ECMWF Report on ERS-2 RA for June 2004

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

By: *Saleh Abdalla*

Date: *12 July 2004*

Overview:

Based on the data received during the whole month, on average, 3416 observations arrived at ECMWF every 6 hours of which 64.82% passed the quality control. The data coverage has been significantly reduced to around 15% of the nominal data reception following the failure of the ERS-2 tape recorders. As can be seen in Figure 1, there was no data gaps for this 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, which are now limited to the **North Atlantic and the western coast of North America**, is as good as usual.

Backscatter:

ESR-2 $<\sigma_0>$ = 11.88 dB (with a main peak at ~11.1 dB and a secondary peak at ~ 10.6 dB)

Wind Speed Comparison with ECMWF wind speeds (bias):

ERS-2 global: -0.525 m/s

ERS-2 northern hemisphere: -0.578 m/s

ERS-2 tropics: +0.064 m/s

ERS-2 southern hemisphere: *missing*

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Wind Speed Comparison with buoy wind speeds (bias):

ERS-2 global: -0.827 m/s

ERS-2 northern hemisphere: -0.821 m/s

ERS-2 tropics: *missing*

Wave Height Comparison with ECMWF wave heights (bias):

ERS-2 global: 0.060 m (lowest waves measured: 0.6m)

ERS-2 northern hemisphere: 0.070 m

ERS-2 tropics: -0.059 m

ERS-2 southern hemisphere: *missing*

Wave Height Comparison with buoy wave heights (bias):

ERS-2 global: 0.057 m

ERS-2 northern hemisphere: 0.056 m

ERS-2 tropics: *missing*

Remarks:

- The quality of Altimeter data, both wind speed and significant wave height, is as good as it used to be.

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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. ESA has the intention to extend the coverage of the Real Time Low Rate acquisition over the North Atlantic in the near future.
- Assimilation of ERS-2 RA wave heights into ECMWF wave model was stopped on 21st. of October 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 if they were not so close).
- ENVISAT Ku-Band wave height data and ERS-2 SAR wave data are assimilated in the ECMWF wave model.
- Starting from time window 00:00 UTC on 29 June 2004, the ECMWF Integrated Forecast System (IFS) set-up was changed to provide early delivery forecasts. This change does not have major impact on the quality of the model products. A different time schedule for data cut-off was implemented. Shorter data time delays are allowed for operational early delivery (ED) analysis and forecasts, while longer delays are allowed for the delayed cut-off (DC) analysis used as the basis to the subsequent operational ED analysis and forecasts.

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 2004.

Figure 2: Distribution of the ERS-2 Altimeter Backscatter after QC for June 2004.

Figure 3: Distribution of the ERS-2 Altimeter wind speeds after QC for June 2004.

Figure 4: Distribution of the ERS-2 Altimeter wind speeds after along track averaging for June 2004.

Figure 5: Global distribution of ECMWF ocean surface wind speeds for June 2004.

Figure 6: Comparison of ECMWF wind speed results with ERS-2 Altimeter wind speed data for June 2004 (global).

Figure 7: Comparison of ECMWF wind speed results with ERS-2 Altimeter wind speed data for June 2004 (northern hemisphere)

Figure 8: Comparison of ECMWF wind speed results with ERS-2 Altimeter wind speed data for June 2004 (tropics)

Figure 9: Comparison of ECMWF wind speed results with ERS-2 Altimeter wind speed data for June 2004 (southern hemisphere)

Figure 10: Comparison of buoy wind speed observations with ERS-2 Altimeter wind speed data for June 2004 (global).

Figure 11: Comparison of buoy wind speed observations with ERS-2 Altimeter wind speed data for June 2004 (northern hemisphere).

Figure 12: Comparison of buoy wind speed observations with ERS-2 Altimeter wind speed data for June 2004 (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 2004.

Figure 15: Distribution of the ERS-2 Altimeter wave heights after along track averaging for June 2004.

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Figure 16: Global distribution of ECMWF wave heights for June 2004.
Figure 17: Comparison of ECMWF wave height results with ERS-2 Altimeter wave height data for June 2004 (global).
Figure 18: Comparison of ECMWF wave height results with ERS-2 Altimeter wave height data for June 2004 (northern hemisphere)
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Figure 24: ERS-2 Altimeter wave heights: Timeseries of bias (ERS-2 - model) and scatter index (SI) for June 2004.
Figure 25: ERS-2 Altimeter wave heights: Timeseries of bias (ERS-2 - model) and scatter index (SI) from December 1996 to June 2004
Figure 26: ERS-2 Altimeter wind speeds: Timeseries of bias (ERS-2 - model) and scatter index (SI) from December 1996 to June 2004

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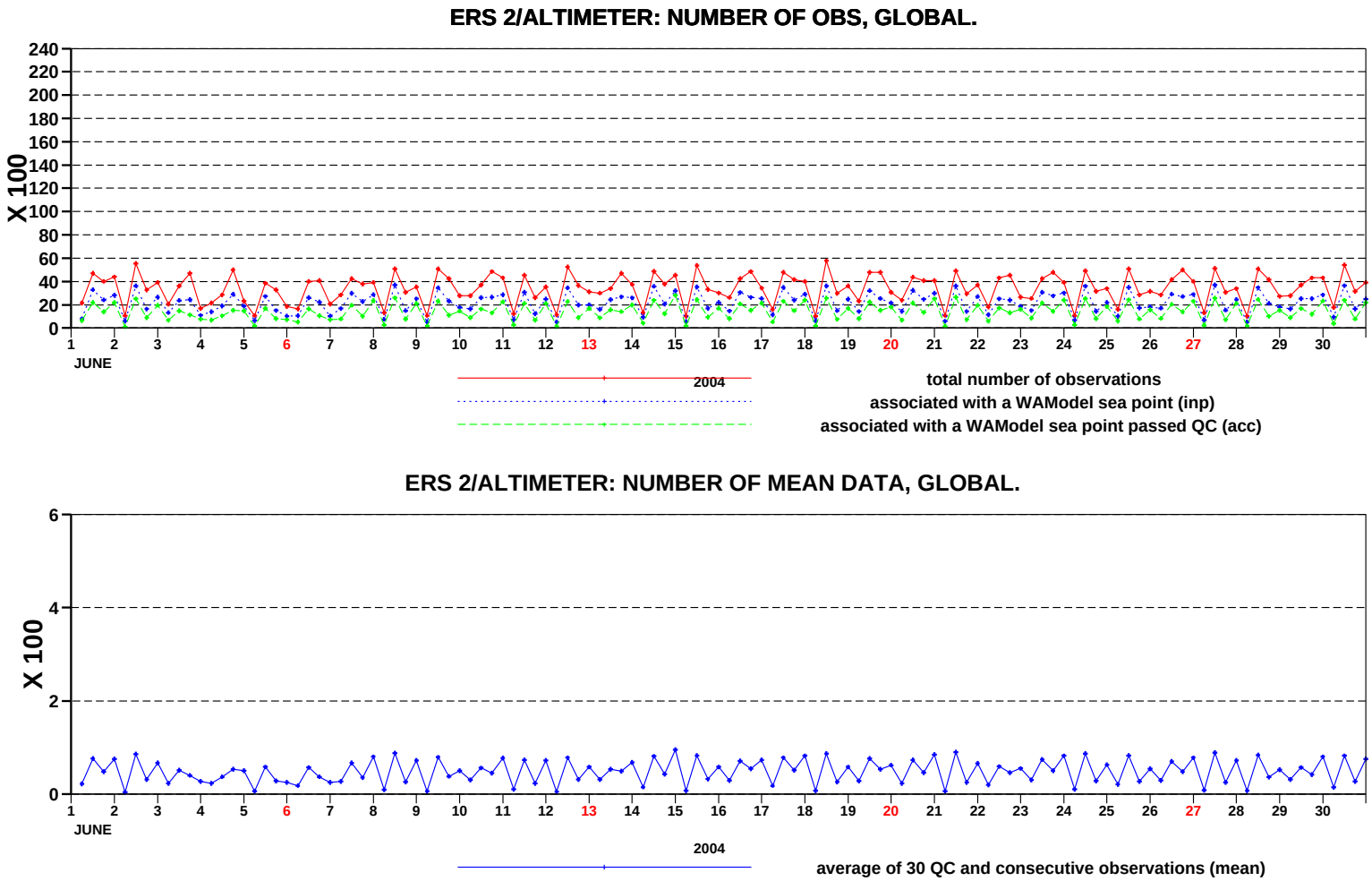


Figure 1: Time series of data reception for ERS-2 Altimeter data for June 2004

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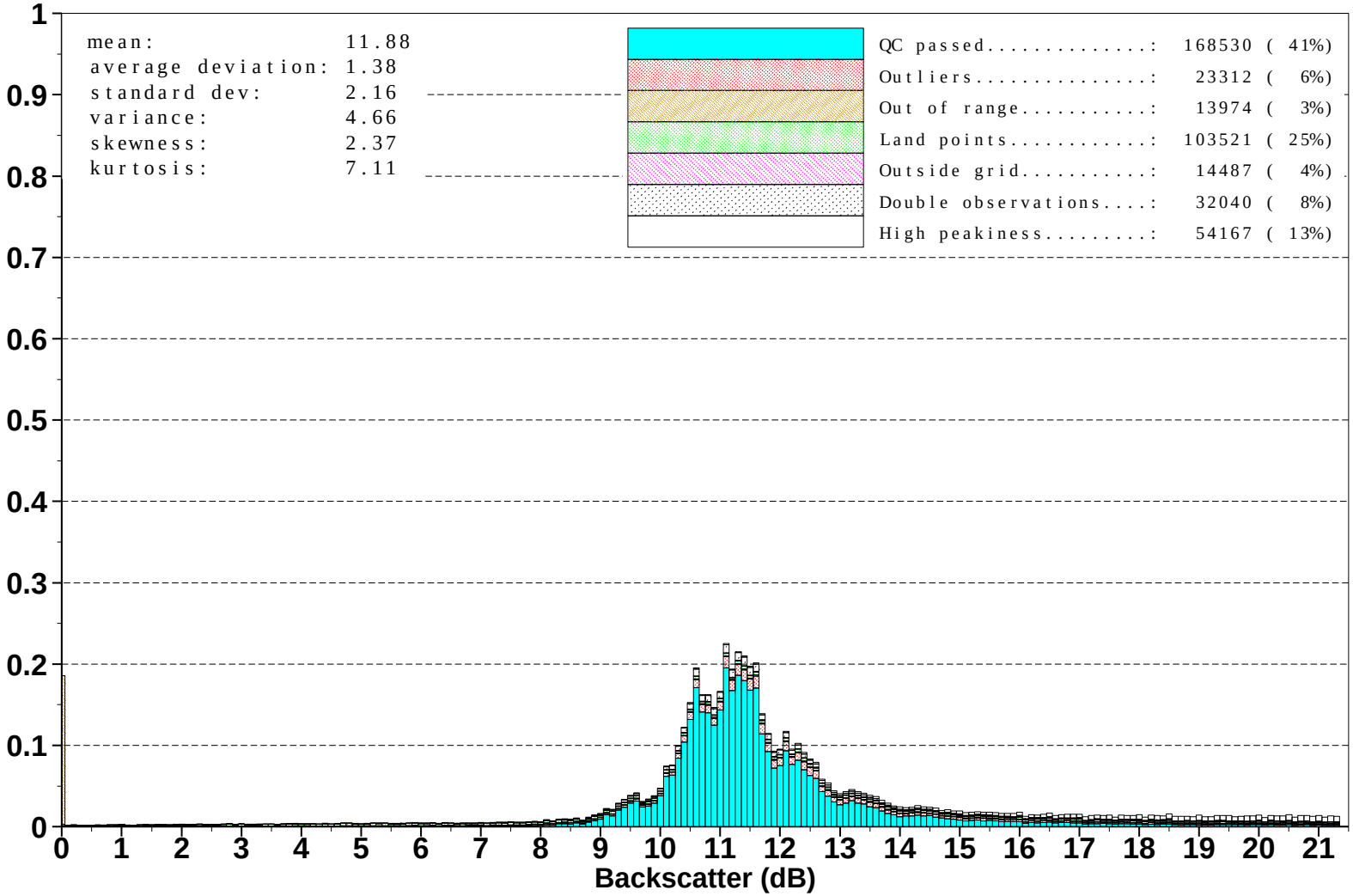


