ECMWF Report on ERS-2 RA for June 2005

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

By: *Saleh Abdalla*

Date: *8 July 2005*

Overview:

Based on the data received during the whole month, on average, 3974 observations arrived at ECMWF every 6 hours of which 67.29% 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 received during the time window centred at 18:00 on the 29th. of the month. Furthermore, there was significant reduction of data at few time windows. **It is important to note that ERS-2 observations around Korea and Japan started to appear since 25 June 2005.** 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, the western coast of North America and around Korea and Japan**, is as good as usual.

Backscatter:

ESR-2 $<\sigma_0>$ = 11.76 dB (with a main peak at ~111.3-11.4 dB and three secondary peaks at 10.8, 11.1 and 10.6 dB).

Wind Speed Comparison with ECMWF wind speeds (bias):

ERS-2 global: - 0.426 m/s

ERS-2 northern hemisphere: - 0.578 m/s

ERS-2 tropics: + 0.283 m/s

ERS-2 southern hemisphere: *missing*

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Wind Speed Comparison with buoy wind speeds (bias):

ERS-2 global: - 1.005 m/s

ERS-2 northern hemisphere: - 1.031 m/s

ERS-2 tropics: *missing*

Wave Height Comparison with ECMWF wave heights (bias):

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

ERS-2 northern hemisphere: + 0.044 m

ERS-2 tropics: - 0.034 m

ERS-2 southern hemisphere: *missing*

Wave Height Comparison with buoy wave heights (bias):

ERS-2 global: + 0.060 m

ERS-2 northern hemisphere: + 0.054 m

ERS-2 tropics: *missing*

Remarks:

- The quality of Altimeter data, both wind speed (apart from few outliers) and significant wave height, is as good as it used to be.
- ERS-2 observations around Korea and Japan started to appear since 25 June 2005.

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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. Coverage extended around Korea/Japan since 25 June 2005.
- 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.
- ECMWF atmospheric model changed on 28 June 2005 to cycle CY29R2 including changes to humidity analysis.

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

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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 2005.

Figure 2: Distribution of the ERS-2 Altimeter Backscatter after QC for June 2005.

Figure 3: Distribution of the ERS-2 Altimeter wind speeds after QC for June 2005.

Figure 4: Distribution of the ERS-2 Altimeter wind speeds after along track averaging for June 2005.

Figure 5: Global distribution of ECMWF ocean surface wind speeds for June 2005.

Figure 6: Comparison of ECMWF wind speed results with ERS-2 Altimeter wind speed data for June 2005 (global).

Figure 7: Comparison of ECMWF wind speed results with ERS-2 Altimeter wind speed data for June 2005 (northern hemisphere)

Figure 8: Comparison of ECMWF wind speed results with ERS-2 Altimeter wind speed data for June 2005 (tropics)

Figure 9: Comparison of ECMWF wind speed results with ERS-2 Altimeter wind speed data for June 2005 (southern hemisphere)

Figure 10: Comparison of buoy wind speed observations with ERS-2 Altimeter wind speed data for June 2005 (global).

Figure 11: Comparison of buoy wind speed observations with ERS-2 Altimeter wind speed data for June 2005 (northern hemisphere).

Figure 12: Comparison of buoy wind speed observations with ERS-2 Altimeter wind speed data for June 2005 (hawaii).

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 2005.

Figure 15: Distribution of the ERS-2 Altimeter wave heights after along track averaging for June 2005.

Figure 16: Global distribution of ECMWF wave heights for June 2005.

Figure 17: Comparison of ECMWF wave height results with ERS-2 Altimeter wave height data for June 2005 (global).

Figure 18: Comparison of ECMWF wave height results with ERS-2 Altimeter wave height data for June 2005 (northern hemisphere)

Figure 19: Comparison of ECMWF wave height results with ERS-2 Altimeter wave height data for June 2005 (tropics)

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Figure 20: Comparison of ECMWF wave height results with ERS-2 Altimeter wave height data for June 2005 (southern hemisphere)
Figure 21: Comparison of buoy wave height observations with ERS-2 Altimeter wave height data for June 2005 (global).
Figure 22: Comparison of buoy wave height observations with ERS-2 Altimeter wave height data for June 2005 (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 2005.
Figure 25: ERS-2 Altimeter wave heights: Timeseries of bias (ERS-2 - model) and scatter index (SI) from December 1996 to June 2005
Figure 26: ERS-2 Altimeter wind speeds: Timeseries of bias (ERS-2 - model) and scatter index (SI) from December 1996 to June 2005

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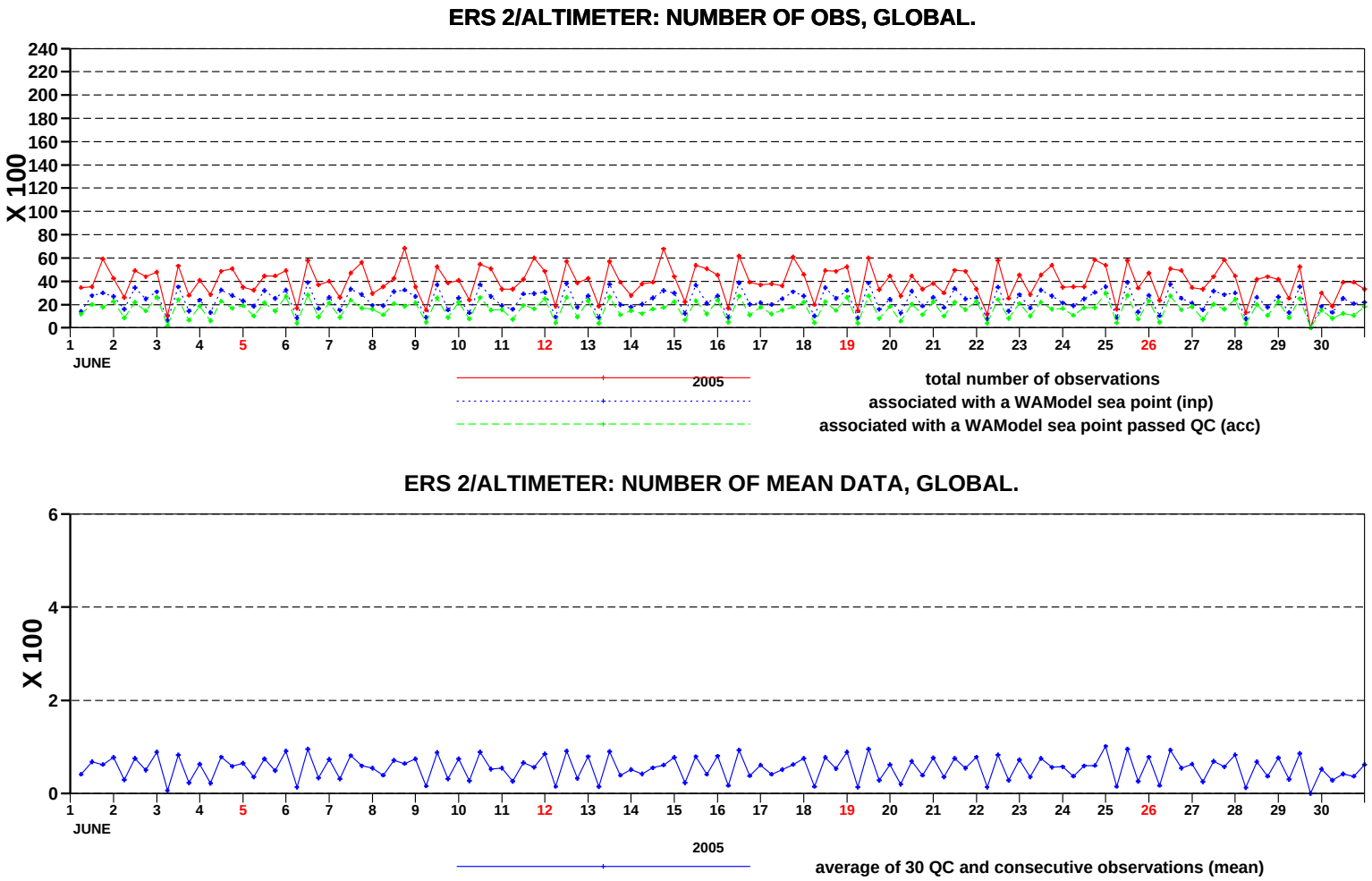


Figure 1:Time series of data reception for ERS-2 Altimeter data for June 2005

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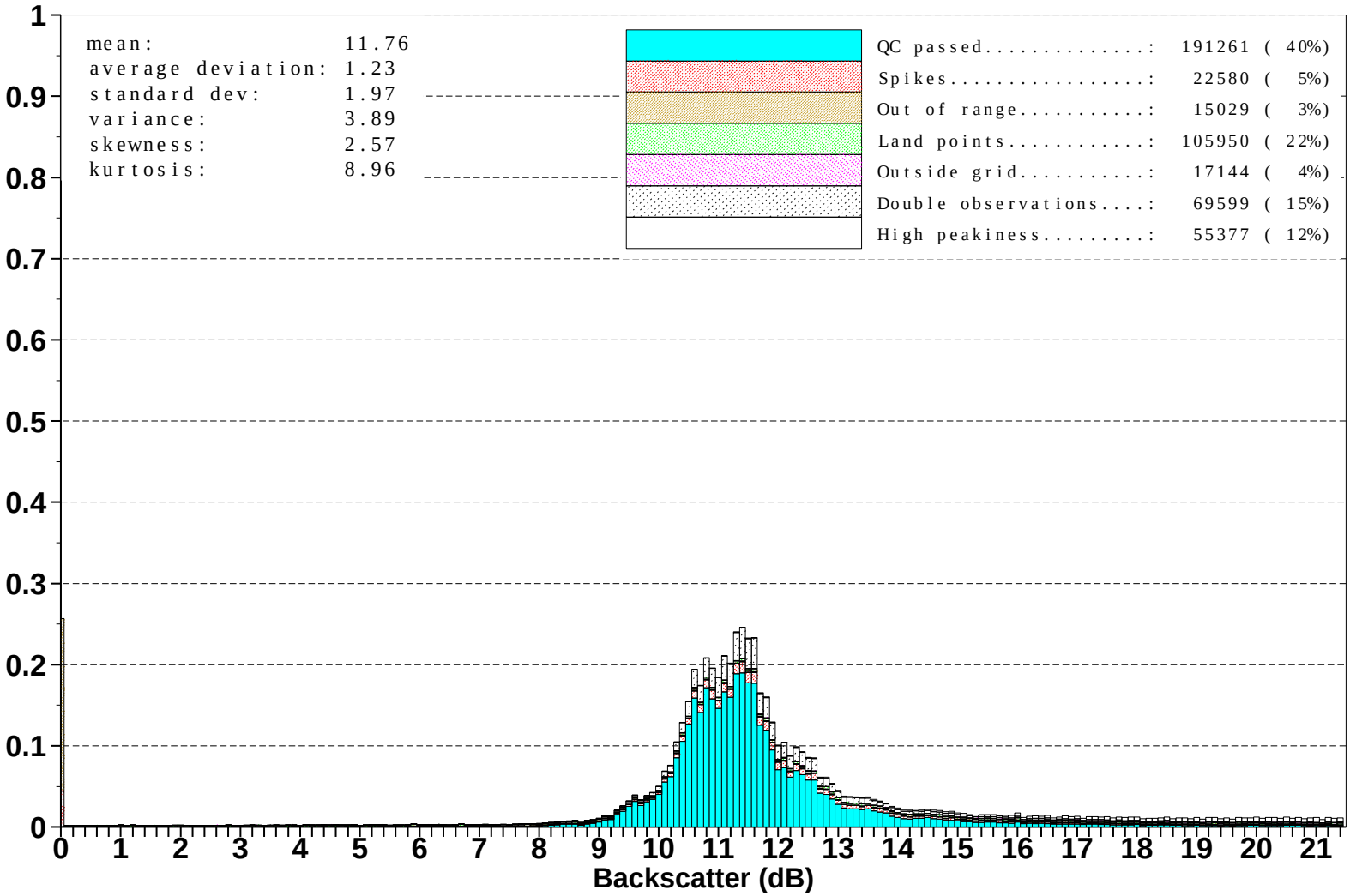


