ECMWF Report on ERS-2 RA for October 2002

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

By: *Saleh Abdalla*

Date: *5 November 2002*

Overview:

Based on the data received during the full month, on average, 15669 observations arrived at ECMWF every 6 hours of which 2659 were initially rejected as being on land, out of model domain or double observation. On average, 79.3% 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 windows centred at 06:00 and 12:00 UTC on the 16th. of October. Significant reduction of data occurred at the time windows centred at 00:00 and 06:00 UTC on the 6th. and the 7th., and at 00:00 on the 27th. and the 28th. 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 usual.

Backscatter:

ESR-2 $<\sigma_0>$ = 11.11 dB (with a main peak at 11.1 dB and a secondary peak at 10.6 dB)

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Wind Speed Comparison with ECMWF wind speeds (bias):

ERS-2 global: 0.027 m/s

ERS-2 northern hemisphere: -0.012 m/s

ERS-2 tropics: -0.099 m/s

ERS-2 southern hemisphere: 0.146 m/s

Wind Speed Comparison with buoy wind speeds (bias):

ERS-2 global: -0.518 m/s

ERS-2 northern hemisphere: -0.478 m/s

ERS-2 tropics: -1.055 m/s

Wave Height Comparison with ECMWF wave heights (bias):

ERS-2 global: -0.014 m (lowest waves measured: 0.6m)

ERS-2 northern hemisphere: 0.070 m

ERS-2 tropics: -0.069 m

ERS-2 southern hemisphere: -0.028 m

Wave Height Comparison with buoy wave heights (bias):

ERS-2 global: -0.08 m

ERS-2 northern hemisphere: -0.08 m

ERS-2 tropics: -0.28 m

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Remarks:

- The quality of Altimeter data is as good as they 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:

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Figure 4: Distribution of the ERS-2 Altimeter wind speeds after along track averaging for October 2002.
Figure 5: Global distribution of ECMWF ocean surface wind speeds for October 2002.
Figure 6: Comparison of ECMWF wind speed results with ERS-2 Altimeter wind speed data for October 2002 (global).
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Figure 21: Comparison of buoy wave height observations with ERS-2 Altimeter wave height data for October 2002 (global).
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Figure 24: ERS-2 Altimeter wave heights: Timeseries of bias (ERS-2 - model) and scatter index (SI) for October 2002.

Figure 25: ERS-2 Altimeter wave heights: Timeseries of bias (ERS-2 - model) and scatter index (SI) from December 1996 to October 2001

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

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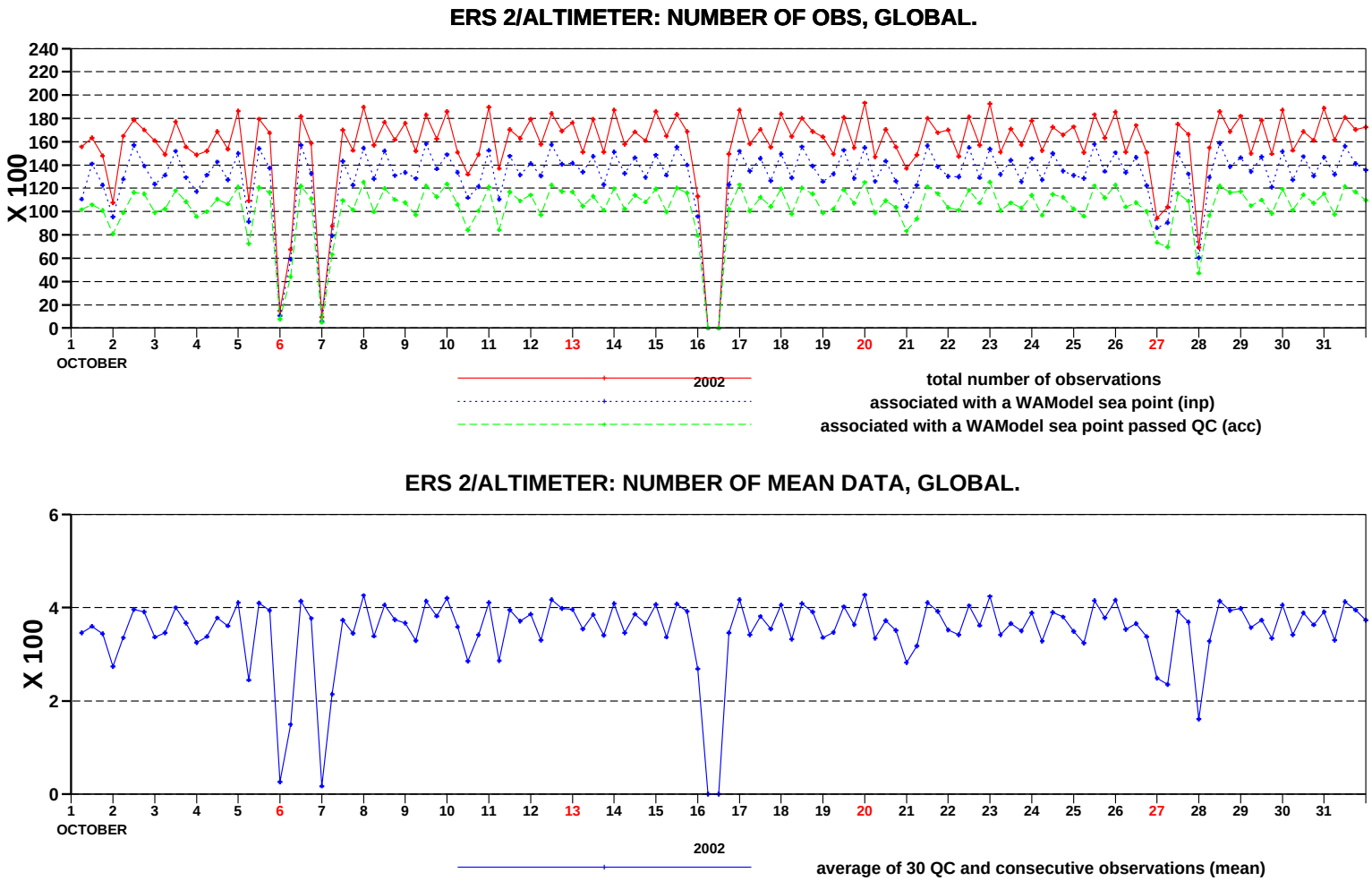


Figure 1: Time series of data reception for ERS-2 Altimeter data for October 2002

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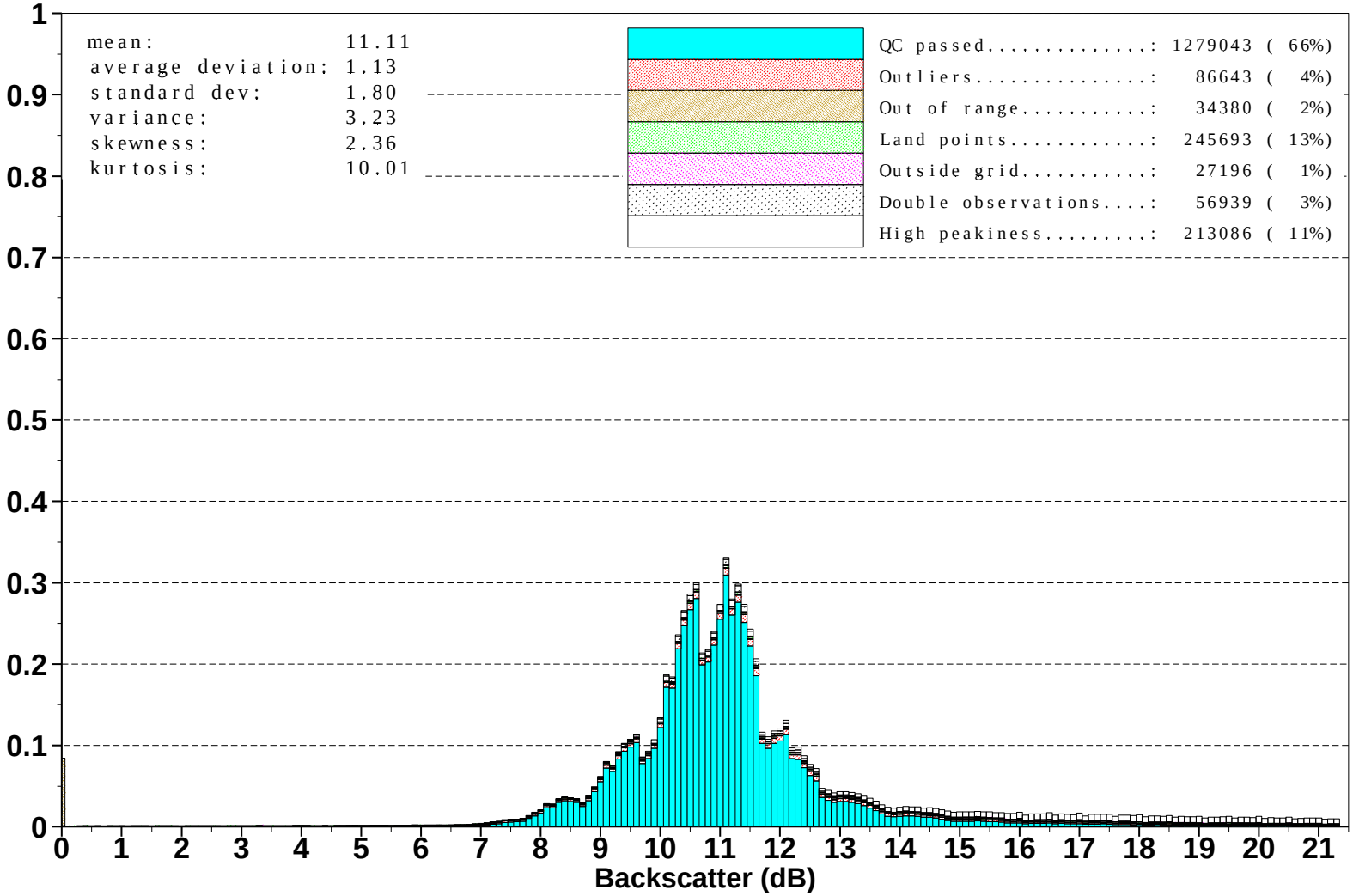


Figure 2: Distribution of the ERS-2 Altimeter backscatter after QC for October 2002