Figure 2: Distribution of the ERS-2 Altimeter backscatter after QC for June 2004

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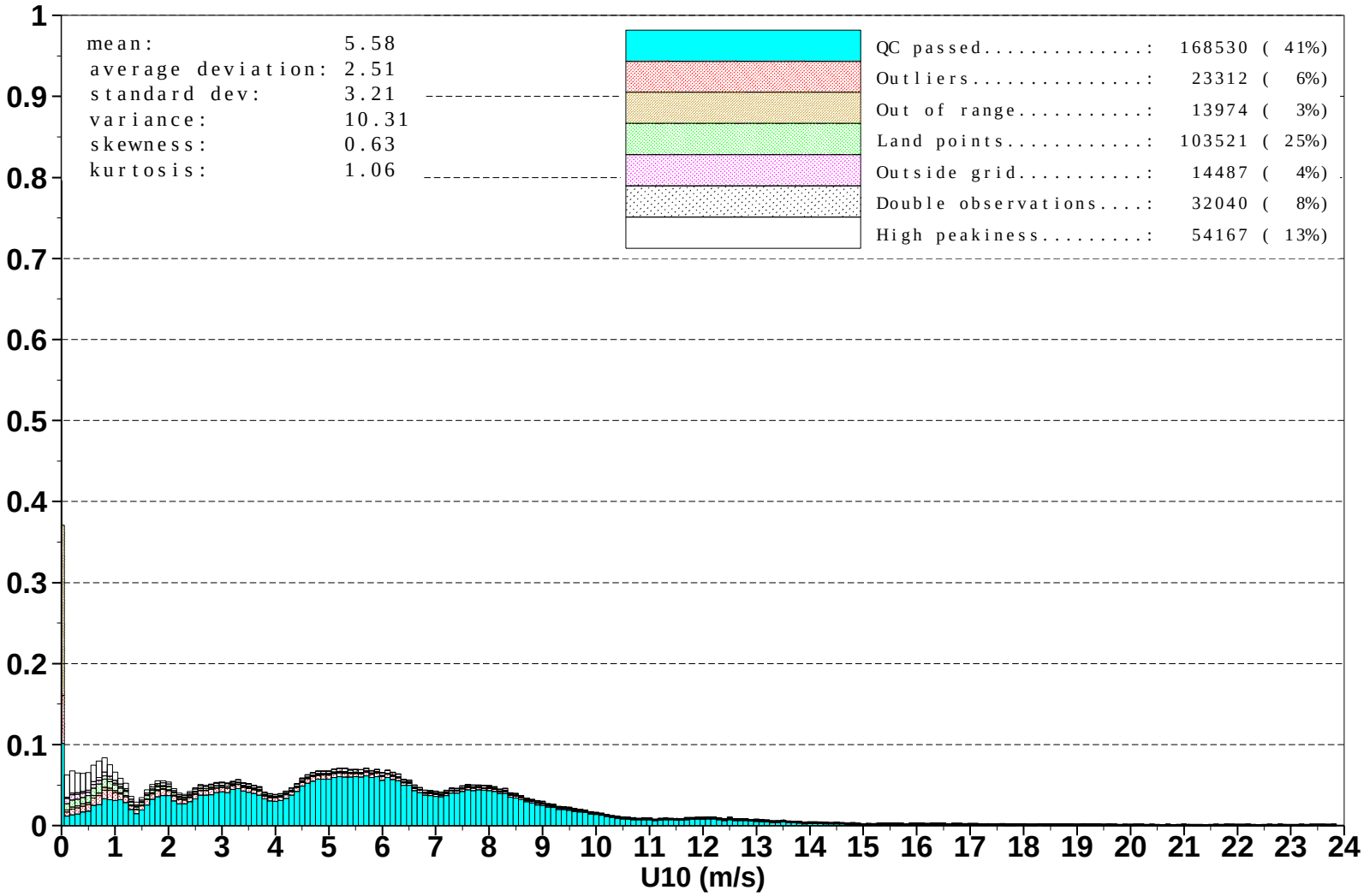


Figure 3: Distribution of the ERS-2 Altimeter wind speeds after QC for June 2004

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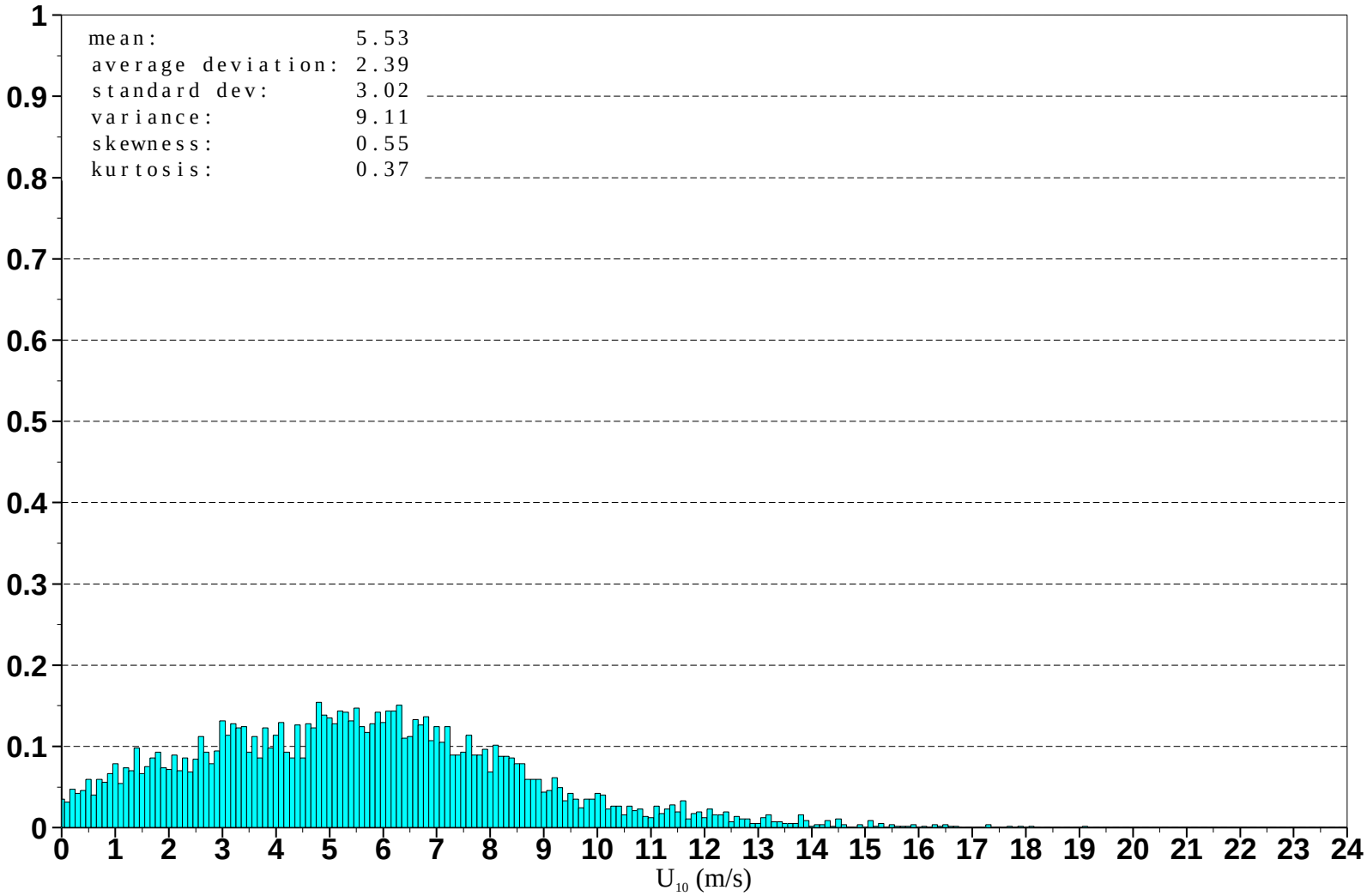


Figure 4: Distribution of ERS-2 Altimeter wind speeds after along track averaging for June 2004

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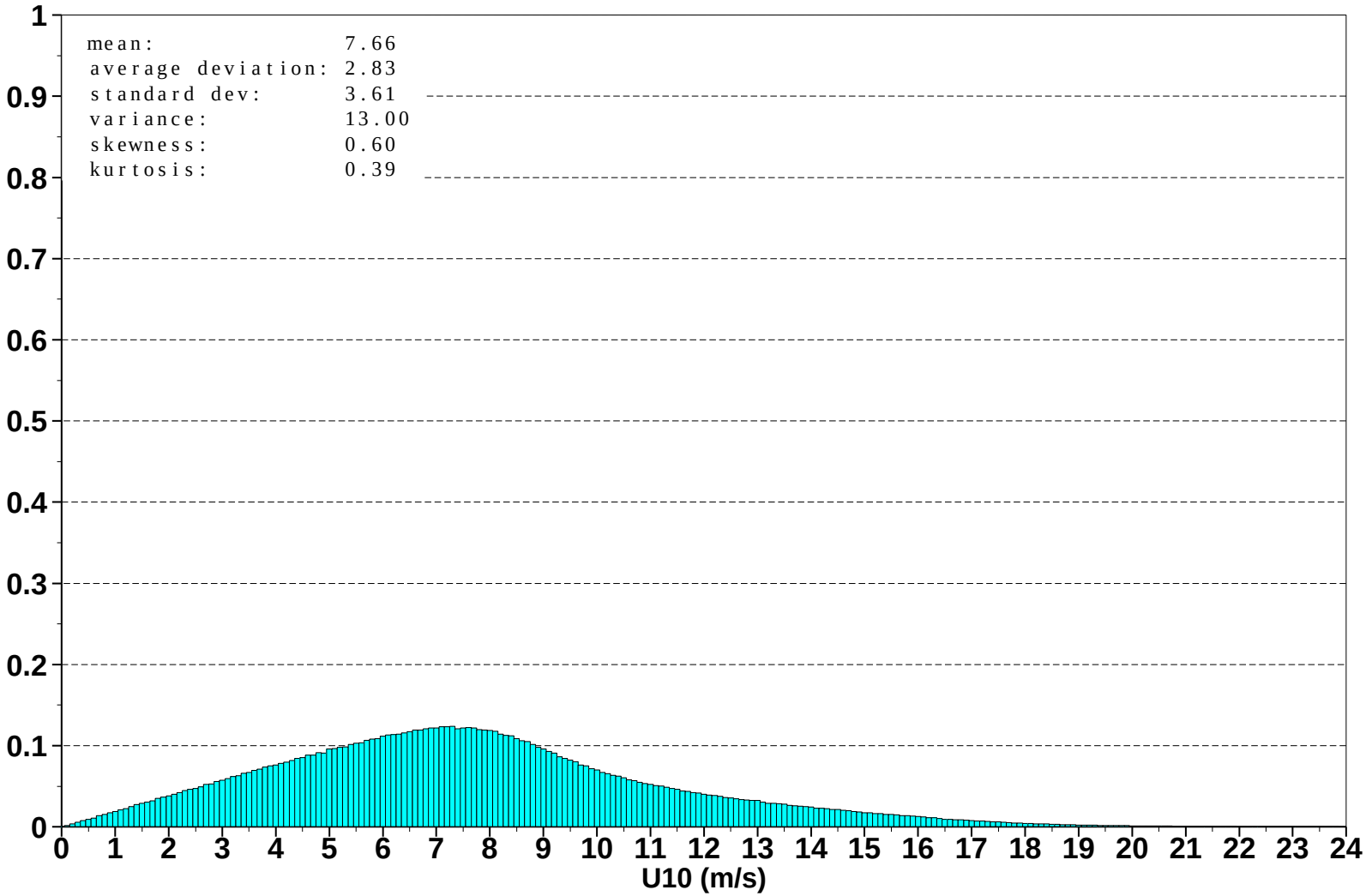
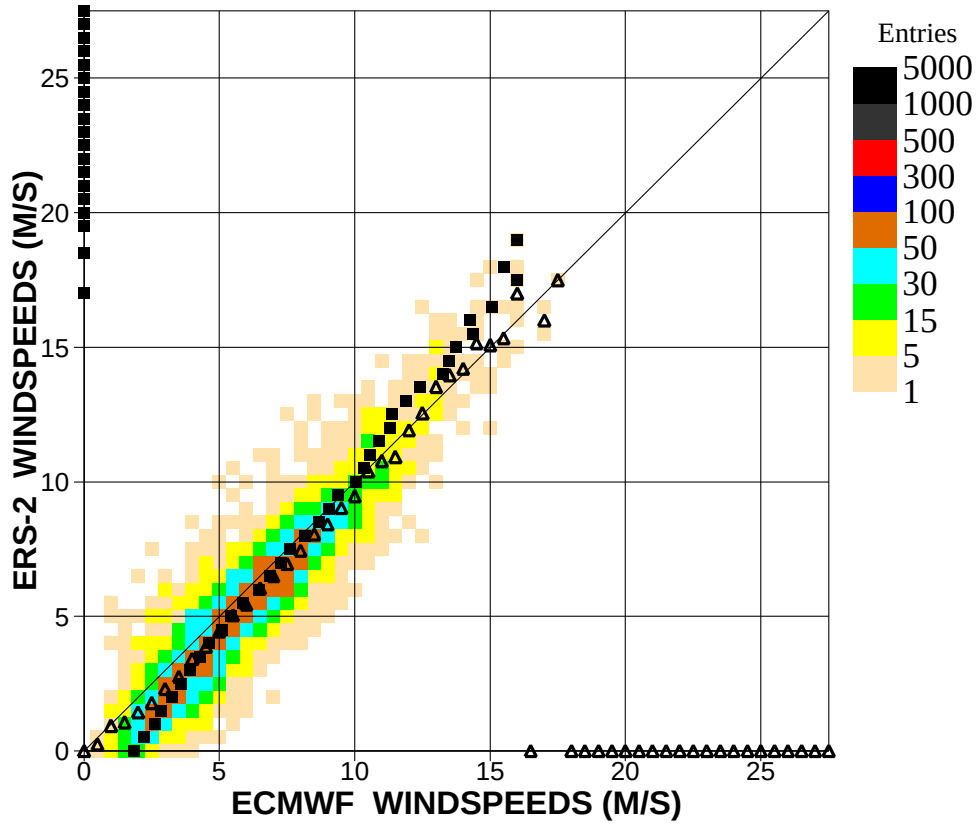