Figure 2: Distribution of the ERS-2 Altimeter backscatter after QC for June 2005

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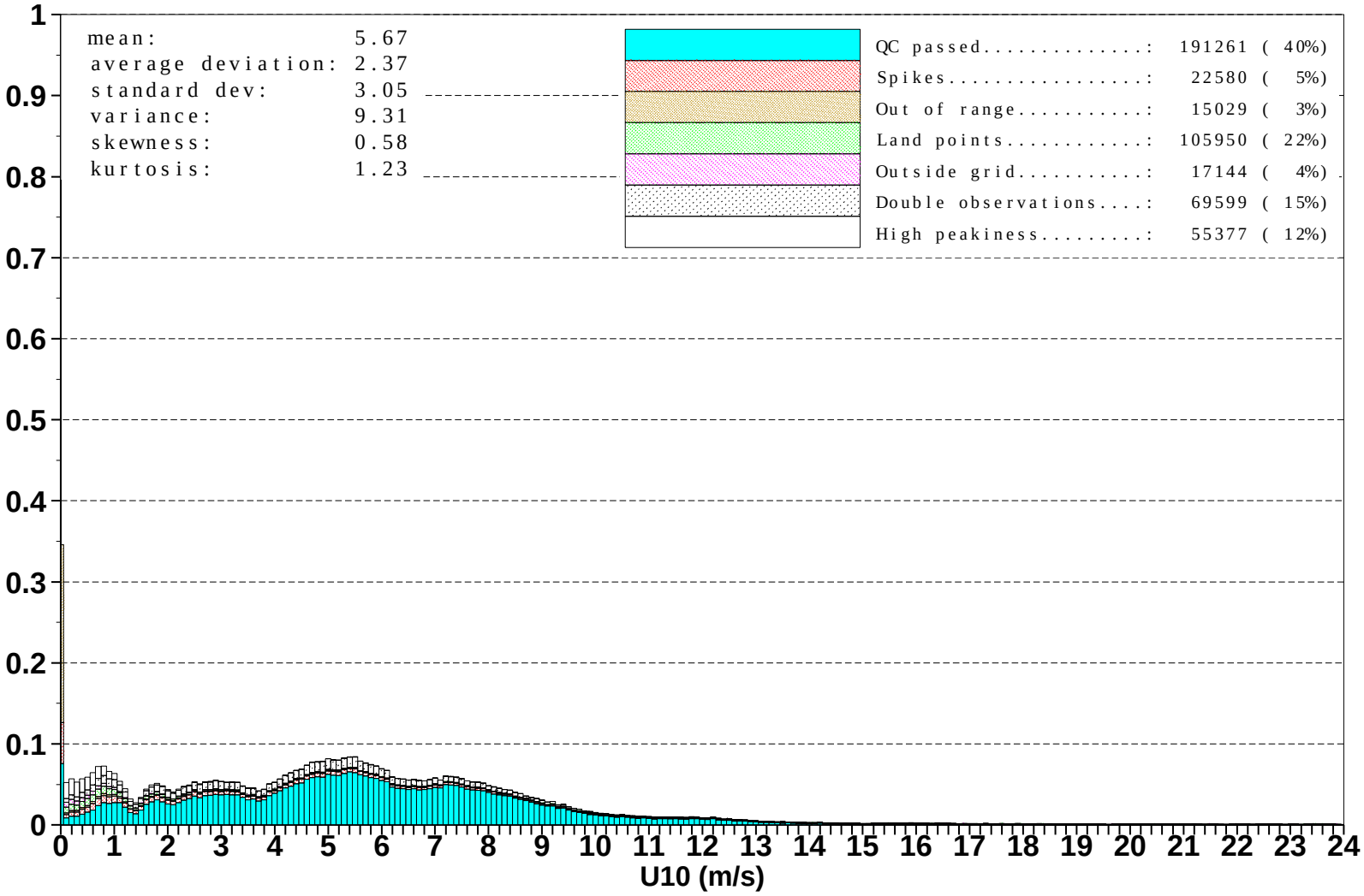


Figure 3: Distribution of the ERS-2 Altimeter wind speeds after QC for June 2005

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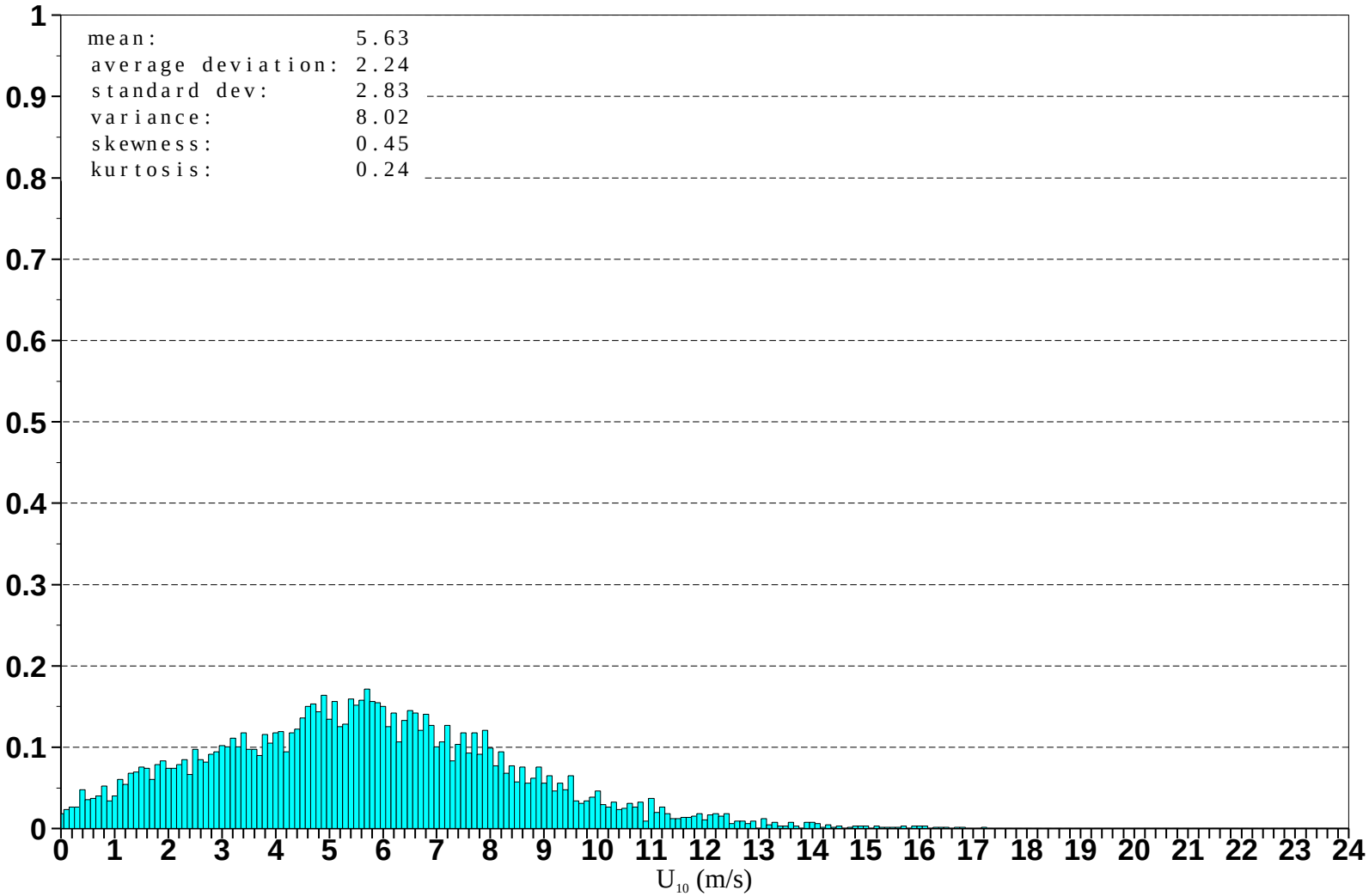


Figure 4: Distribution of ERS-2 Altimeter wind speeds after along track averaging for June 2005

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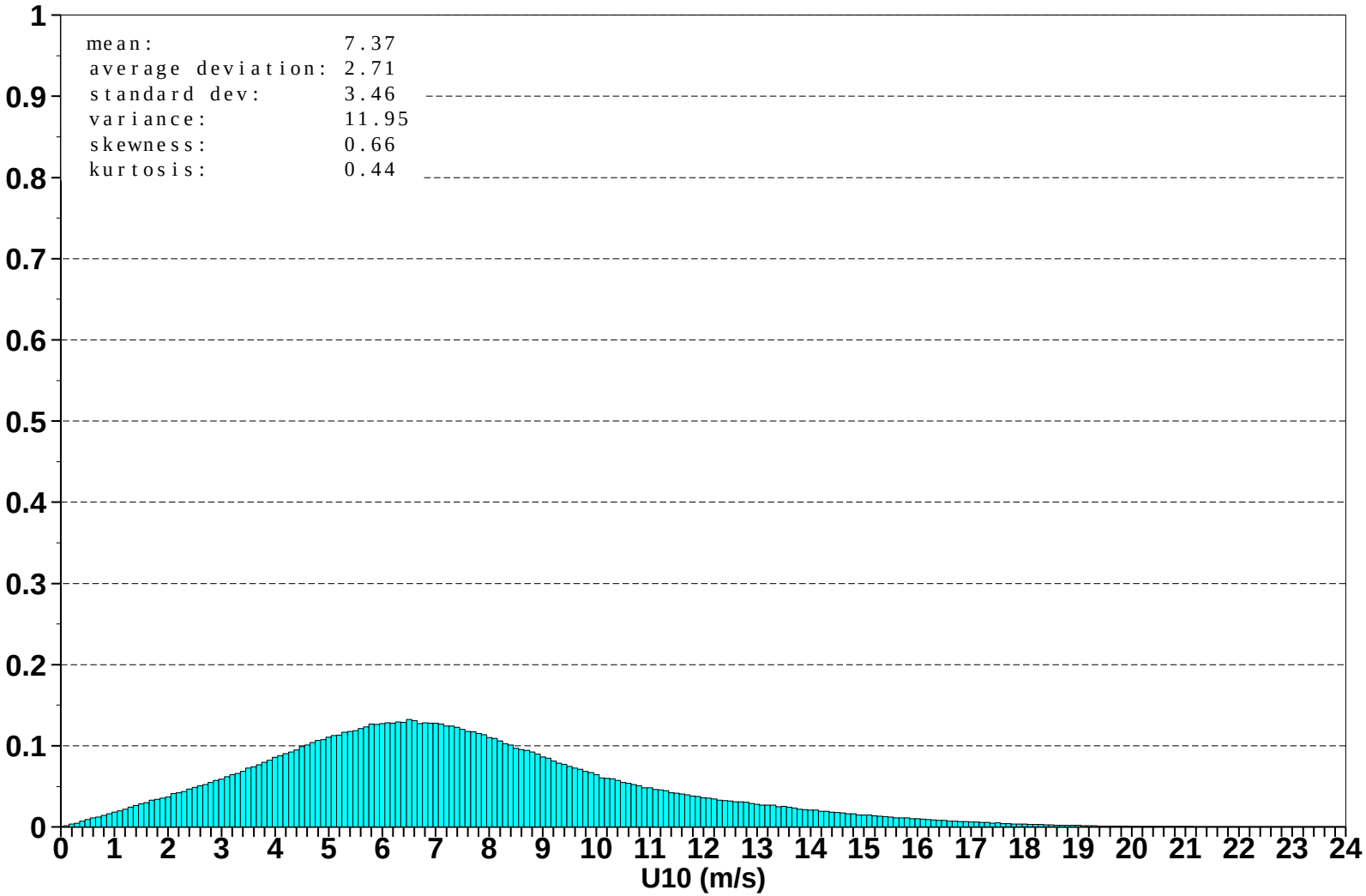
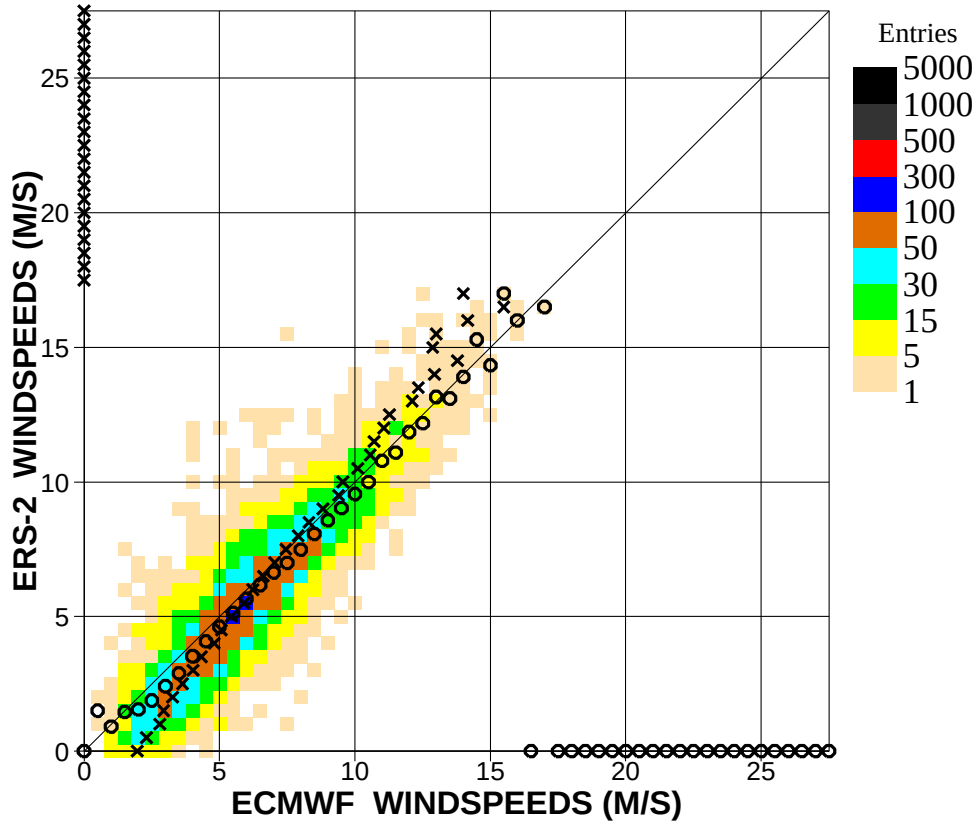


