

■ ECMWF Report on ERS-2 RA for September 2004 ■

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

By: Saleh Abdalla

Date: 13 October 2004

Overview:

Based on the data received during the whole month, on average, 3525 observations arrived at ECMWF every 6 hours of which 78.17% 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 time windows with missing data (apart from significant reduction of data at few time windows). 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:

ERS-2 $\langle \sigma_0 \rangle = 11.33$ dB (with two main peaks at ~ 10.6 dB and at 11.3 and other minor peaks).

Wind Speed Comparison with ECMWF wind speeds (bias):

ERS-2 global: -0.245 m/s

ERS-2 northern hemisphere: -0.302 m/s

ERS-2 tropics: +0.442 m/s

ERS-2 southern hemisphere: *missing*



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Wind Speed Comparison with buoy wind speeds (bias):

ERS-2 global: -0.687 m/s

ERS-2 northern hemisphere: -0.689 m/s

ERS-2 tropics: *missing*

Wave Height Comparison with ECMWF wave heights (bias):

ERS-2 global: 0.079 m (lowest waves measured: 0.6m)

ERS-2 northern hemisphere: 0.089 m

ERS-2 tropics: -0.044 m

ERS-2 southern hemisphere: *missing*

Wave Height Comparison with buoy wave heights (bias):

ERS-2 global: -0.066 m

ERS-2 northern hemisphere: -0.069 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.
- The high wind speed bias values in the tropics during several days (especially between 16 and 21 September) as can be seen in Figure 13 are due to the hurricanes which were active during this month especially hurricane Karl. ECMWF



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atmospheric model with its current resolution and numerics can not resolve such low scale features accurately and therefore affecting the model wind speed predictions. Keeping in mind the current limited coverage of ERS-2 which results in less than 20 altimeter-model collocations each day in the tropics, the impact of any model prediction problem in those limited collections would be significant. Similar, but less pronounced, impact can be found for wave height statistics.

- 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.
- The ECMWF atmospheric and wave models were changed to CY28R3 on the 28th. of September 2004. The relevant change was in the model set-up to allow the proper propagation of the wave analyses information at time windows 06:00 and 18:00 to model to next time windows.

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 September 2004.

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

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

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

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

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

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

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

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

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

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

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

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 September 2004.

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

Figure 16: Global distribution of ECMWF wave heights for September 2004.

Figure 17: Comparison of ECMWF wave height results with ERS-2 Altimeter wave height data for September 2004 (global).

Figure 18: Comparison of ECMWF wave height results with ERS-2 Altimeter wave height data for September 2004 (northern hemisphere)

Figure 19: Comparison of ECMWF wave height results with ERS-2 Altimeter wave height data for September 2004 (tropics)

Figure 20: Comparison of ECMWF wave height results with ERS-2 Altimeter wave height data for September 2004 (southern hemisphere)

Figure 21: Comparison of buoy wave height observations with ERS-2 Altimeter wave height data for September 2004 (global).

Figure 22: Comparison of buoy wave height observations with ERS-2 Altimeter wave height data for September 2004 (northern hemisphere).

Figure 23: Comparison of buoy wave height observations with ERS-2 Altimeter wave height data for September 2004 (tropics).

Figure 24: ERS-2 Altimeter wave heights: Timeseries of bias (ERS-2 - model) and scatter index (SI) for September 2004.

Figure 25: ERS-2 Altimeter wave heights: Timeseries of bias (ERS-2 - model) and scatter index (SI) from December 1996 to September 2004

Figure 26: ERS-2 Altimeter wind speeds: Timeseries of bias (ERS-2 - model) and scatter index (SI) from December 1996 to September 2004



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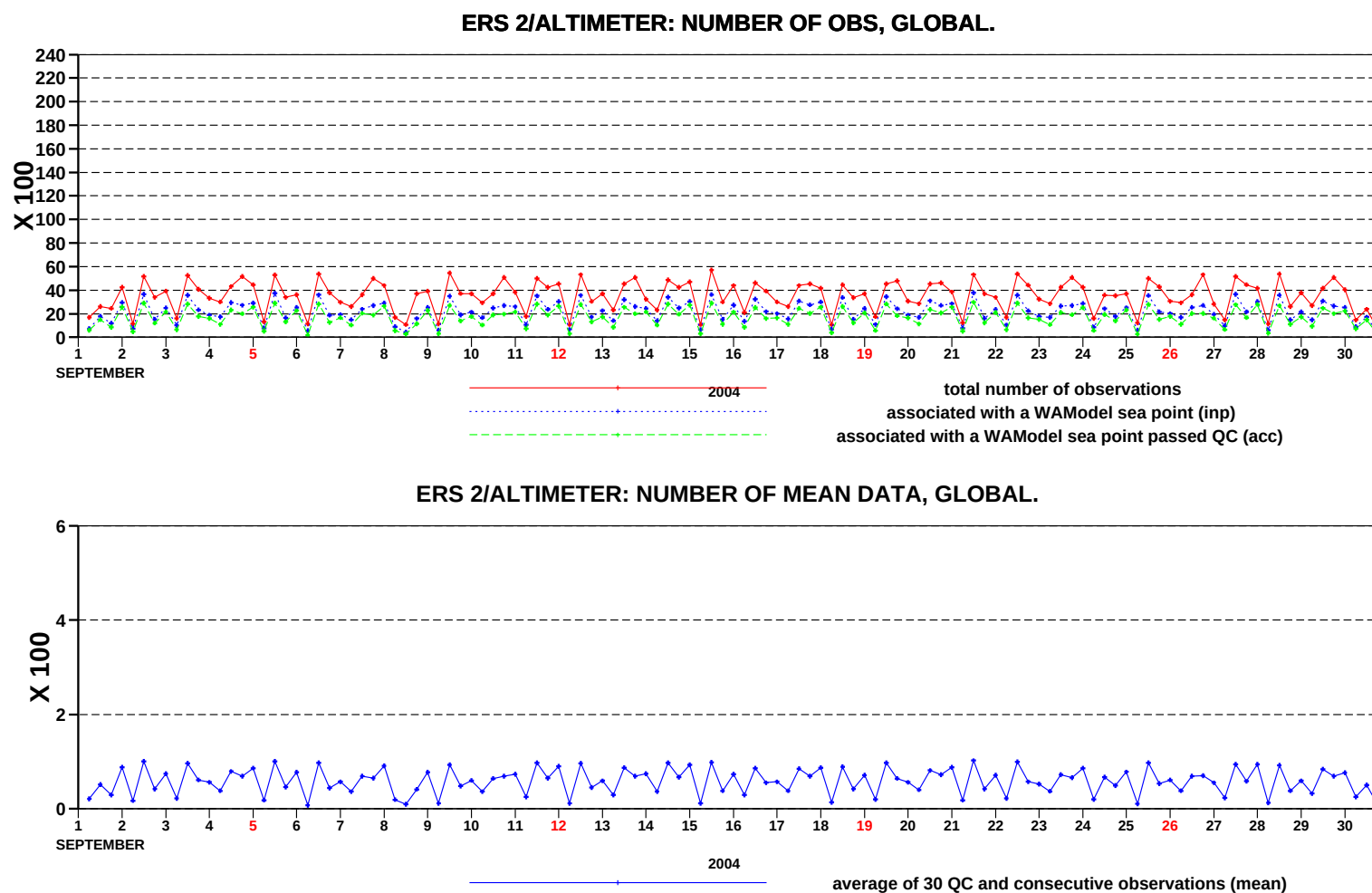


Figure 1: Time series of data reception for ERS-2 Altimeter data for September 2004

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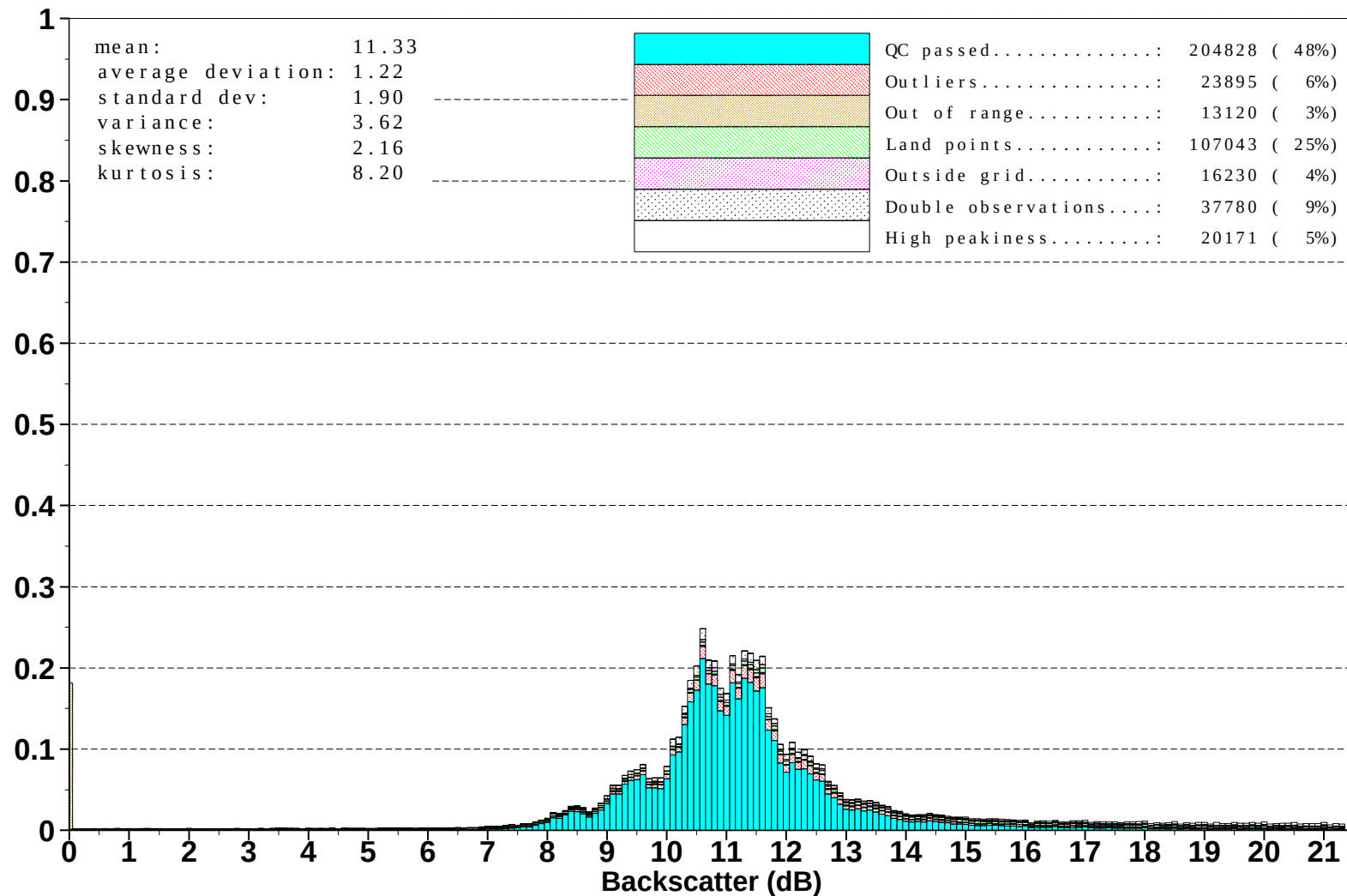


Figure 2: Distribution of the ERS-2 Altimeter backscatter after QC for September 2004