Figure 5: Global distribution of ECMWF ocean surface wind speeds for June 2004

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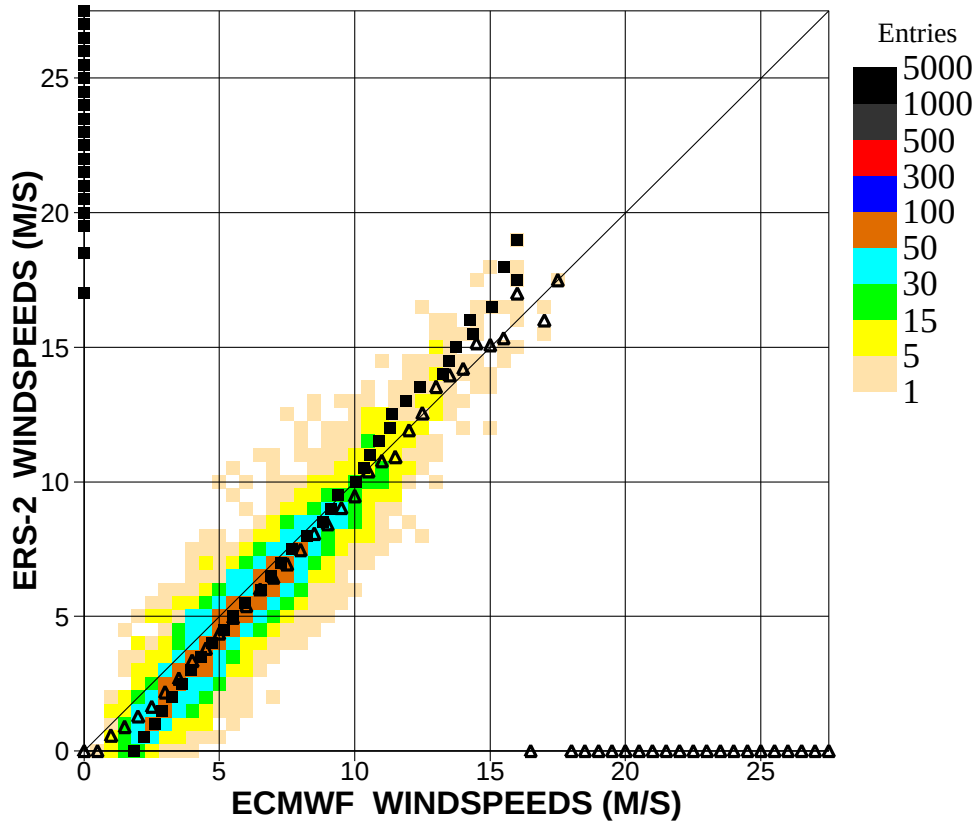
STATISTICS

ENTRIES	5709	
MEAN ECMWF	6.0509	
MEAN ERS-2	5.5256	
BIAS (ERS-2 - ECMWF)	-0.5253	
STANDARD DEVIATION	1.1495	
SCATTER INDEX	0.1900	
CORRELATION	0.9255	
SYMMETRIC SLOPE	0.9519	(0.0059)
REGR. COEFFICIENT	1.0455	(0.0057)
REGR. CONSTANT	-0.8004	(0.0375)

Figure 6. Comparison of ECMWF wind speed results with ERS2 Altimeter wind speed data for June 2004 (global)

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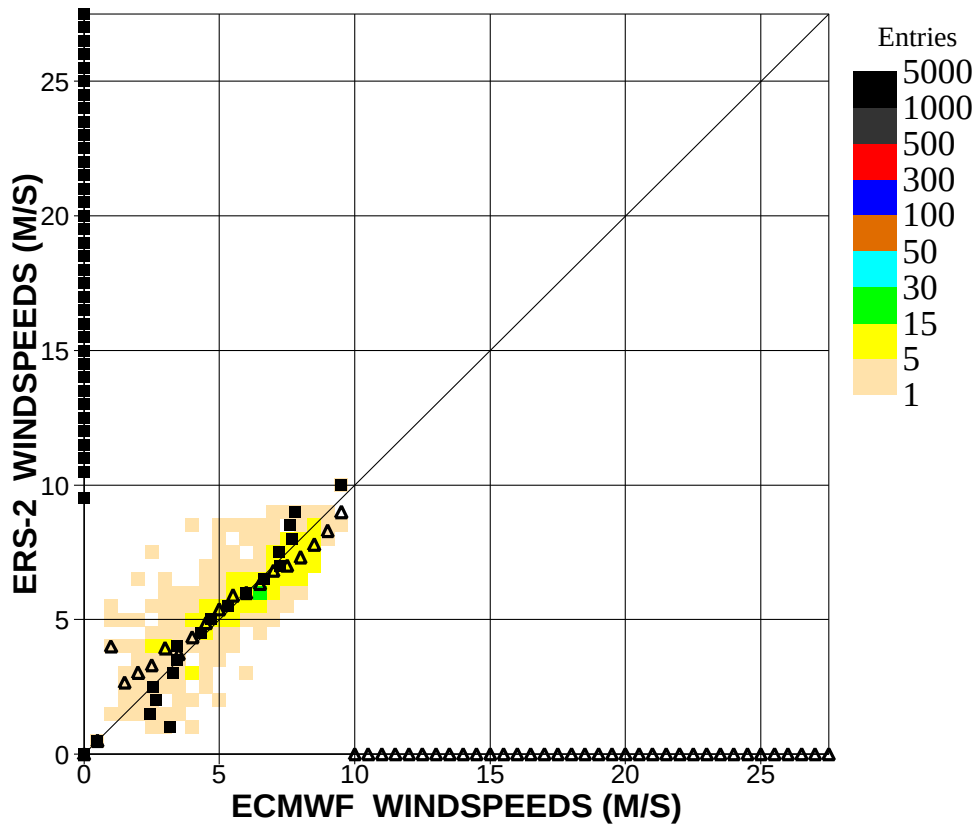
STATISTICS

ENTRIES	5256	
MEAN ECMWF	6.0854	
MEAN ERS-2	5.5070	
BIAS (ERS-2 - ECMWF)	-0.5784	
STANDARD DEVIATION	1.1280	
SCATTER INDEX	0.1854	
CORRELATION	0.9330	
SYMMETRIC SLOPE	0.9481	(0.0060)
REGR. COEFFICIENT	1.0641	(0.0057)
REGR. CONSTANT	-0.9685	(0.0377)

Figure 7. Comparison of ECMWF wind speed results with ERS2 Altimeter wind speed data for June 2004 (n.hem.)

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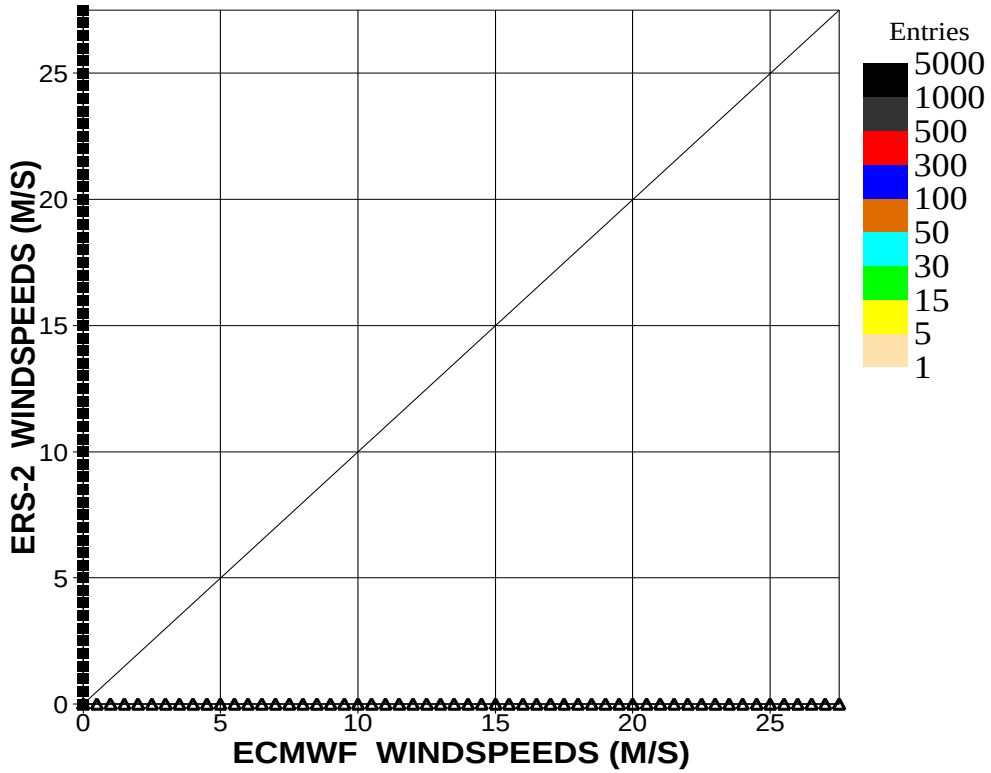
STATISTICS

ENTRIES	472	
MEAN ECMWF	5.6890	
MEAN ERS-2	5.7534	
BIAS (ERS-2 - ECMWF)	0.0644	
STANDARD DEVIATION	1.2108	
SCATTER INDEX	0.2128	
CORRELATION	0.8091	
SYMMETRIC SLOPE	0.9994	(0.0275)
REGR. COEFFICIENT	0.7291	(0.0244)
REGR. CONSTANT	1.6054	(0.1476)