Figure 5: Global distribution of ECMWF ocean surface wind speeds for June 2005

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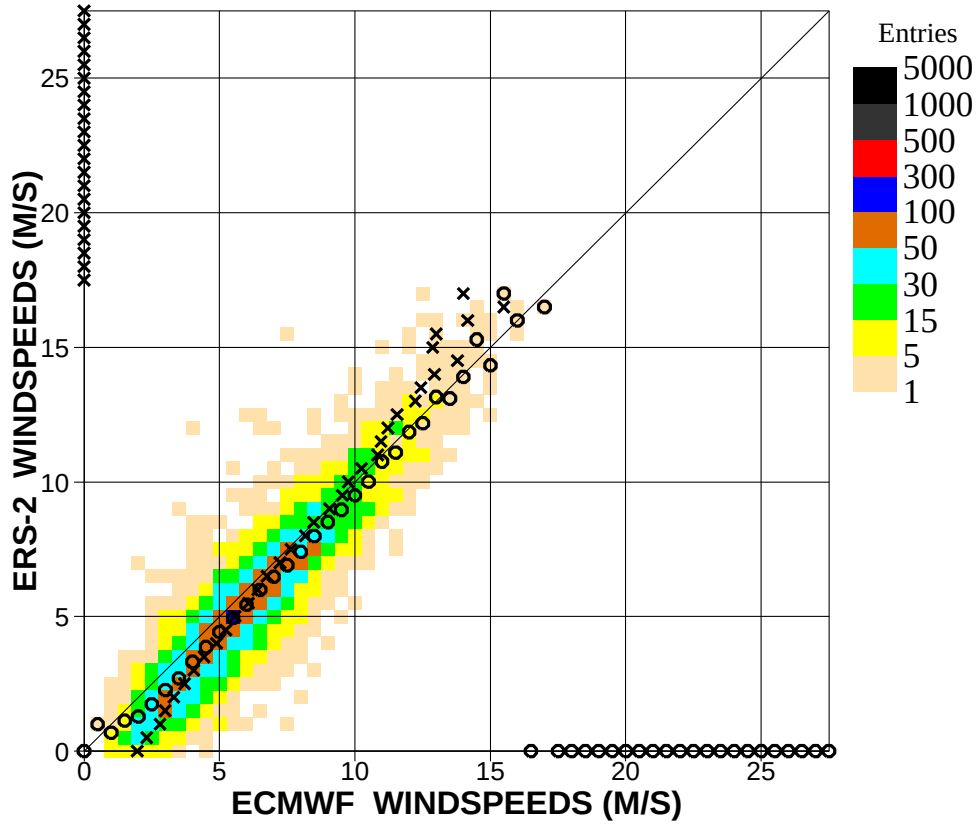
STATISTICS

ENTRIES	6468	
MEAN ECMWF	6.0565	
MEAN ERS-2	5.6301	
BIAS (ERS-2 - ECMWF)	-.4264	
STANDARD DEVIATION	1.2827	
SCATTER INDEX	.2118	
CORRELATION	.8917	
SYMMETRIC SLOPE	.9630	(.0065)
REGR. COEFFICIENT	1.0186	(.0064)
REGR. CONSTANT	-.5390	(.0421)

Figure 6. Comparison of ECMWF wind speed results with ERS2 Altimeter wind speed data for June 2005 (global)

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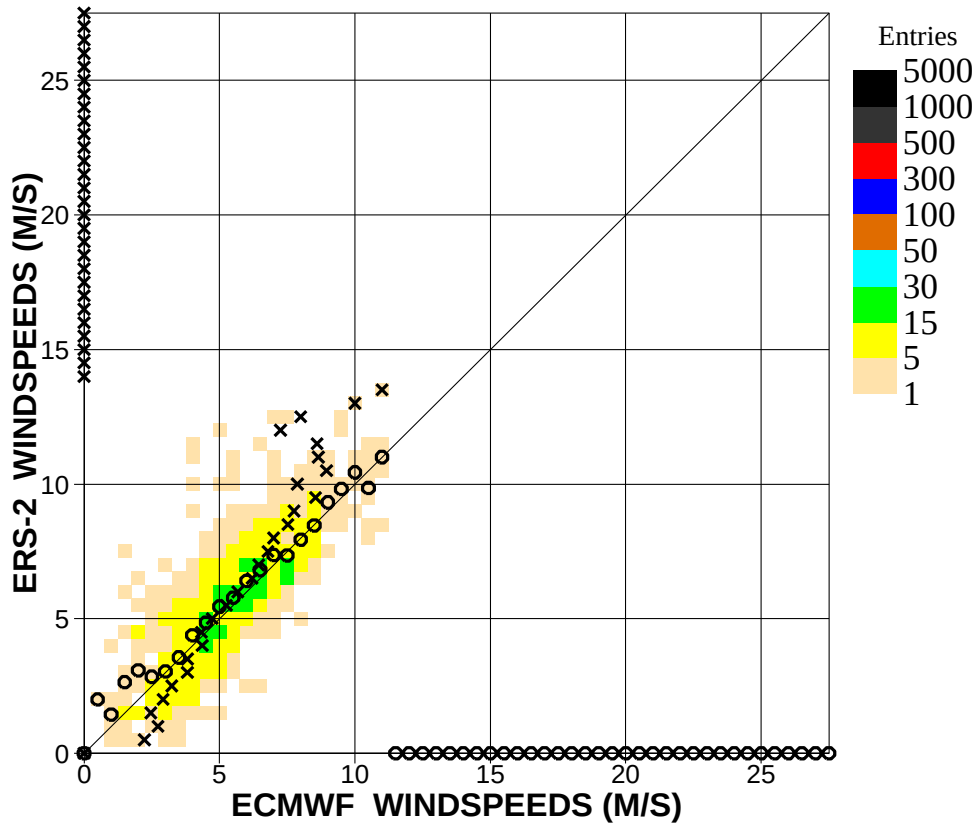
STATISTICS

ENTRIES	5362	
MEAN ECMWF	6.1681	
MEAN ERS-2	5.5906	
BIAS (ERS-2 - ECMWF)	-.5775	
STANDARD DEVIATION	1.2108	
SCATTER INDEX	.1963	
CORRELATION	.9115	
SYMMETRIC SLOPE	.9450	(.0067)
REGR. COEFFICIENT	1.0422	(.0064)
REGR. CONSTANT	-.8379	(.0429)

Figure 7. Comparison of ECMWF wind speed results with ERS2 Altimeter wind speed data for June 2005 (n.hem.)

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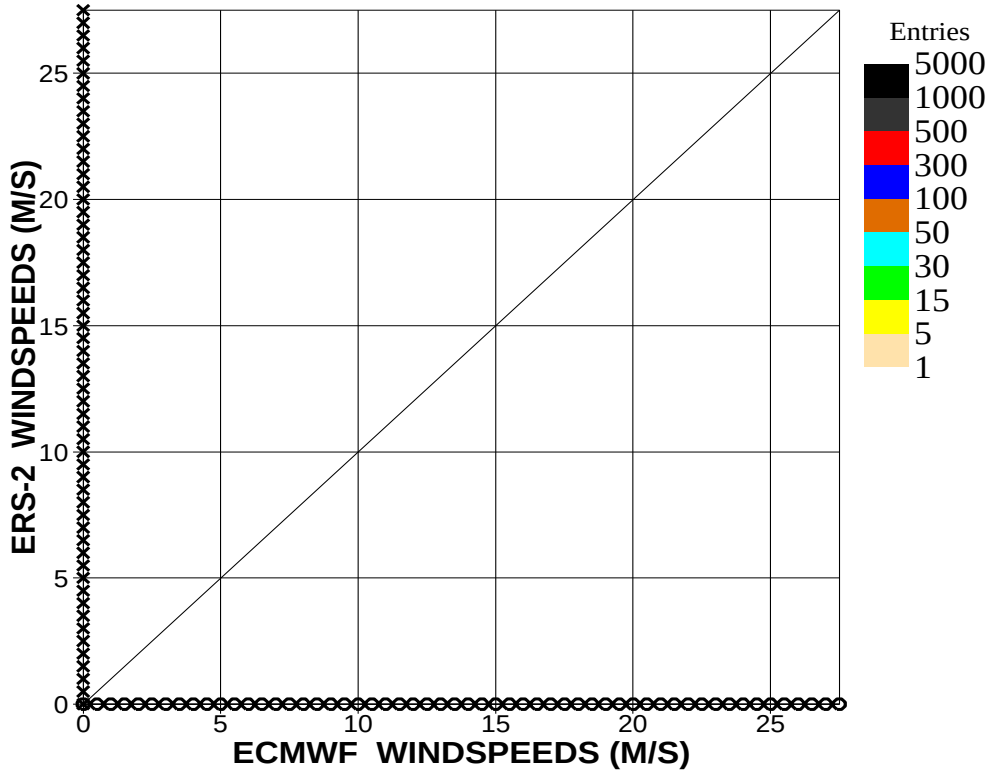


STATISTICS

ENTRIES	1140	
MEAN ECMWF	5.5231	
MEAN ERS-2	5.8056	
BIAS (ERS-2 - ECMWF)	.2825	
STANDARD DEVIATION	1.3670	
SCATTER INDEX	.2475	
CORRELATION	.7988	
SYMMETRIC SLOPE	1.0657	(.0214)
REGR. COEFFICIENT	.9422	(.0210)
REGR. CONSTANT	.6020	(.1230)

Figure 8. Comparison of ECMWF wind speed results with ERS2 Altimeter wind speed data for June 2005 (tropics)