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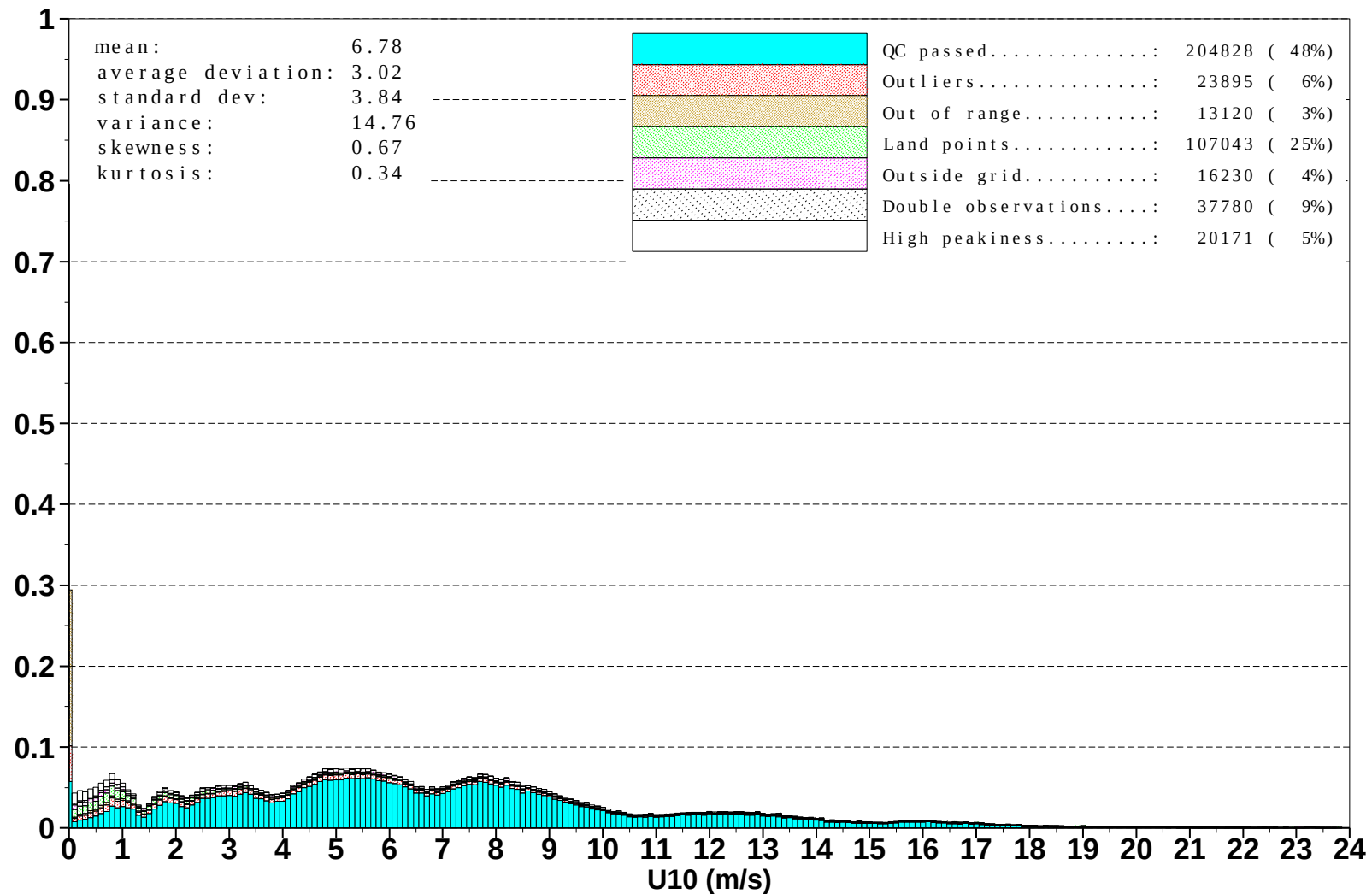


Figure 3: Distribution of the ERS-2 Altimeter wind speeds after QC for September 2004



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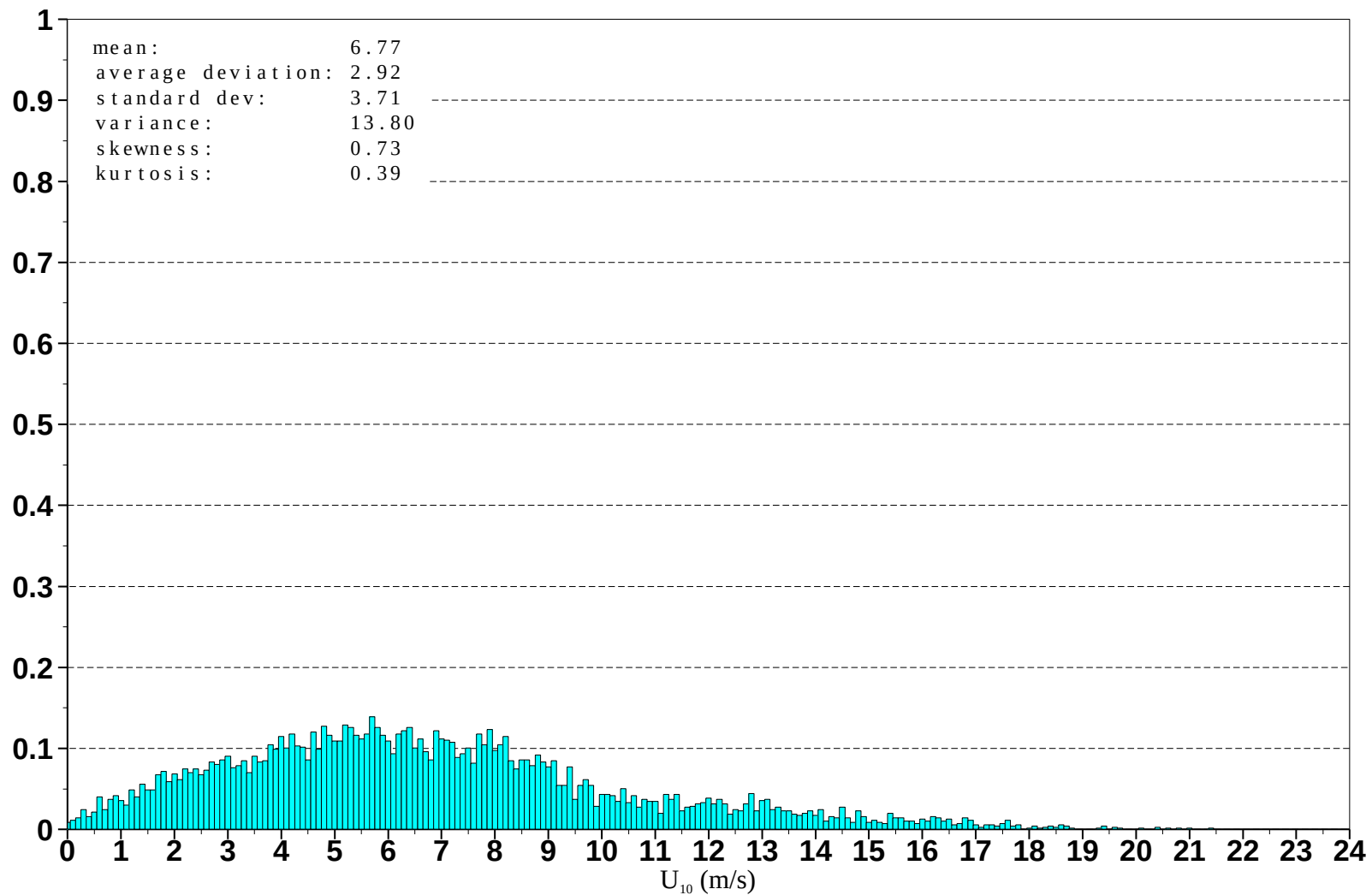


Figure 4: Distribution of ERS-2 Altimeter wind speeds after along track averaging for September 2004



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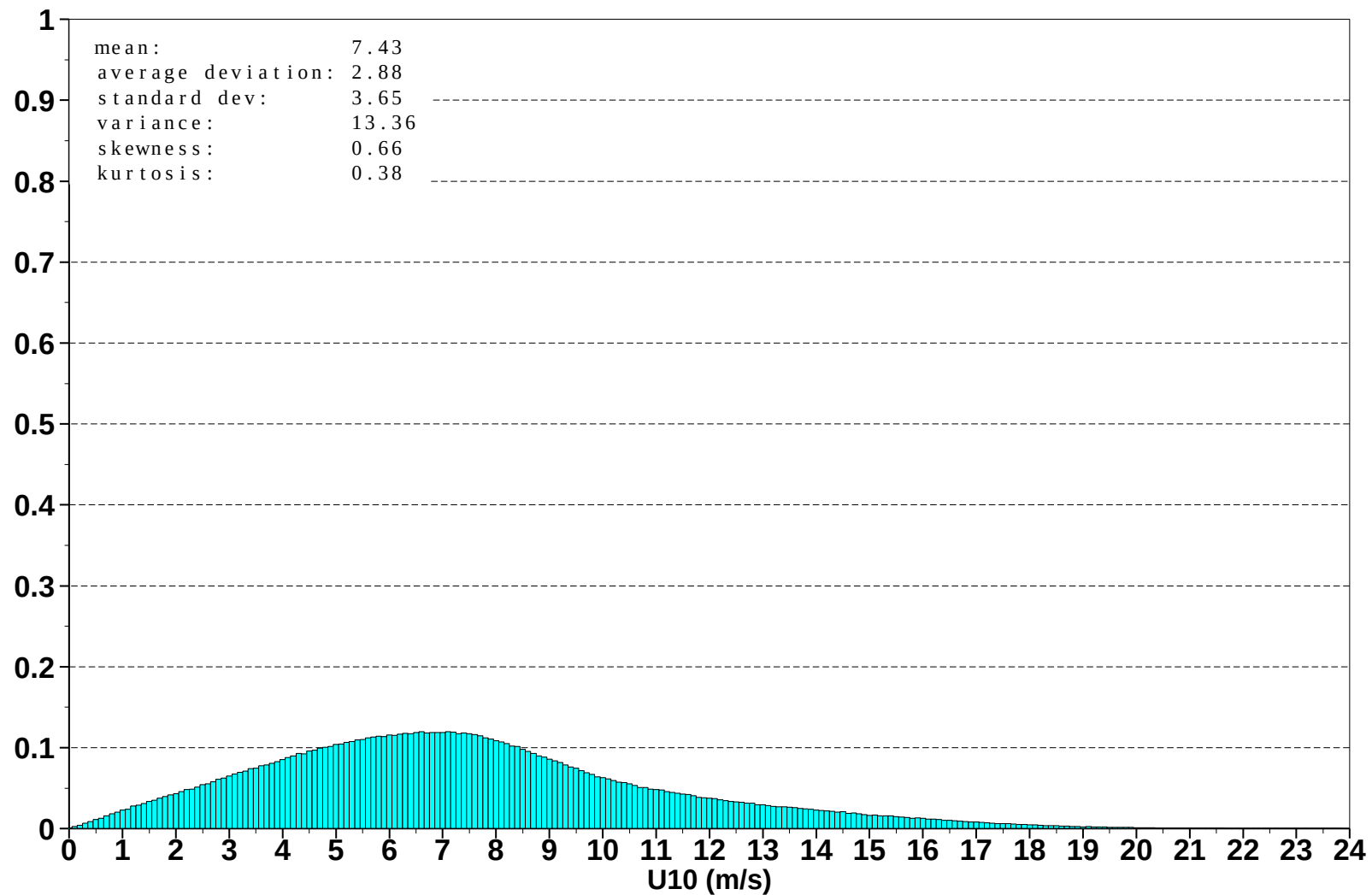


Figure 5: Global distribution of ECMWF ocean surface wind speeds for September 2004



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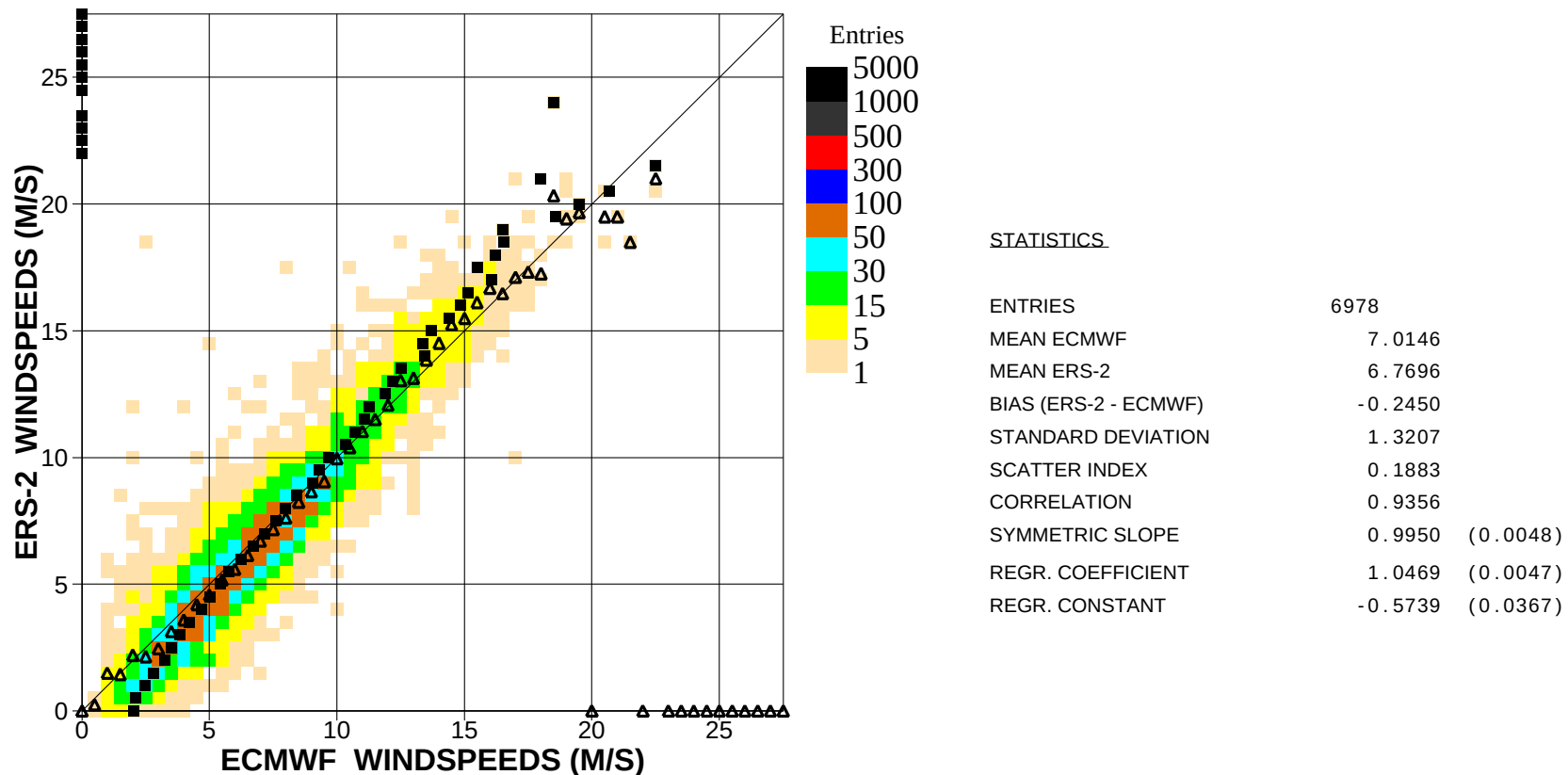