Figure 8. Comparison of ECMWF wind speed results with ERS2 Altimeter wind speed data for June 2004 (tropics)

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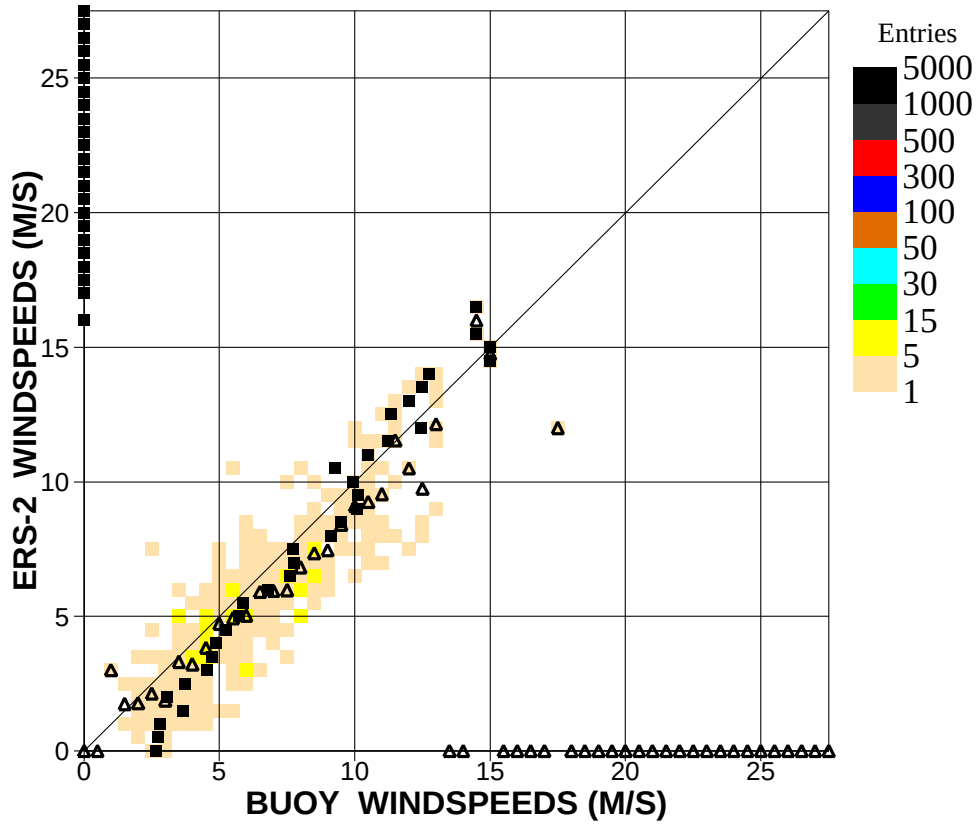
STATISTICS

ENTRIES	0
MEAN ECMWF	0.0000
MEAN ERS-2	0.0000
BIAS (ERS-2 - ECMWF)	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 9. Comparison of ECMWF wind speed results with ERS2 Altimeter wind speed data for June 2004 (s.hem.)

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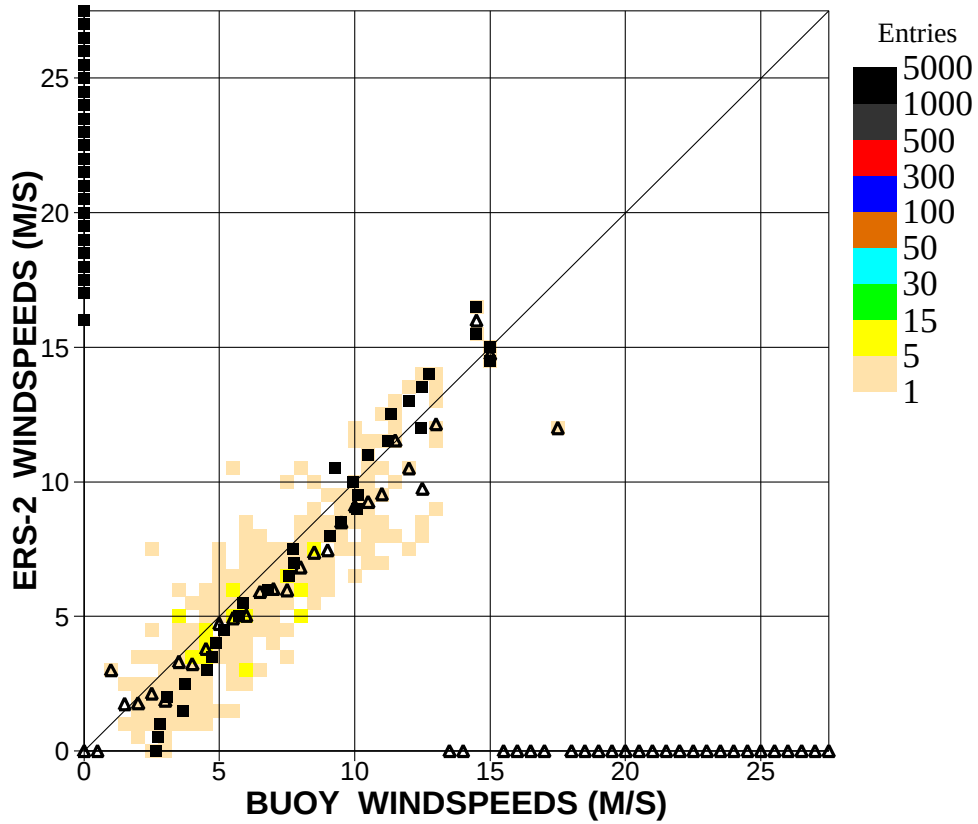
STATISTICS

ENTRIES	426	
MEAN BUOY	6.6637	
MEAN ERS-2	5.8364	
BIAS (ERS-2 - BUOY)	-0.8273	
STANDARD DEVIATION	1.4861	
SCATTER INDEX	0.2230	
CORRELATION	0.8755	
SYMMETRIC SLOPE	0.9063	(0.0250)
REGR. COEFFICIENT	0.9232	(0.0247)
REGR. CONSTANT	-0.3157	(0.1796)

Figure 10. Comparison of buoy wind speed observations with ERS2 Altimeter wind speed data for June 2004 (global)

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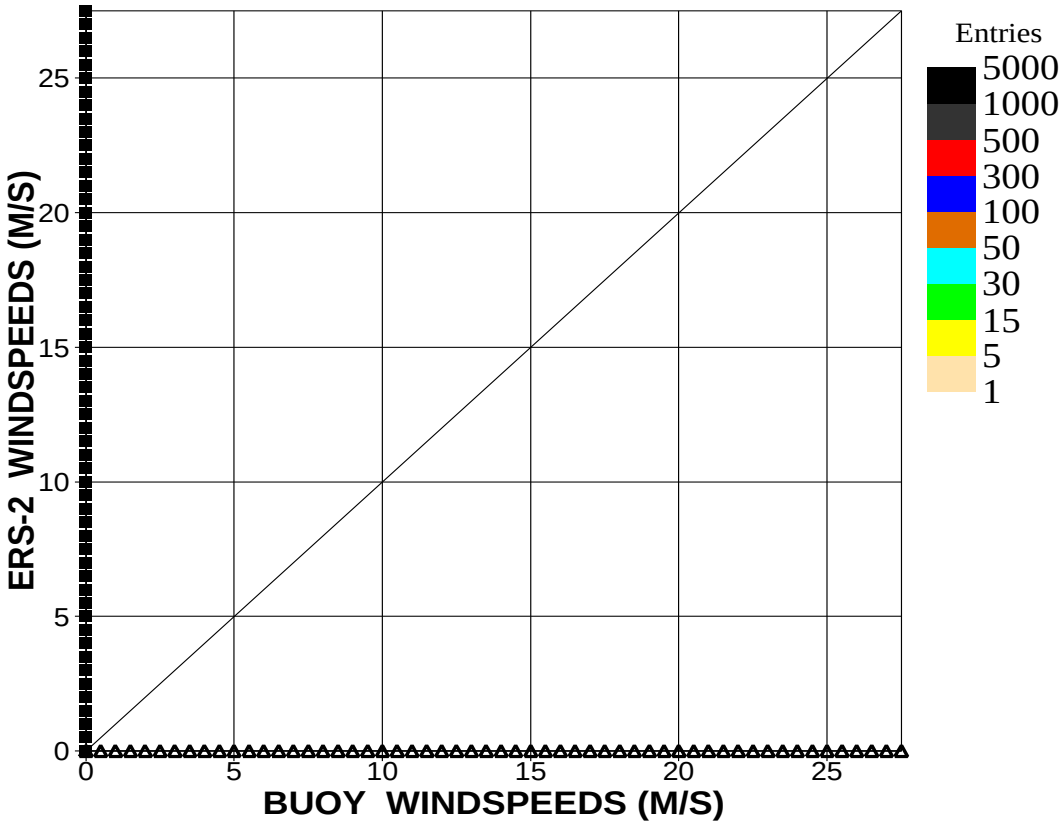


STATISTICS

ENTRIES	421	
MEAN BUOY	6.6622	
MEAN ERS-2	5.8413	
BIAS (ERS-2 - BUOY)	-0.8209	
STANDARD DEVIATION	1.4893	
SCATTER INDEX	0.2235	
CORRELATION	0.8759	
SYMMETRIC SLOPE	0.9075	(0.0252)
REGR. COEFFICIENT	0.9250	(0.0249)
REGR. CONSTANT	-0.3215	(0.1808)

Figure 11. Comparison of buoy wind speed observations with ERS2 Altimeter wind speed data for June 2004 (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 12. Comparison of buoy wind speed observations with ERS2 Altimeter wind speed data for June 2004 (hawaii)

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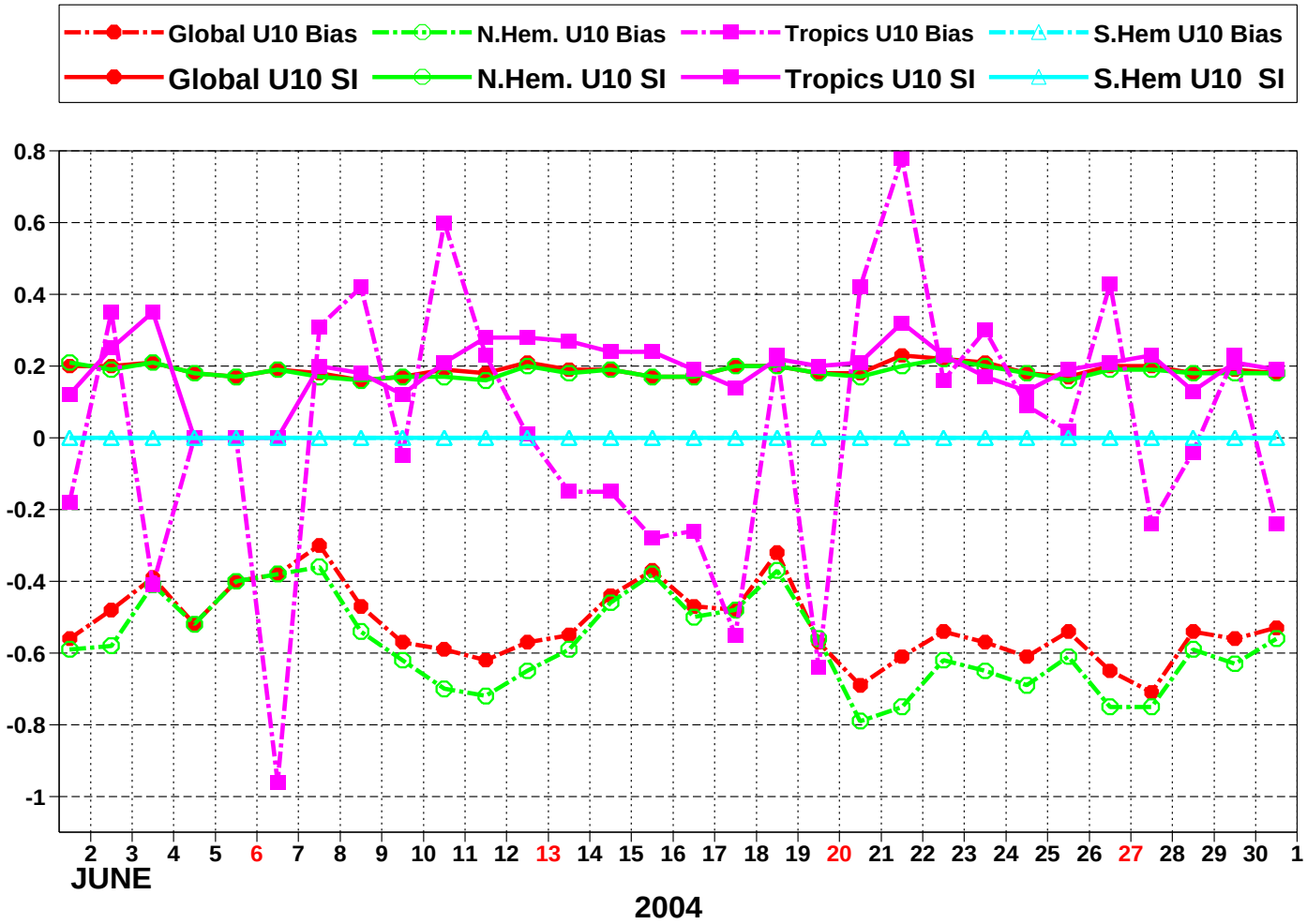