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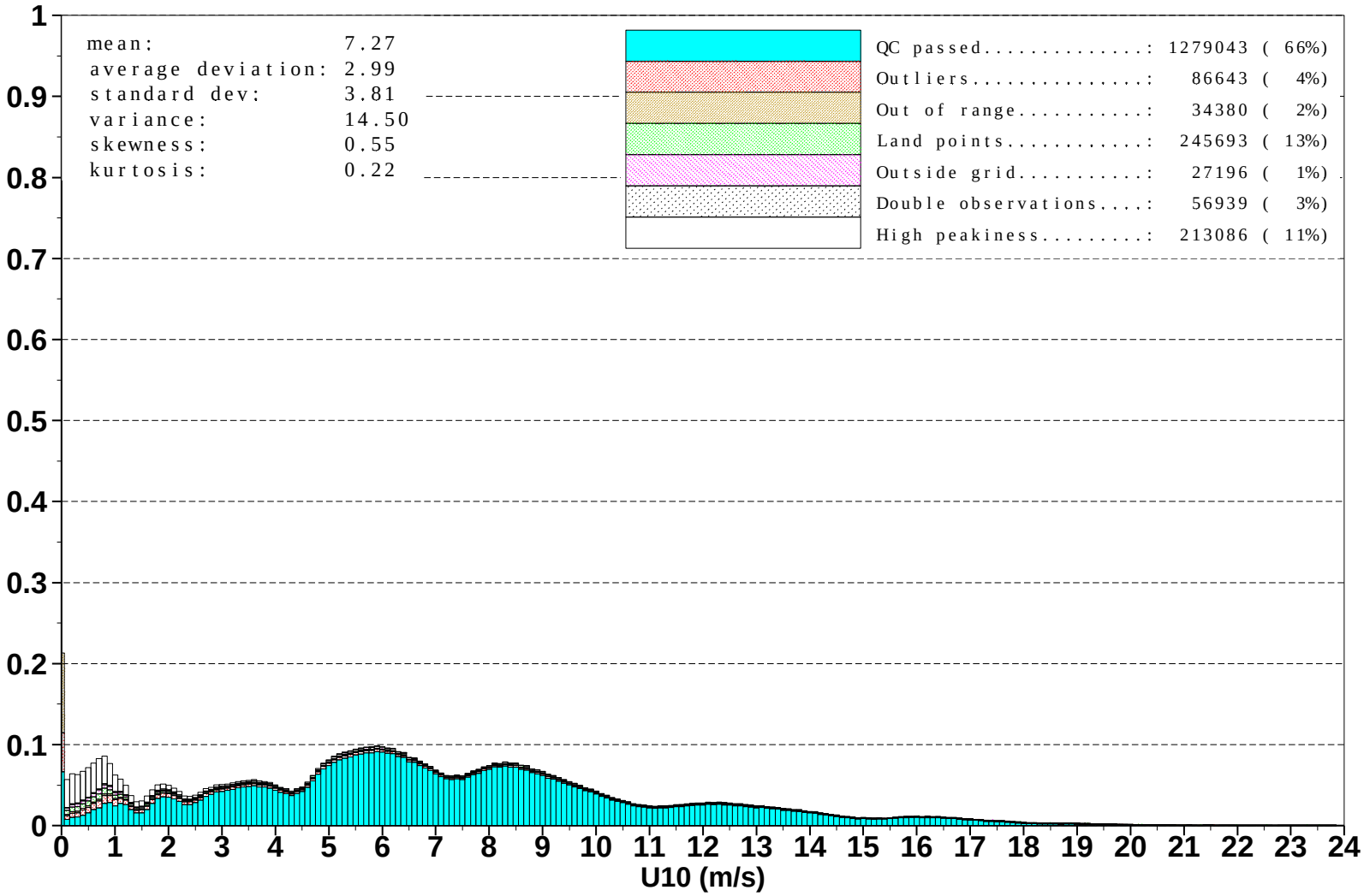


Figure 3: Distribution of the ERS-2 Altimeter wind speeds after QC for October 2002

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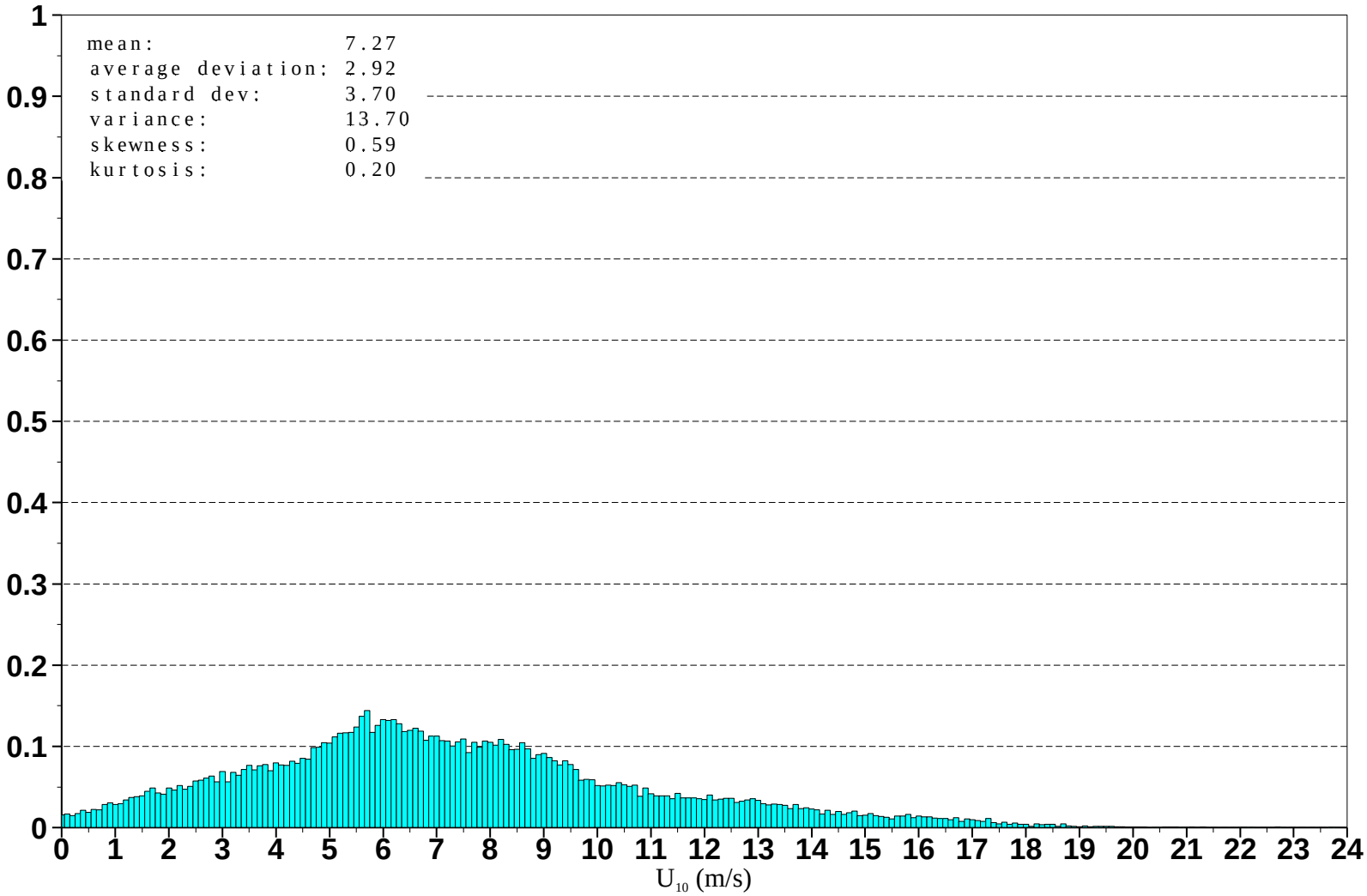


Figure 4: Distribution of ERS-2 Altimeter wind speeds after along track averaging for October 2002

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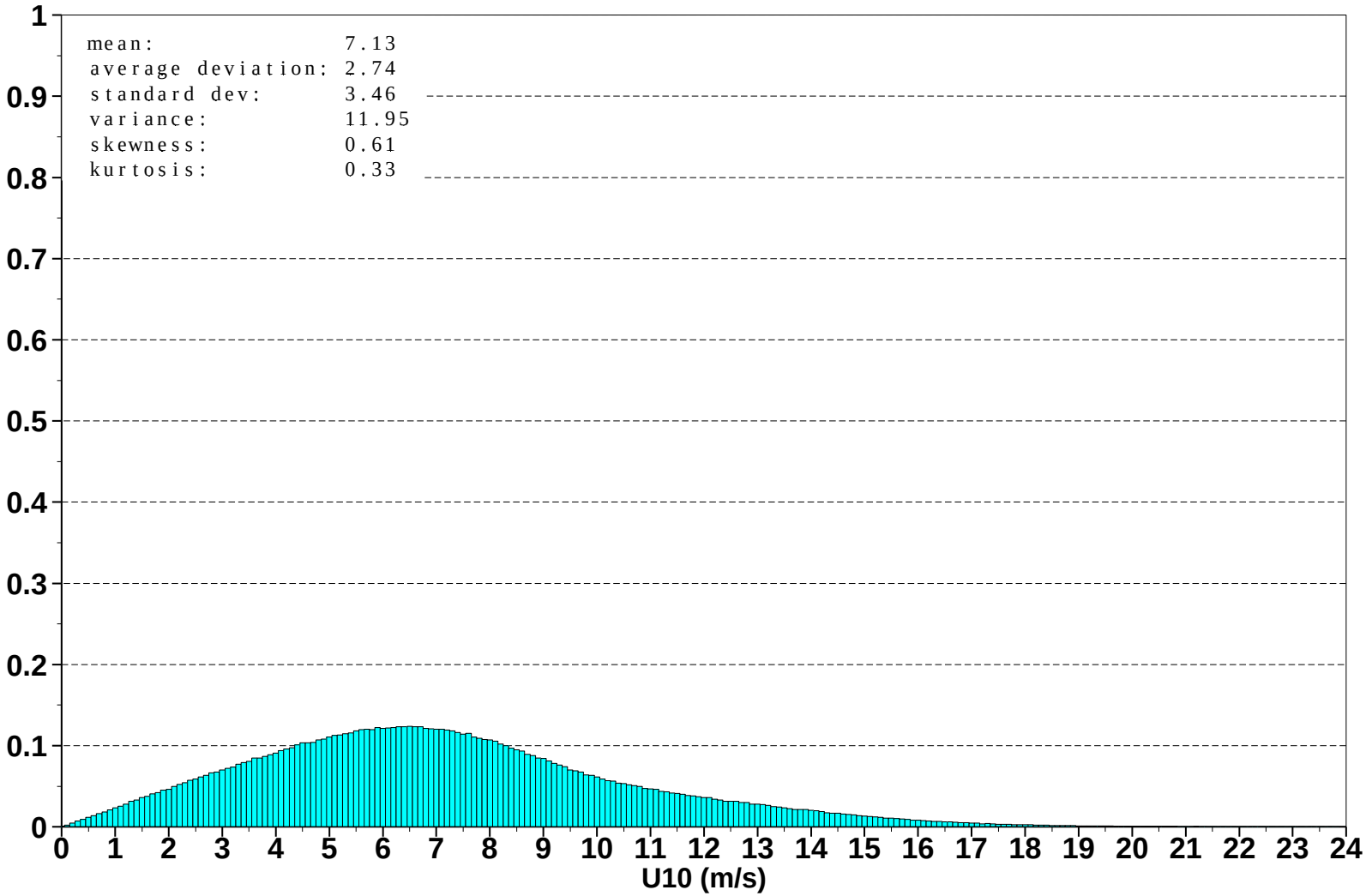
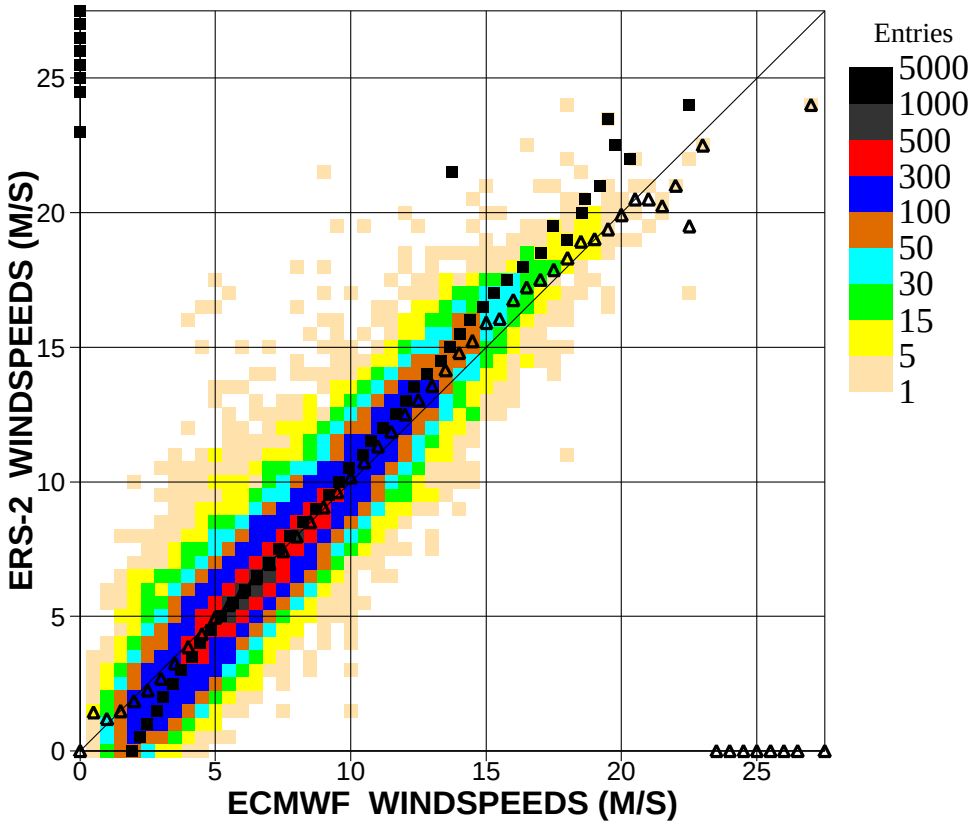