Figure 6. Comparison of ECMWF wind speed results with ERS2 Altimeter wind speed data for September 2004 (global)

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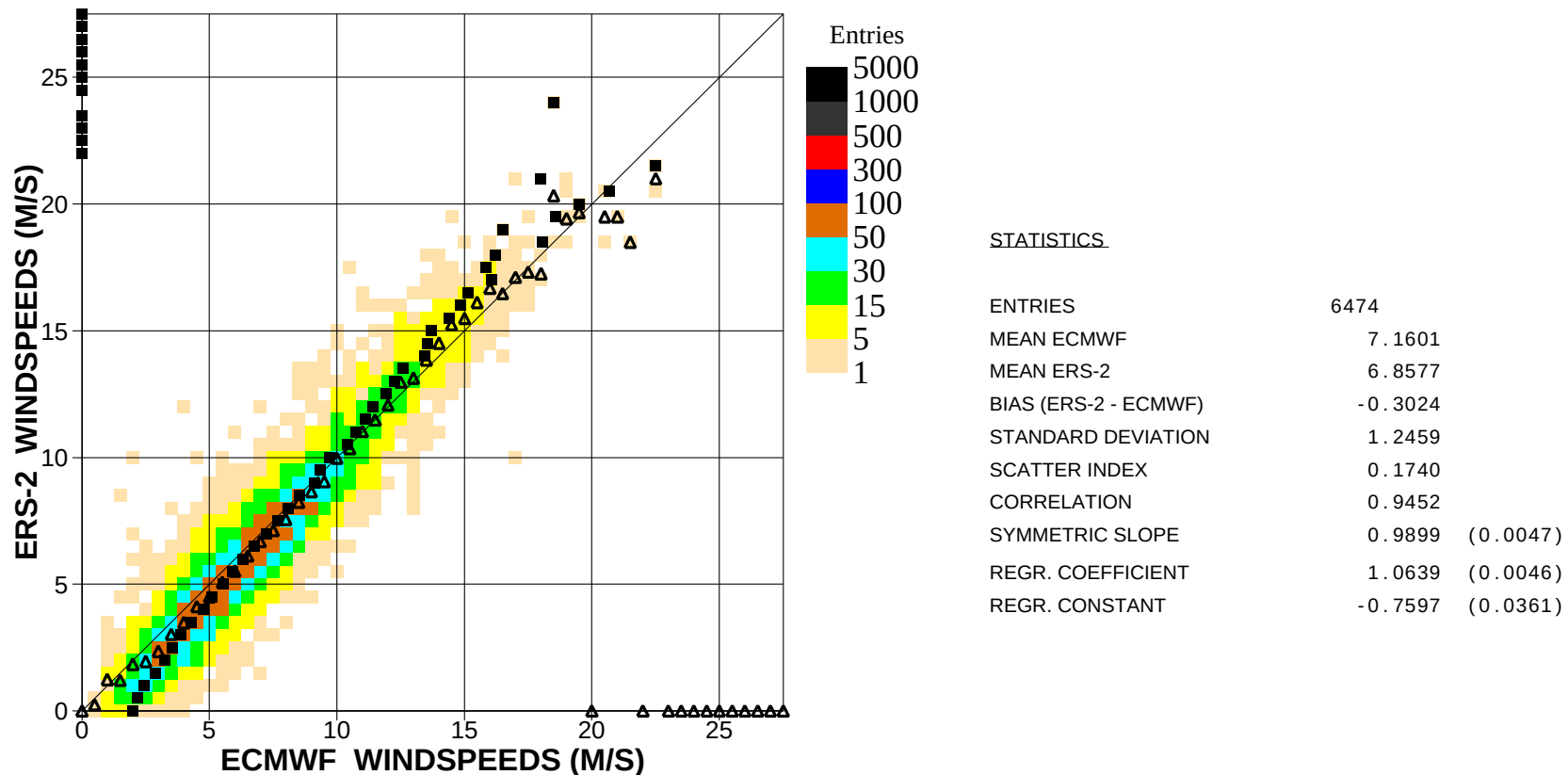


Figure 7. Comparison of ECMWF wind speed results with ERS2 Altimeter wind speed data for September 2004 (n.hem.)

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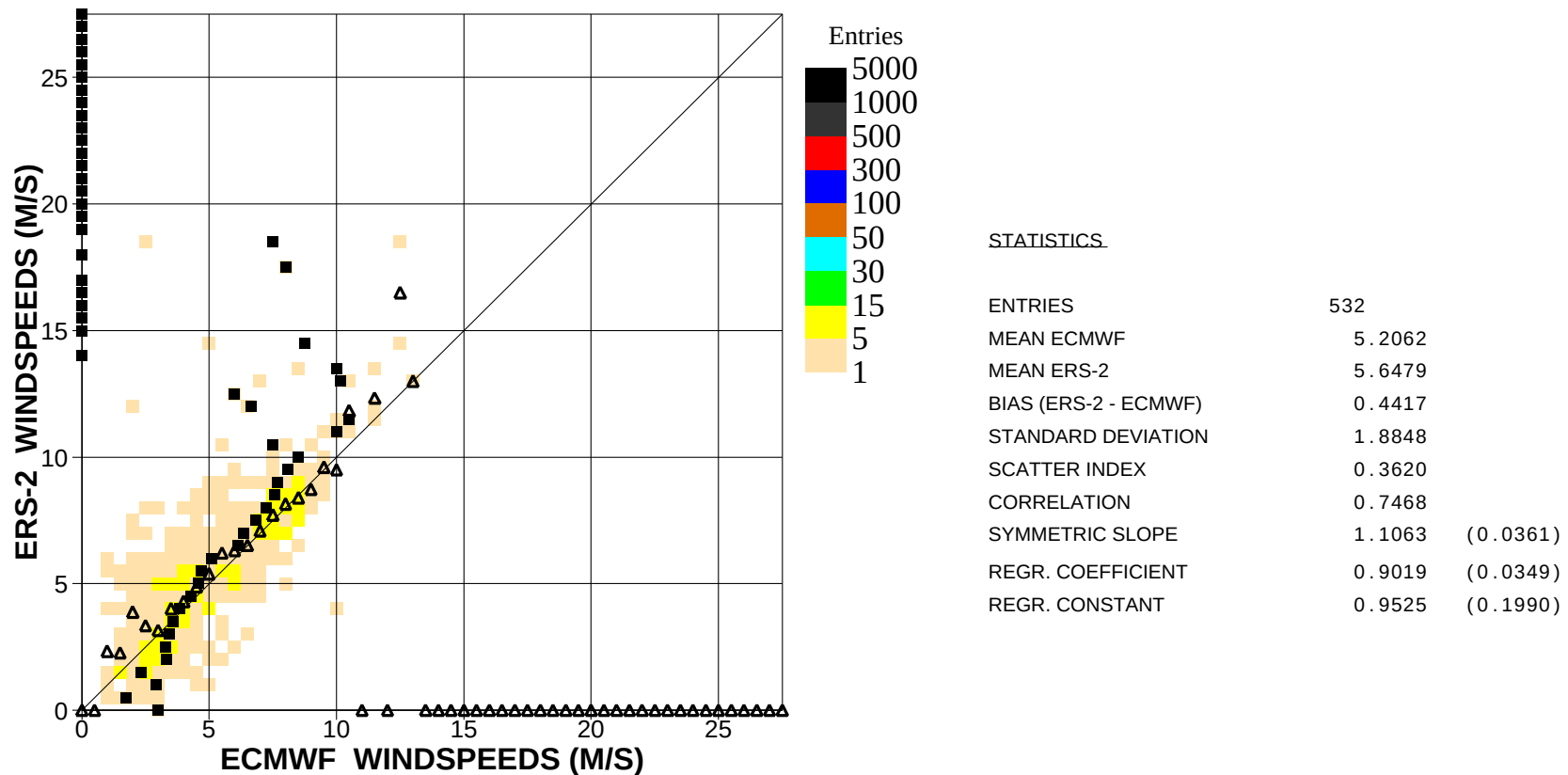


Figure 8. Comparison of ECMWF wind speed results with ERS2 Altimeter wind speed data for September 2004 (tropics)

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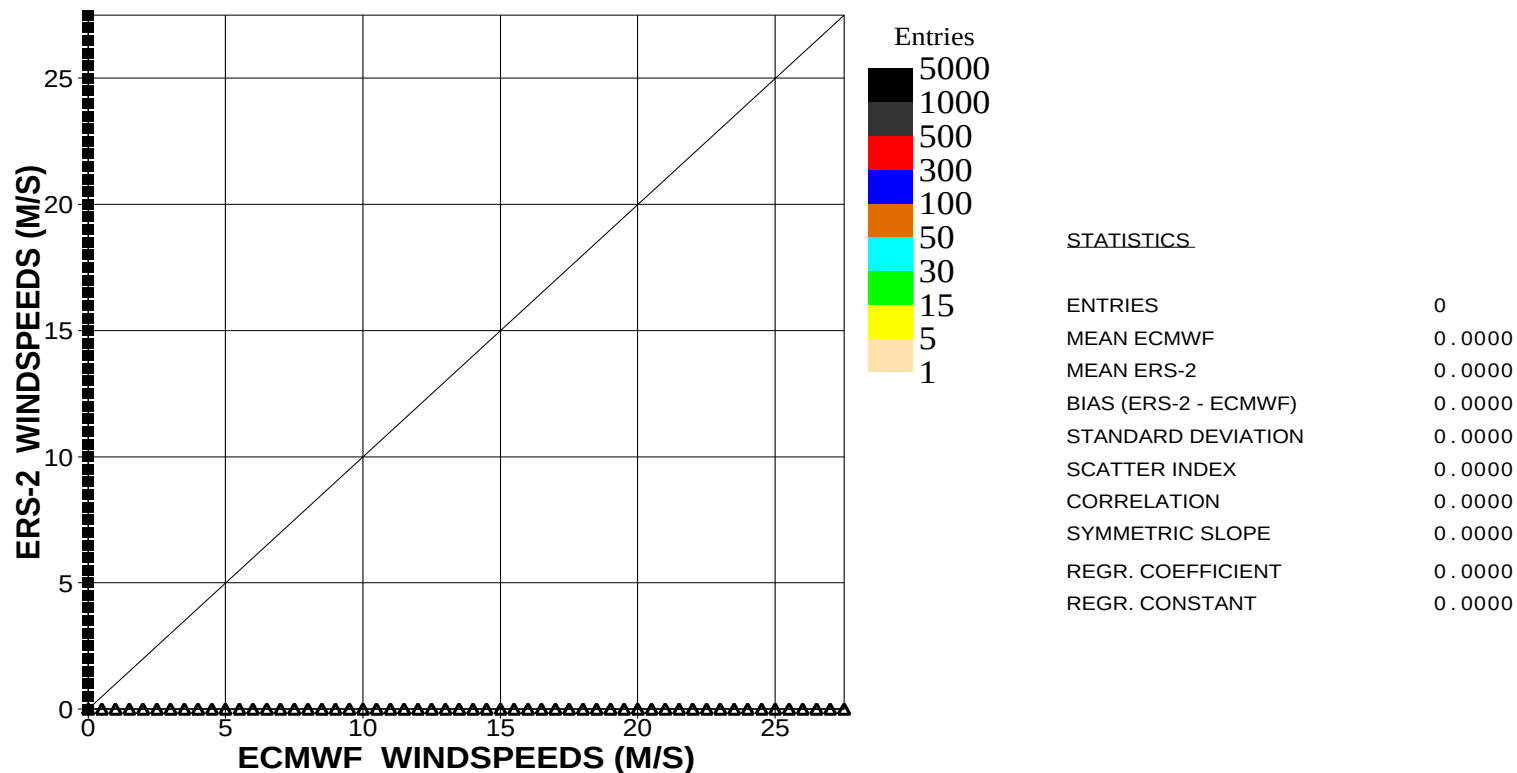


Figure 9. Comparison of ECMWF wind speed results with ERS2 Altimeter wind speed data for September 2004 (s.hem.)