Figure 13: ERS-2 Altimeter wind speeds: Timeseries of bias (ERS-2 - model) and scatter index (SI)

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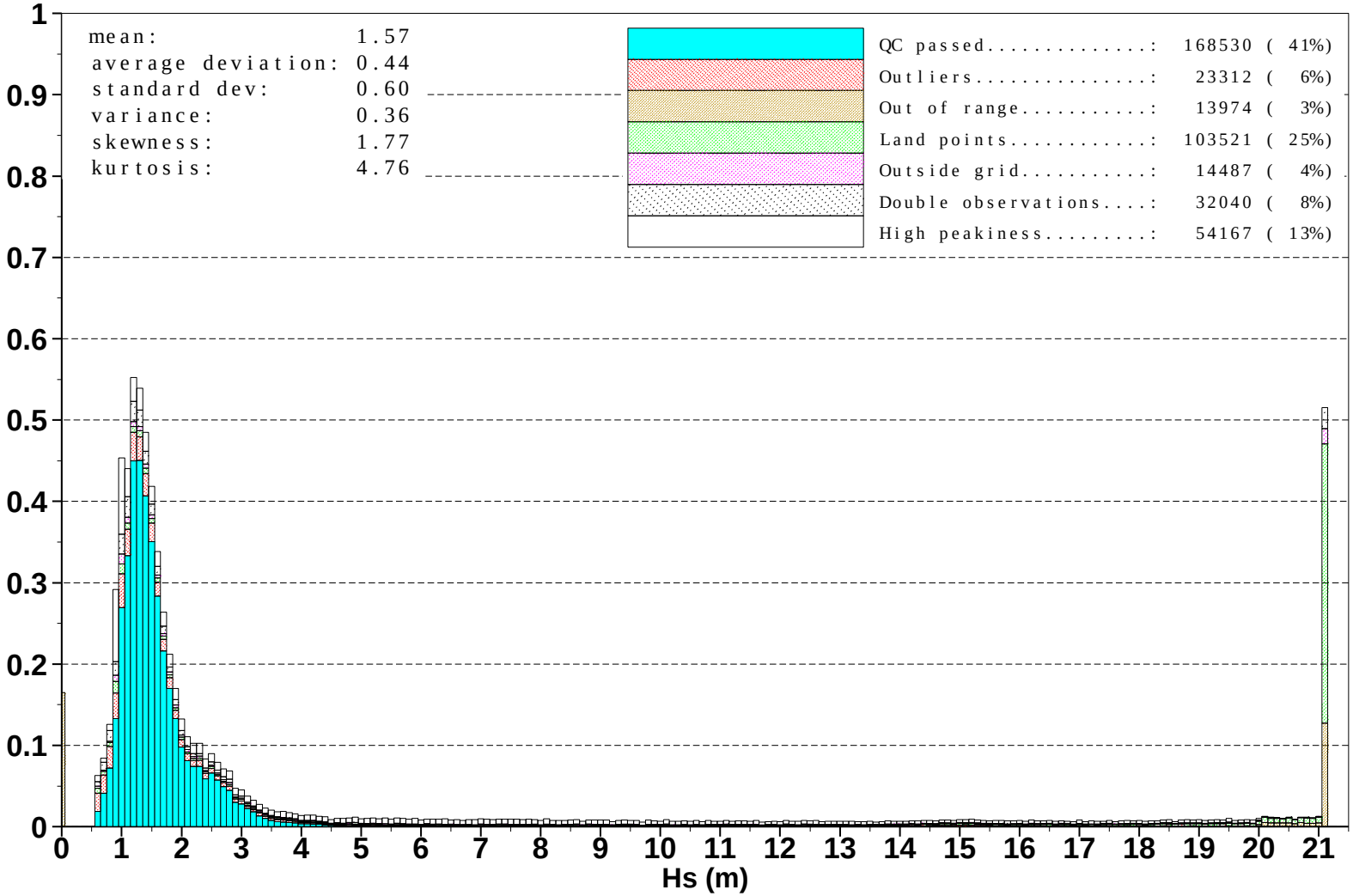


Figure 14: Distribution of the ERS-2 Altimeter wave heights after QC for June 2004

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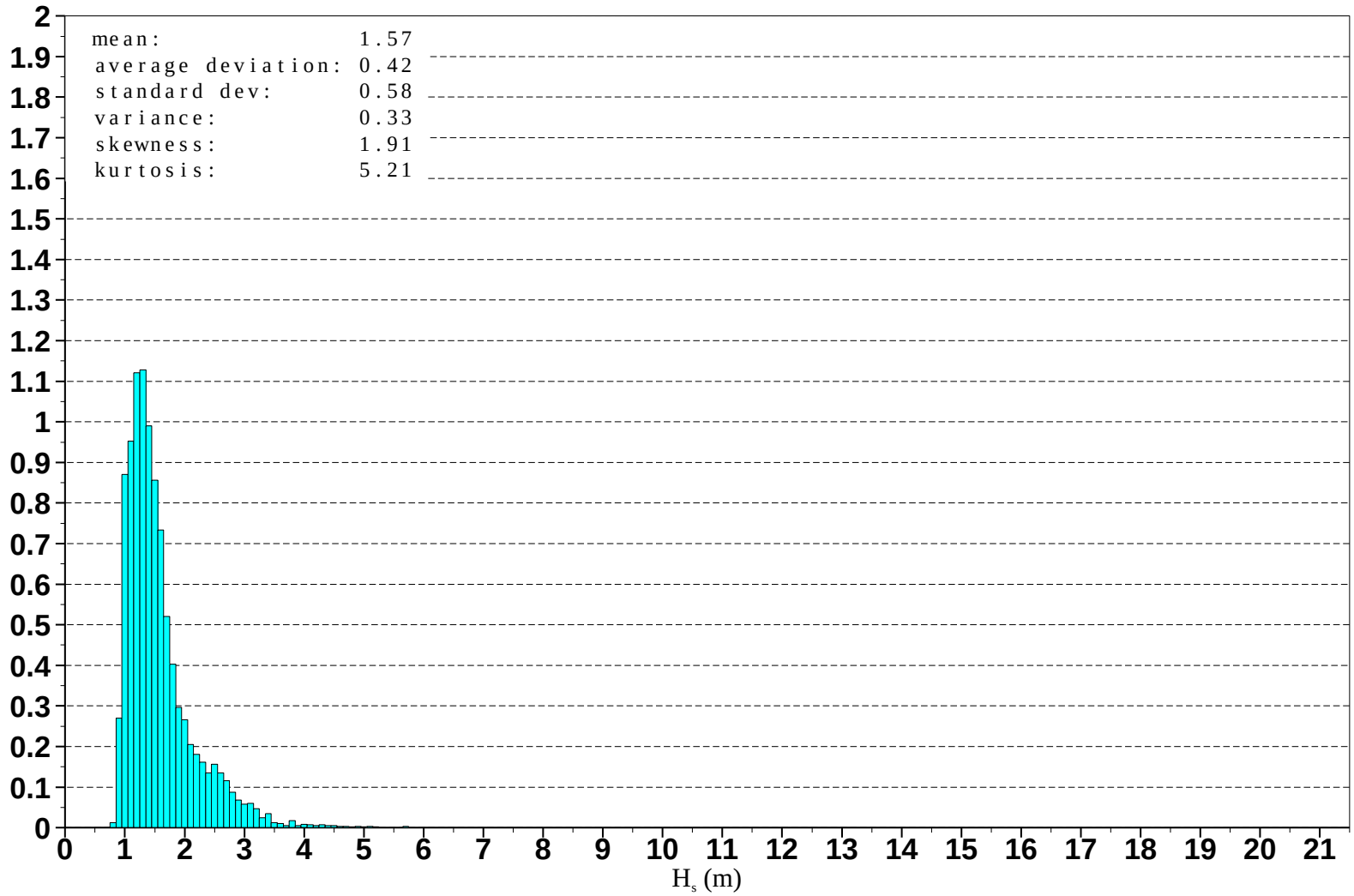


Figure 15: Distribution of ERS-2 Altimeter wave heights after along track averaging for June 2004