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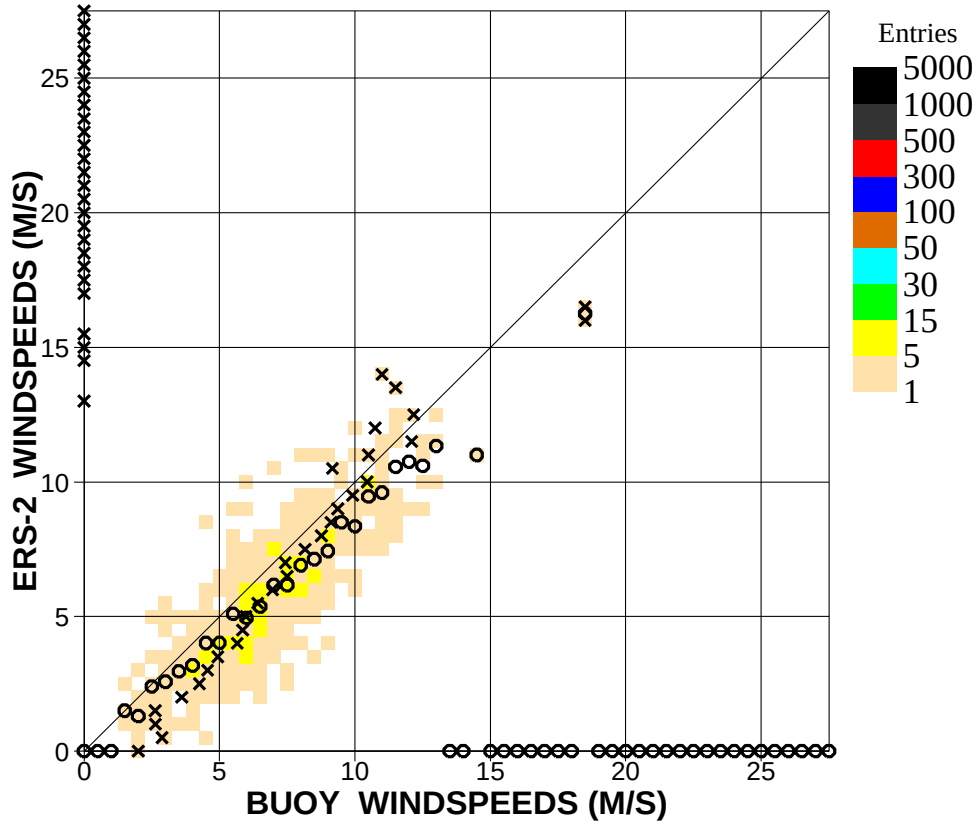
STATISTICS

ENTRIES	0
MEAN ECMWF	.0000
MEAN ERS-2	.0000
BIAS (ERS-2 - ECMWF)	.0000
STANDARD DEVIATION	.0000
SCATTER INDEX	.0000
CORRELATION	.0000
SYMMETRIC SLOPE	.0000
REGR. COEFFICIENT	.0000
REGR. CONSTANT	.0000

Figure 9. Comparison of ECMWF wind speed results with ERS2 Altimeter wind speed data for June 2005 (s.hem.)

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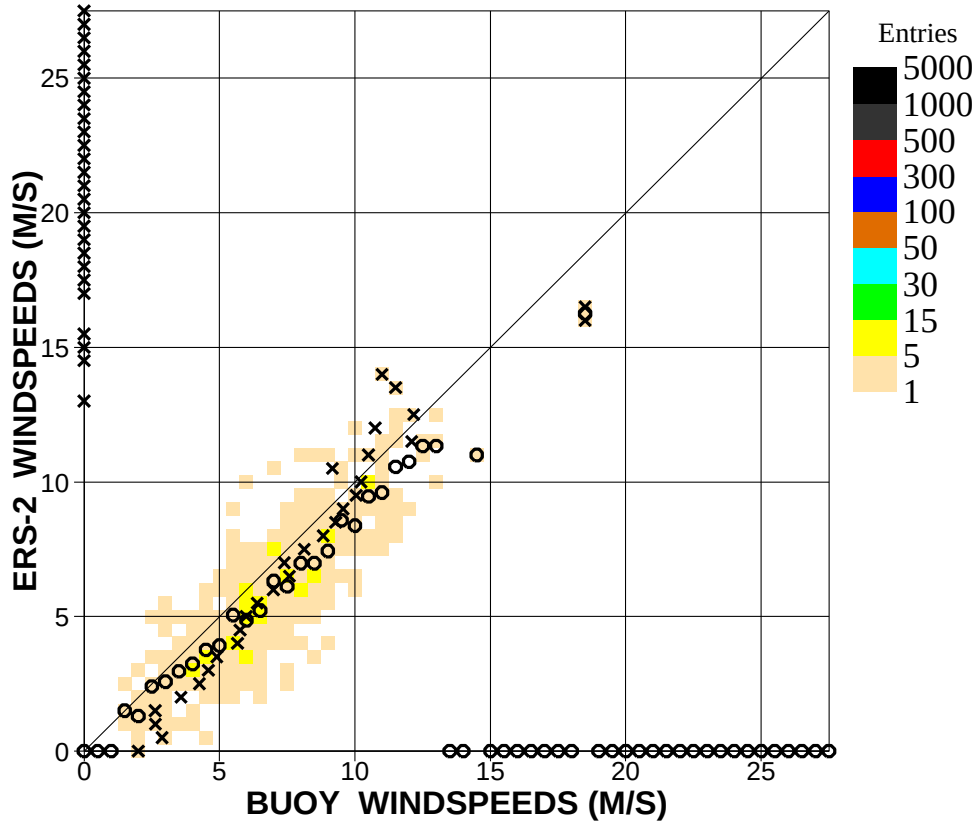


STATISTICS

ENTRIES	469	
MEAN BUOY	6.7782	
MEAN ERS-2	5.7736	
BIAS (ERS-2 - BUOY)	-1.0047	
STANDARD DEVIATION	1.4706	
SCATTER INDEX	.2170	
CORRELATION	.8477	
SYMMETRIC SLOPE	.8774	(.0256)
REGR. COEFFICIENT	.8759	(.0254)
REGR. CONSTANT	-.1638	(.1843)

Figure 10. Comparison of buoy wind speed observations with ERS2 Altimeter wind speed data for June 2005 (global)

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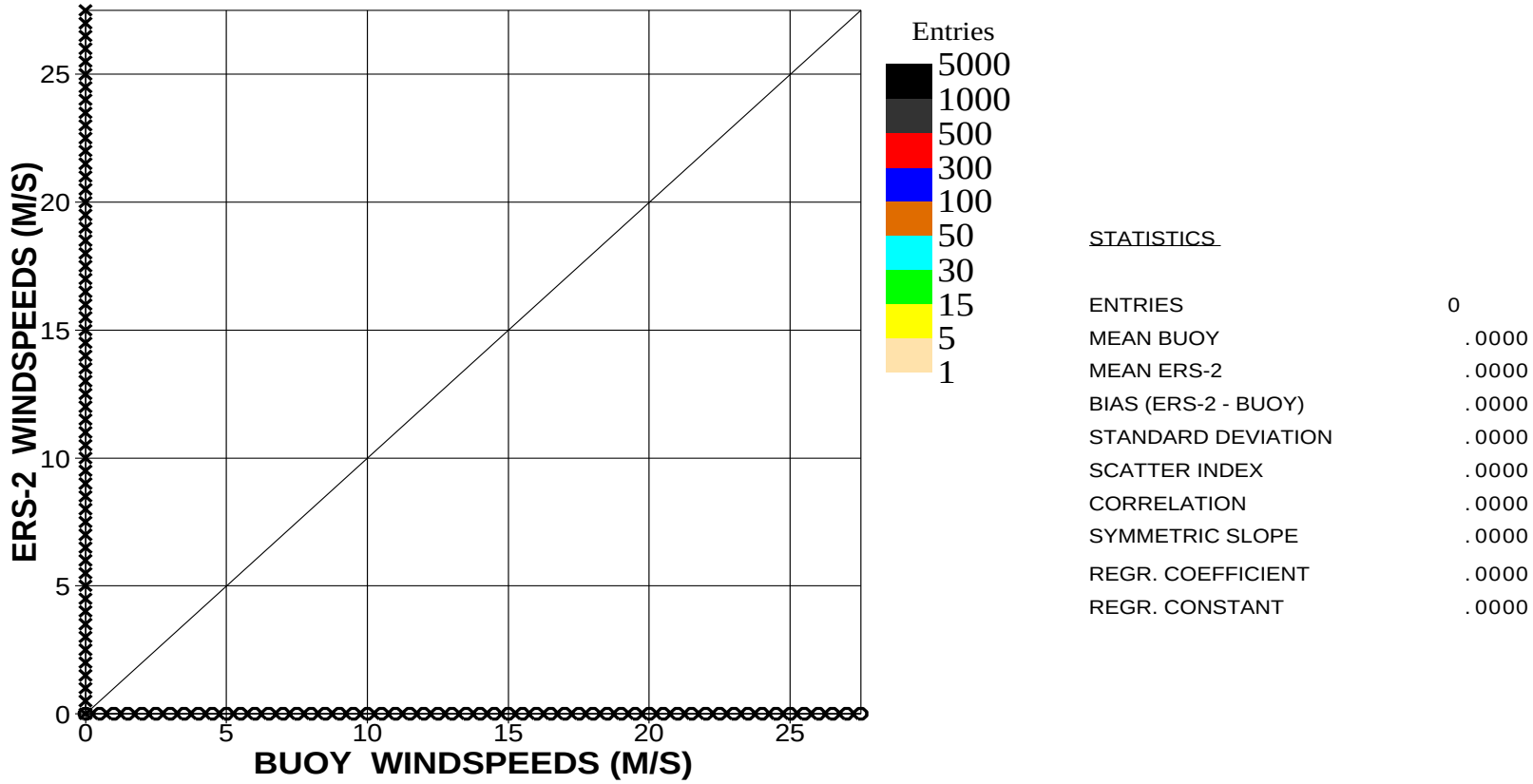


STATISTICS

ENTRIES	421	
MEAN BUOY	6.7475	
MEAN ERS-2	5.7164	
BIAS (ERS-2 - BUOY)	-1.0311	
STANDARD DEVIATION	1.4688	
SCATTER INDEX	.2177	
CORRELATION	.8562	
SYMMETRIC SLOPE	.8752	(.0264)
REGR. COEFFICIENT	.8862	(.0261)
REGR. CONSTANT	-.2634	(.1897)

Figure 11. Comparison of buoy wind speed observations with ERS2 Altimeter wind speed data for June 2005 (n.hem.)

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STATISTICS

ENTRIES	0
MEAN BUOY	.0000
MEAN ERS-2	.0000
BIAS (ERS-2 - BUOY)	.0000
STANDARD DEVIATION	.0000
SCATTER INDEX	.0000
CORRELATION	.0000
SYMMETRIC SLOPE	.0000
REGR. COEFFICIENT	.0000
REGR. CONSTANT	.0000

Figure 12. Comparison of buoy wind speed observations with ERS2 Altimeter wind speed data for June 2005 (hawaii)