Figure 5: Global distribution of ECMWF ocean surface wind speeds for October 2002

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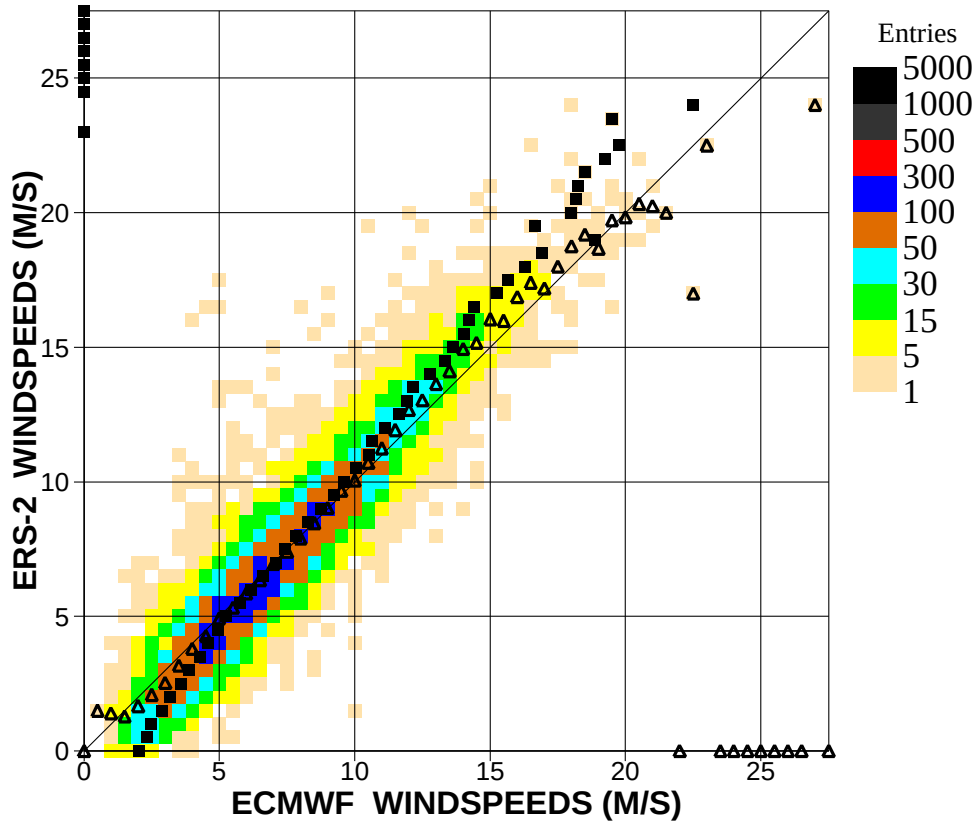
STATISTICS

ENTRIES	43165
MEAN ECMWF	7.2434
MEAN ERS-2	7.2706
BIAS (ERS-2 - ECMWF)	0.0271
STANDARD DEVIATION	1.2890
SCATTER INDEX	0.1780
CORRELATION	0.9393
SYMMETRIC SLOPE	1.0274 (0.0019)
REGR. COEFFICIENT	1.0680 (0.0019)
REGR. CONSTANT	-0.4654 (0.0149)

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

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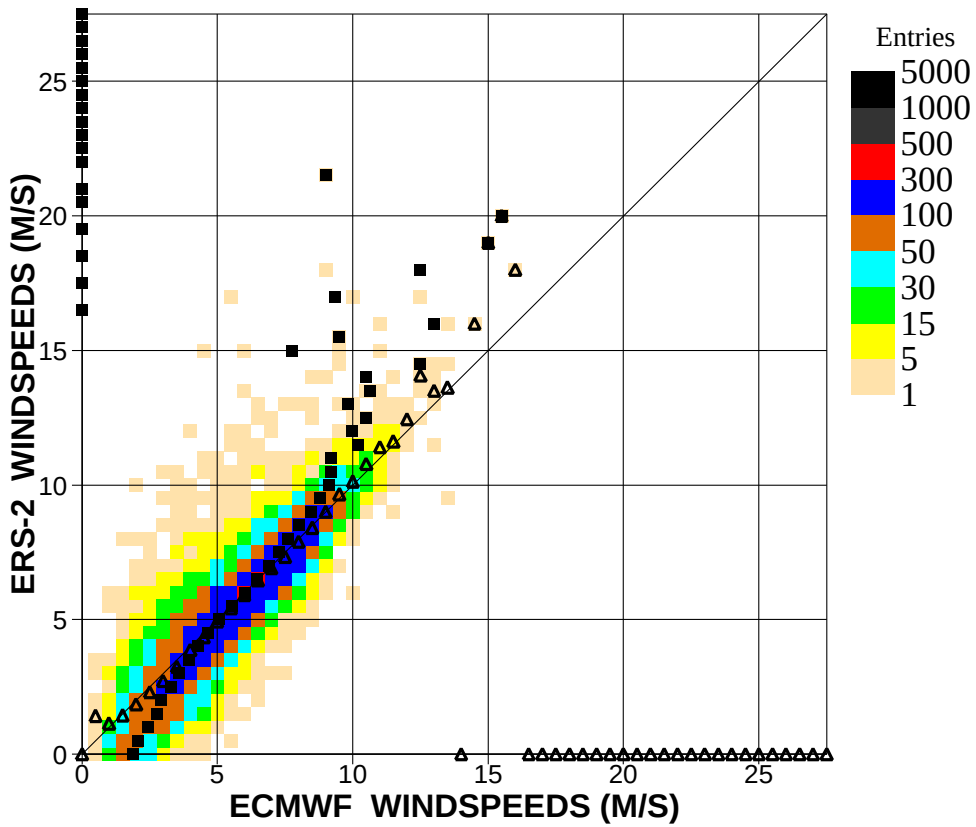
STATISTICS

ENTRIES	11847
MEAN ECMWF	7.3809
MEAN ERS-2	7.3686
BIAS (ERS-2 - ECMWF)	-0.0123
STANDARD DEVIATION	1.3584
SCATTER INDEX	0.1840
CORRELATION	0.9367
SYMMETRIC SLOPE	1.0260 (0.0038)
REGR. COEFFICIENT	1.0822 (0.0037)
REGR. CONSTANT	-0.6190 (0.0300)

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

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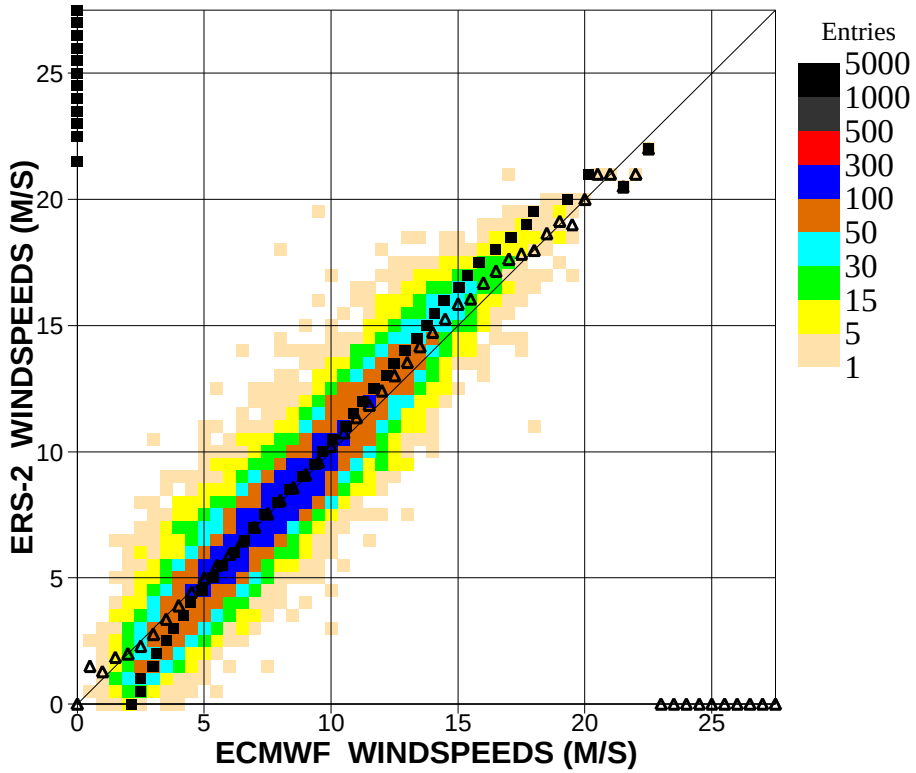
STATISTICS

ENTRIES	13929
MEAN ECMWF	5.6824
MEAN ERS-2	5.5839
BIAS (ERS-2 - ECMWF)	-0.0985
STANDARD DEVIATION	1.1932
SCATTER INDEX	0.2100
CORRELATION	0.8830
SYMMETRIC SLOPE	1.0083 (0.0047)
REGR. COEFFICIENT	1.0318 (0.0046)
REGR. CONSTANT	-0.2791 (0.0283)