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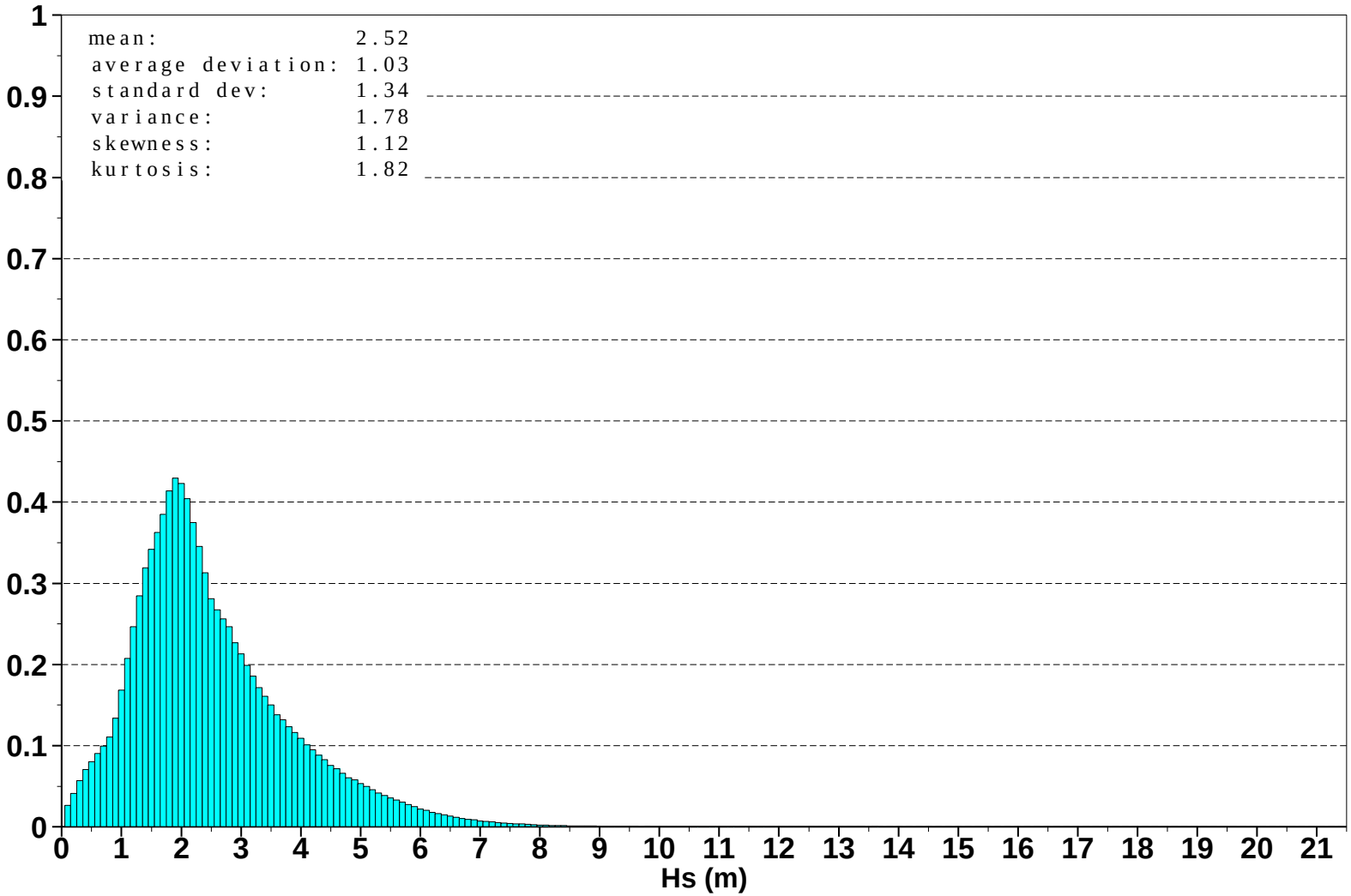
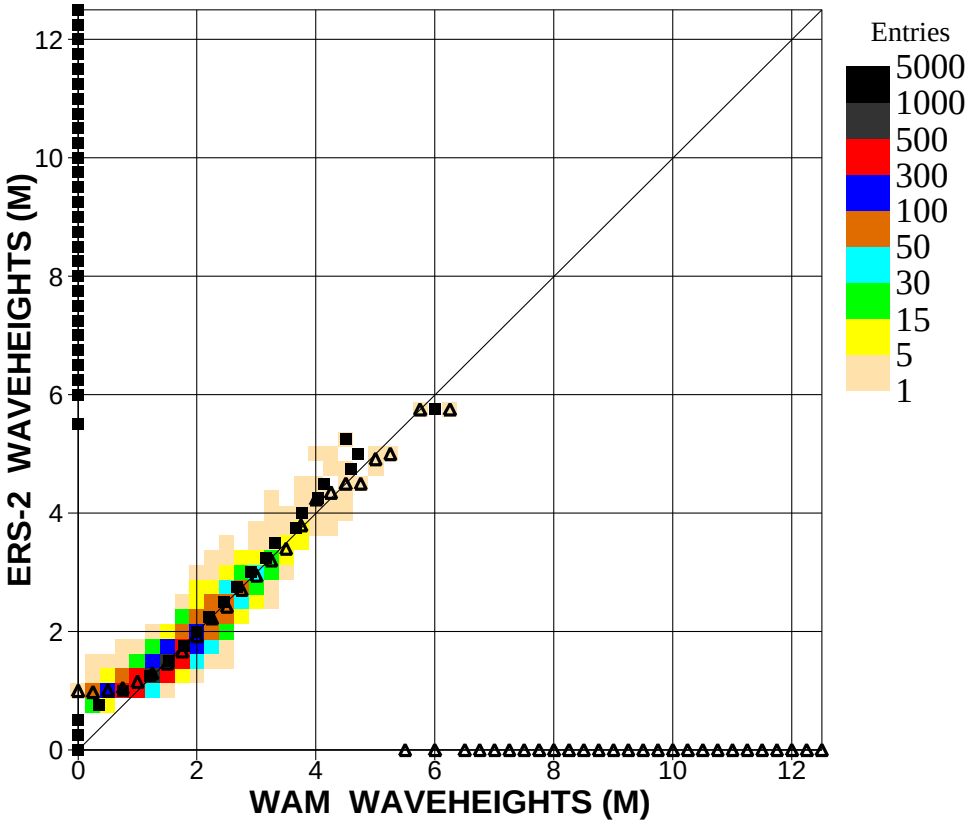


Figure 16: Global distribution of ECMWF wave heights for June 2004

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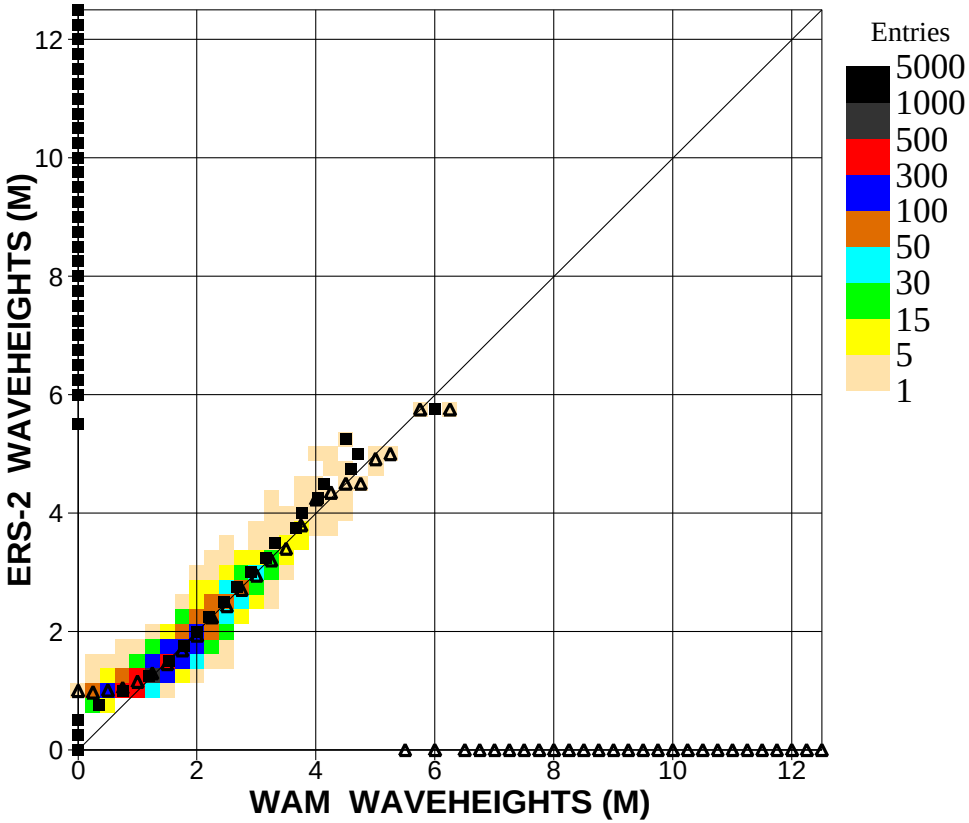


STATISTICS

ENTRIES	5709	
MEAN WAM	1.5096	
MEAN ERS-2	1.5692	
BIAS (ERS-2 - WAM)	0.0596	
STANDARD DEVIATION	0.2393	
SCATTER INDEX	0.1585	
CORRELATION	0.9339	
SYMMETRIC SLOPE	1.0147	(0.0050)
REGR. COEFFICIENT	0.8154	(0.0041)
REGR. CONSTANT	0.3383	(0.0068)

Figure 17. Comparison of ECMWF wave height results with ERS2 Altimeter wave height data for June 2004 (global)

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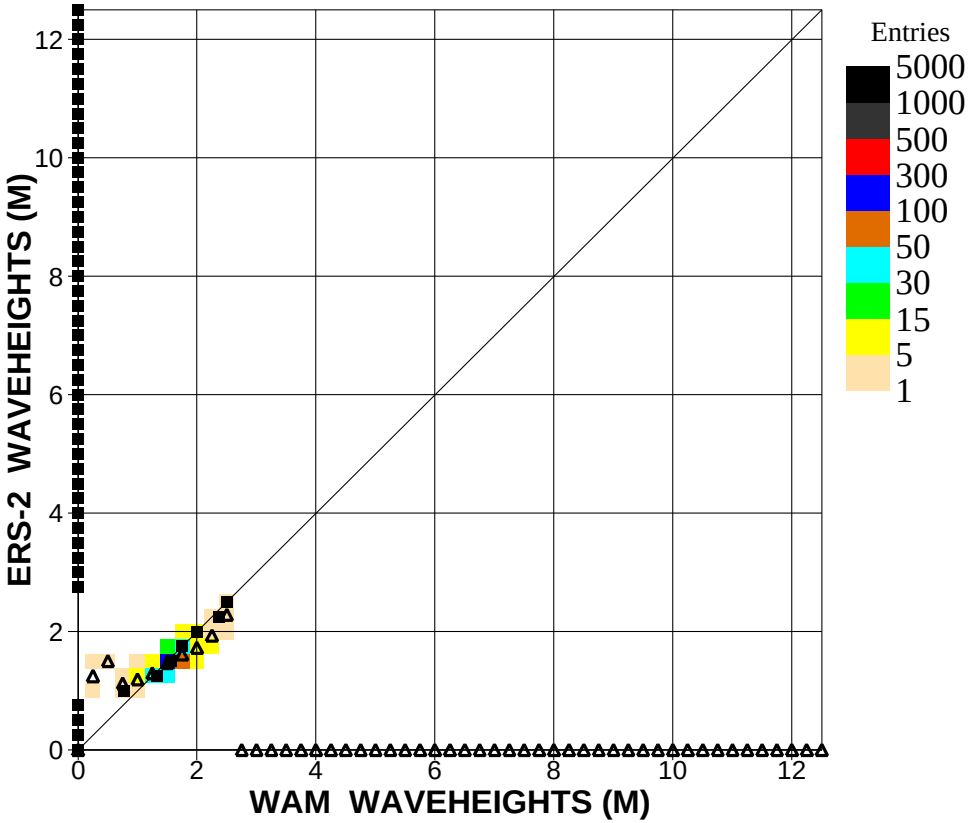


STATISTICS

ENTRIES	5256	
MEAN WAM	1.5038	
MEAN ERS-2	1.5737	
BIAS (ERS-2 - WAM)	0.0700	
STANDARD DEVIATION	0.2421	
SCATTER INDEX	0.1610	
CORRELATION	0.9371	
SYMMETRIC SLOPE	1.0192	(0.0051)
REGR. COEFFICIENT	0.8196	(0.0042)
REGR. CONSTANT	0.3412	(0.0070)

Figure 18. Comparison of ECMWF wave height results with ERS2 Altimeter wave height data for June 2004 (n.hem.)