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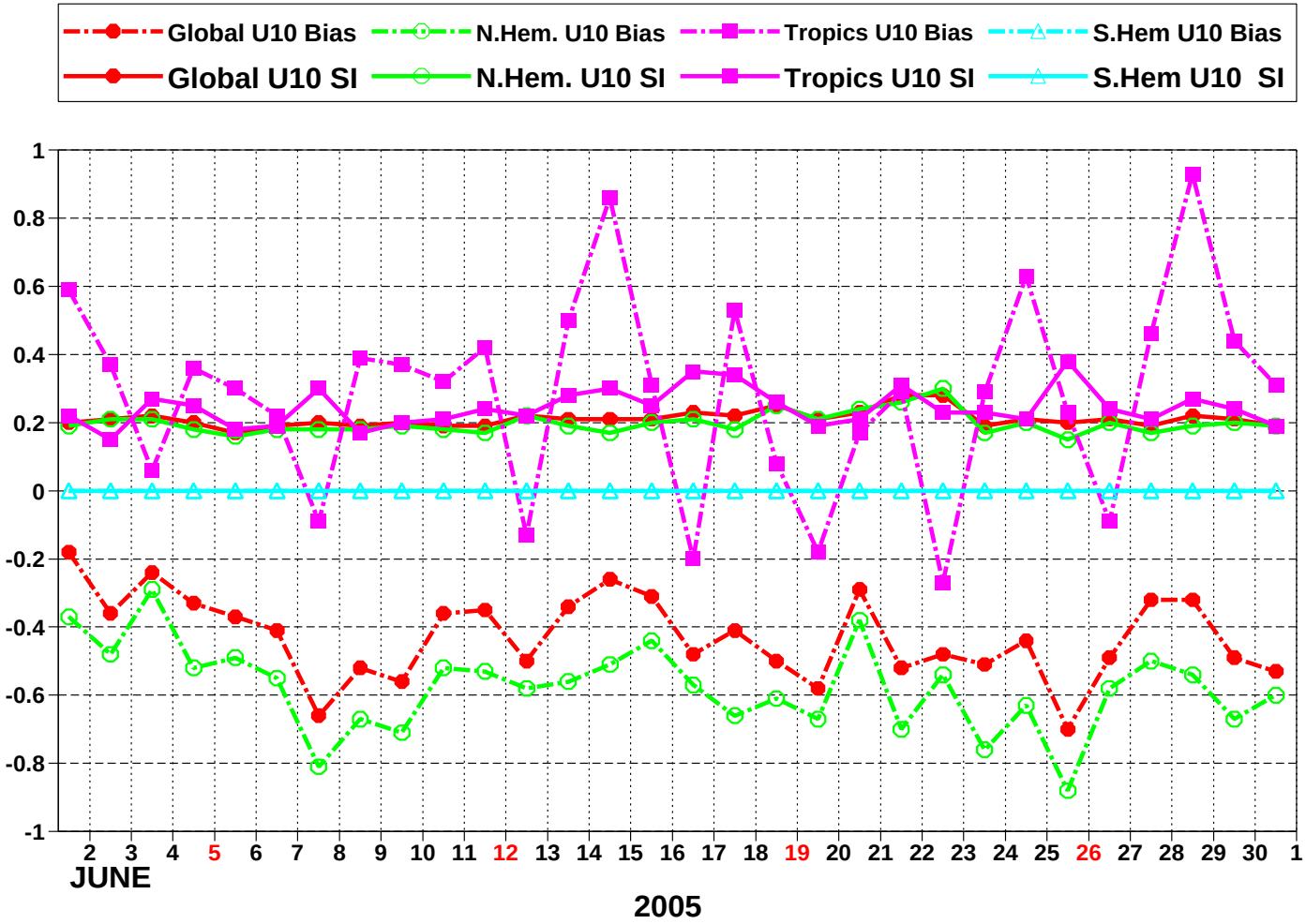


Figure 13: ERS-2 Altimeter wind speeds: Timeseries of bias (ERS-2 - model) and scatter index (SI)

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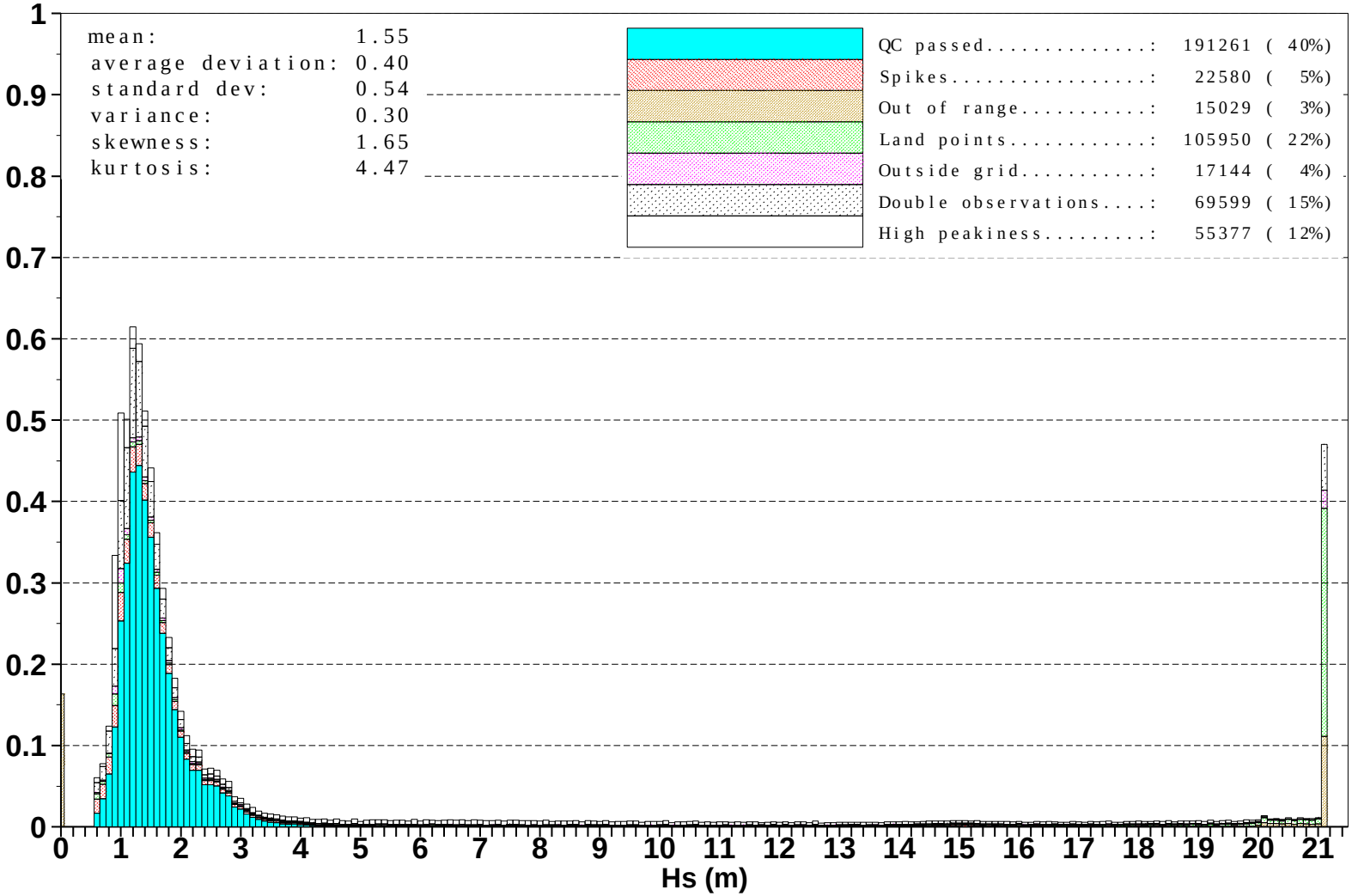


Figure 14: Distribution of the ERS-2 Altimeter wave heights after QC for June 2005

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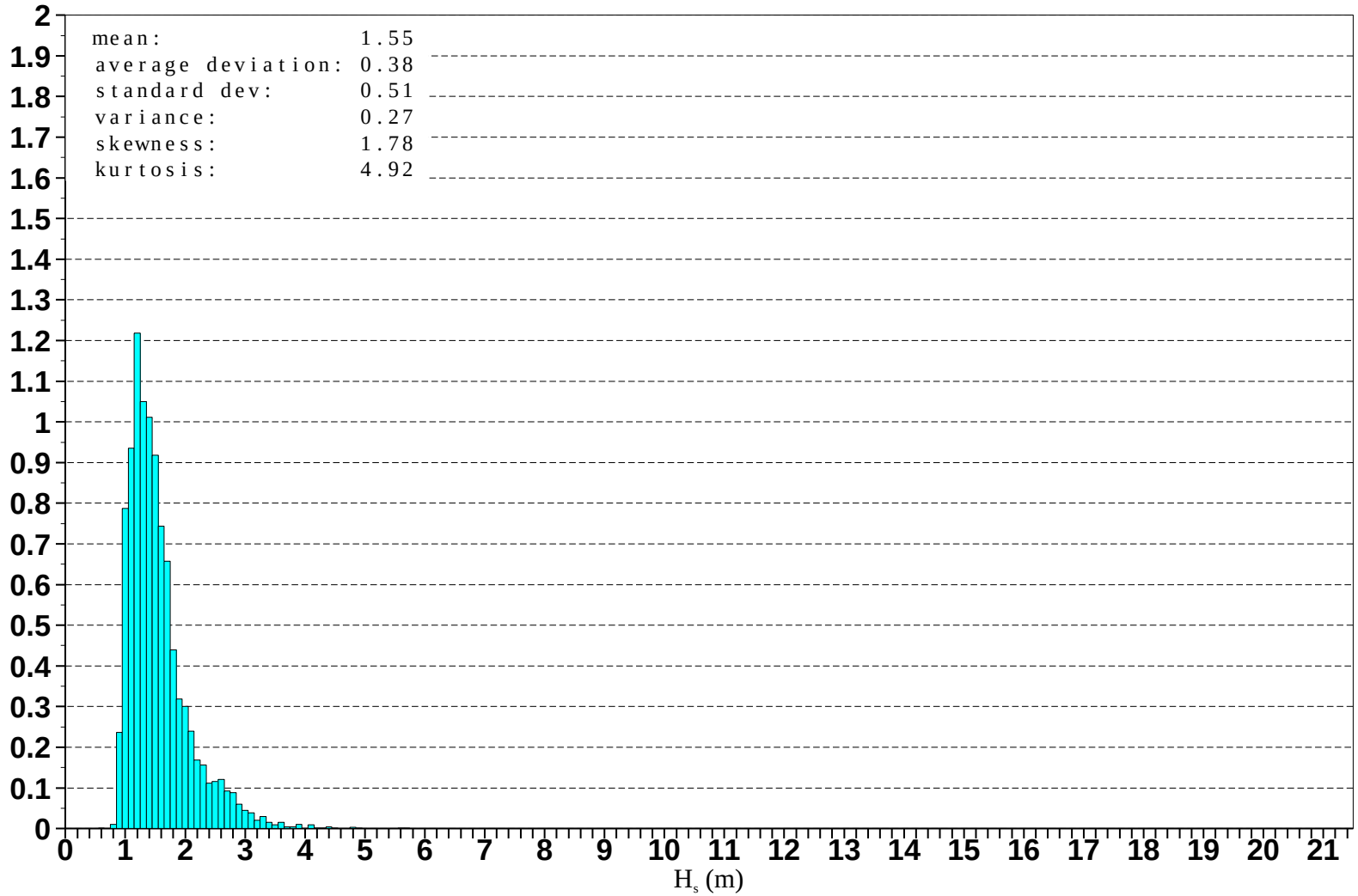


Figure 15: Distribution of ERS-2 Altimeter wave heights after along track averaging for June 2005