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

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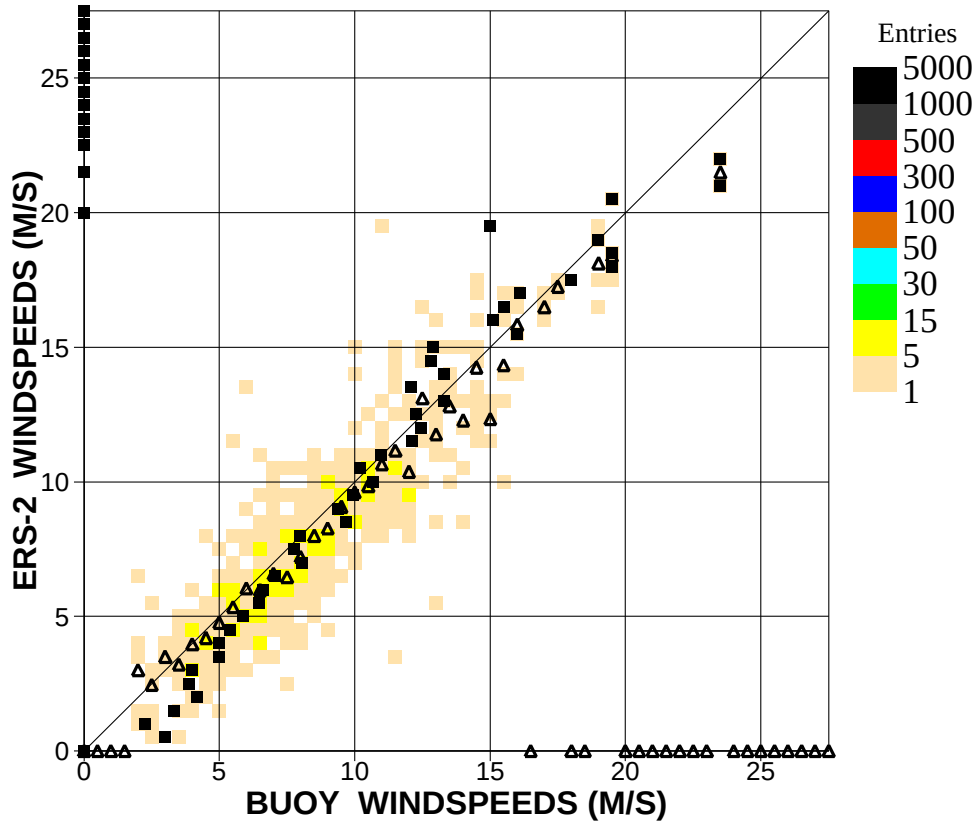


STATISTICS

ENTRIES	17730
MEAN ECMWF	8.3618
MEAN ERS-2	8.5078
BIAS (ERS-2 - ECMWF)	0.1460
STANDARD DEVIATION	1.3007
SCATTER INDEX	0.1555
CORRELATION	0.9437
SYMMETRIC SLOPE	1.0343 (0.0028)
REGR. COEFFICIENT	1.0654 (0.0028)
REGR. CONSTANT	-0.4011 (0.0253)

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

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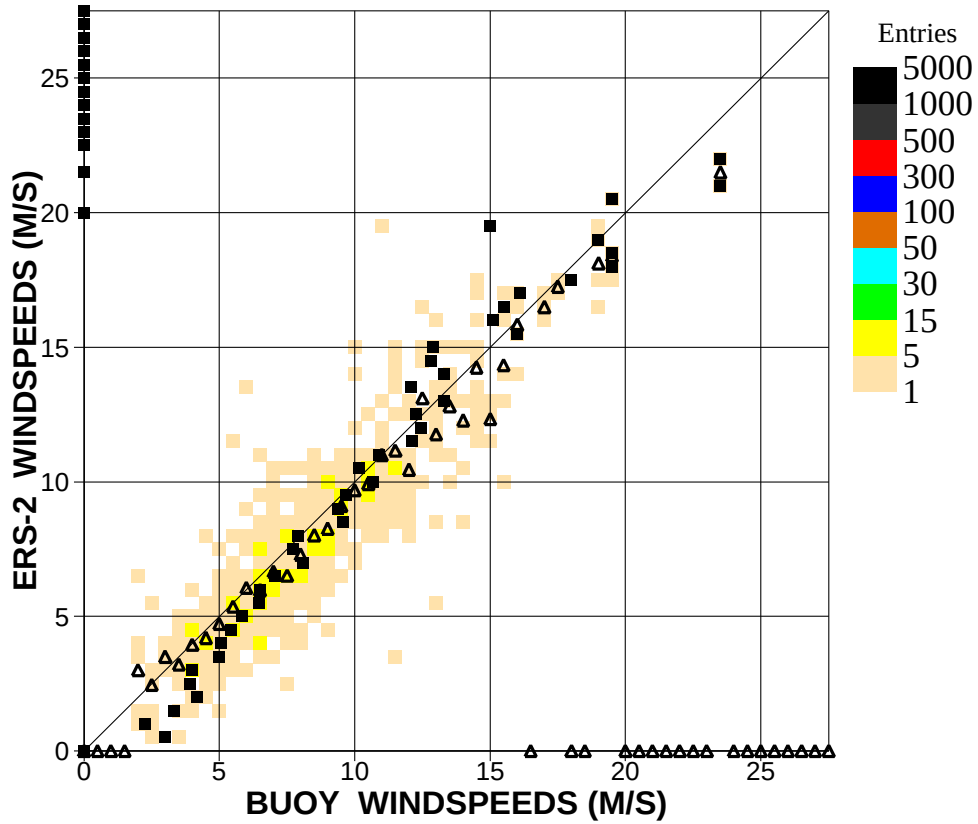


STATISTICS

ENTRIES	654	
MEAN BUOY	8.4098	
MEAN ERS-2	7.8916	
BIAS (ERS-2 - BUOY)	-0.5182	
STANDARD DEVIATION	1.6572	
SCATTER INDEX	0.1971	
CORRELATION	0.8932	
SYMMETRIC SLOPE	0.9546	(0.0185)
REGR. COEFFICIENT	0.9322	(0.0184)
REGR. CONSTANT	0.0520	(0.1674)

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

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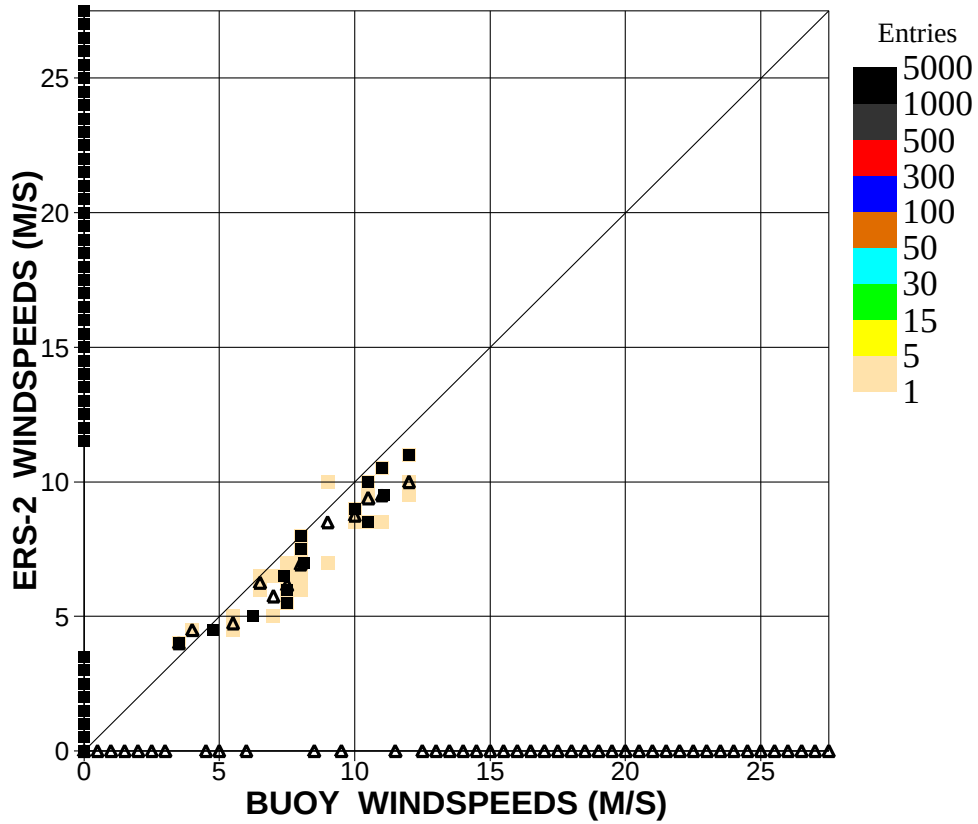


STATISTICS

ENTRIES	596	
MEAN BUOY	8.4343	
MEAN ERS-2	7.9567	
BIAS (ERS-2 - BUOY)	-0.4776	
STANDARD DEVIATION	1.7143	
SCATTER INDEX	0.2033	
CORRELATION	0.8928	
SYMMETRIC SLOPE	0.9601	(0.0194)
REGR. COEFFICIENT	0.9348	(0.0194)
REGR. CONSTANT	0.0720	(0.1775)

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

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STATISTICS

ENTRIES	38	
MEAN BUOY	8.4835	
MEAN ERS-2	7.4289	
BIAS (ERS-2 - BUOY)	-1.0545	
STANDARD DEVIATION	0.7883	
SCATTER INDEX	0.0929	
CORRELATION	0.9288	
SYMMETRIC SLOPE	0.8766	(0.0557)
REGR. COEFFICIENT	0.8284	(0.0551)
REGR. CONSTANT	0.4017	(0.4812)

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

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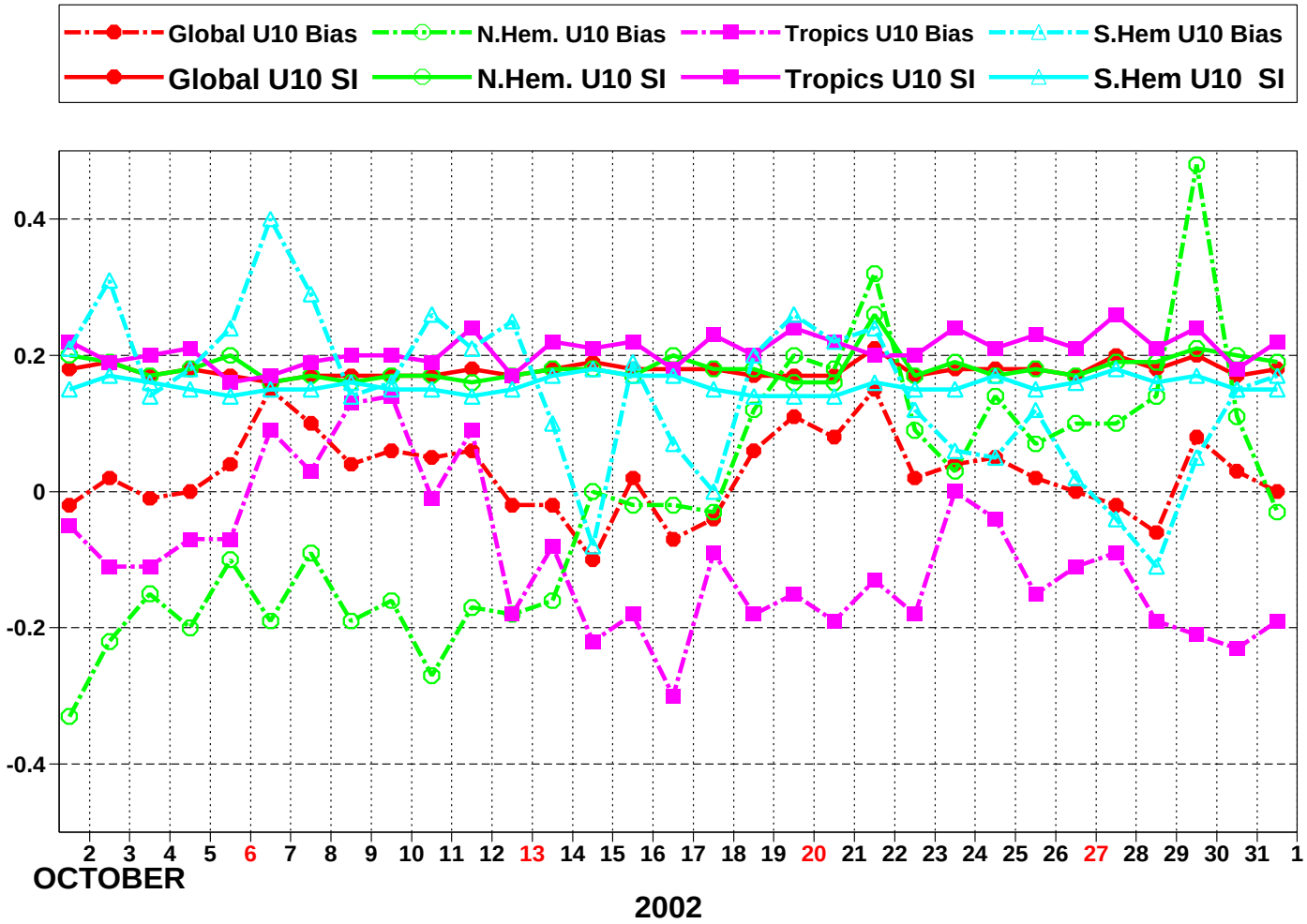