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STATISTICS

ENTRIES	472	
MEAN WAM	1.5735	
MEAN ERS-2	1.5141	
BIAS (ERS-2 - WAM)	-0.0594	
STANDARD DEVIATION	0.1707	
SCATTER INDEX	0.1085	
CORRELATION	0.7984	
SYMMETRIC SLOPE	0.9564	(0.0266)
REGR. COEFFICIENT	0.5985	(0.0208)
REGR. CONSTANT	0.5724	(0.0333)

Figure 19. Comparison of ECMWF wave height results with ERS2 Altimeter wave height data for June 2004 (tropics)

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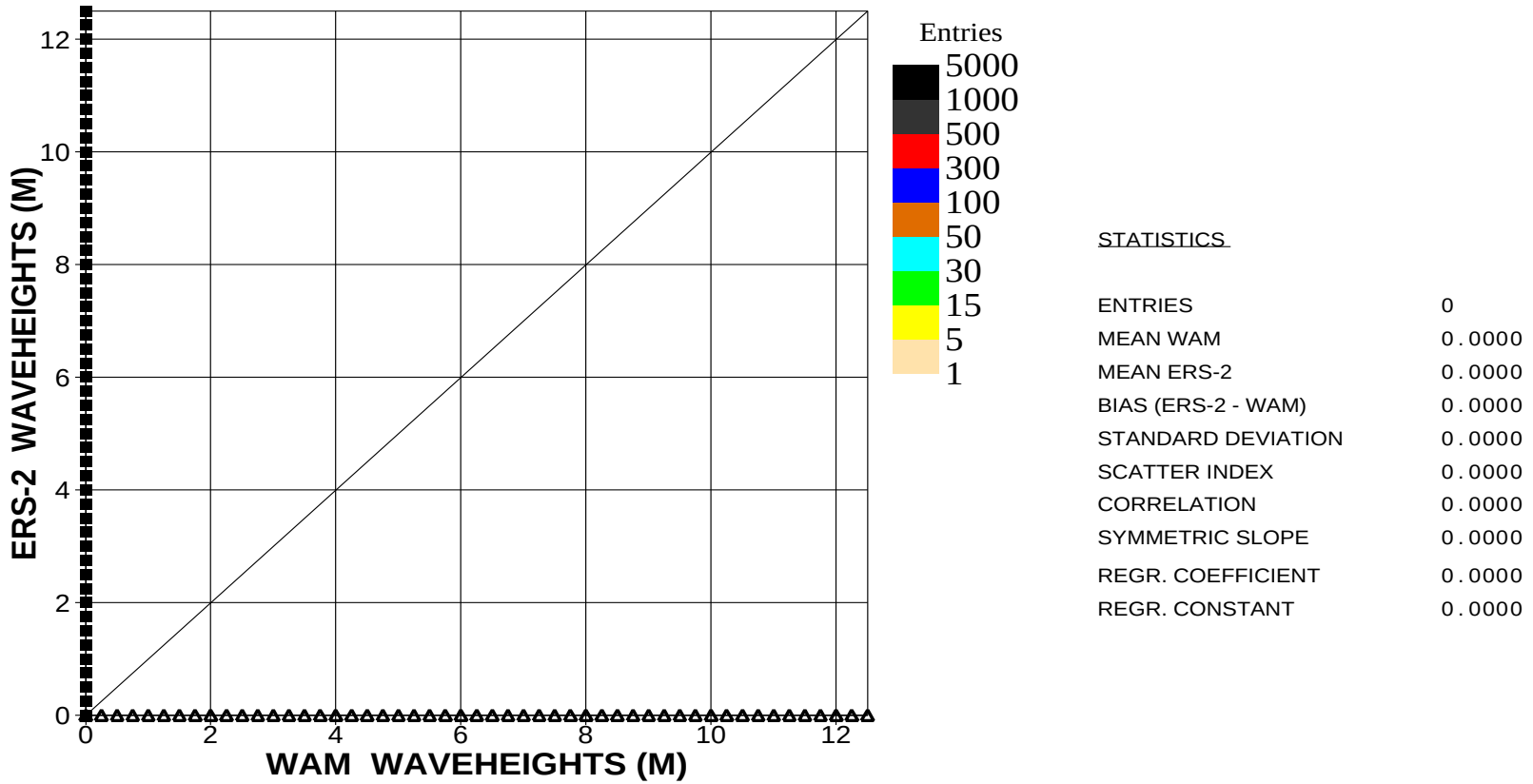
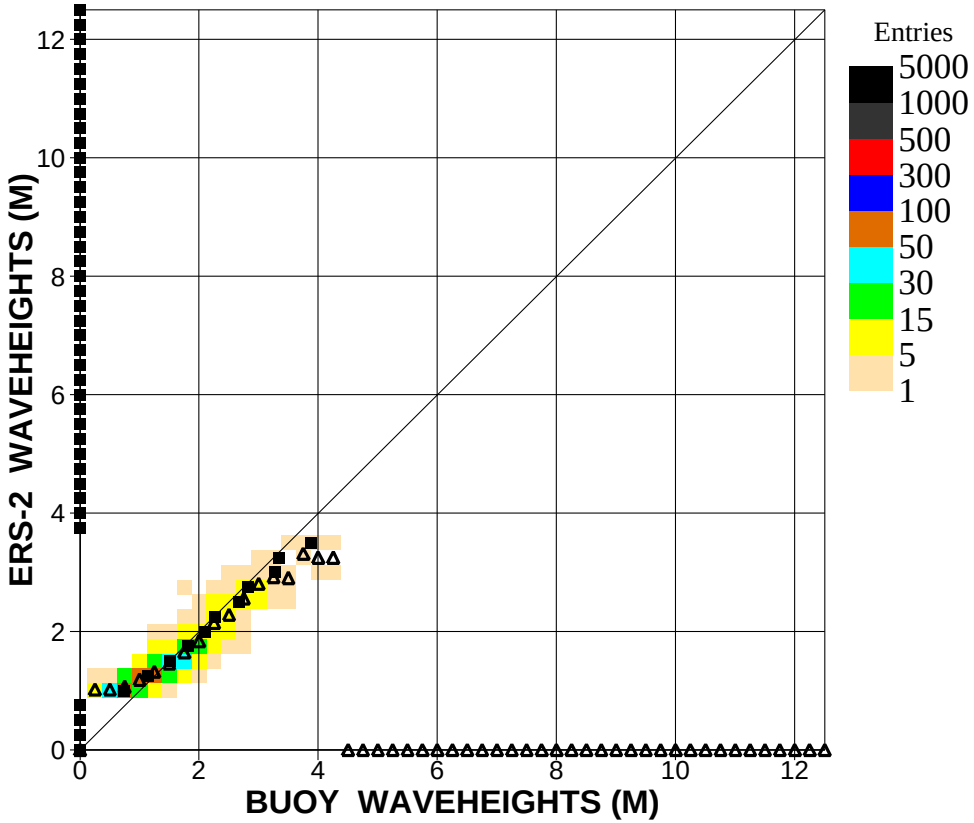


Figure 20. Comparison of ECMWF wave height results with ERS2 Altimeter wave height data for June 2004 (s.hem.)

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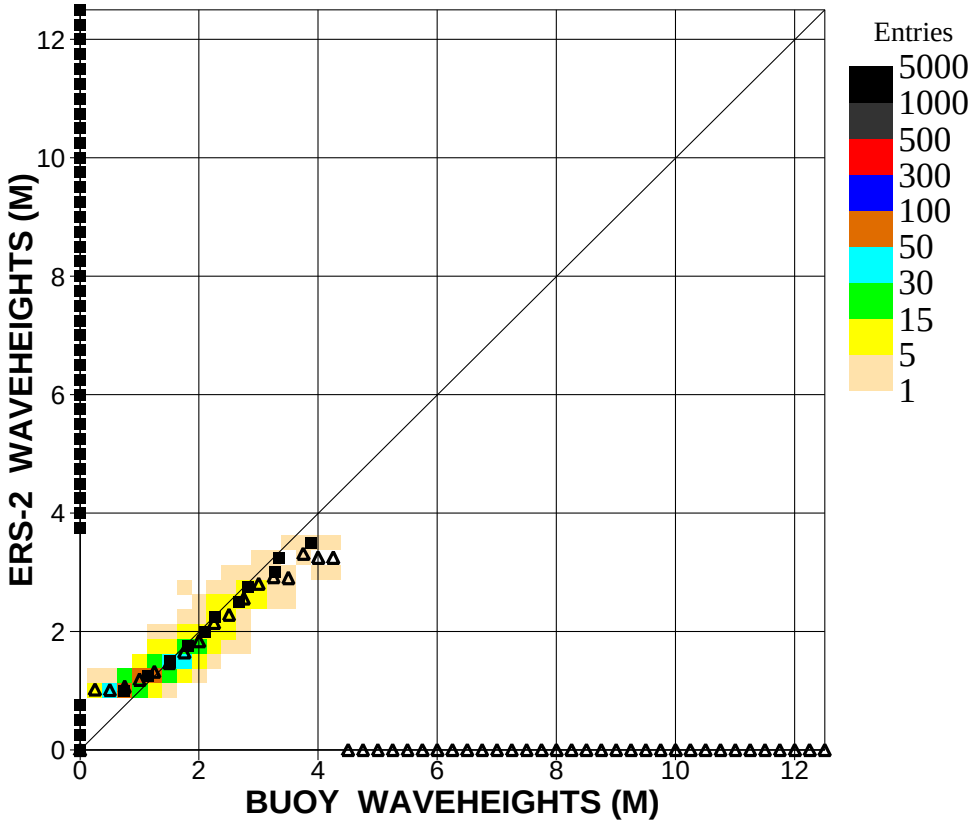


STATISTICS

ENTRIES	652	
MEAN BUOY	1.5022	
MEAN ERS-2	1.5595	
BIAS (ERS-2 - BUOY)	0.0573	
STANDARD DEVIATION	0.3046	
SCATTER INDEX	0.2028	
CORRELATION	0.9328	
SYMMETRIC SLOPE	0.9868	(0.0160)
REGR. COEFFICIENT	0.6963	(0.0106)
REGR. CONSTANT	0.5135	(0.0177)

Figure 21. Comparison of buoy wave height observations with ERS2 Altimeter wave height data for June 2004 (global)

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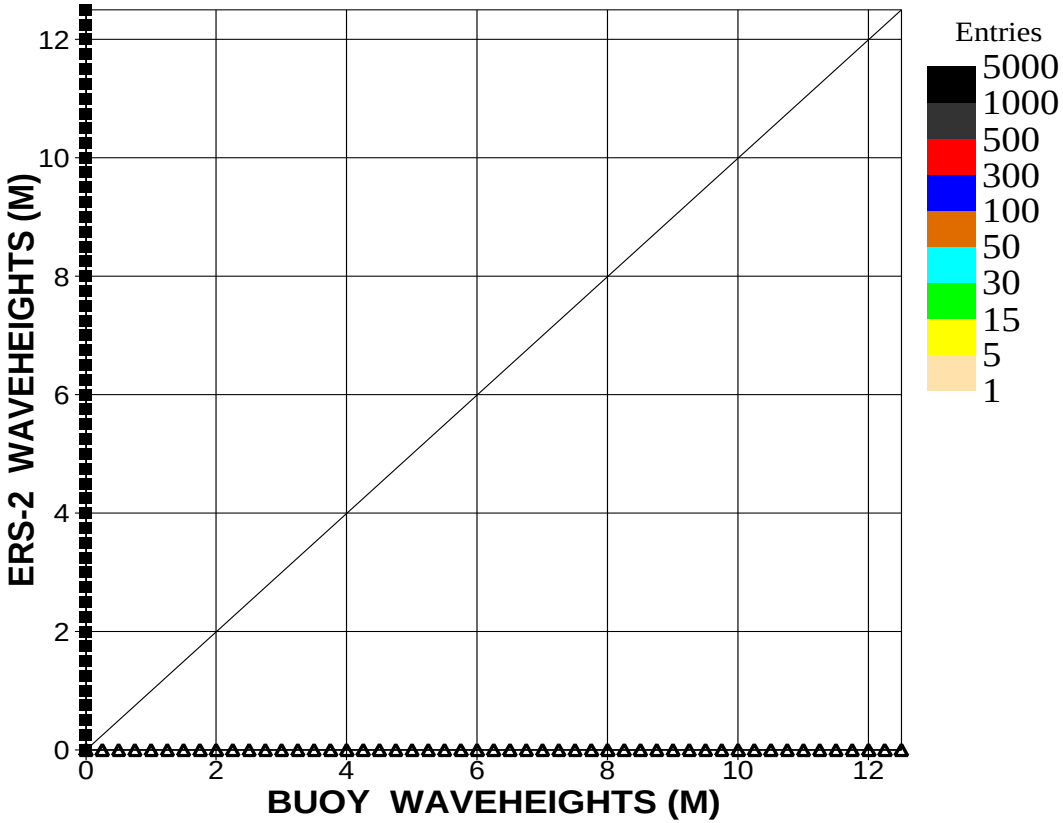


STATISTICS

ENTRIES	646	
MEAN BUOY	1.5065	
MEAN ERS-2	1.5626	
BIAS (ERS-2 - BUOY)	0.0561	
STANDARD DEVIATION	0.3039	
SCATTER INDEX	0.2017	
CORRELATION	0.9332	
SYMMETRIC SLOPE	0.9864	(0.0161)
REGR. COEFFICIENT	0.6978	(0.0106)
REGR. CONSTANT	0.5114	(0.0178)