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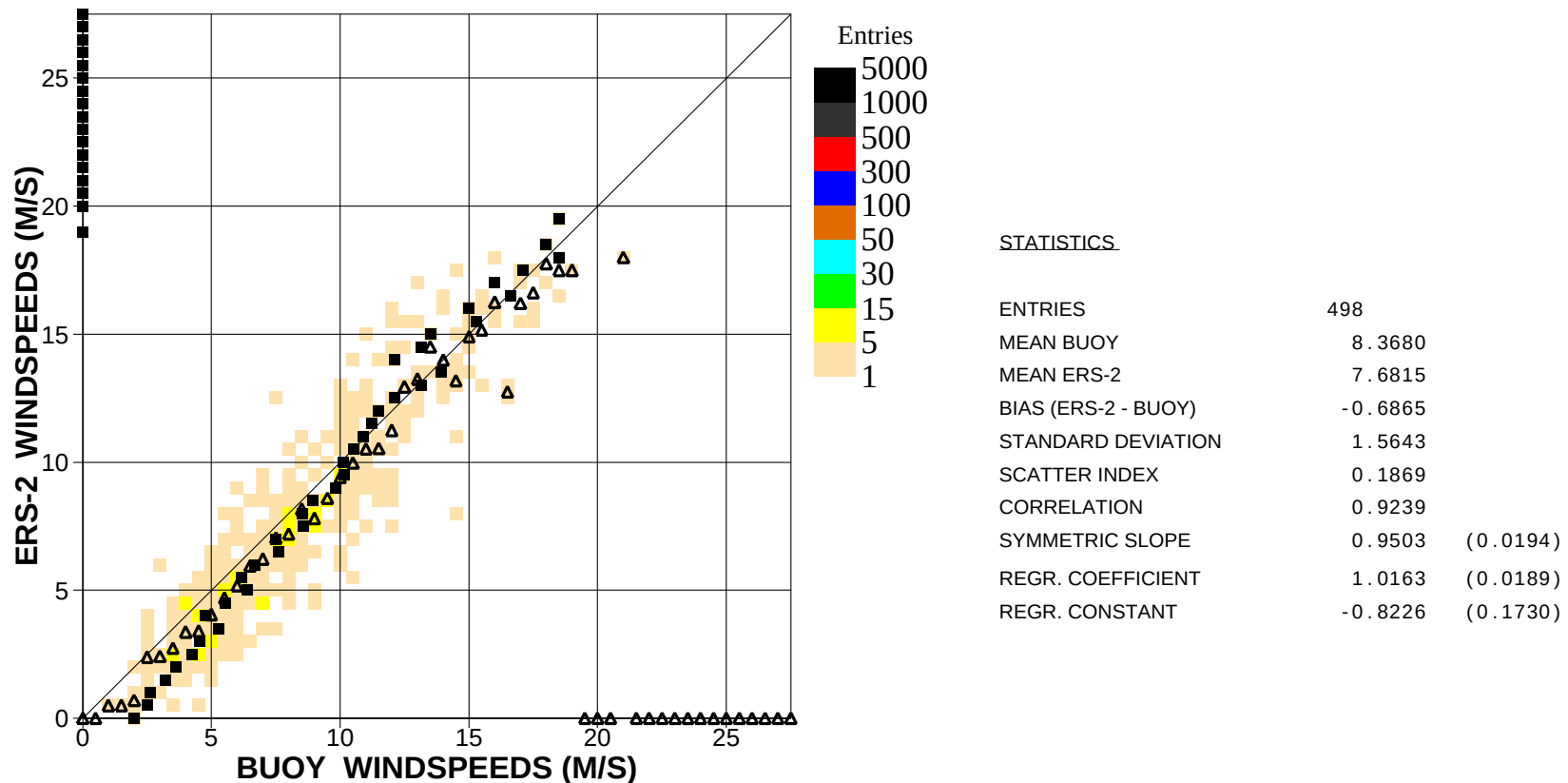


Figure 10. Comparison of buoy wind speed observations with ERS2 Altimeter wind speed data for September 2004 (global)

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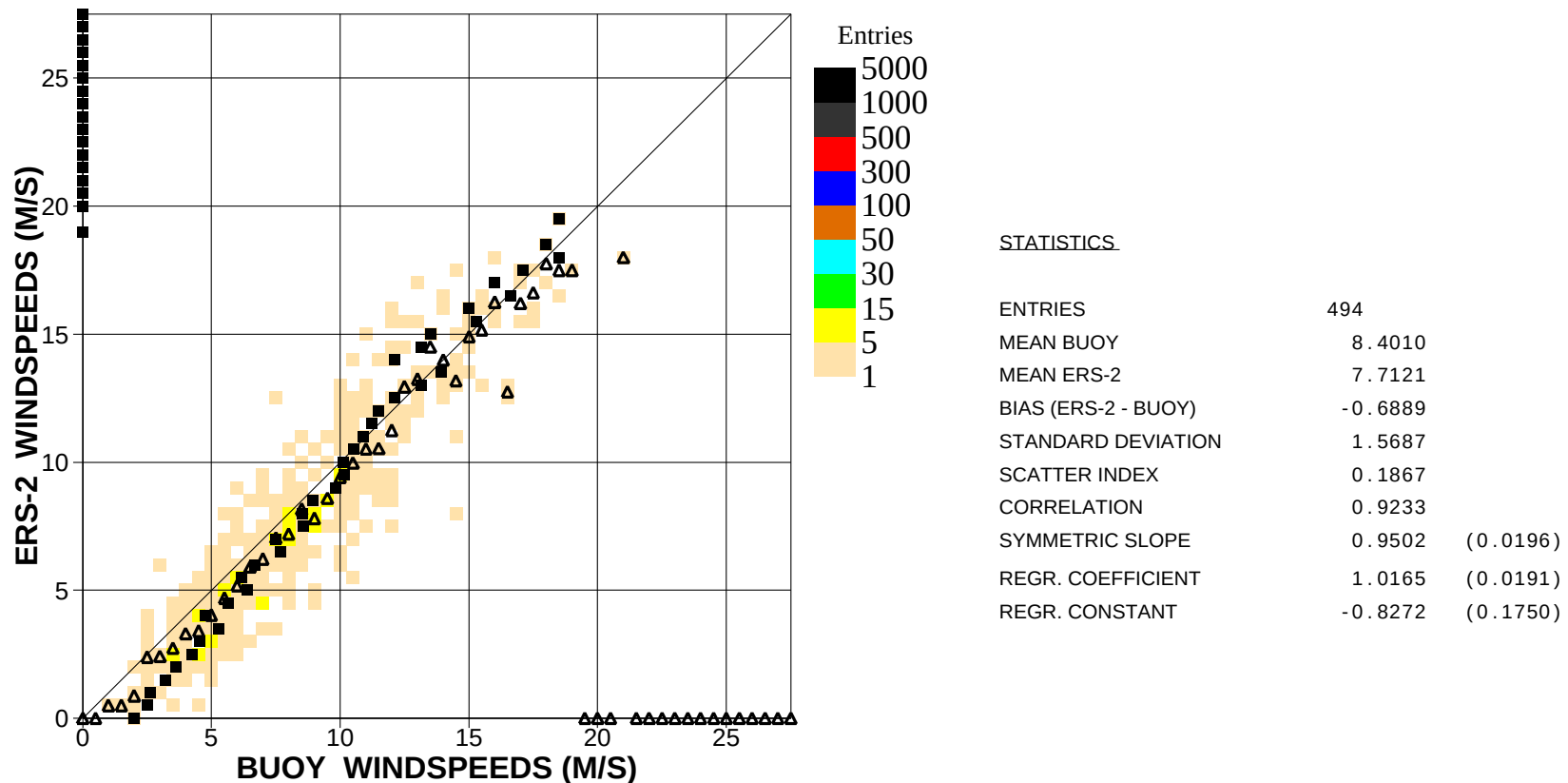


Figure 11. Comparison of buoy wind speed observations with ERS2 Altimeter wind speed data for September 2004 (n.hem.)

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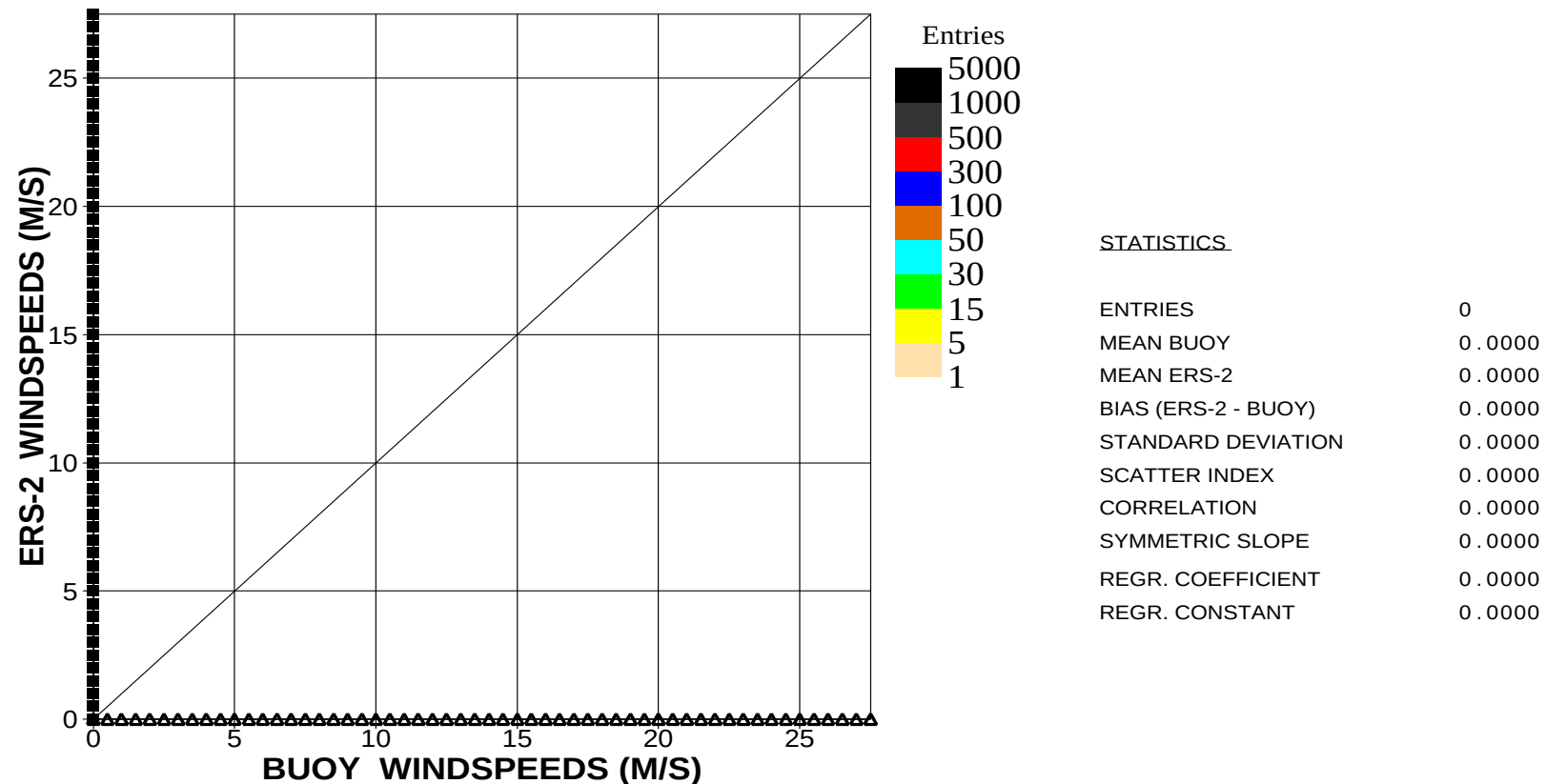


Figure 12. Comparison of buoy wind speed observations with ERS2 Altimeter wind speed data for September 2004 (hawaii)



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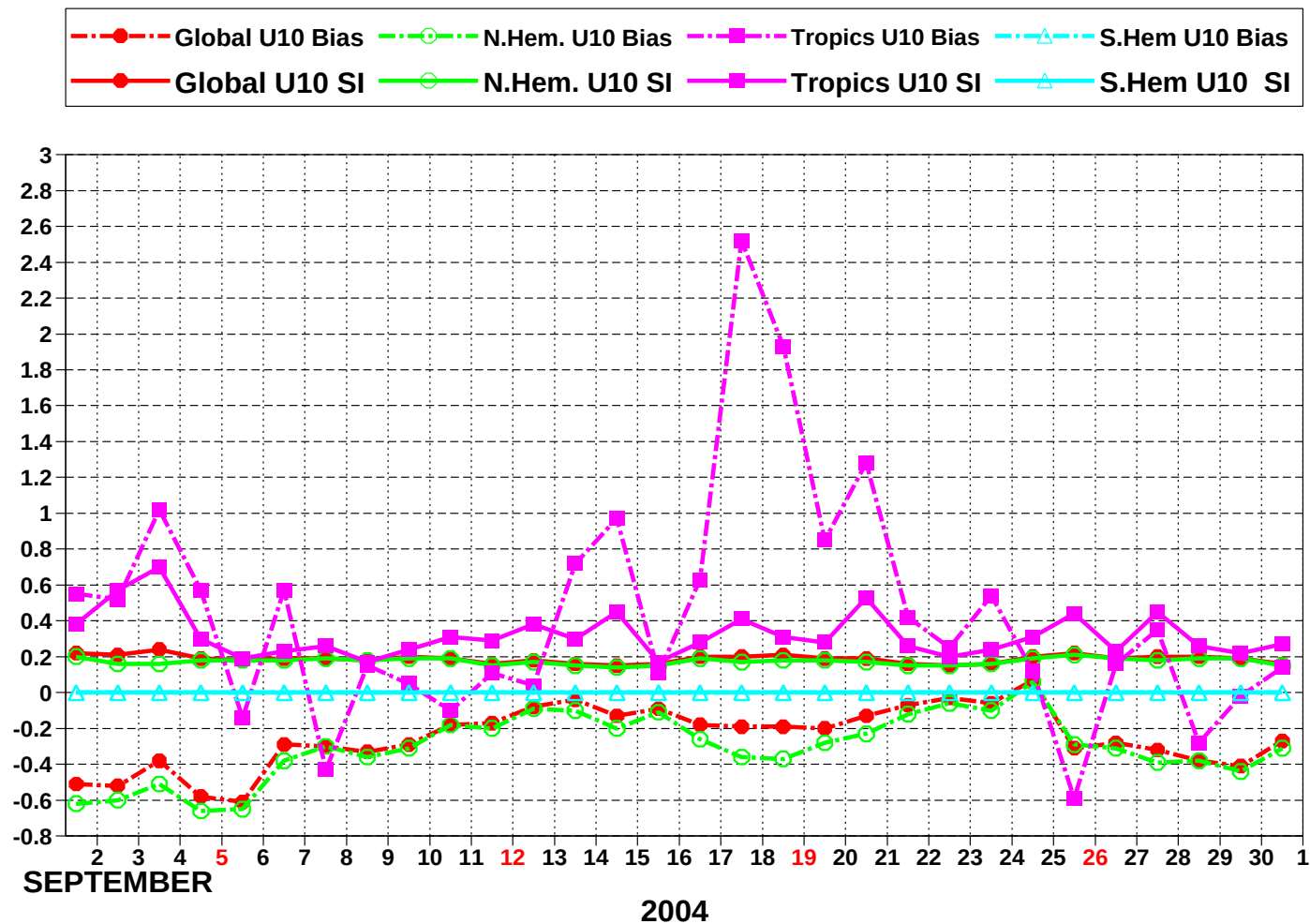