Figure 13: ERS-2 Altimeter wind speeds: Timeseries of bias (ERS-2 - model) and scatter index (SI)

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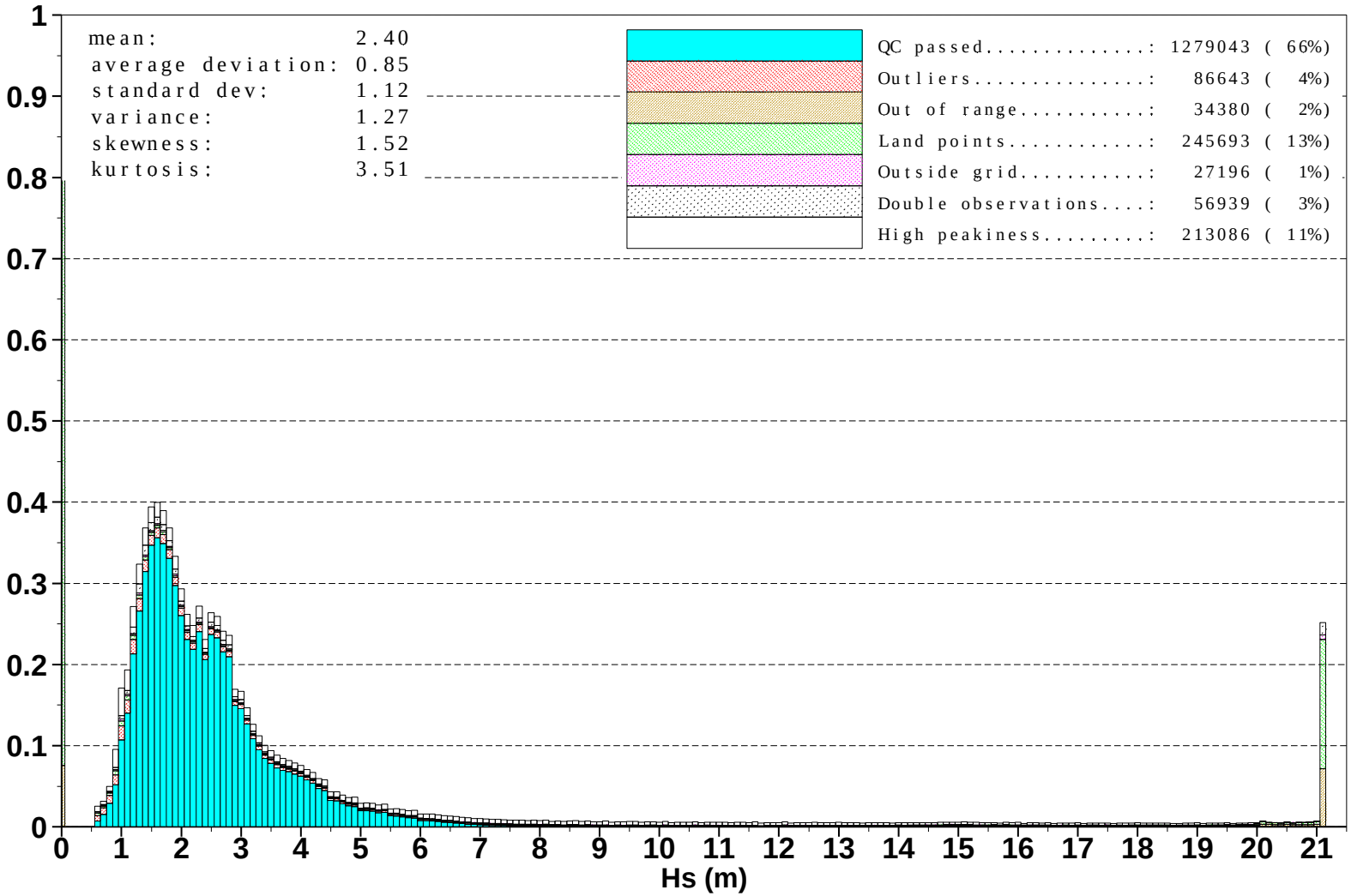


Figure 14: Distribution of the ERS-2 Altimeter wave heights after QC for October 2002

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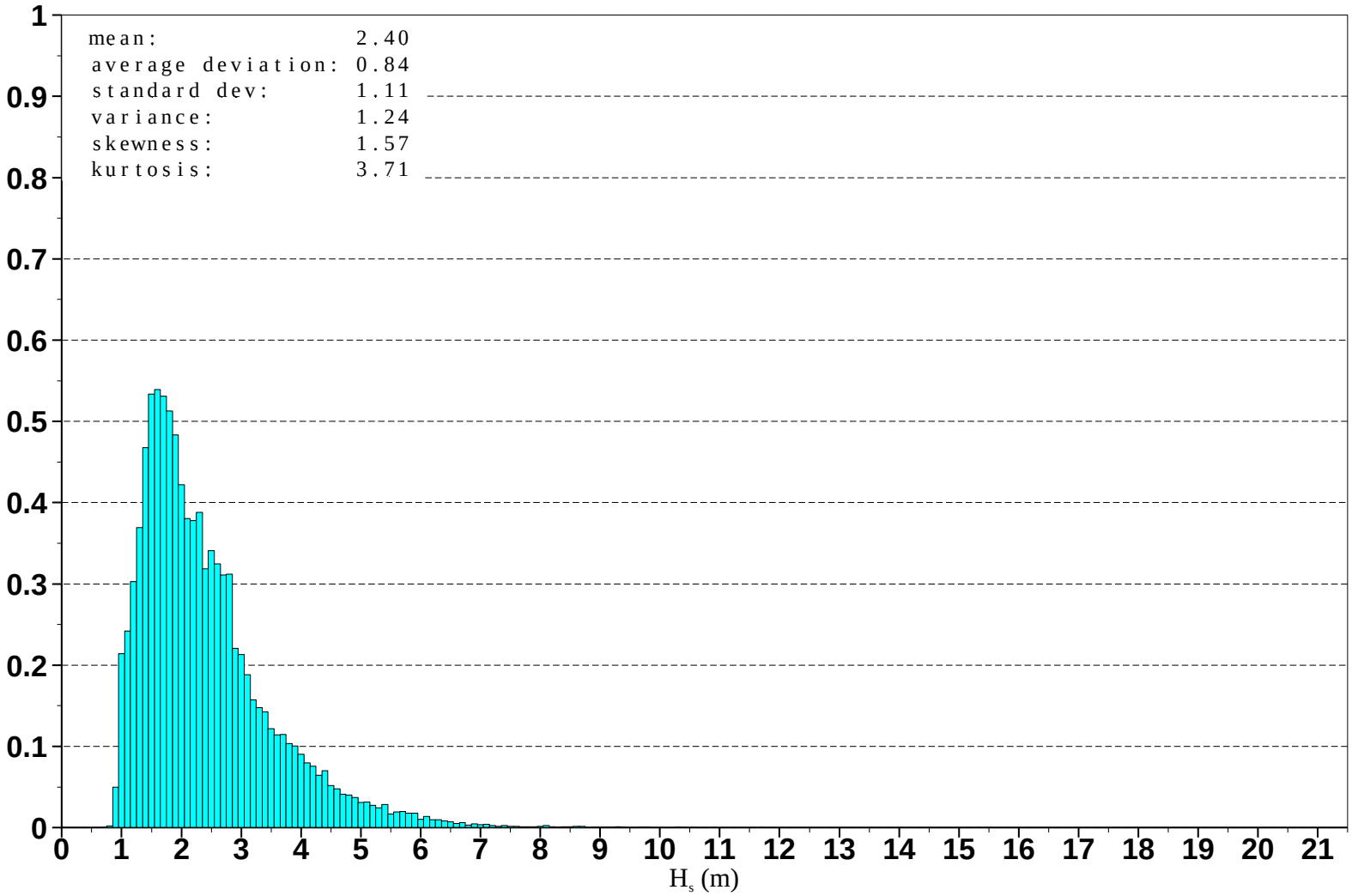


Figure 15: Distribution of ERS-2 Altimeter wave heights after along track averaging for October 2002