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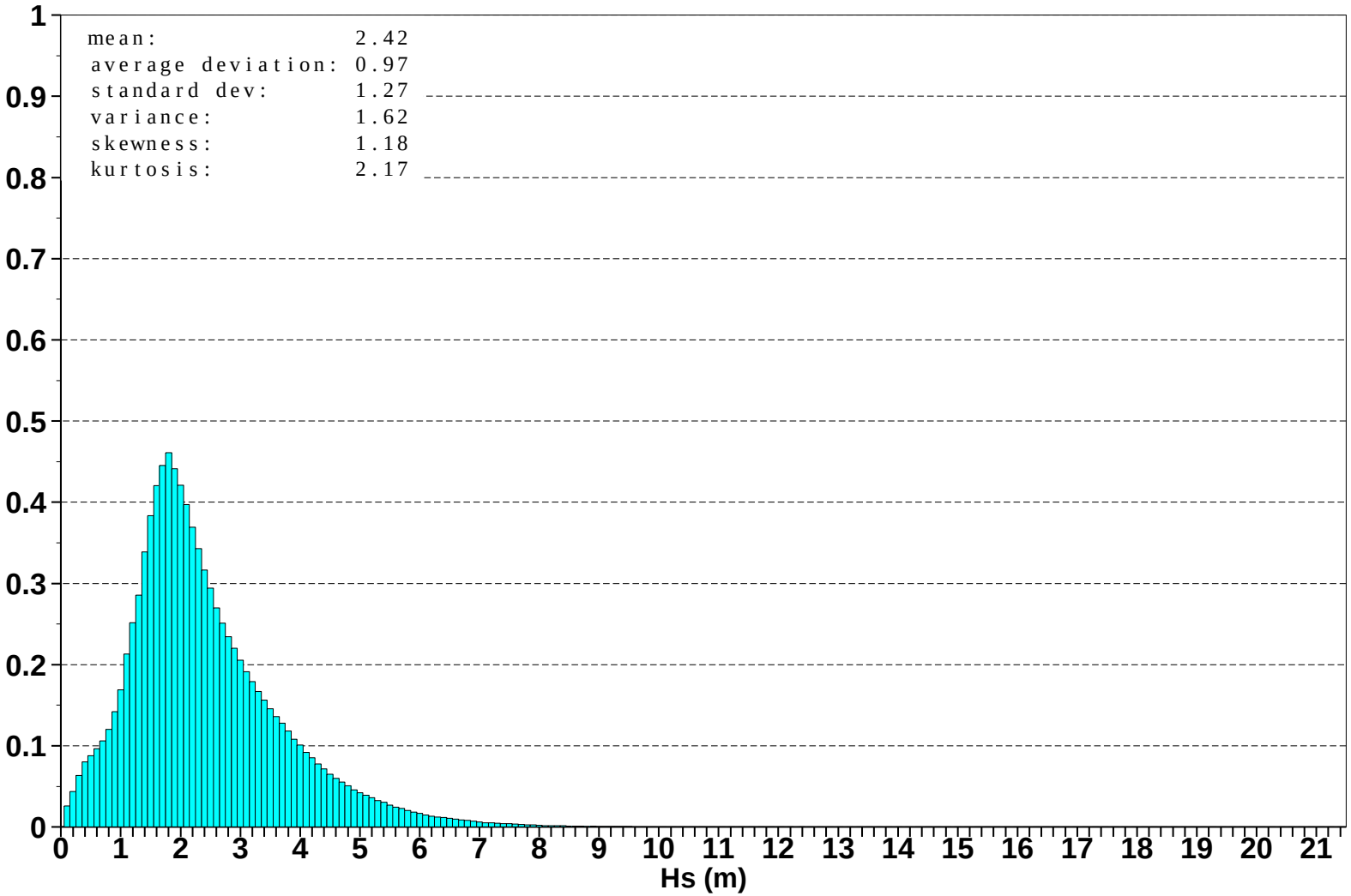
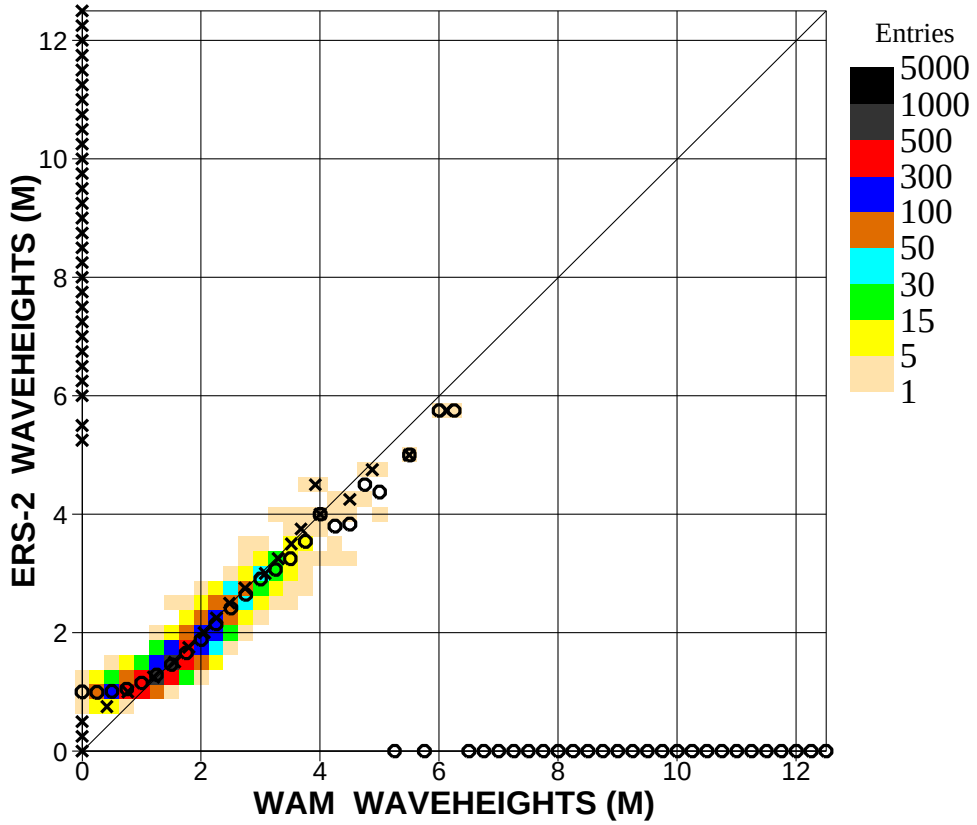


Figure 16: Global distribution of ECMWF wave heights for June 2005

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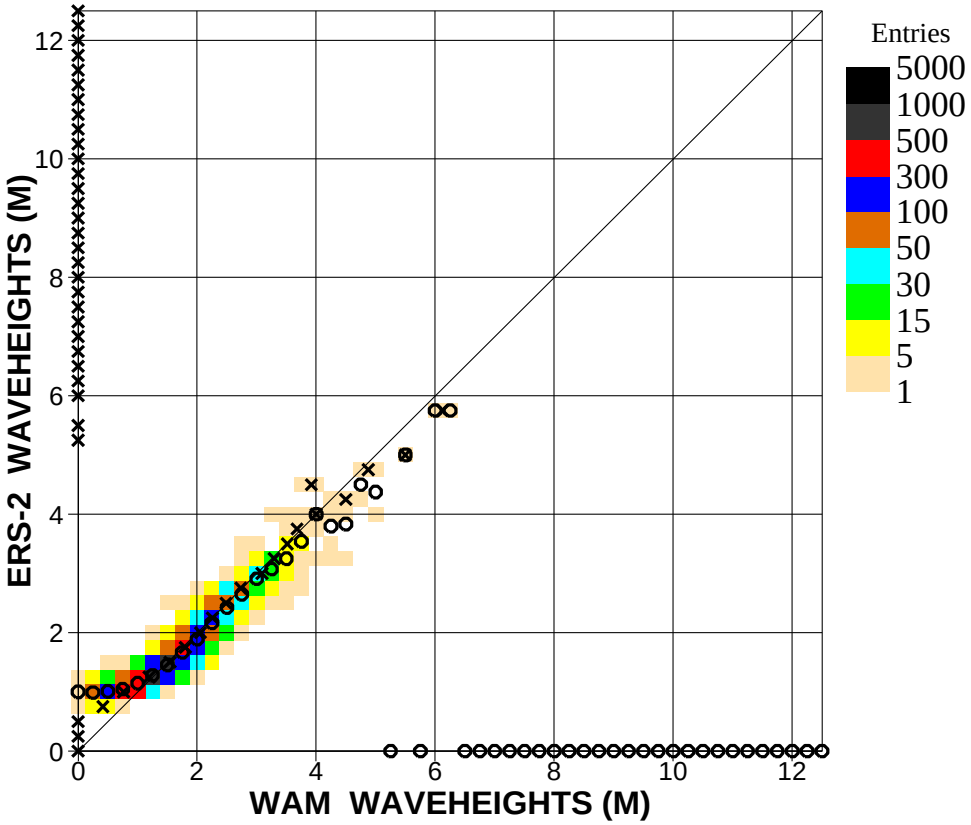


STATISTICS

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MEAN ERS-2	1.5457	
BIAS (ERS-2 - WAM)	.0306	
STANDARD DEVIATION	.2305	
SCATTER INDEX	.1521	
CORRELATION	.9359	
SYMMETRIC SLOPE	.9943	(.0046)
REGR. COEFFICIENT	.7721	(.0036)
REGR. CONSTANT	.3760	(.0059)

Figure 17. Comparison of ECMWF wave height results with ERS2 Altimeter wave height data for June 2005 (global)

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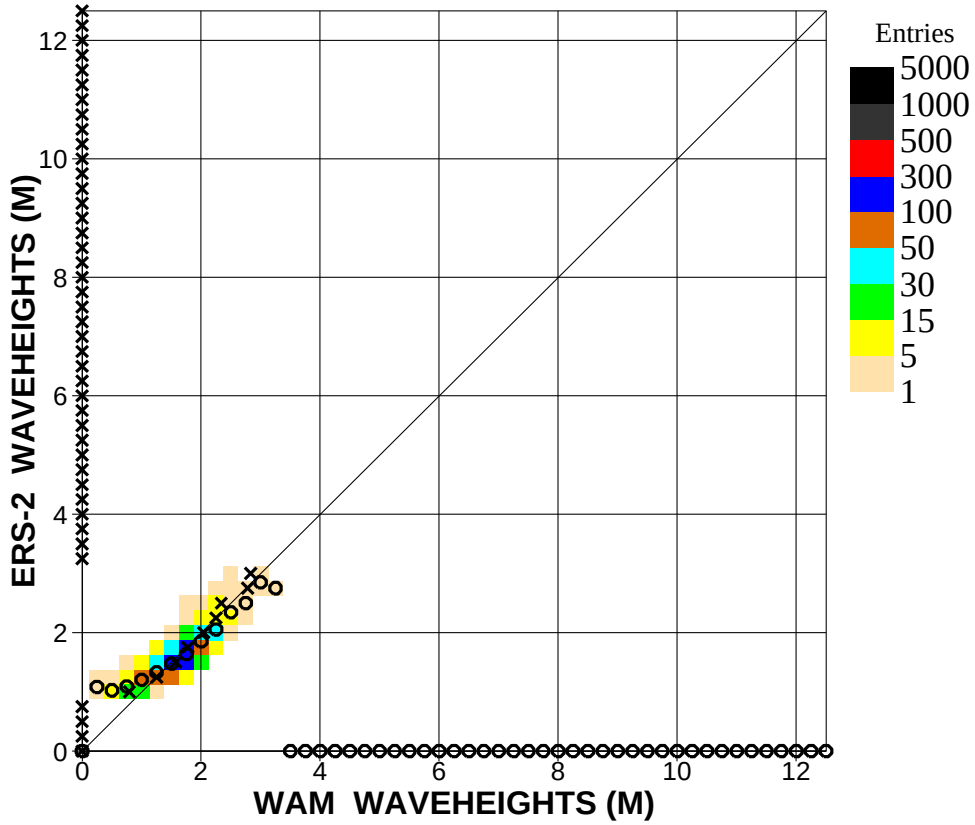


STATISTICS

ENTRIES	5362	
MEAN WAM	1.4977	
MEAN ERS-2	1.5421	
BIAS (ERS-2 - WAM)	.0444	
STANDARD DEVIATION	.2353	
SCATTER INDEX	.1571	
CORRELATION	.9412	
SYMMETRIC SLOPE	.9997	(.0049)
REGR. COEFFICIENT	.7805	(.0038)
REGR. CONSTANT	.3732	(.0063)

Figure 18. Comparison of ECMWF wave height results with ERS2 Altimeter wave height data for June 2005 (n.hem.)