Figure 13: ERS-2 Altimeter wind speeds: Timeseries of bias (ERS-2 - model) and scatter index (SI)

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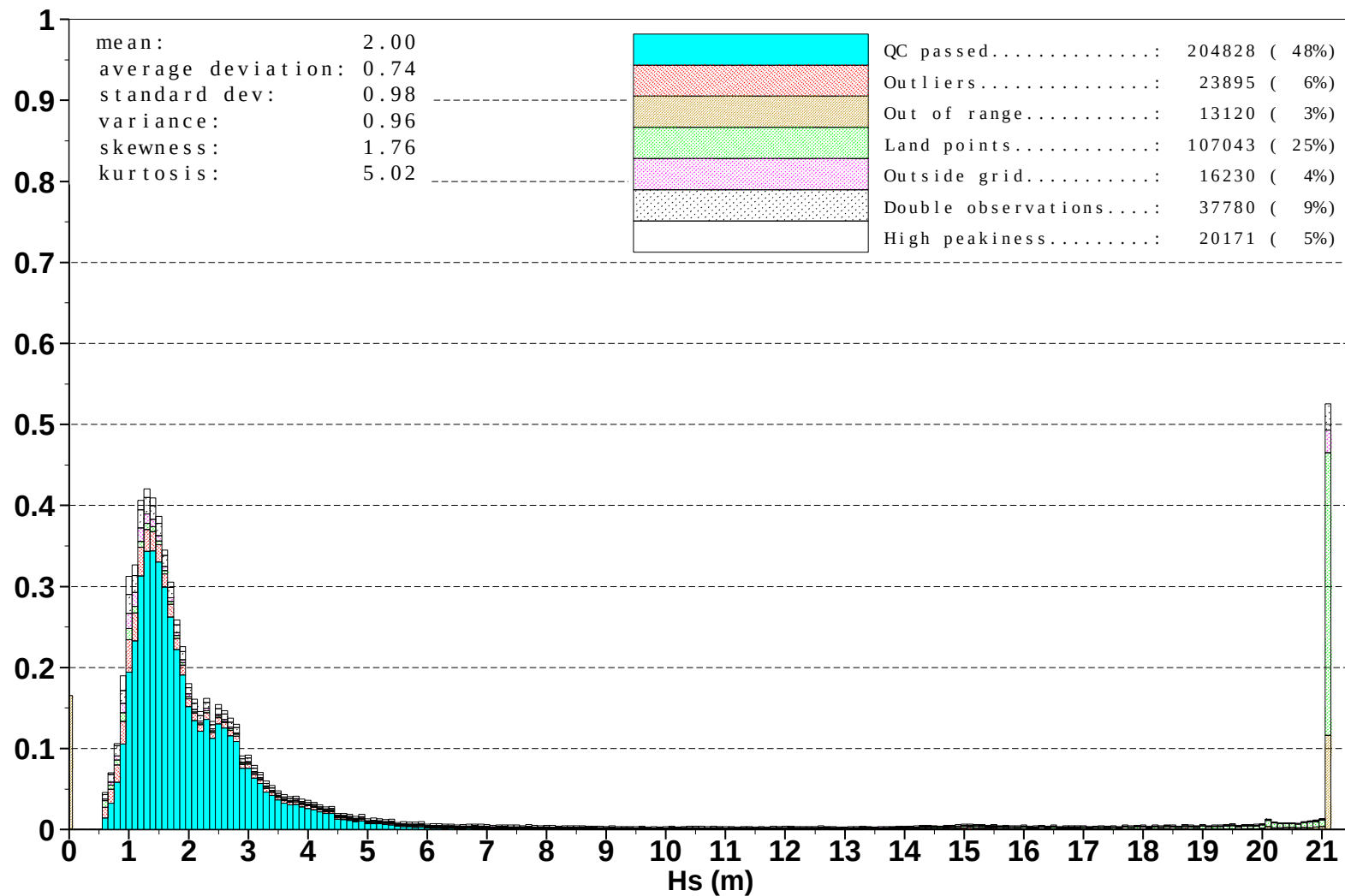


Figure 14: Distribution of the ERS-2 Altimeter wave heights after QC for September 2004

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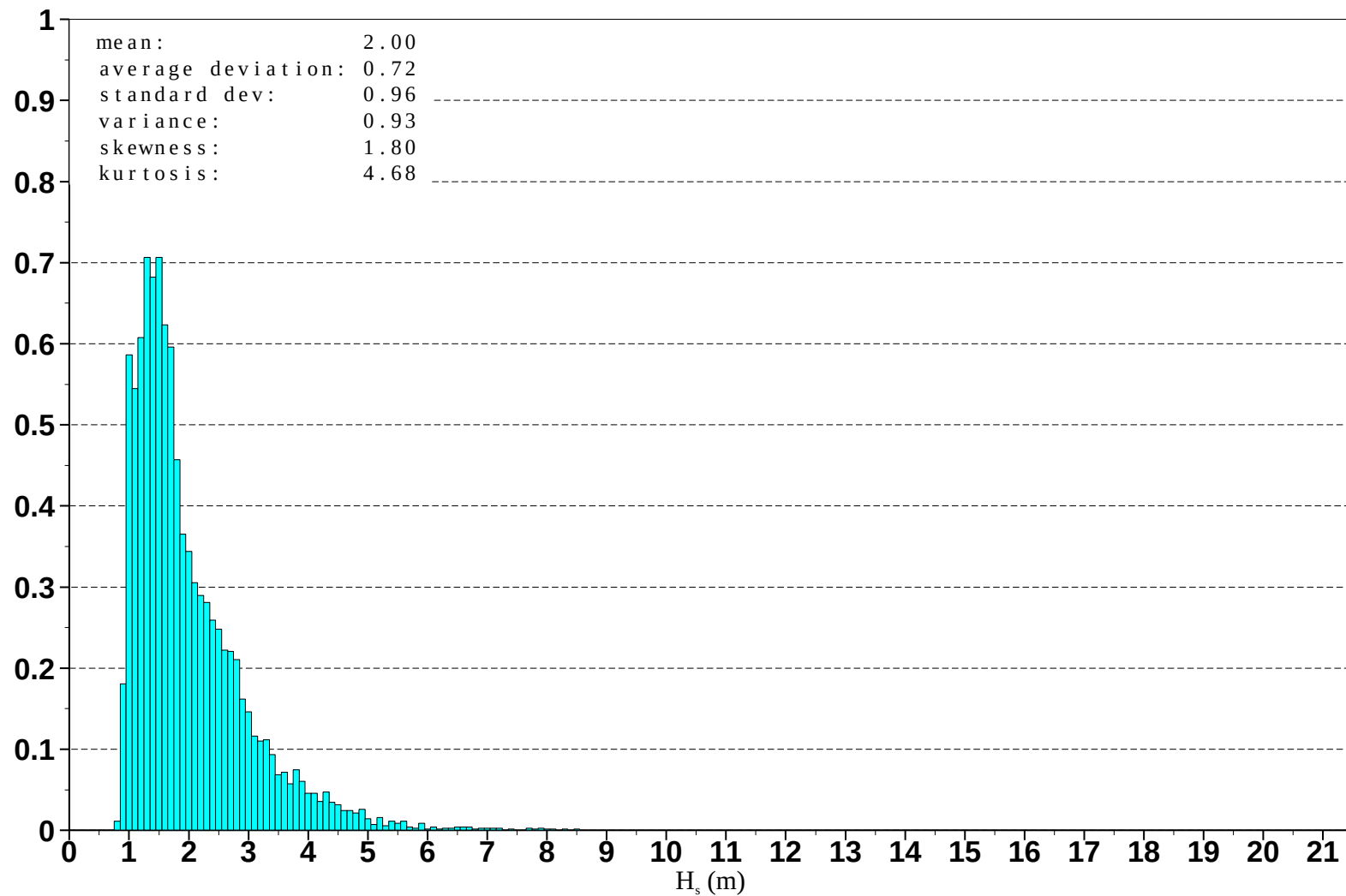


Figure 15: Distribution of ERS-2 Altimeter wave heights after along track averaging for September 2004

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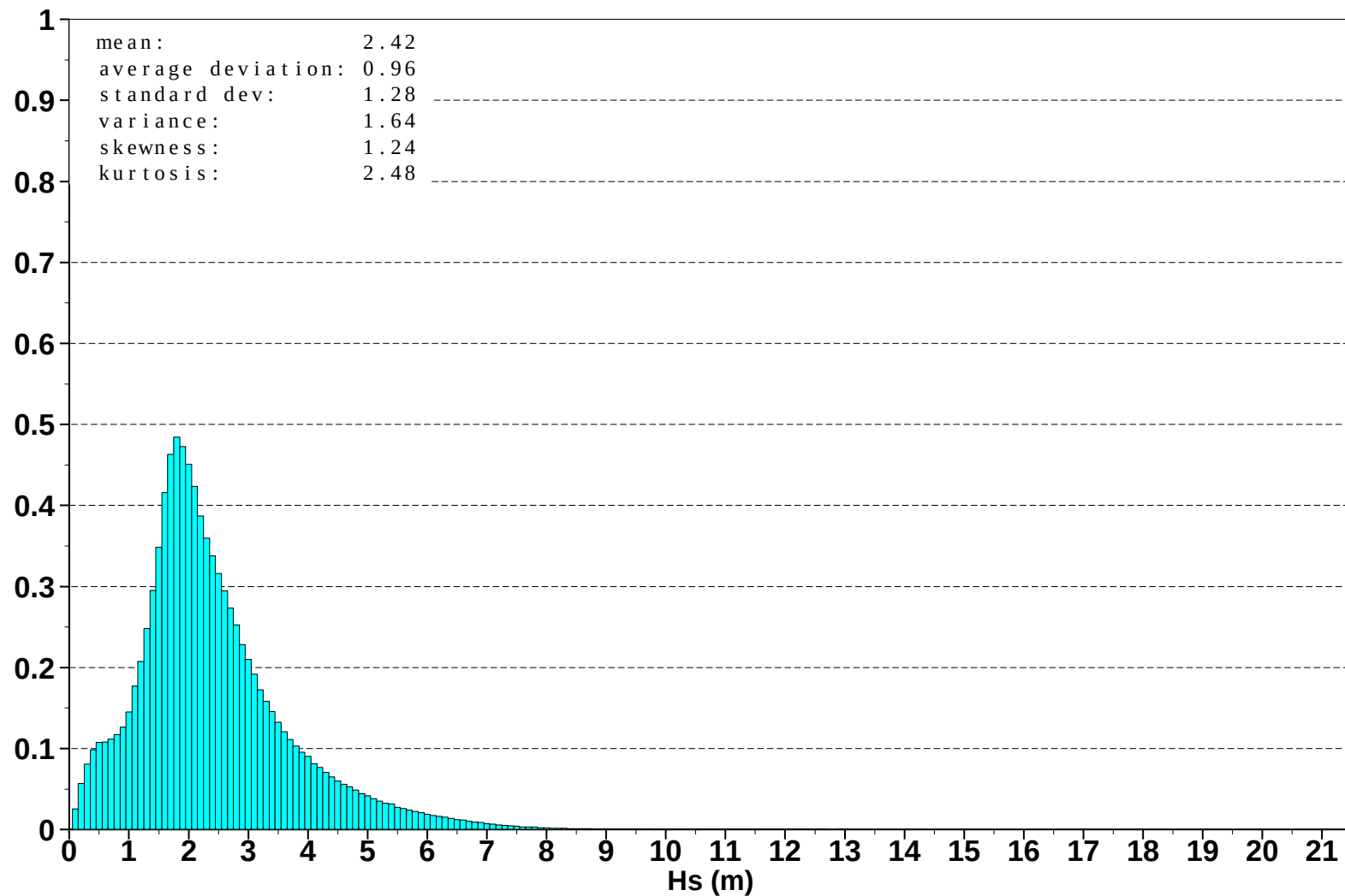


