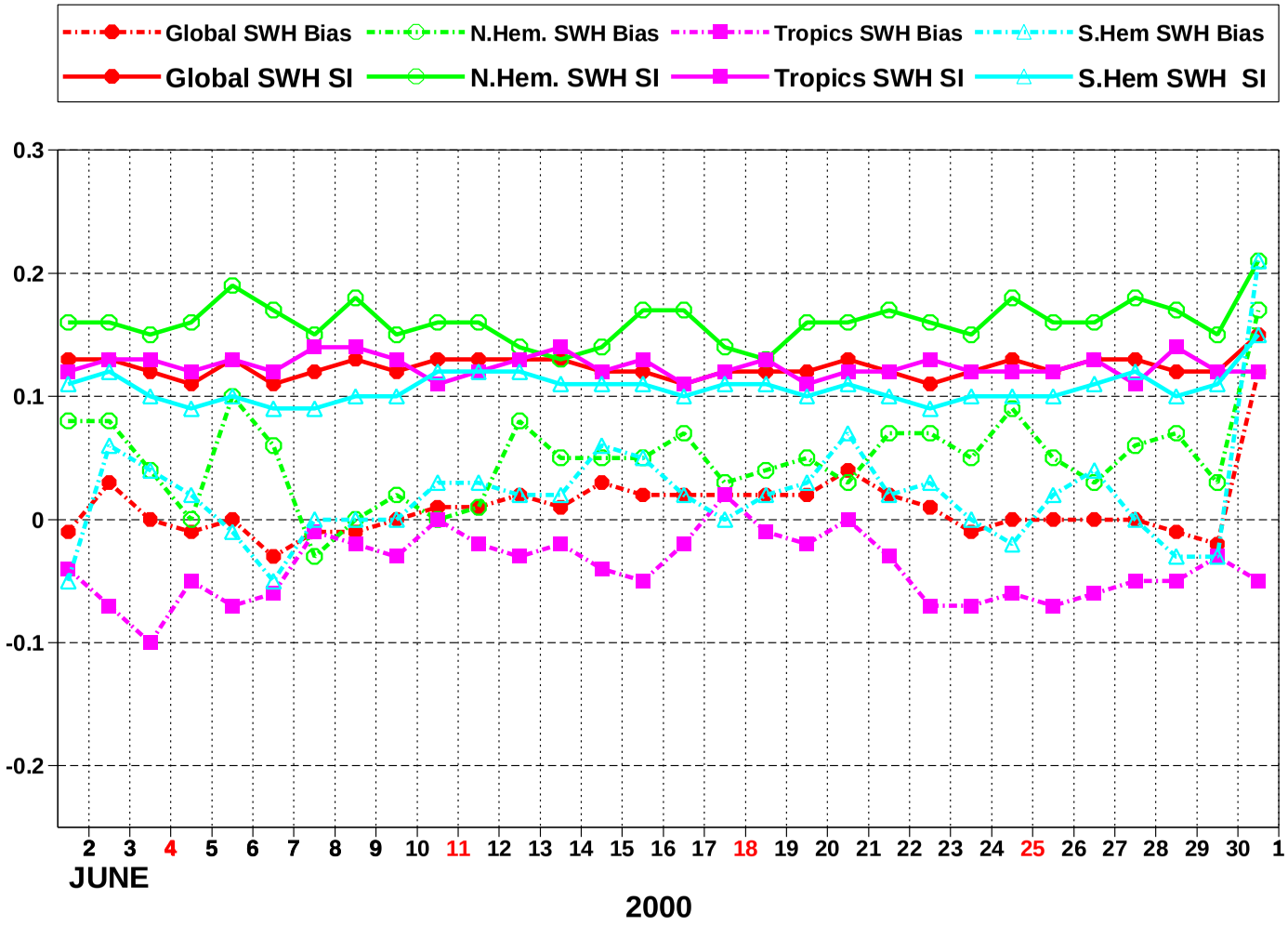


Figure 24: ERS-2 Altimeter wave heights: Timeseries of bias (ERS-2 - model) and scatter index (SI)