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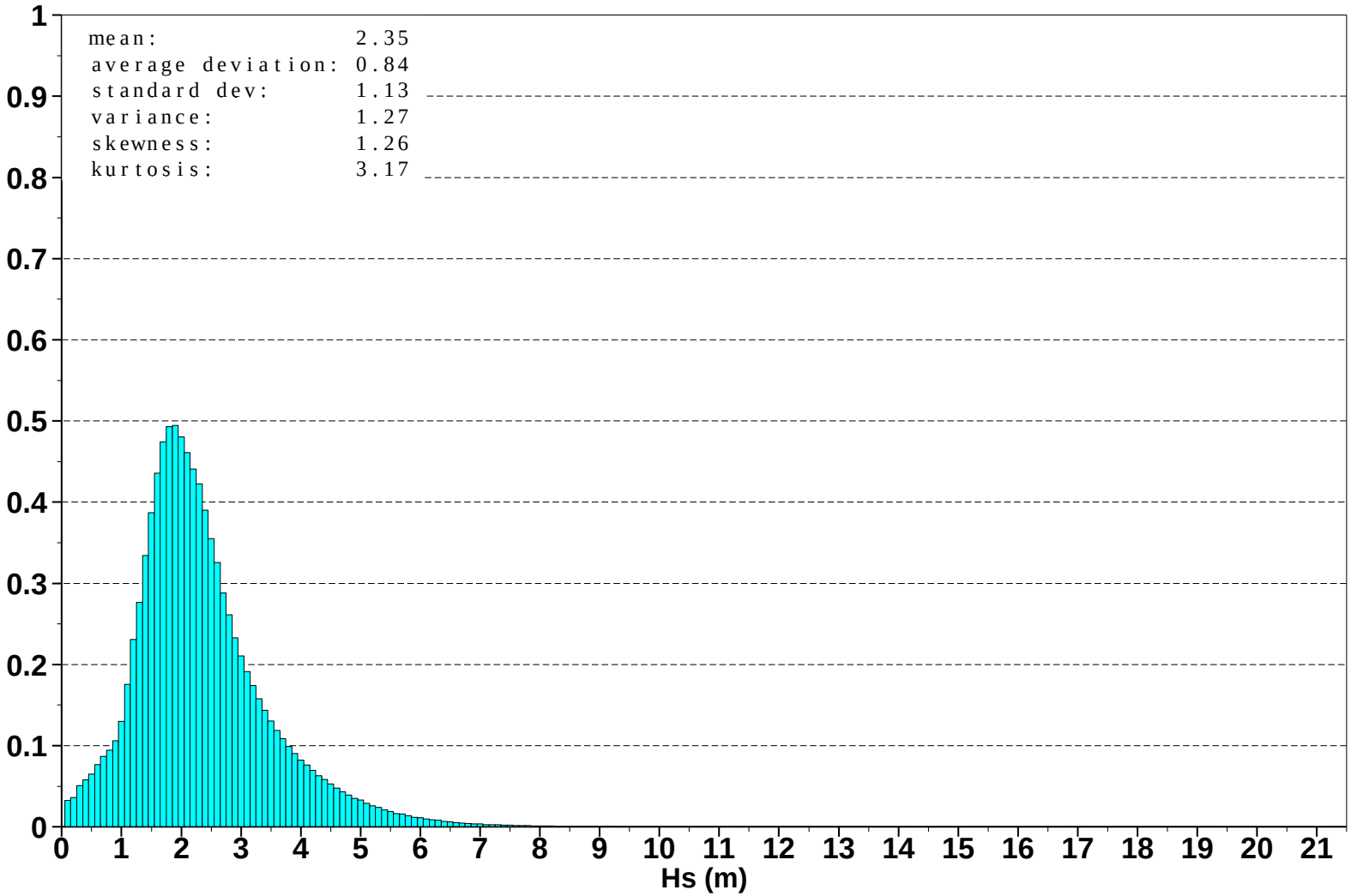
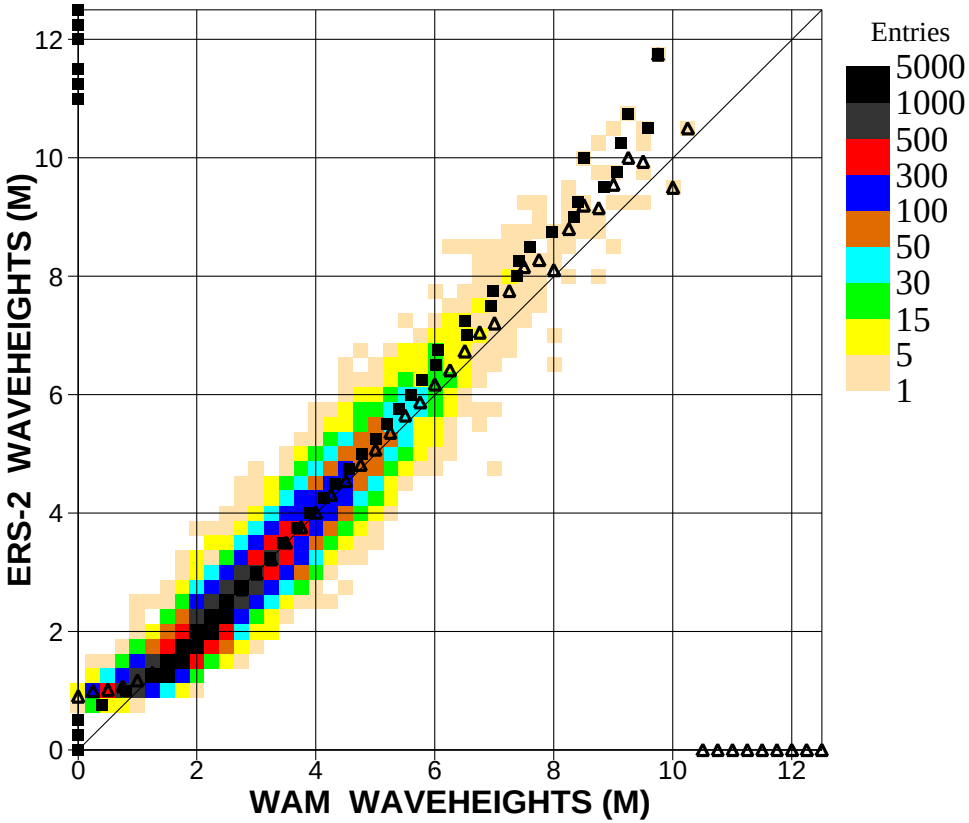


Figure 16: Global distribution of ECMWF wave heights for October 2002

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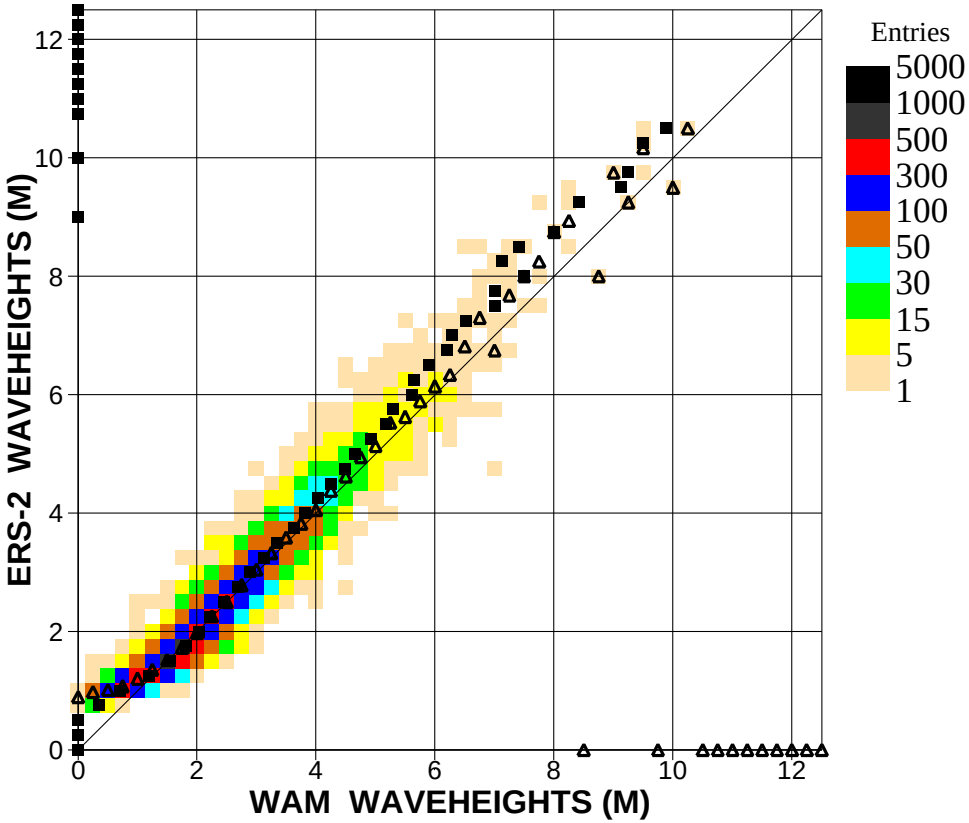


STATISTICS

ENTRIES	43165	
MEAN WAM	2.4158	
MEAN ERS-2	2.4016	
BIAS (ERS-2 - WAM)	-0.0142	
STANDARD DEVIATION	0.2822	
SCATTER INDEX	0.1168	
CORRELATION	0.9673	
SYMMETRIC SLOPE	1.0014	(0.0013)
REGR. COEFFICIENT	1.0040	(0.0013)
REGR. CONSTANT	-0.0239	(0.0033)

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

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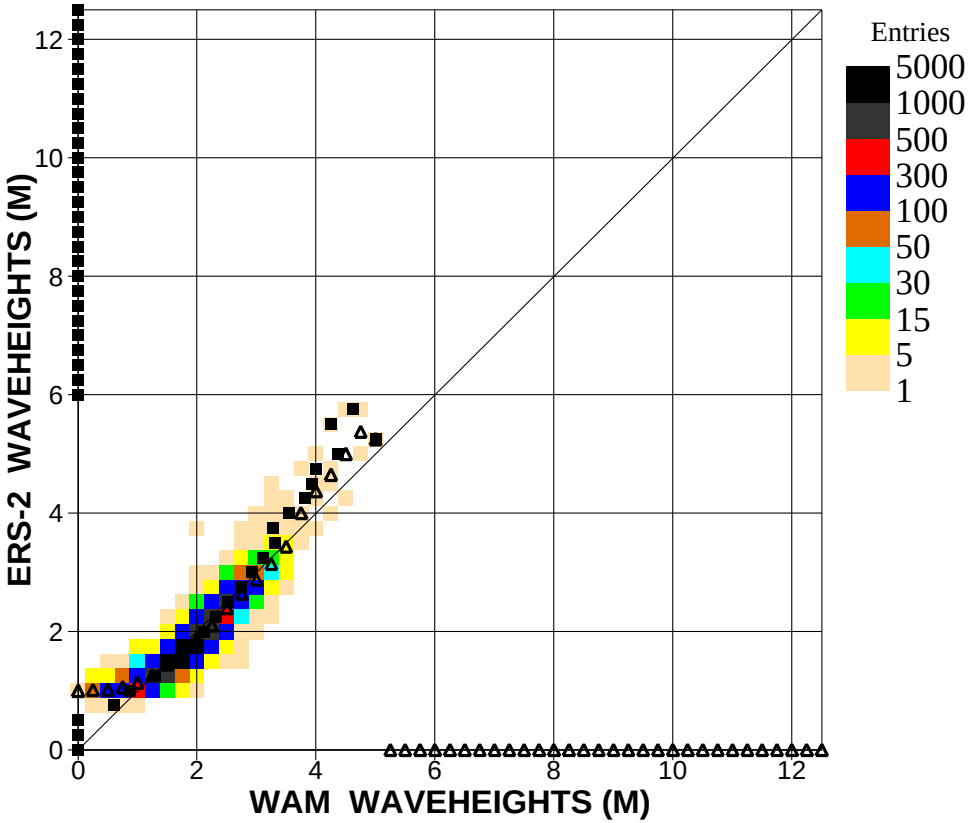


STATISTICS

ENTRIES	11847	
MEAN WAM	2.2569	
MEAN ERS-2	2.3266	
BIAS (ERS-2 - WAM)	0.0697	
STANDARD DEVIATION	0.3109	
SCATTER INDEX	0.1378	
CORRELATION	0.9615	
SYMMETRIC SLOPE	1.0285	(0.0026)
REGR. COEFFICIENT	0.9794	(0.0026)
REGR. CONSTANT	0.1161	(0.0065)

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

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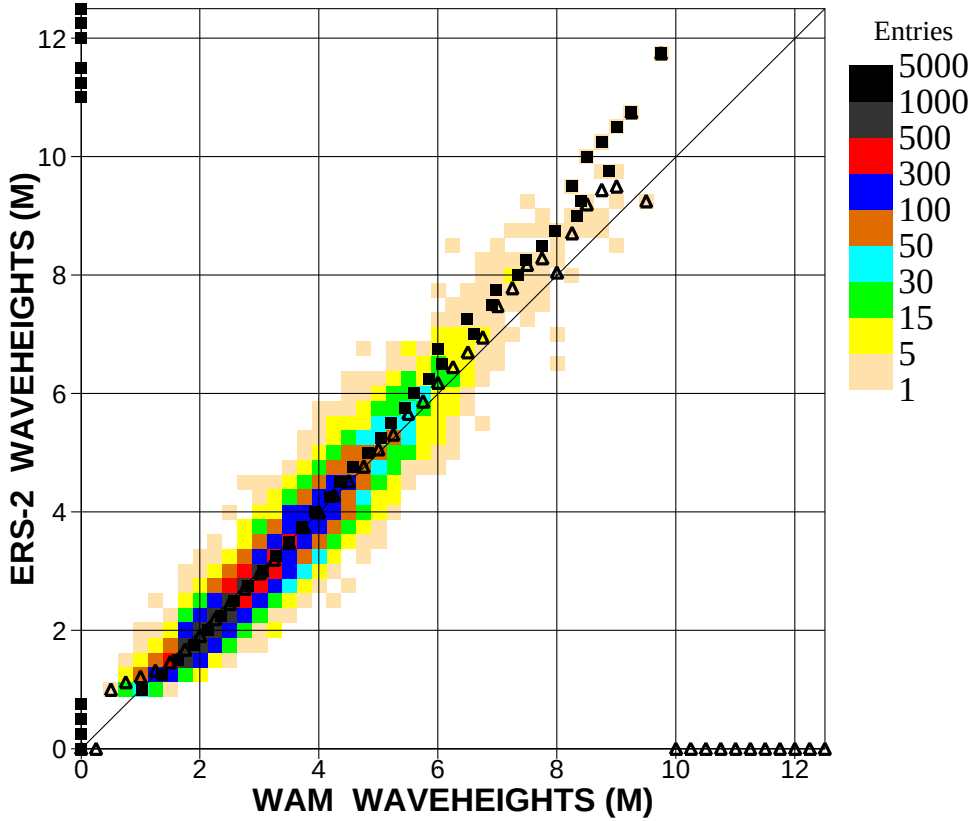