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STATISTICS

ENTRIES	1140	
MEAN WAM	1.5928	
MEAN ERS-2	1.5585	
BIAS (ERS-2 - WAM)	-.0343	
STANDARD DEVIATION	.1937	
SCATTER INDEX	.1216	
CORRELATION	.8730	
SYMMETRIC SLOPE	.9685	(.0142)
REGR. COEFFICIENT	.6846	(.0113)
REGR. CONSTANT	.4681	(.0186)

Figure 19. Comparison of ECMWF wave height results with ERS2 Altimeter wave height data for June 2005 (tropics)

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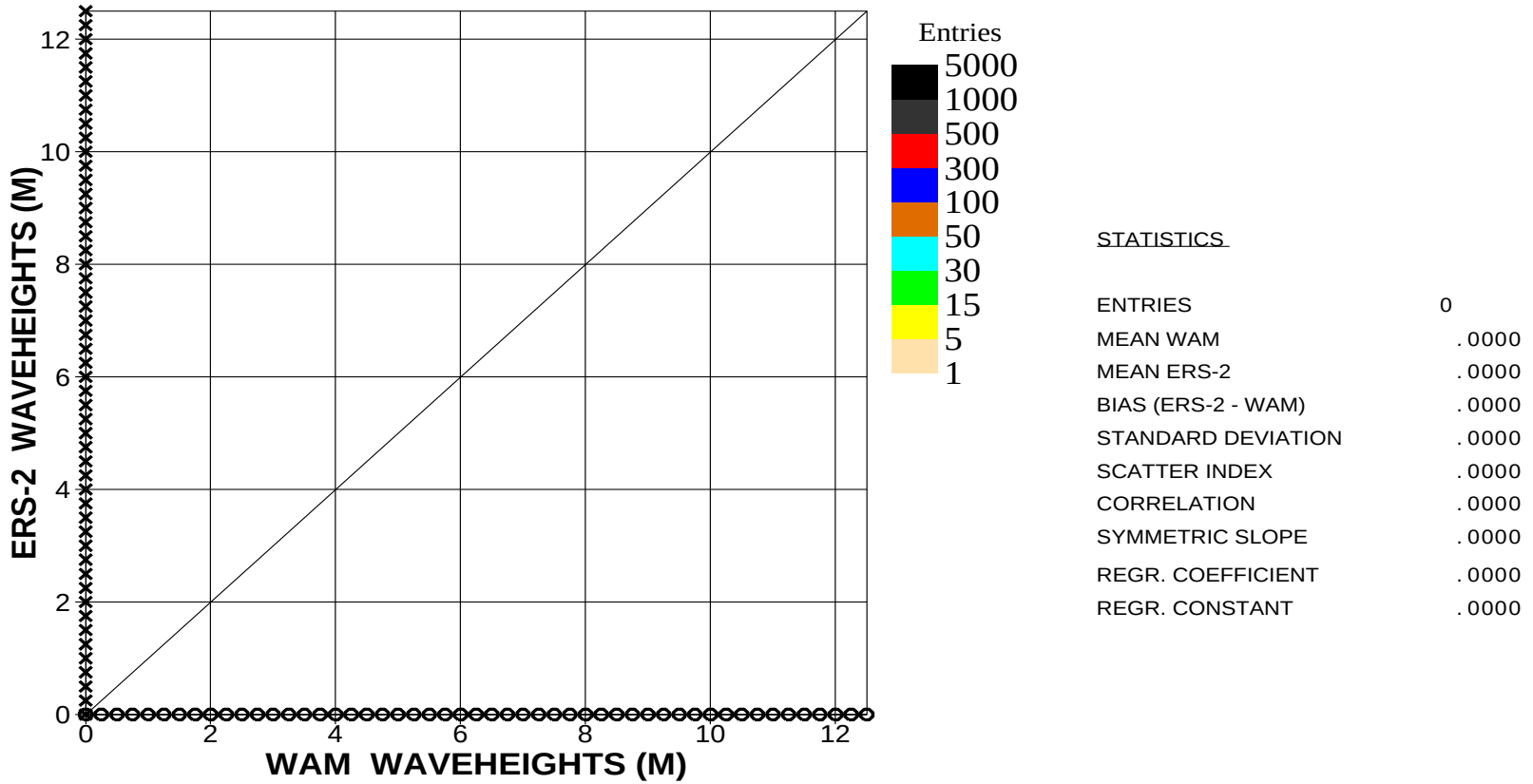
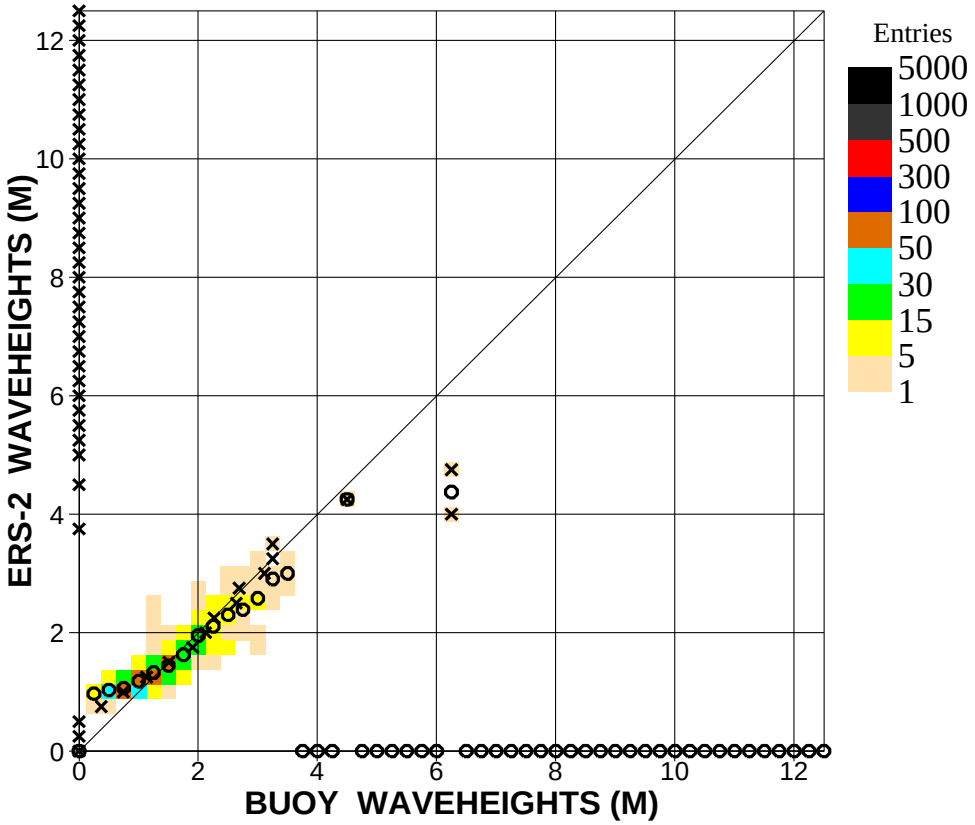


Figure 20. Comparison of ECMWF wave height results with ERS2 Altimeter wave height data for June 2005 (s.hem.)

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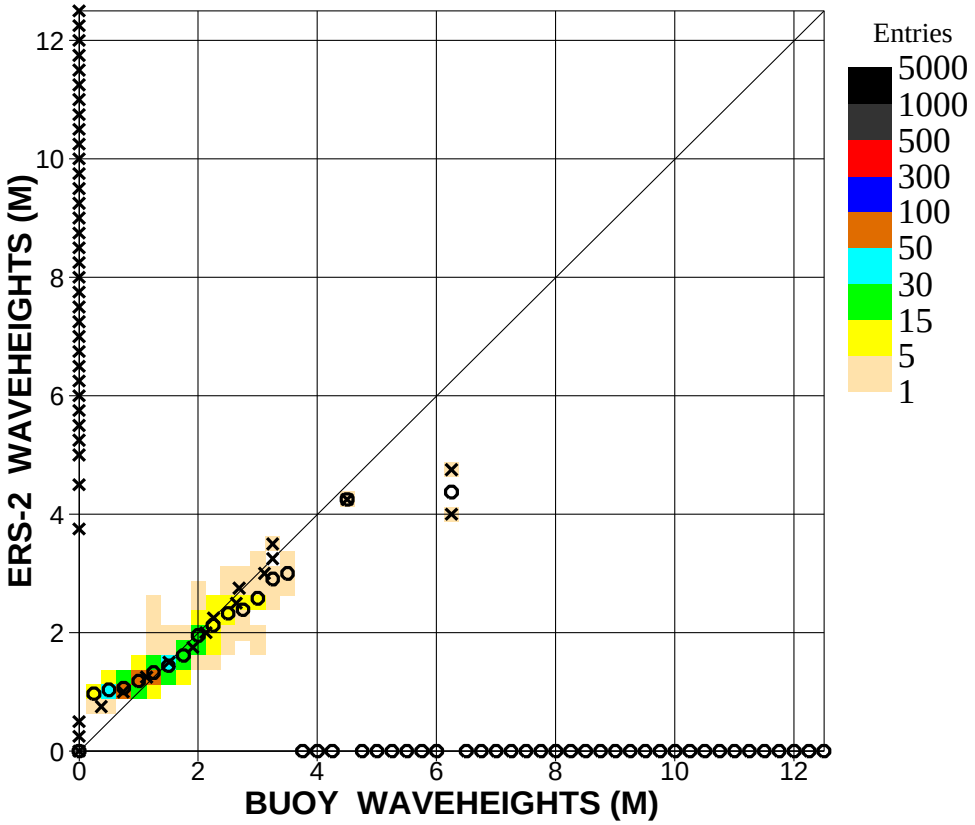


STATISTICS

ENTRIES	699	
MEAN BUOY	1.4652	
MEAN ERS-2	1.5251	
BIAS (ERS-2 - BUOY)	.0599	
STANDARD DEVIATION	.3130	
SCATTER INDEX	.2136	
CORRELATION	.9258	
SYMMETRIC SLOPE	.9863	(.0163)
REGR. COEFFICIENT	.6747	(.0104)
REGR. CONSTANT	.5366	(.0171)

Figure 21. Comparison of buoy wave height observations with ERS2 Altimeter wave height data for June 2005 (global)

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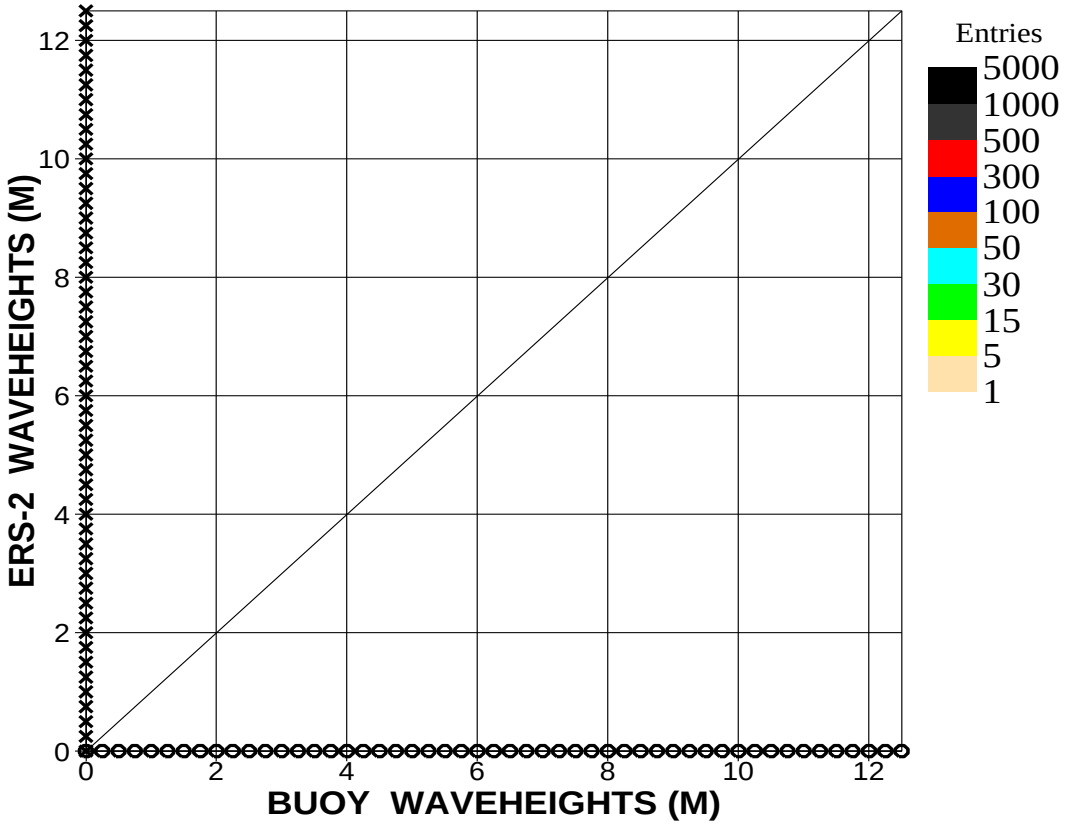


STATISTICS

ENTRIES	643	
MEAN BUOY	1.4892	
MEAN ERS-2	1.5429	
BIAS (ERS-2 - BUOY)	.0537	
STANDARD DEVIATION	.3183	
SCATTER INDEX	.2137	
CORRELATION	.9252	
SYMMETRIC SLOPE	.9825	(.0168)
REGR. COEFFICIENT	.6767	(.0110)
REGR. CONSTANT	.5351	(.0183)

Figure 22. Comparison of buoy wave height observations with ERS2 Altimeter wave height data for June 2005 (n.hem.)