Figure 16: Global distribution of ECMWF wave heights for September 2004



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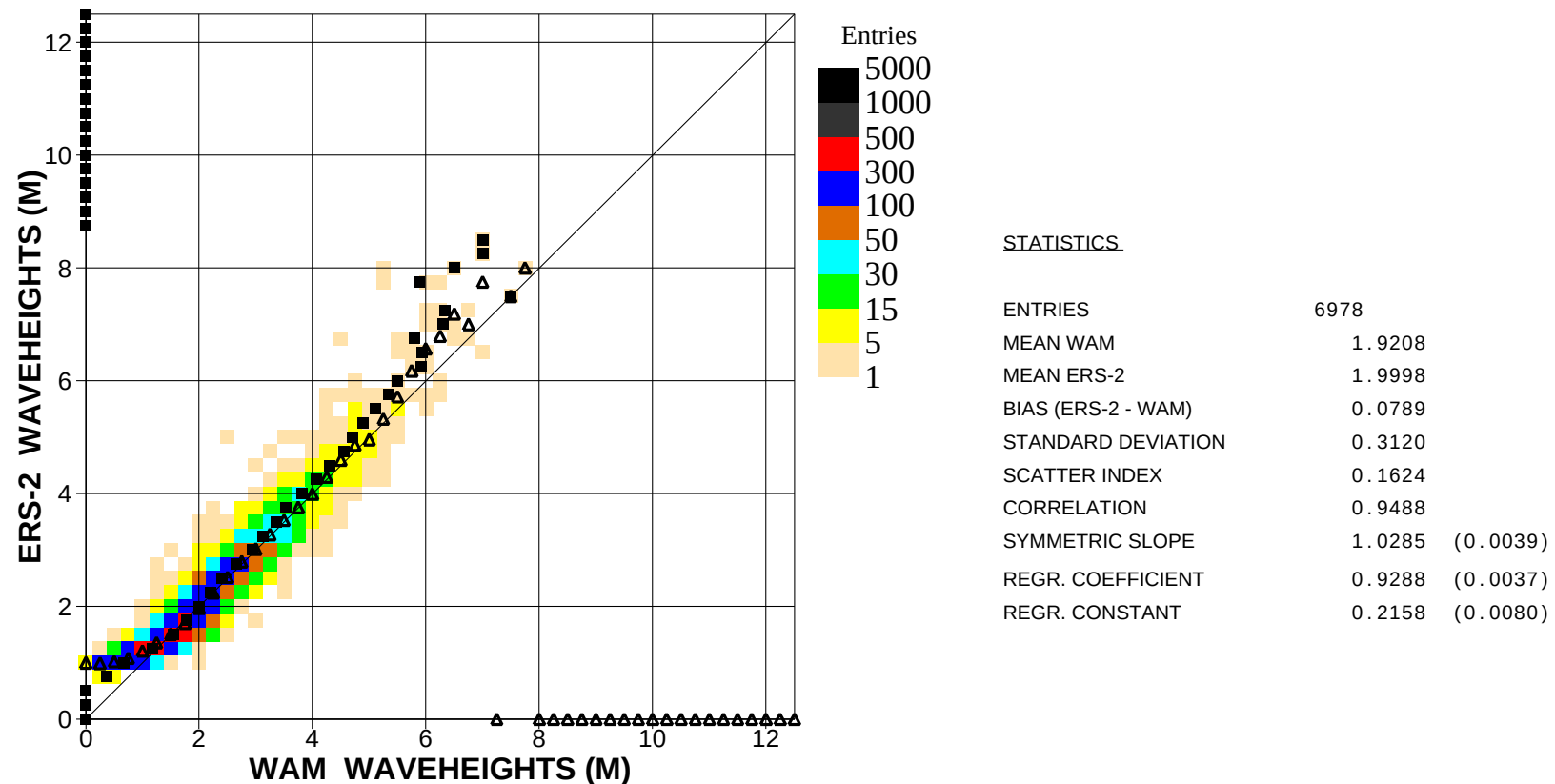


Figure 17. Comparison of ECMWF wave height results with ERS2 Altimeter wave height data for September 2004 (global)

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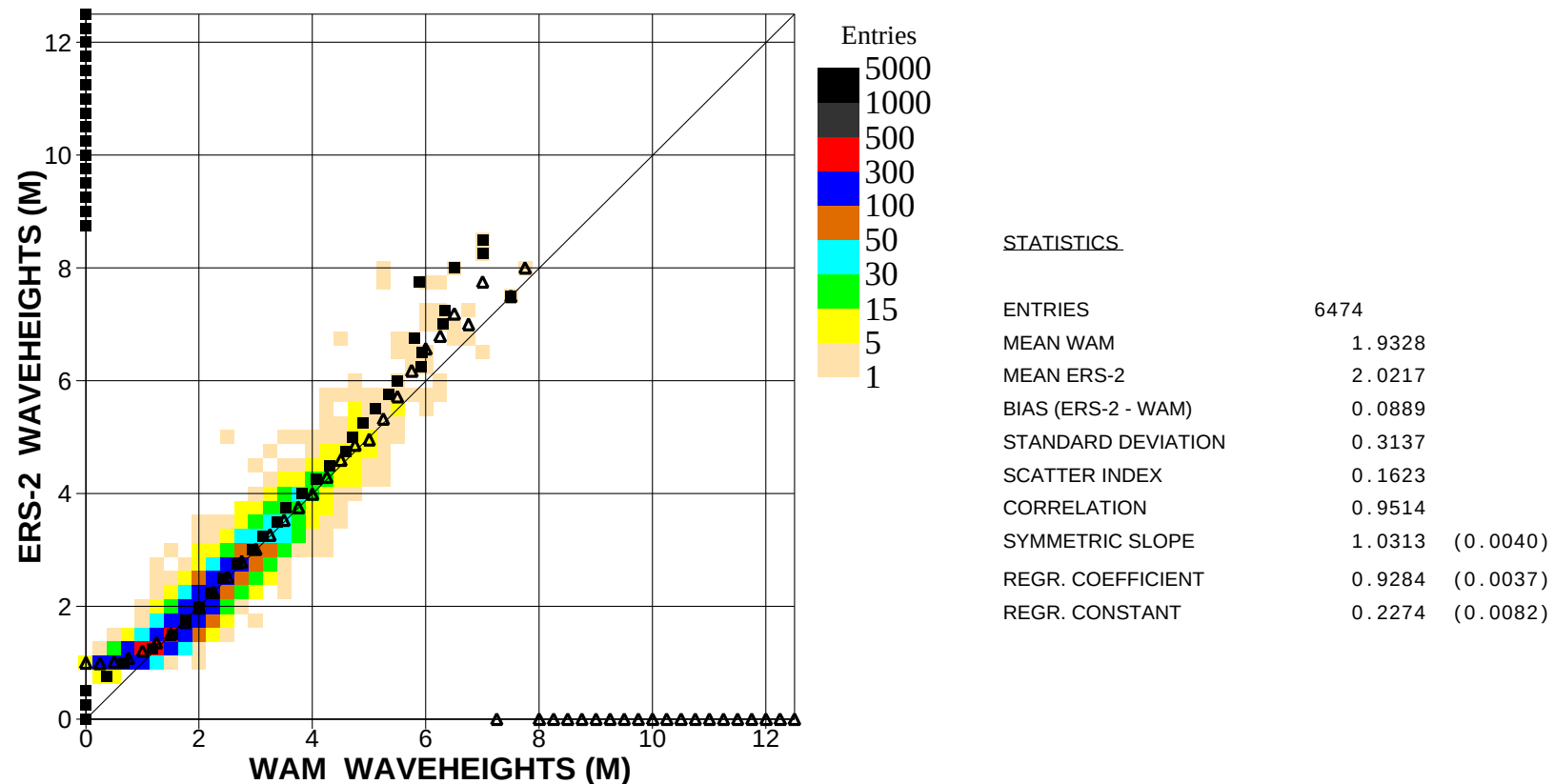


Figure 18. Comparison of ECMWF wave height results with ERS2 Altimeter wave height data for September 2004 (n.hem.)

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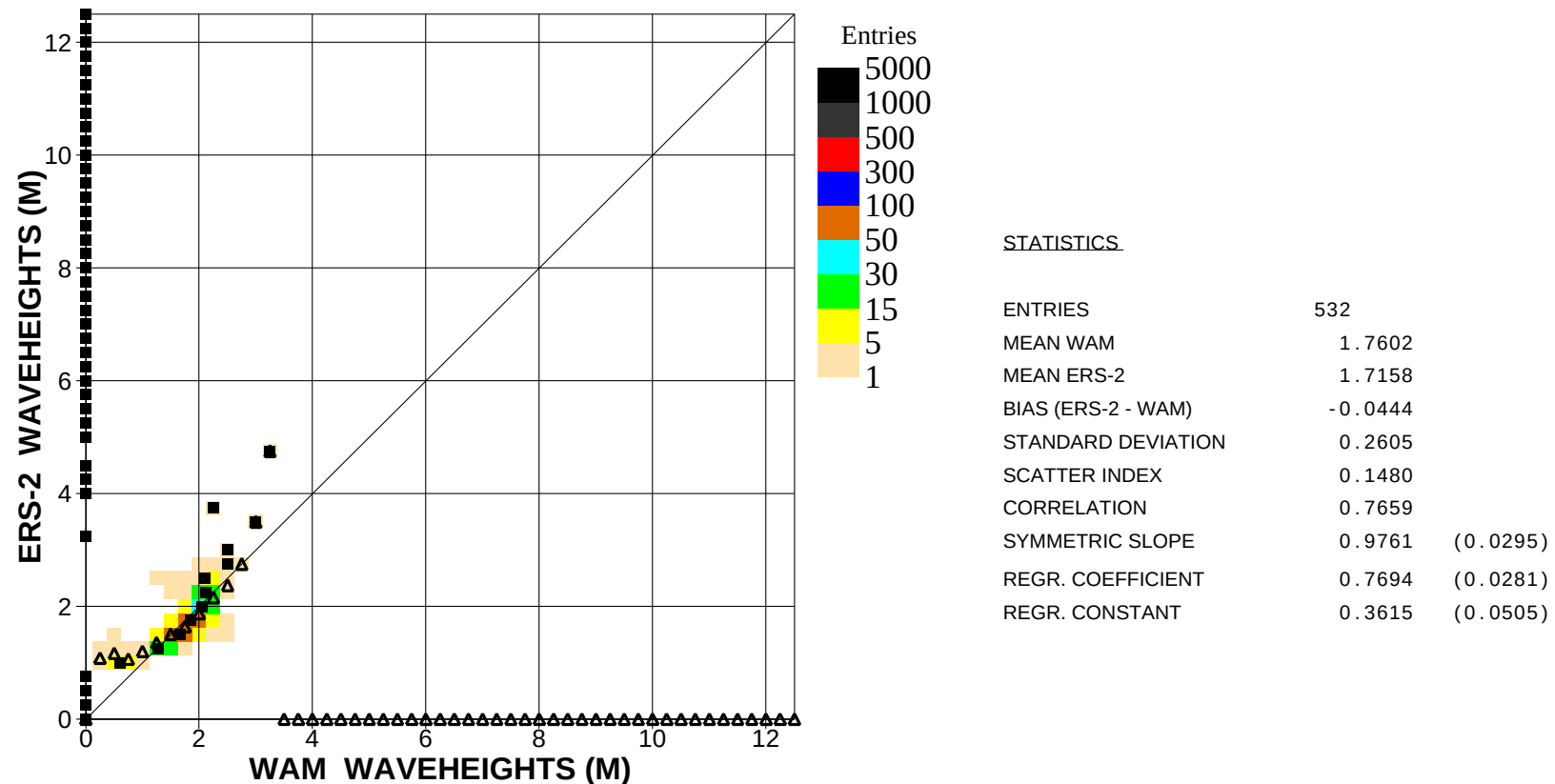


Figure 19. Comparison of ECMWF wave height results with ERS2 Altimeter wave height data for September 2004 (tropics)