STATISTICS

ENTRIES	13929	
MEAN WAM	1.8497	
MEAN ERS-2	1.7804	
BIAS (ERS-2 - WAM)	-0.0693	
STANDARD DEVIATION	0.2014	
SCATTER INDEX	0.1089	
CORRELATION	0.9277	
SYMMETRIC SLOPE	0.9594	(0.0030)
REGR. COEFFICIENT	0.8554	(0.0029)
REGR. CONSTANT	0.1980	(0.0056)

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

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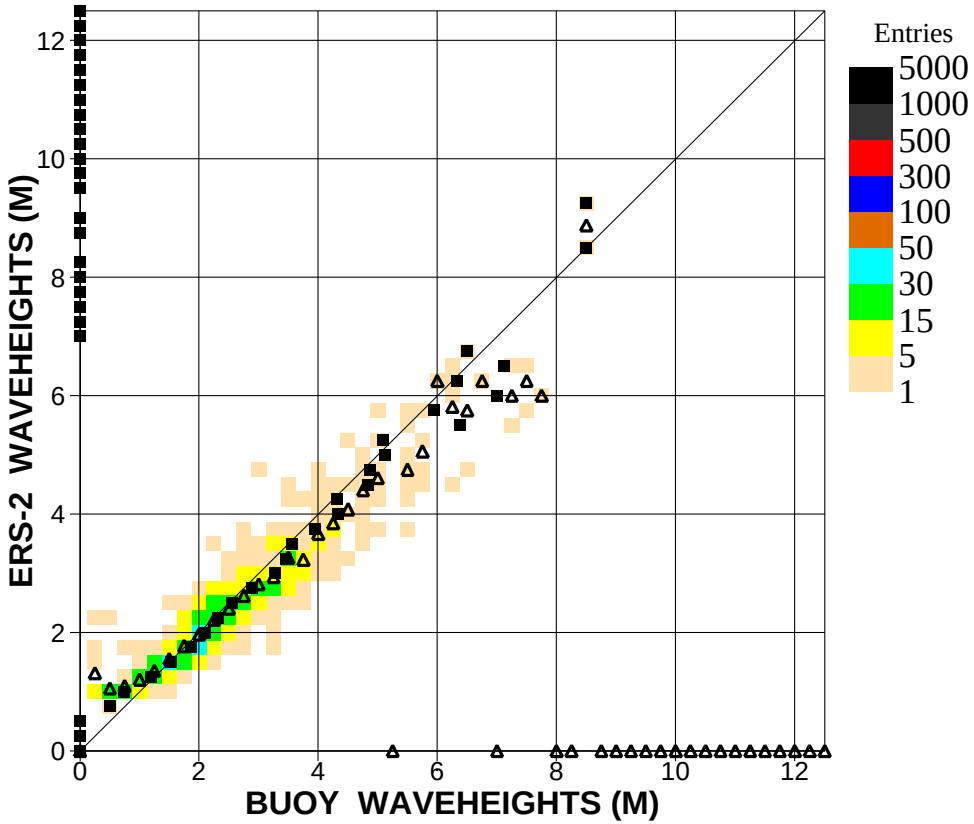


STATISTICS

ENTRIES	17730	
MEAN WAM	2.9589	
MEAN ERS-2	2.9310	
BIAS (ERS-2 - WAM)	-0.0279	
STANDARD DEVIATION	0.3016	
SCATTER INDEX	0.1019	
CORRELATION	0.9677	
SYMMETRIC SLOPE	1.0016	(0.0021)
REGR. COEFFICIENT	1.0442	(0.0020)
REGR. CONSTANT	-0.1586	(0.0064)

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

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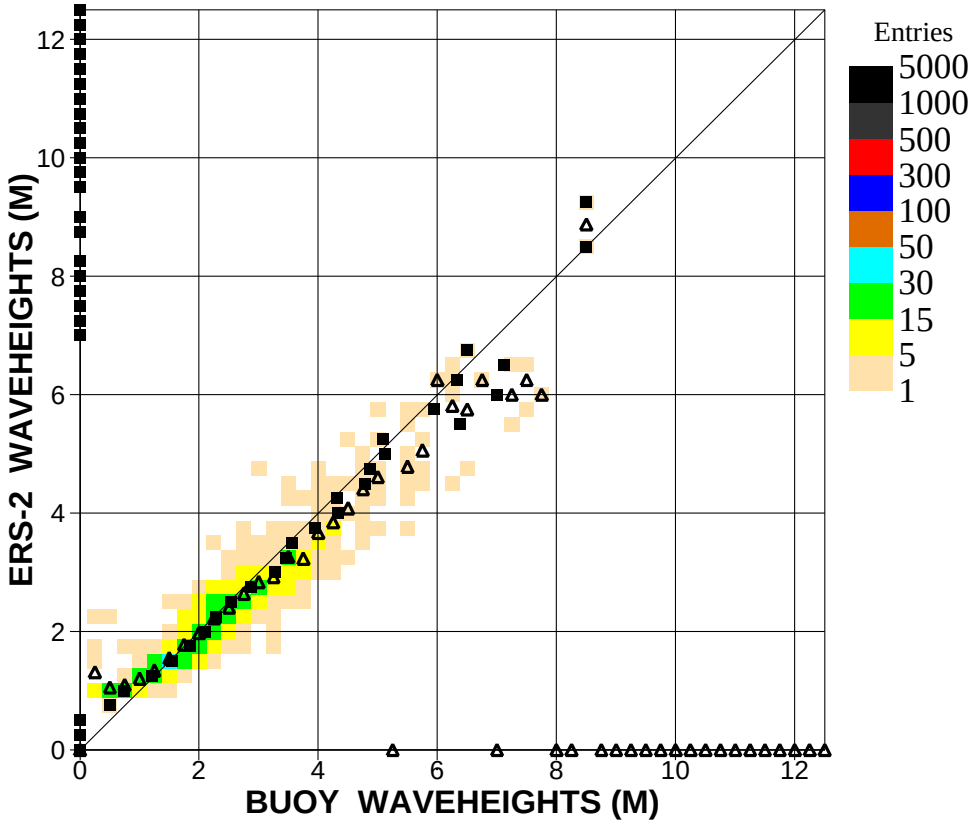


STATISTICS

ENTRIES	895	
MEAN BUOY	2.4725	
MEAN ERS-2	2.3901	
BIAS (ERS-2 - BUOY)	-0.0824	
STANDARD DEVIATION	0.4261	
SCATTER INDEX	0.1723	
CORRELATION	0.9407	
SYMMETRIC SLOPE	0.9475	(0.0109)
REGR. COEFFICIENT	0.8137	(0.0098)
REGR. CONSTANT	0.3783	(0.0271)

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

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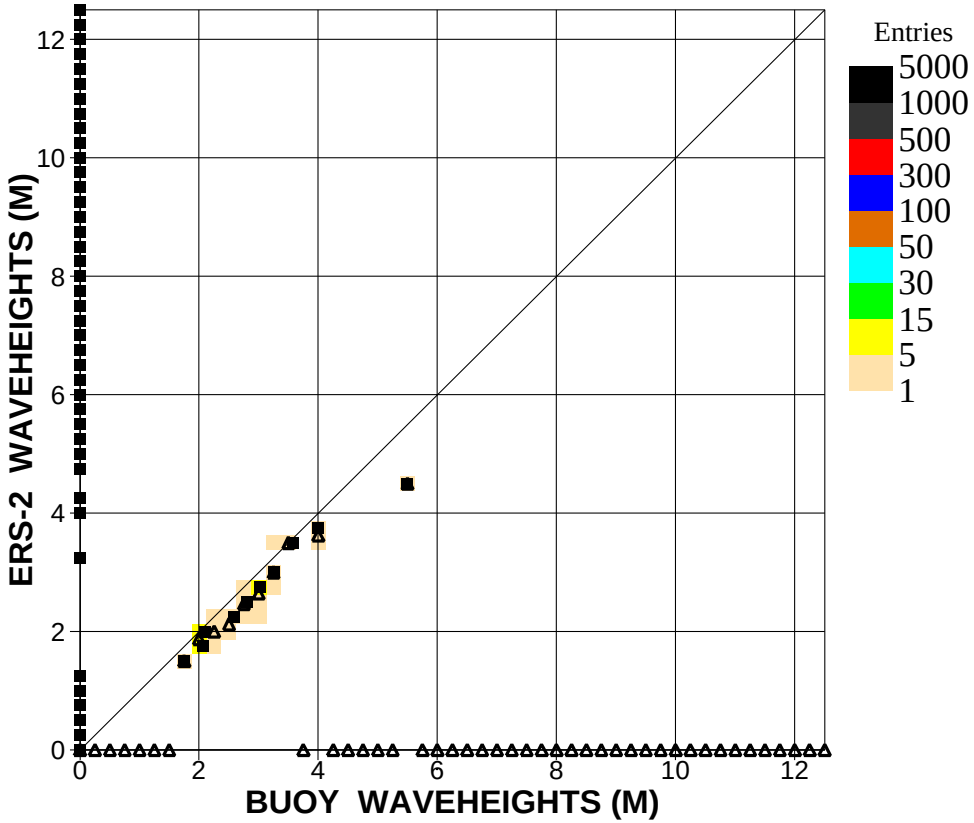


STATISTICS

ENTRIES	834	
MEAN BUOY	2.4828	
MEAN ERS-2	2.4048	
BIAS (ERS-2 - BUOY)	-0.0780	
STANDARD DEVIATION	0.4343	
SCATTER INDEX	0.1749	
CORRELATION	0.9403	
SYMMETRIC SLOPE	0.9490	(0.0113)
REGR. COEFFICIENT	0.8150	(0.0102)
REGR. CONSTANT	0.3814	(0.0284)

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

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STATISTICS

ENTRIES	40	
MEAN BUOY	2.7171	
MEAN ERS-2	2.4333	
BIAS (ERS-2 - BUOY)	-0.2839	
STANDARD DEVIATION	0.2385	
SCATTER INDEX	0.0878	
CORRELATION	0.9514	
SYMMETRIC SLOPE	0.8930	(0.0446)
REGR. COEFFICIENT	0.8153	(0.0428)
REGR. CONSTANT	0.2179	(0.1204)