Figure 22. Comparison of buoy wave height observations with ERS2 Altimeter wave height data for June 2004 (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 2004 (hawaii)

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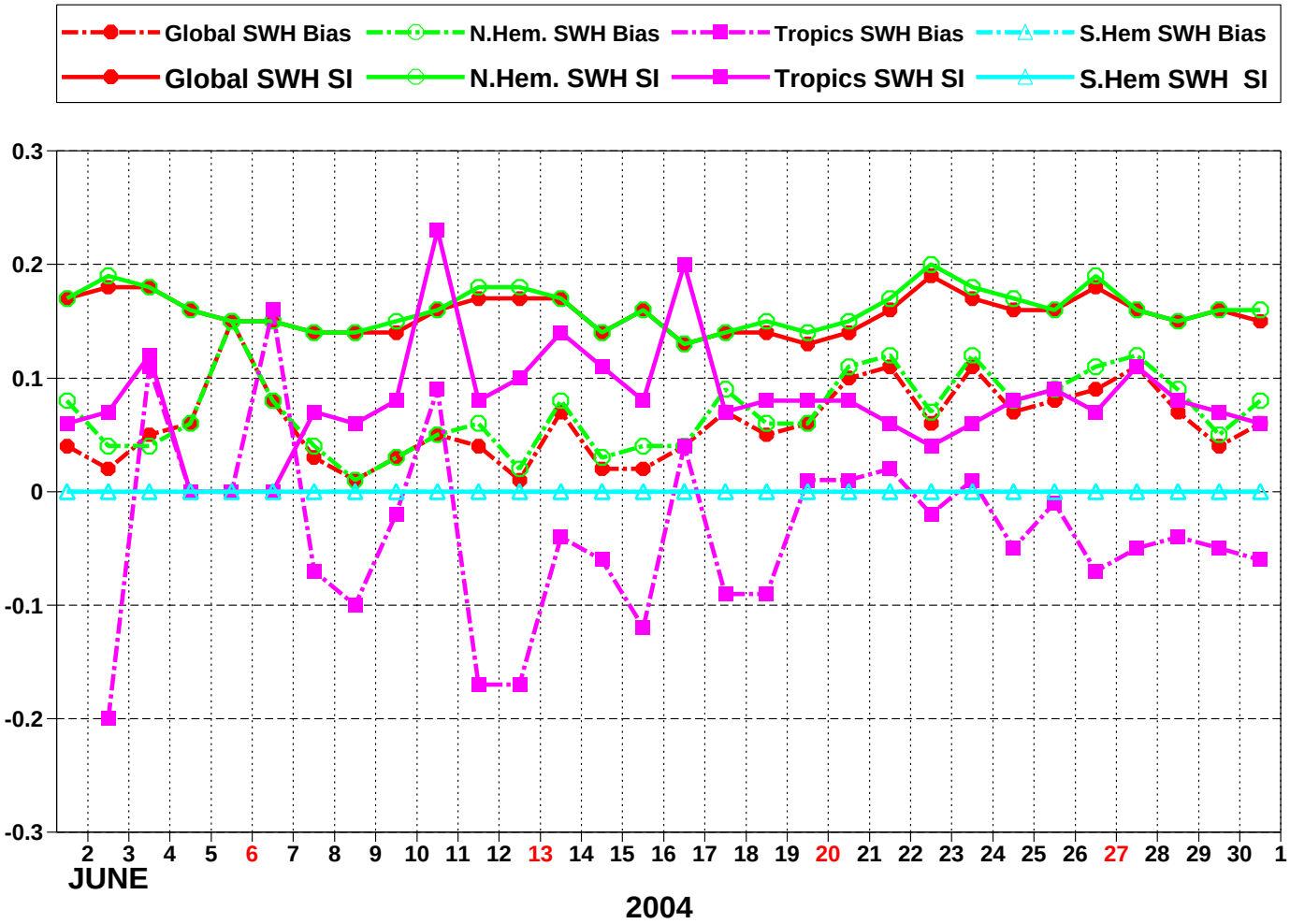


Figure 24: ERS-2 Altimeter wave heights: Timeseries of bias (ERS-2 - model) and scatter index (SI)

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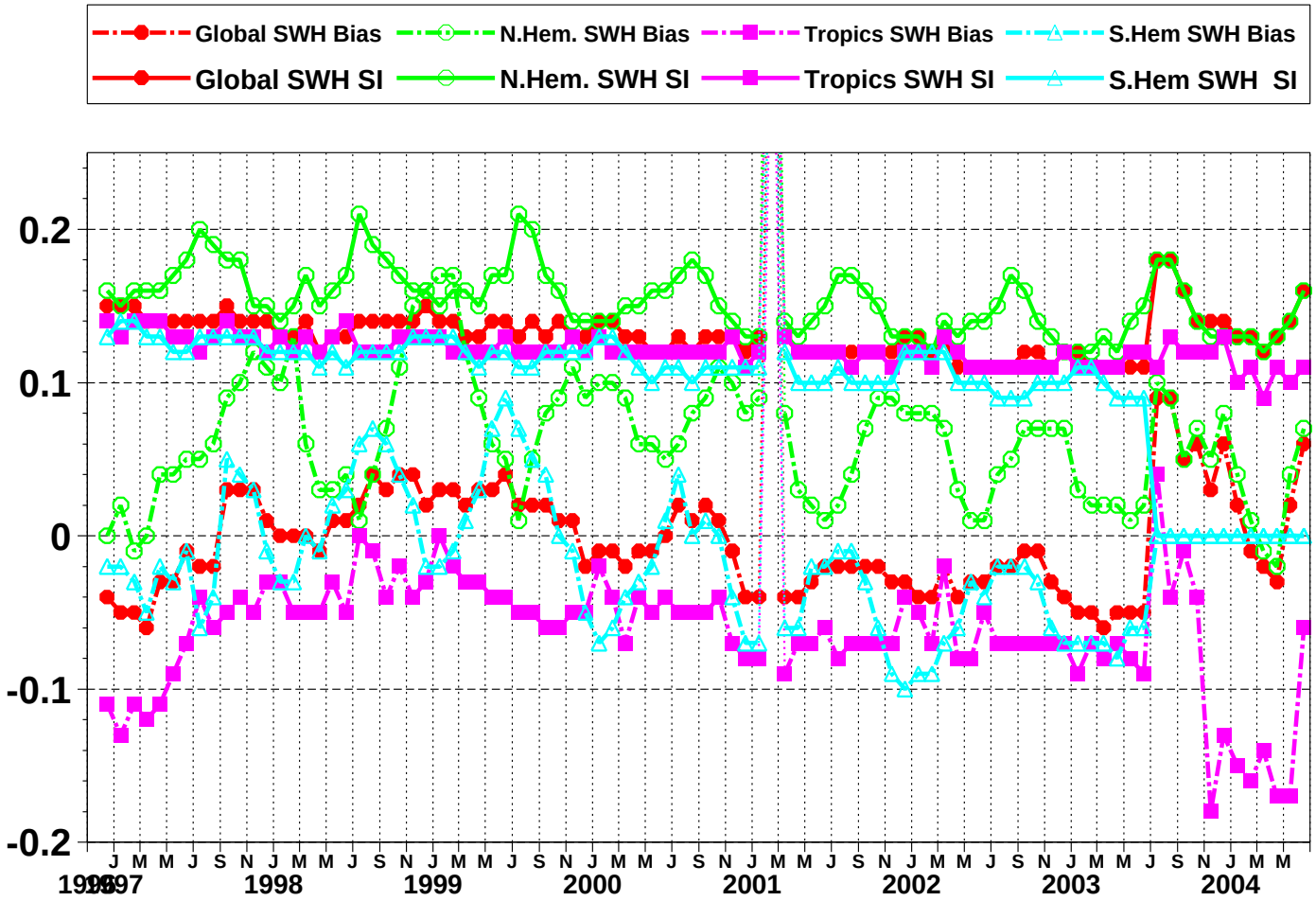


Figure 25: ERS-2 Altimeter wave heights: Timeseries of bias (ERS-2 - model) and scatter index (SI)

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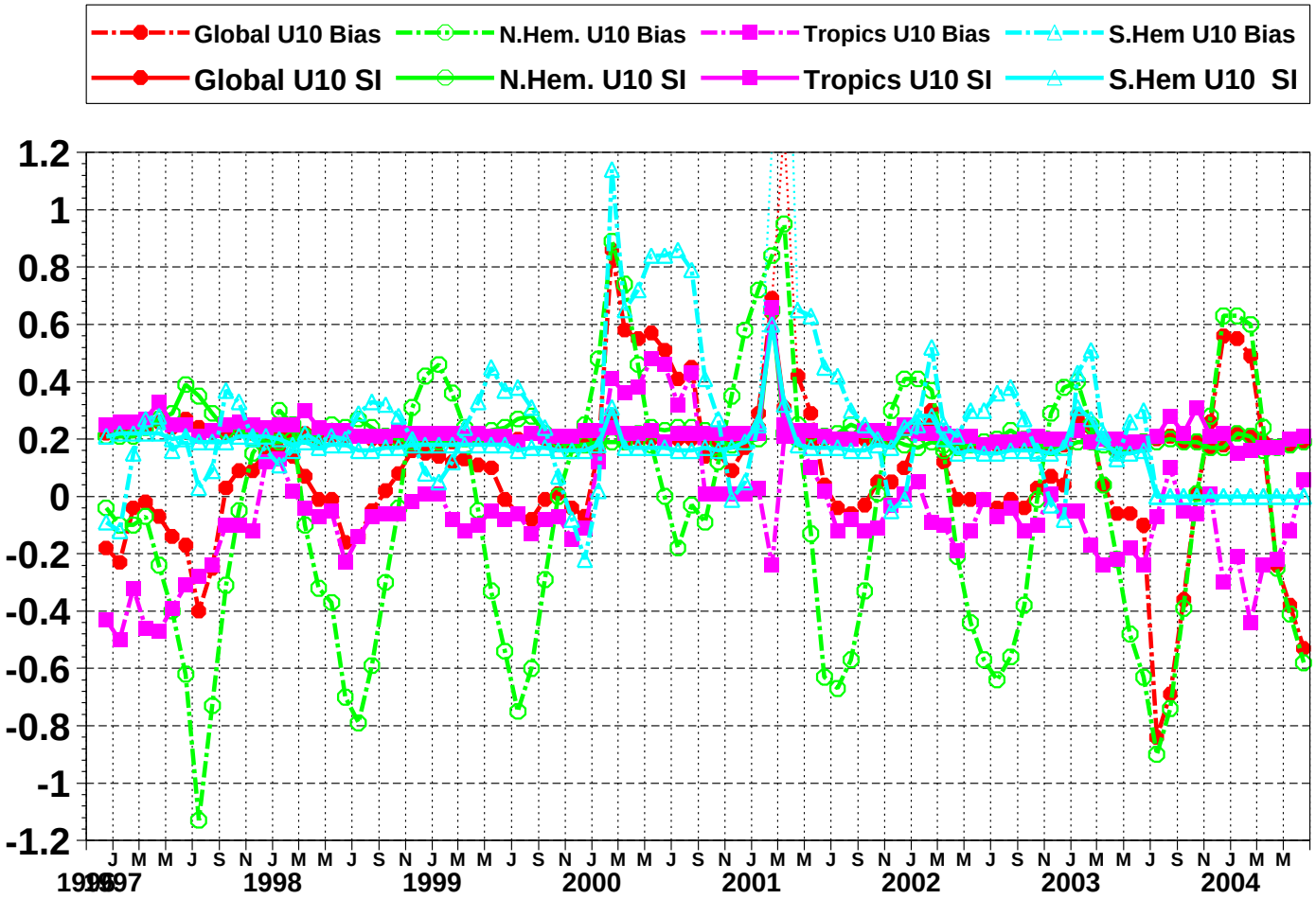


Figure 26: ERS-2 Altimeter wind speeds: Timeseries of bias (ERS-2 - model) and scatter index (SI)

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