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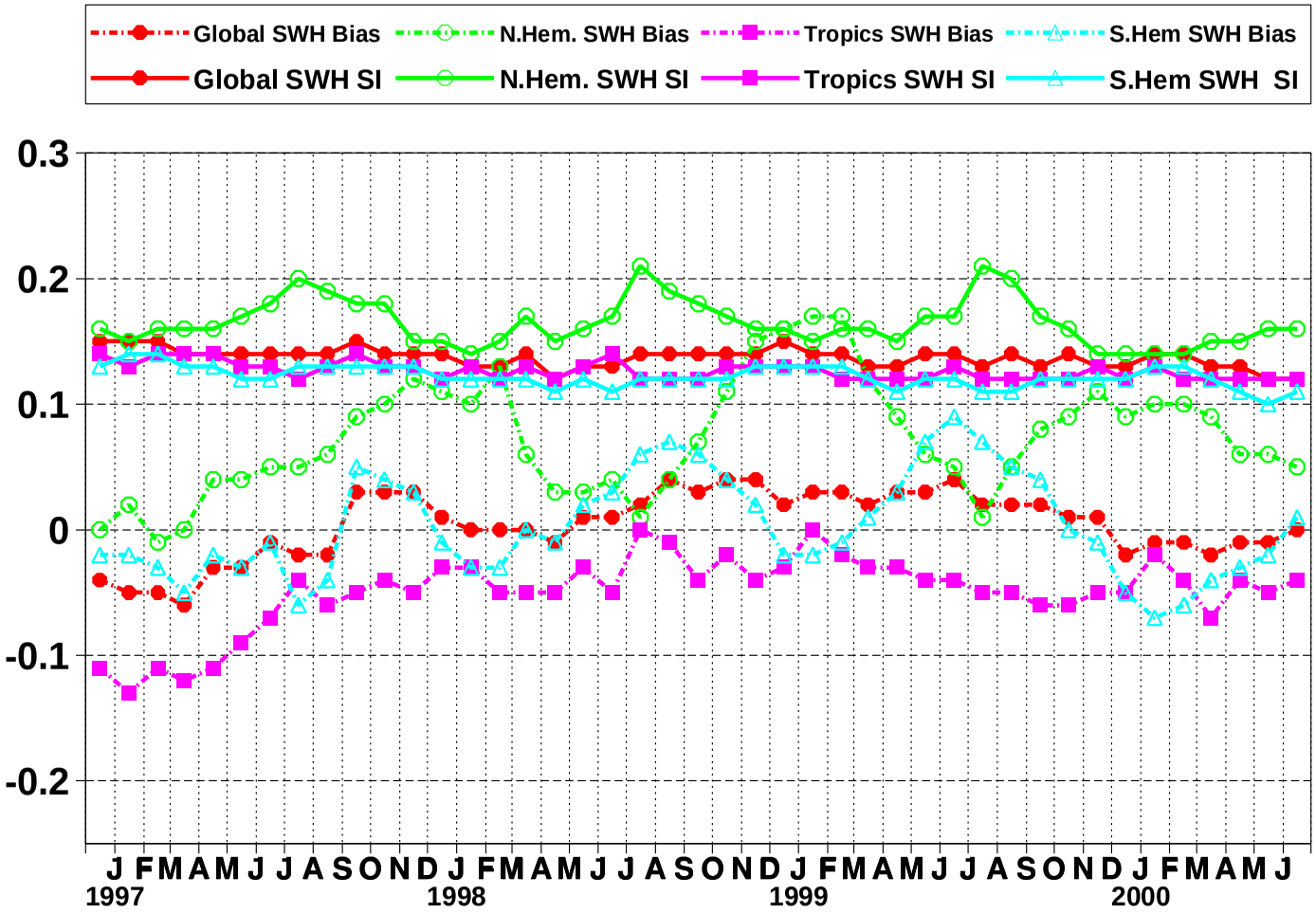


Figure 25: ERS-2 Altimeter wave heights: Timeseries of bias (ERS-2 - model) and scatter index (SI)