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

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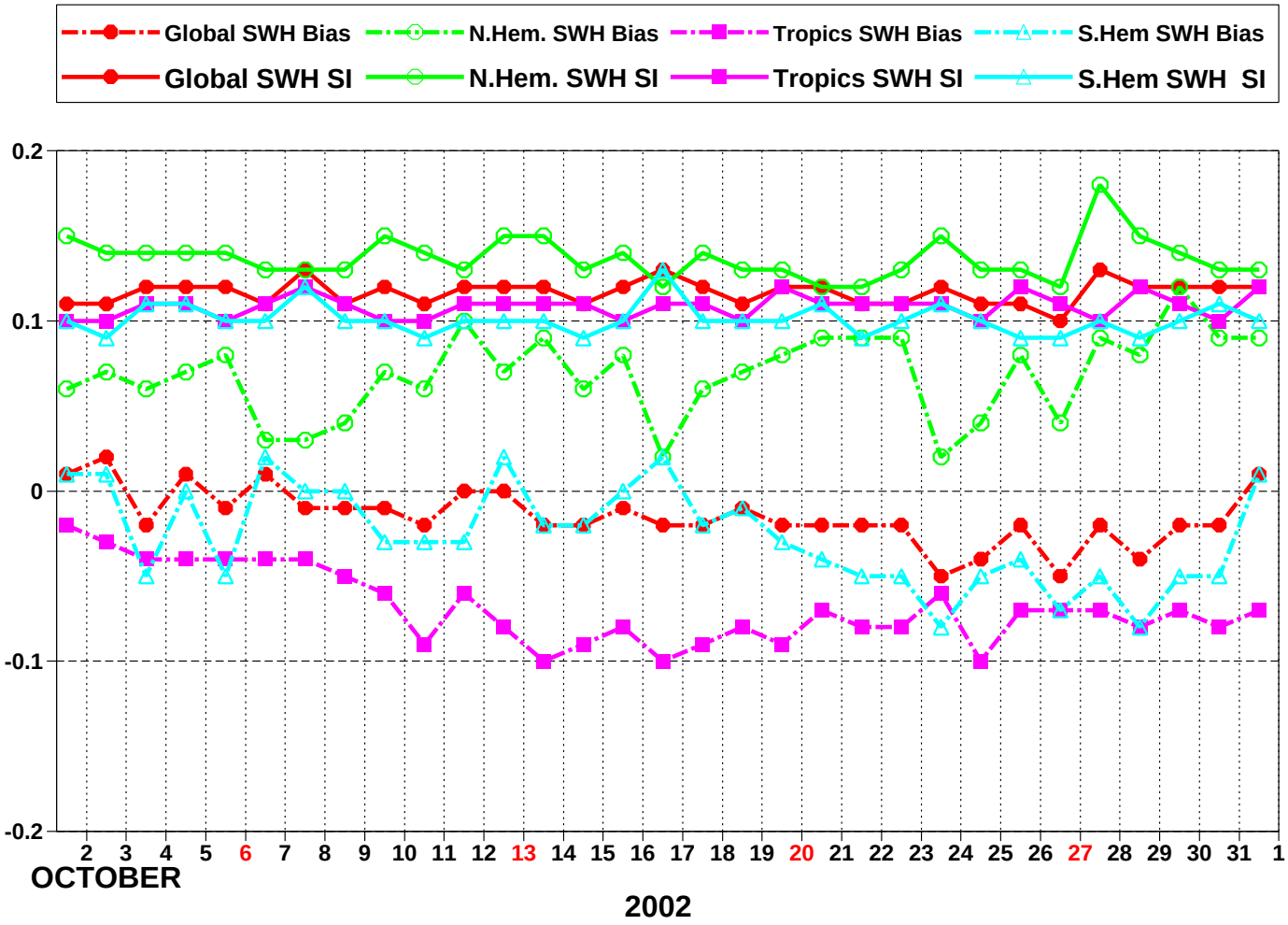


Figure 24: ERS-2 Altimeter wave heights: Timeseries of bias (ERS-2 - model) and scatter index (SI)

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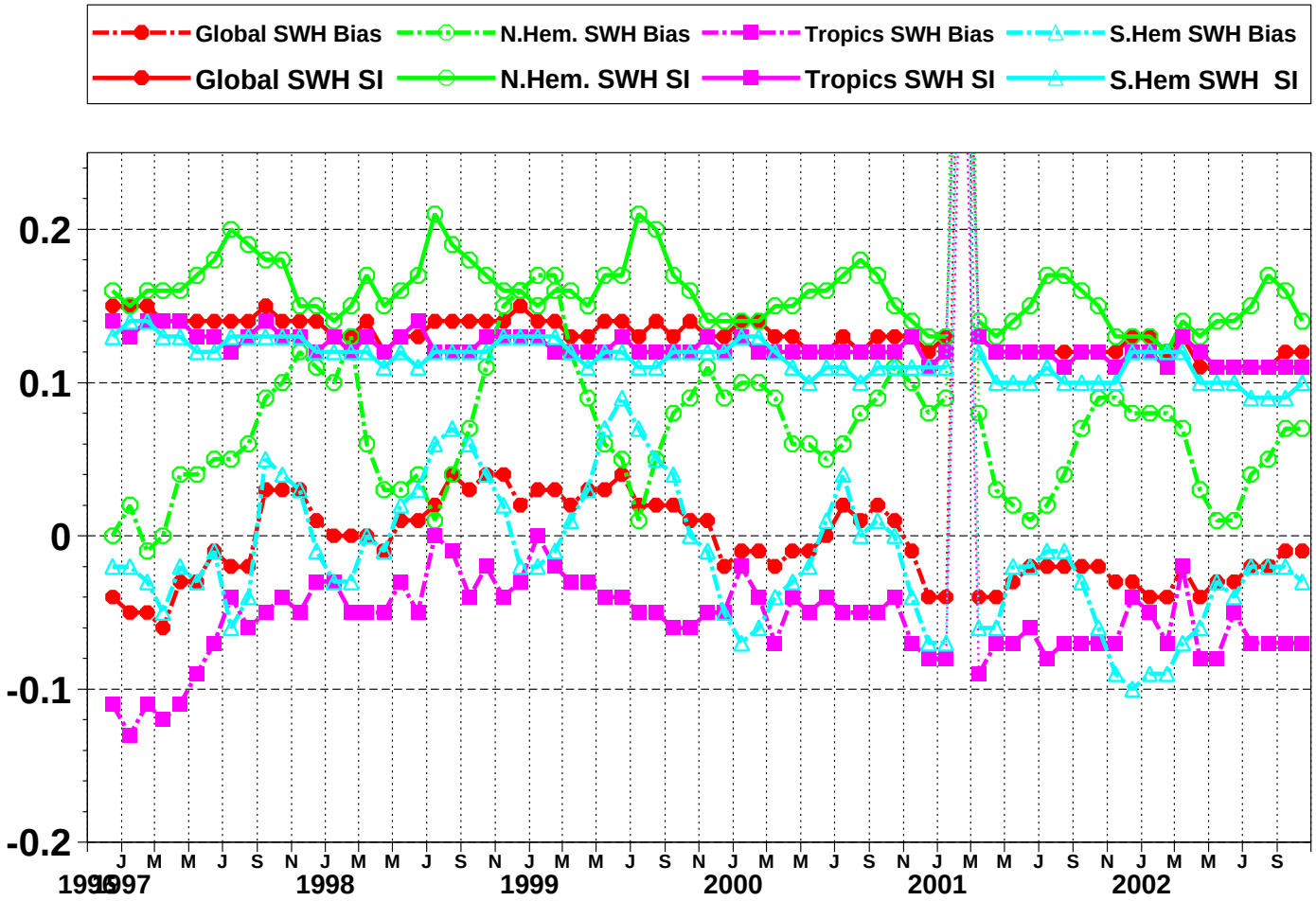


Figure 25: ERS-2 Altimeter wave heights: Timeseries of bias (ERS-2 - model) and scatter index (SI)

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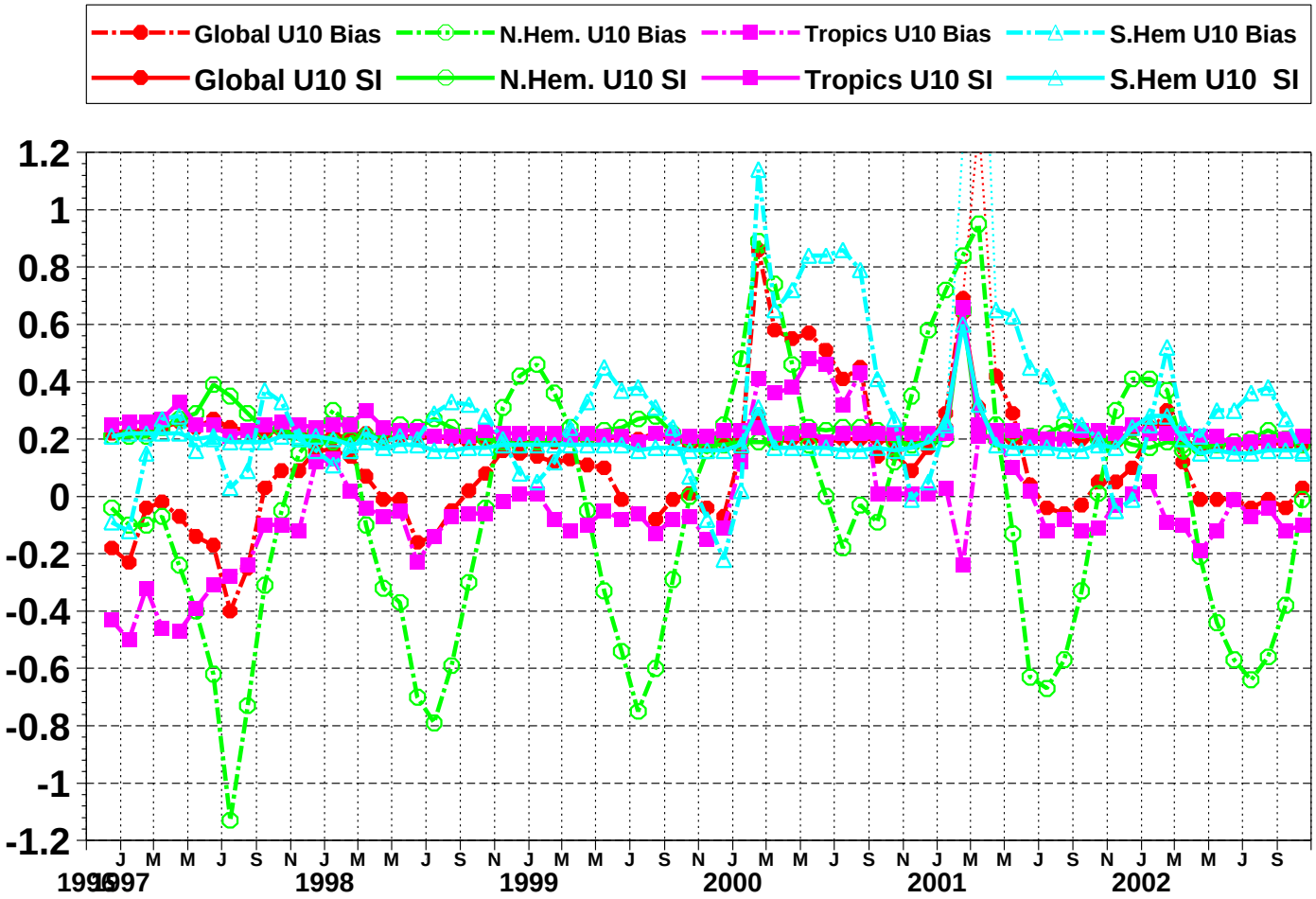


Figure 26: ERS-2 Altimeter wind speeds: Timeseries of bias (ERS-2 - model) and scatter index (SI)

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