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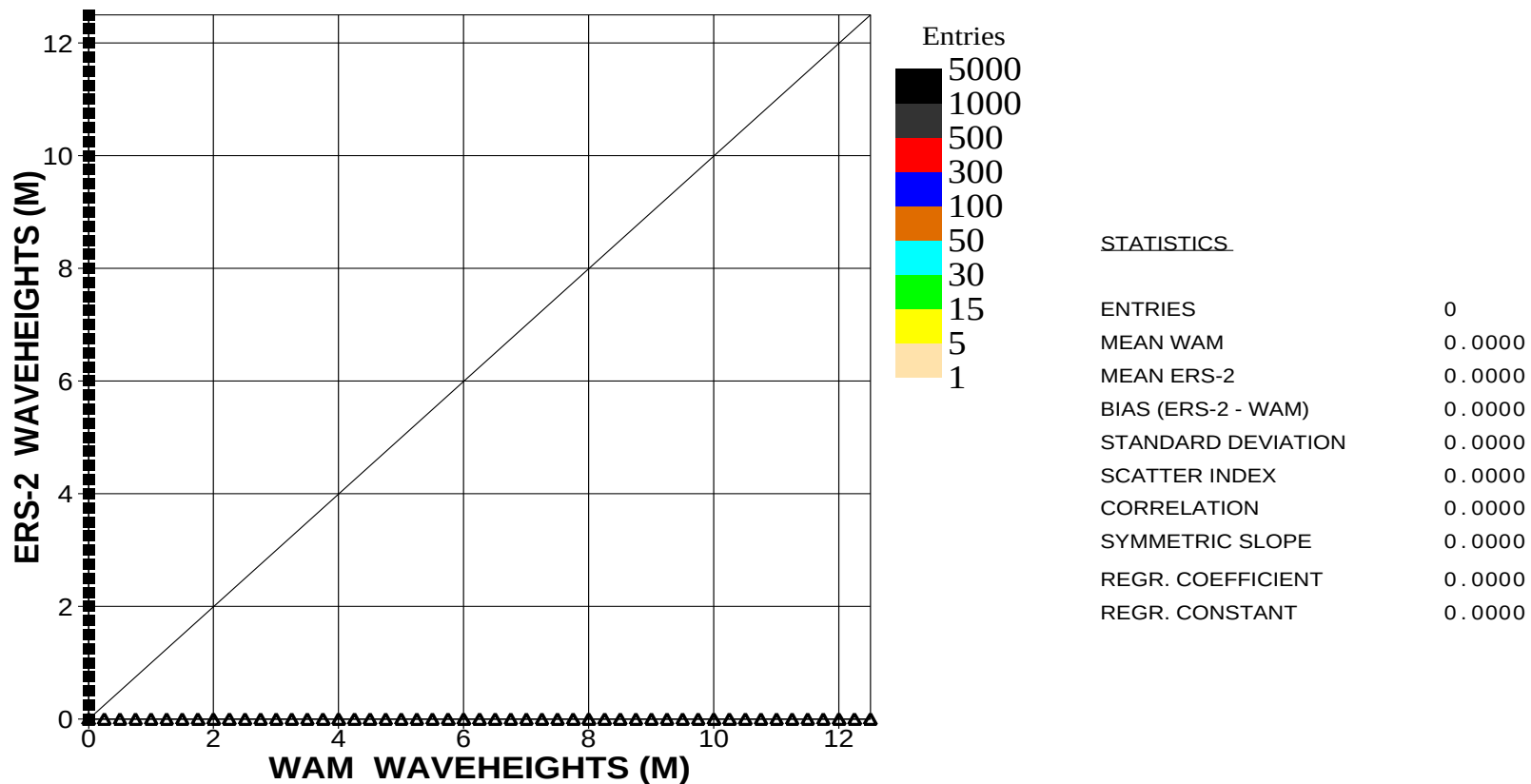


Figure 20. Comparison of ECMWF wave height results with ERS2 Altimeter wave height data for September 2004 (s.hem.)



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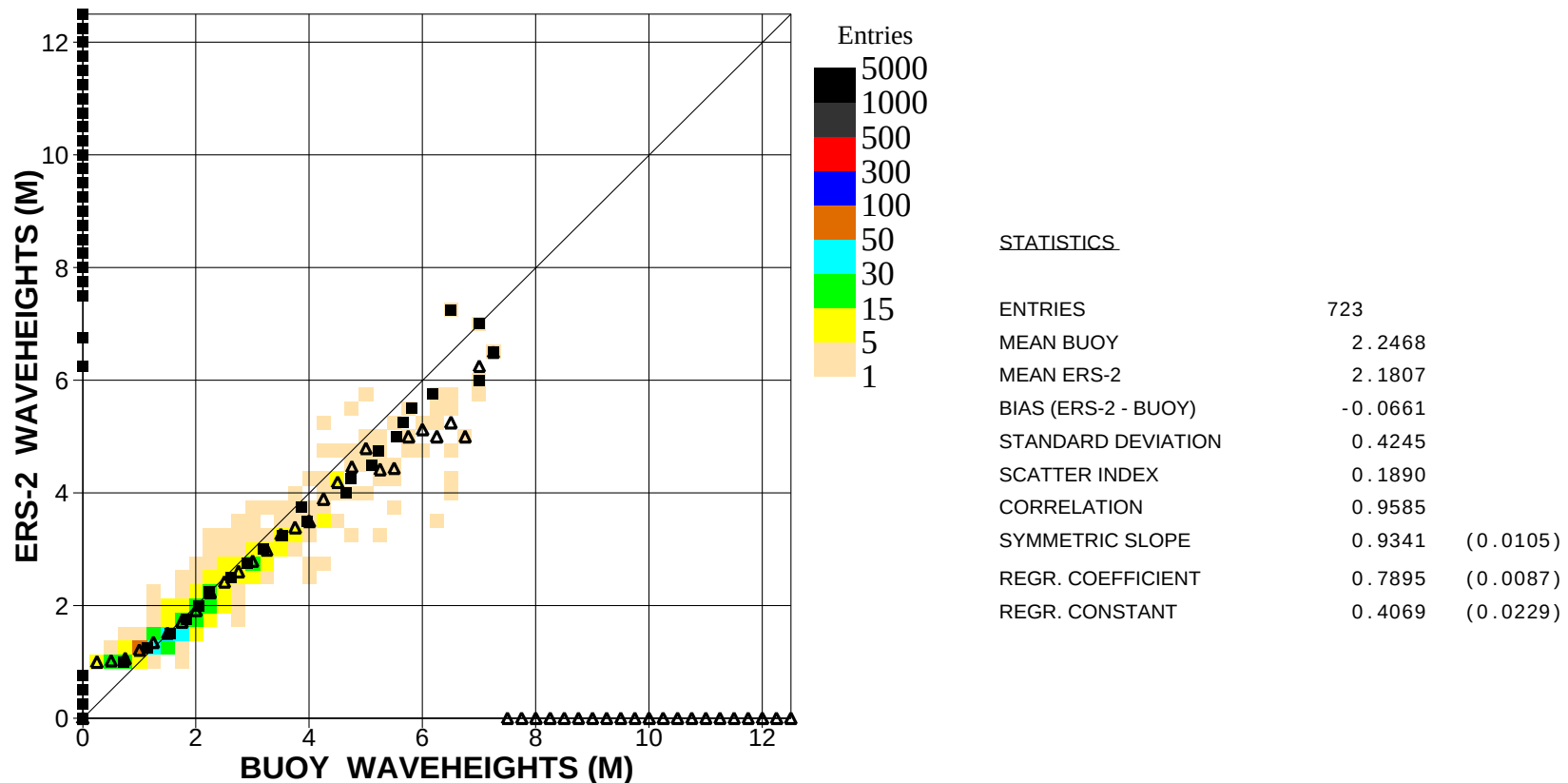


Figure 21. Comparison of buoy wave height observations with ERS2 Altimeter wave height data for September 2004 (global)

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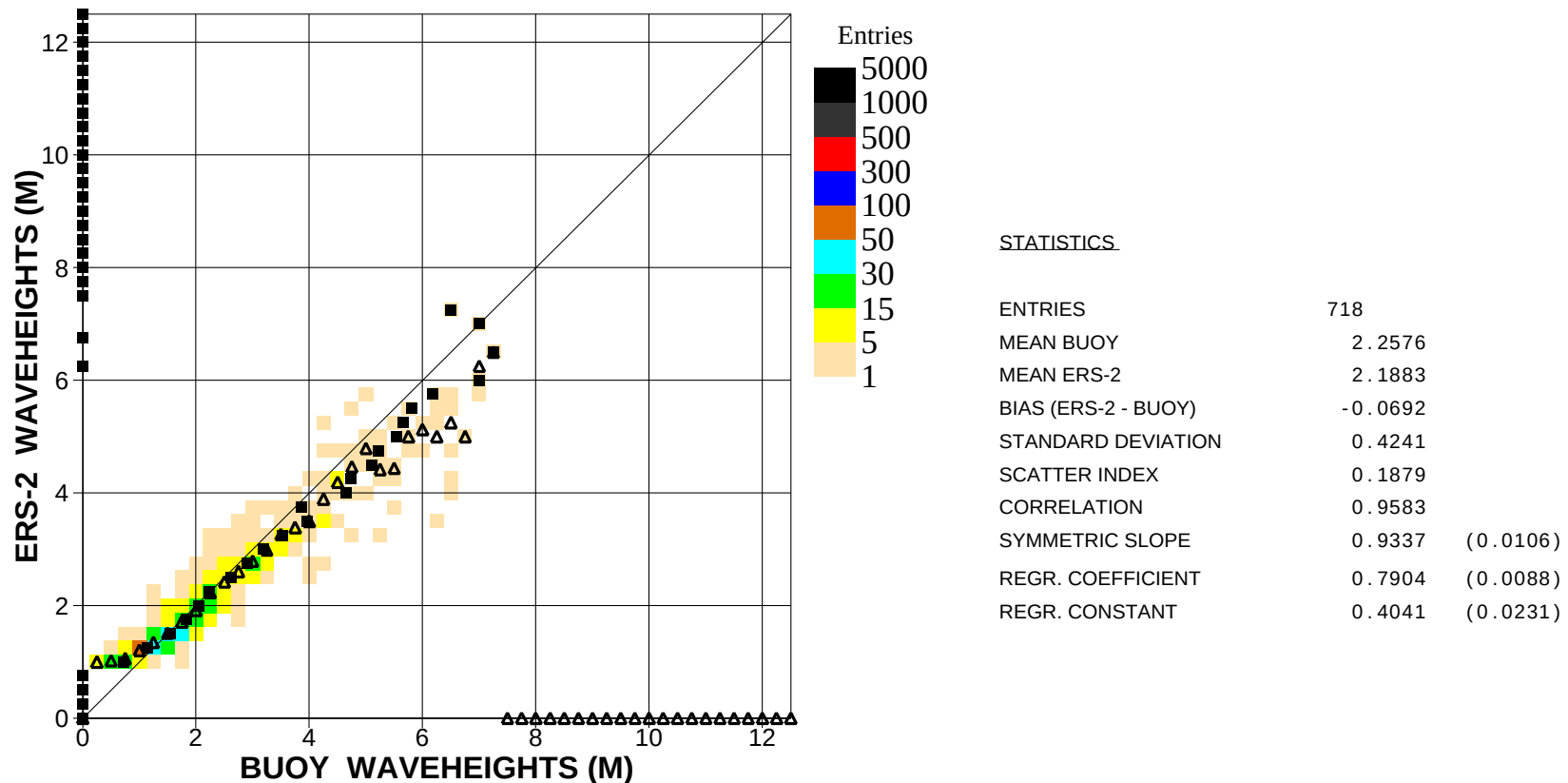


Figure 22. Comparison of buoy wave height observations with ERS2 Altimeter wave height data for September 2004 (n.hem.)

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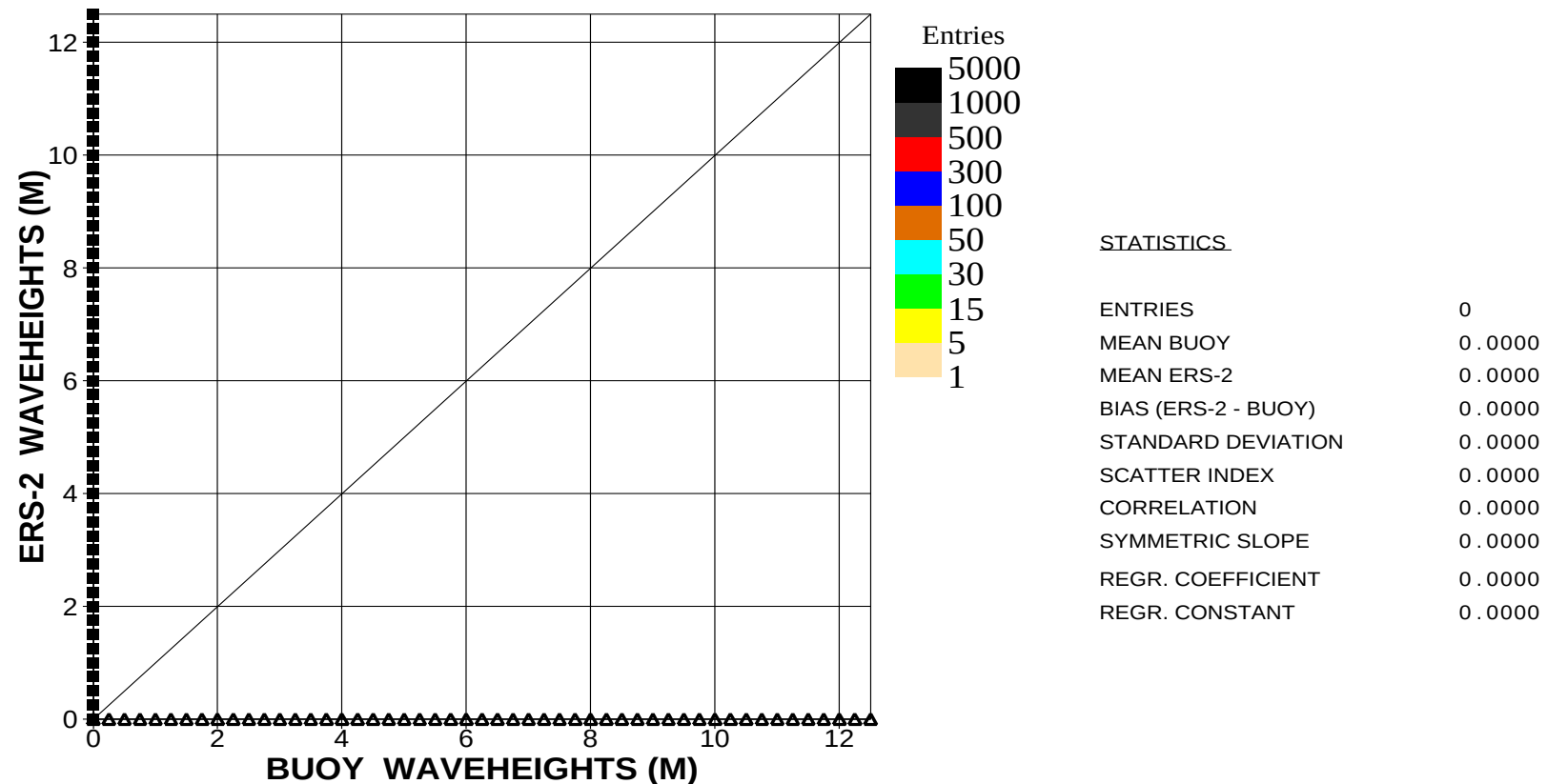