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STATISTICS

ENTRIES	0
MEAN BUOY	.0000
MEAN ERS-2	.0000
BIAS (ERS-2 - BUOY)	.0000
STANDARD DEVIATION	.0000
SCATTER INDEX	.0000
CORRELATION	.0000
SYMMETRIC SLOPE	.0000
REGR. COEFFICIENT	.0000
REGR. CONSTANT	.0000

Figure 23. Comparison of buoy wave height observations with ERS2 Altimeter wave height data for June 2005 (hawaii)

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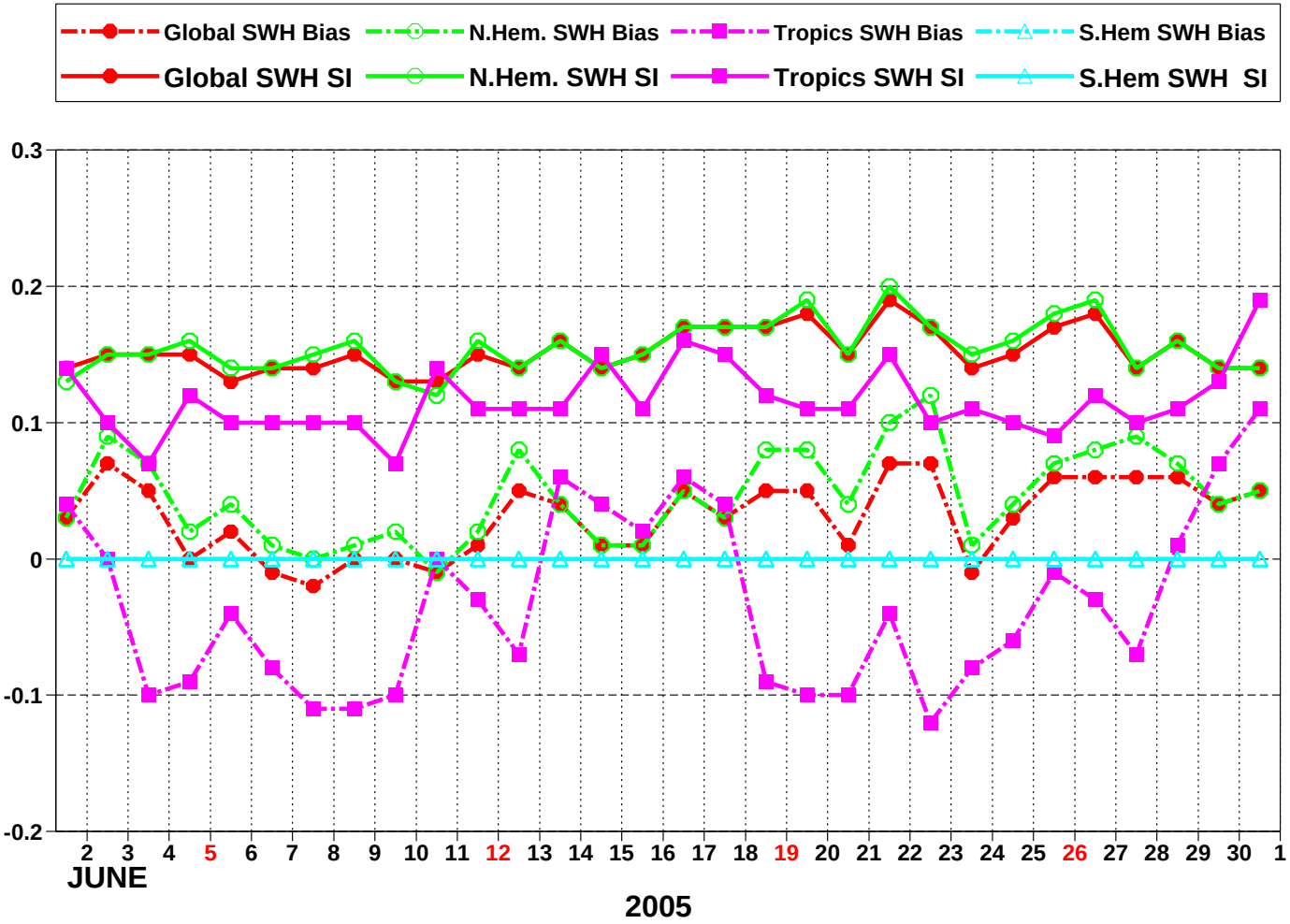


Figure 24: ERS-2 Altimeter wave heights: Timeseries of bias (ERS-2 - model) and scatter index (SI)

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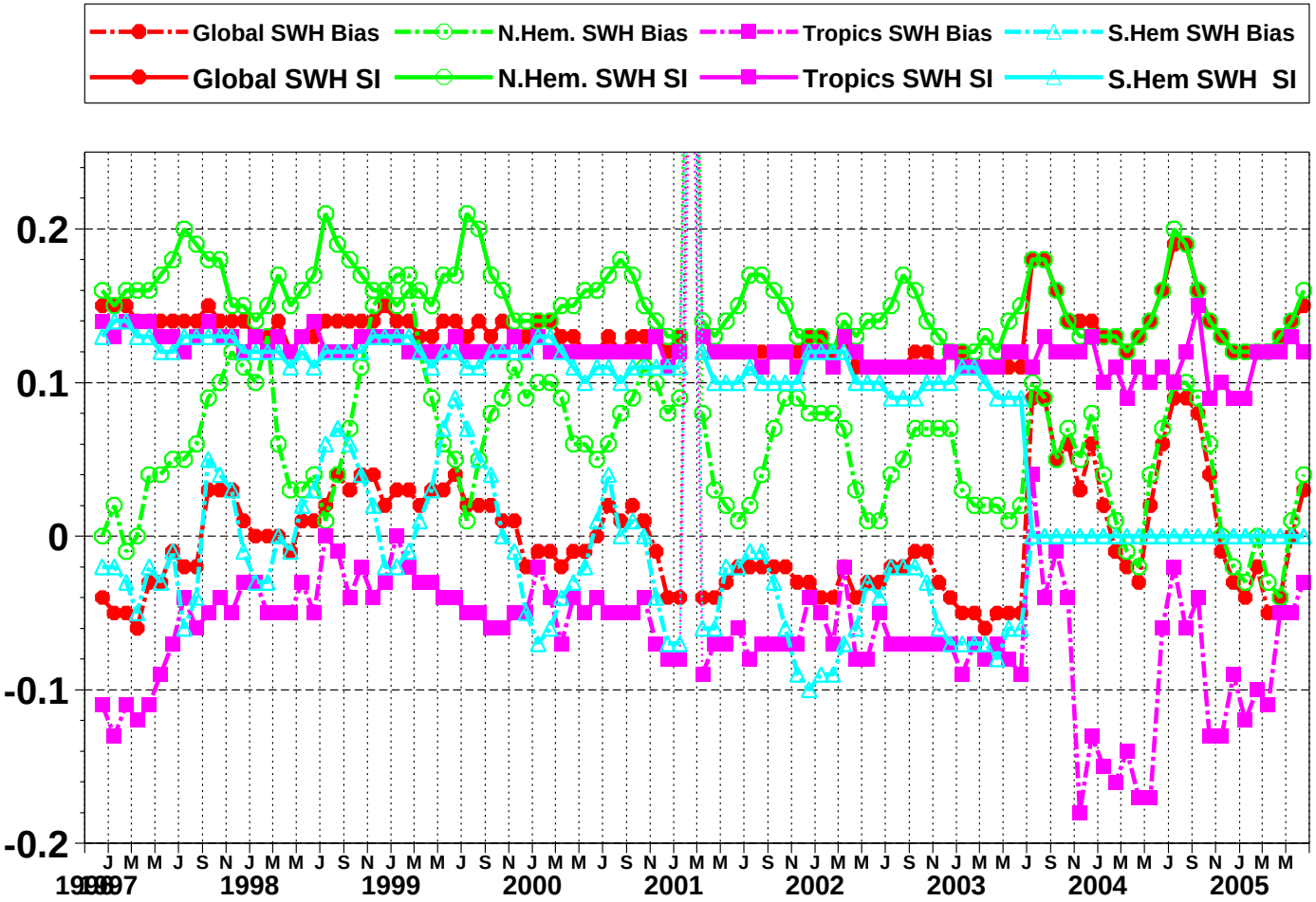


Figure 25: ERS-2 Altimeter wave heights: Timeseries of bias (ERS-2 - model) and scatter index (SI)

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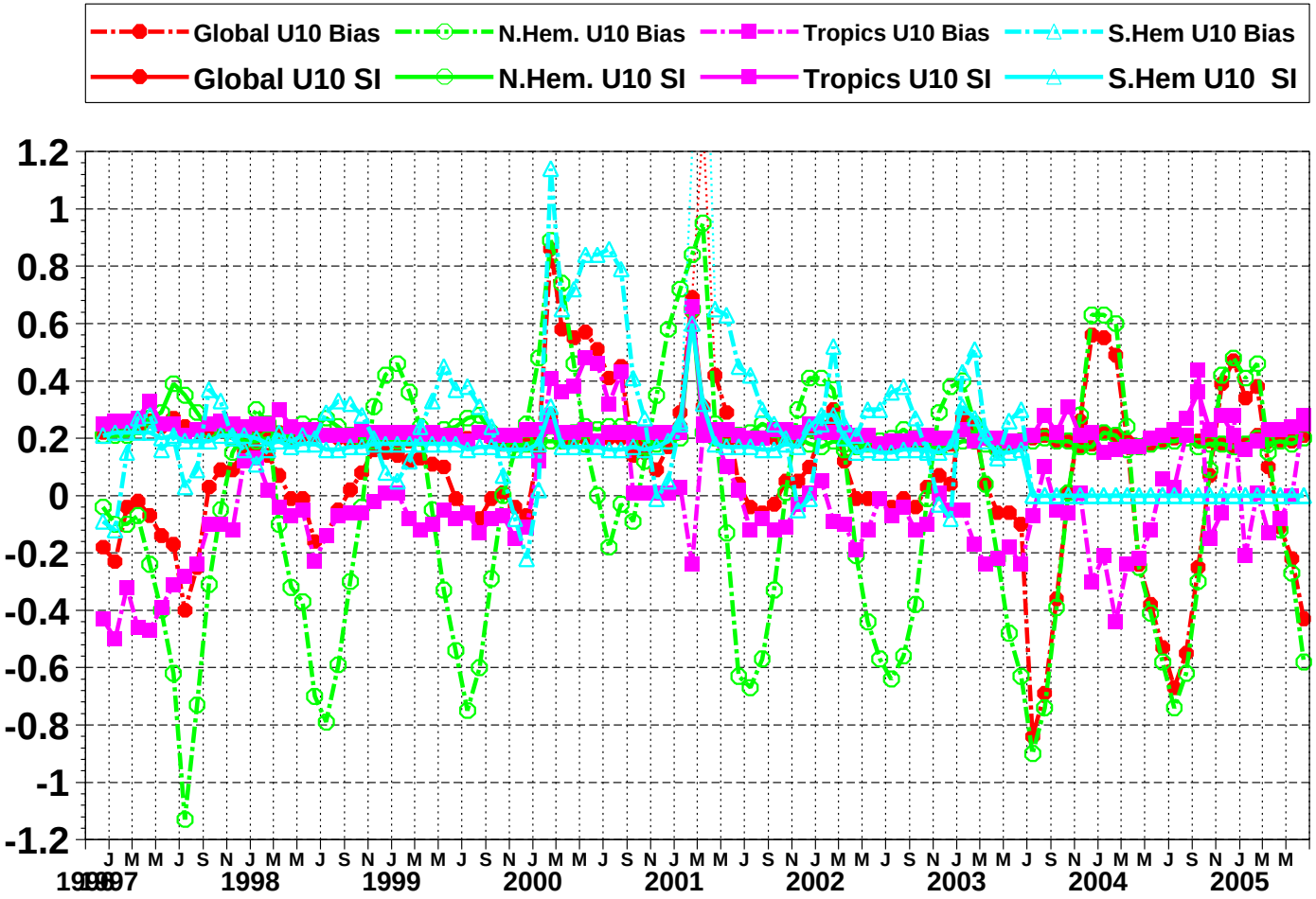


Figure 26: ERS-2 Altimeter wind speeds: Timeseries of bias (ERS-2 - model) and scatter index (SI)

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