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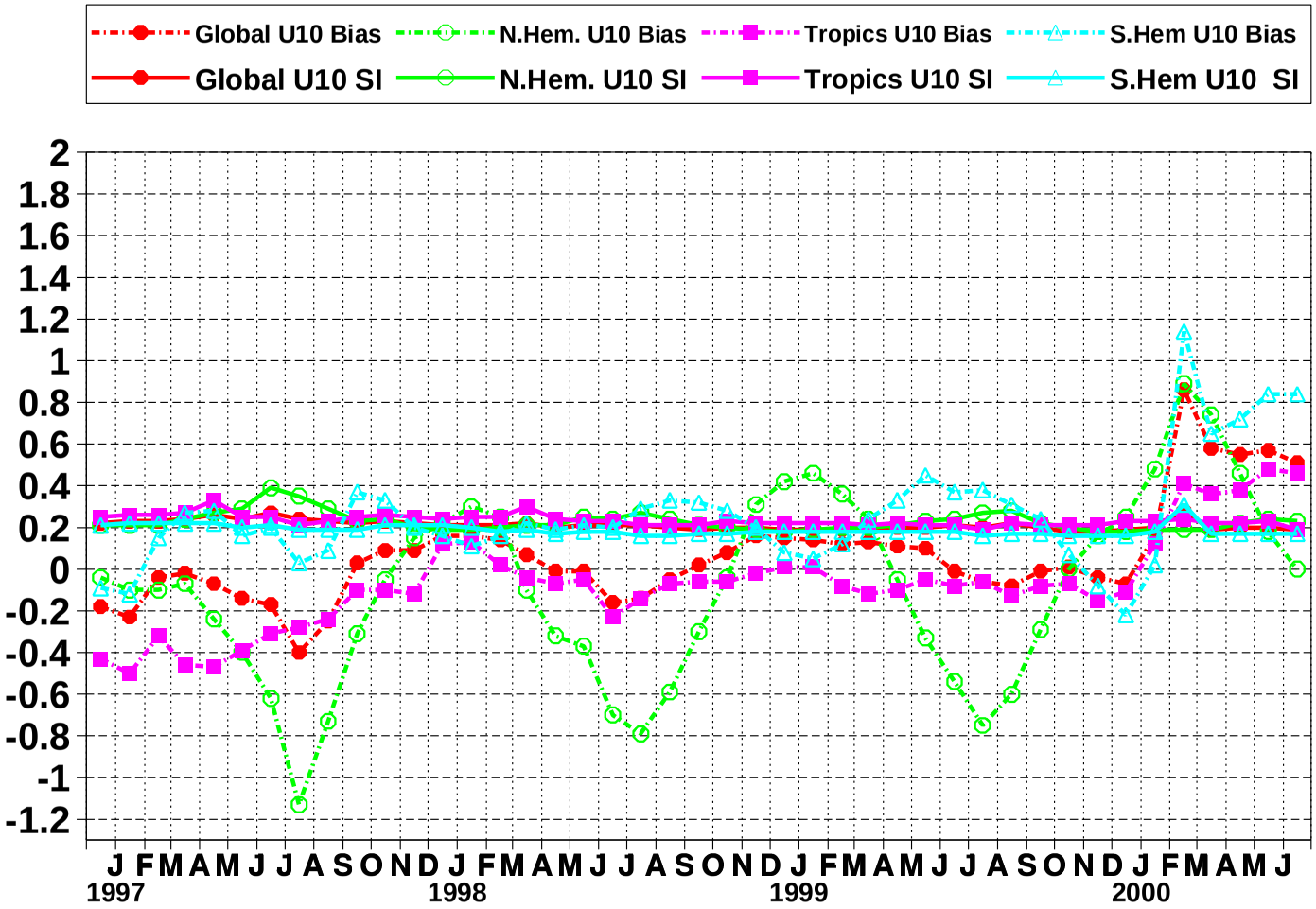


Figure 26: ERS-2 Altimeter wind speeds: Timeseries of bias (ERS-2 - model) and scatter index (SI)

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