Figure 23. Comparison of buoy wave height observations with ERS2 Altimeter wave height data for September 2004 (hawaii)

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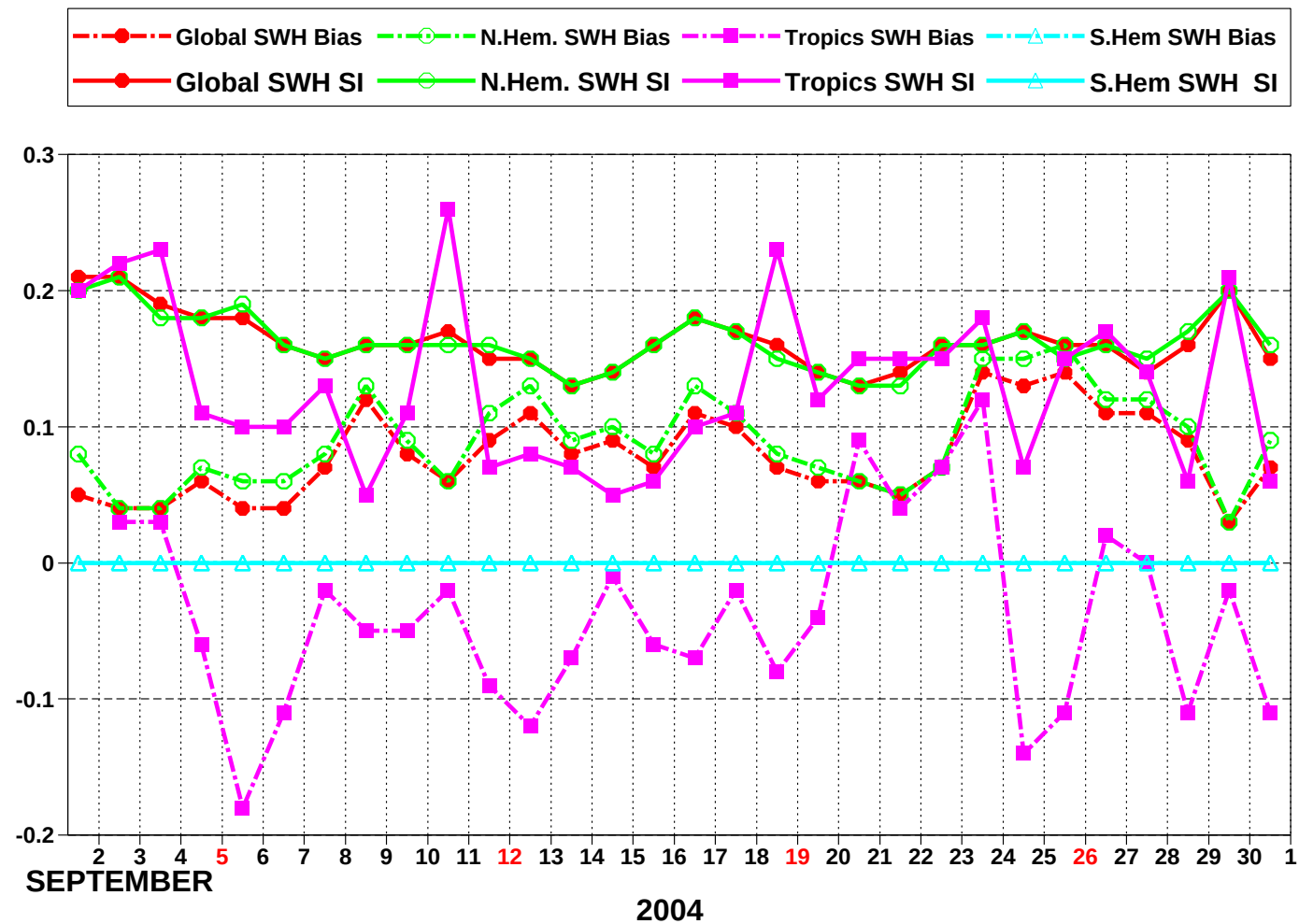


Figure 24: ERS-2 Altimeter wave heights: Timeseries of bias (ERS-2 - model) and scatter index (SI)

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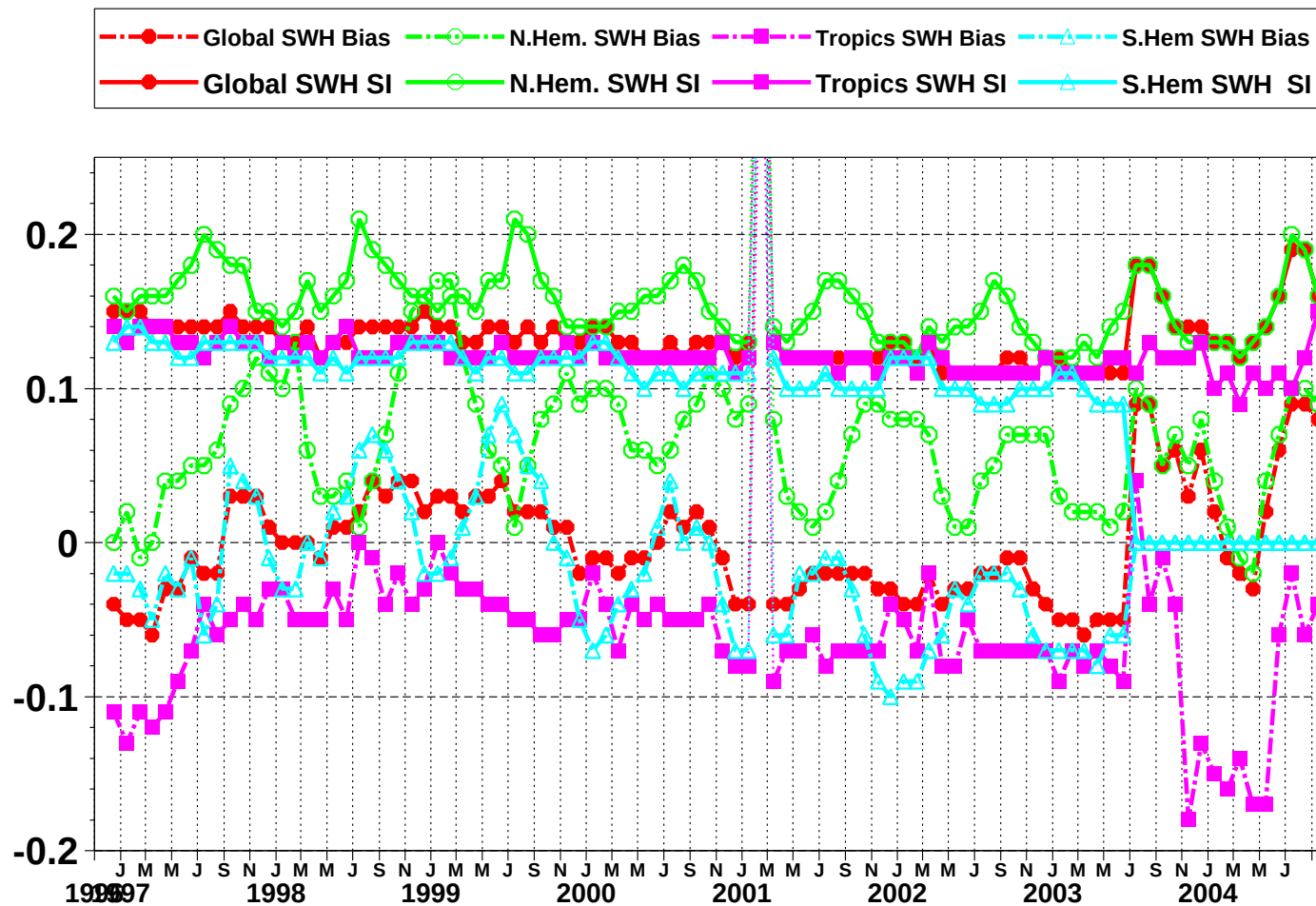


Figure 25: ERS-2 Altimeter wave heights: Timeseries of bias (ERS-2 - model) and scatter index (SI)

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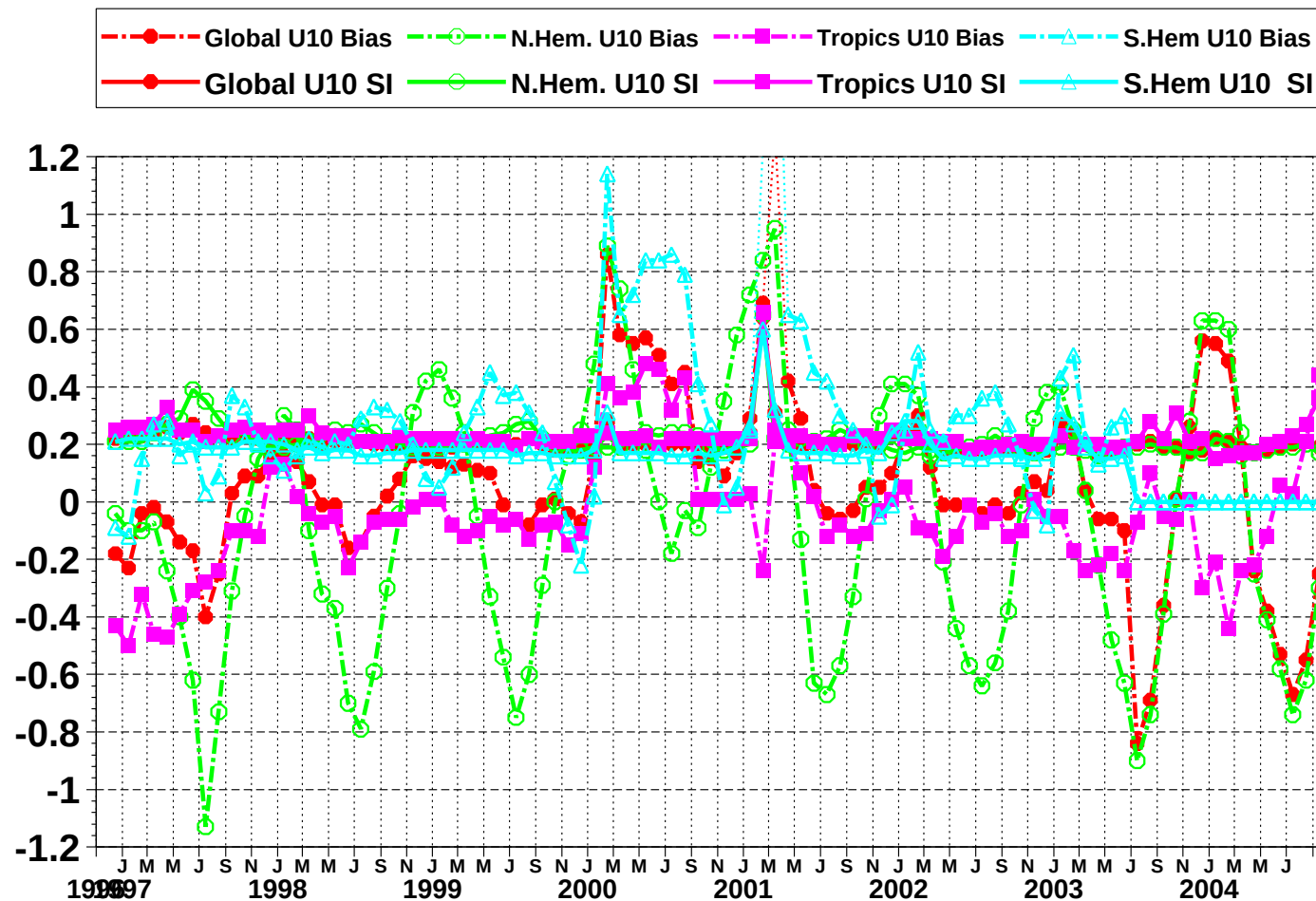


Figure 26: ERS-2 Altimeter wind speeds: Timeseries of bias (ERS-2 - model) and scatter index (SI)

