

■ ECMWF Report on ERS-2 RA for December 2005 ■

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

By: *Saleh Abdalla*

Date: *13 January 2006*

Overview:

Based on the data received at ECMWF during the whole month, on average, 4052 observations arrived at ECMWF every 6 hours of which 84.25% 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 in June 2003. As can be seen in Figure 1, there was no data gaps during the whole month. However, there was significant reduction of data at few time windows. The current coverage of the data covers: the North Atlantic, the western coast of North America, the eastern coast of China and around Korea and Japan, and the Southern Ocean as can be seen in Figure 27. The quality of the received data is as good as usual.

Backscatter:

ERS-2 $\langle \sigma_0 \rangle = 11.03$ dB (with a tendency to have a main peak at ~ 10.6 dB and few other secondary peaks).

Wind Speed Comparison with ECMWF wind speeds (bias):

ERS-2 global: - 0.116 m/s

ERS-2 northern hemisphere: - 0.041 m/s

ERS-2 tropics: - 0.318 m/s

ERS-2 southern hemisphere: - 0.453 m/s



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Wind Speed Comparison with buoy wind speeds (bias):

ERS-2 global: - 0.436 m/s

ERS-2 northern hemisphere: - 0.412 m/s

ERS-2 tropics (Hawaii): *missing*

Wave Height Comparison with ECMWF wave heights (bias):

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

ERS-2 northern hemisphere: - 0.052 m

ERS-2 tropics: - 0.042 m

ERS-2 southern hemisphere: - 0.166 m

Wave Height Comparison with buoy wave heights (bias):

ERS-2 global: - 0.104 m

ERS-2 northern hemisphere: - 0.116 m

ERS-2 tropics (Hawaii): *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.



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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 to include eastern coast of China and around Korea and Japan since 25 June 2005 and the Southern Ocean since 4 July 2005. Current coverage can be seen in Figure 27.
- Assimilation of ERS-2 RA wave heights into ECMWF wave model was stopped on 21st. of October 2003 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 safely 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.
- There was no related ECMWF model changes this month (current operational cycle is CY29R2 since 28 June 2005).

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



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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 December 2005.
- Figure 2: Distribution of the ERS-2 Altimeter Backscatter after QC for December 2005.
- Figure 3: Distribution of the ERS-2 Altimeter wind speeds after QC for December 2005.
- Figure 4: Distribution of the ERS-2 Altimeter wind speeds after along track averaging for December 2005.
- Figure 5: Global distribution of ECMWF ocean surface wind speeds for December 2005.
- Figure 6: Comparison of ECMWF wind speed results with ERS-2 Altimeter wind speed data for December 2005 (global).
- Figure 7: Comparison of ECMWF wind speed results with ERS-2 Altimeter wind speed data for December 2005 (northern hemisphere)
- Figure 8: Comparison of ECMWF wind speed results with ERS-2 Altimeter wind speed data for December 2005 (tropics)
- Figure 9: Comparison of ECMWF wind speed results with ERS-2 Altimeter wind speed data for December 2005 (southern hemisphere)
- Figure 10: Comparison of buoy wind speed observations with ERS-2 Altimeter wind speed data for December 2005 (global).
- Figure 11: Comparison of buoy wind speed observations with ERS-2 Altimeter wind speed data for December 2005 (northern hemisphere).
- Figure 12: Comparison of buoy wind speed observations with ERS-2 Altimeter wind speed data for December 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 December 2005.
- Figure 15: Distribution of the ERS-2 Altimeter wave heights after along track averaging for December 2005.
- Figure 16: Global distribution of ECMWF wave heights for December 2005.
- Figure 17: Comparison of ECMWF wave height results with ERS-2 Altimeter wave height data for December 2005 (global).
- Figure 18: Comparison of ECMWF wave height results with ERS-2 Altimeter wave height data for December 2005 (northern hemisphere)



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

Figure 20: Comparison of ECMWF wave height results with ERS-2 Altimeter wave height data for December 2005 (southern hemisphere)

Figure 21: Comparison of buoy wave height observations with ERS-2 Altimeter wave height data for December 2005 (global).

Figure 22: Comparison of buoy wave height observations with ERS-2 Altimeter wave height data for December 2005 (northern hemisphere).

Figure 23: Comparison of buoy wave height observations with ERS-2 Altimeter wave height data for December 2005 (hawaii).

Figure 24: ERS-2 Altimeter wave heights: Timeseries of bias (ERS-2 - model) and scatter index (SI) for December 2005.

Figure 25: ERS-2 Altimeter wave heights: Timeseries of bias (ERS-2 - model) and scatter index (SI) from December 1996 to December 2005.

Figure 26: ERS-2 Altimeter wind speeds: Timeseries of bias (ERS-2 - model) and scatter index (SI) from December 1996 to December 2005.

Figure 27: Significant wave height: Monthly mean difference of ERS-2 altimeter data minus wave model results for December 2005.



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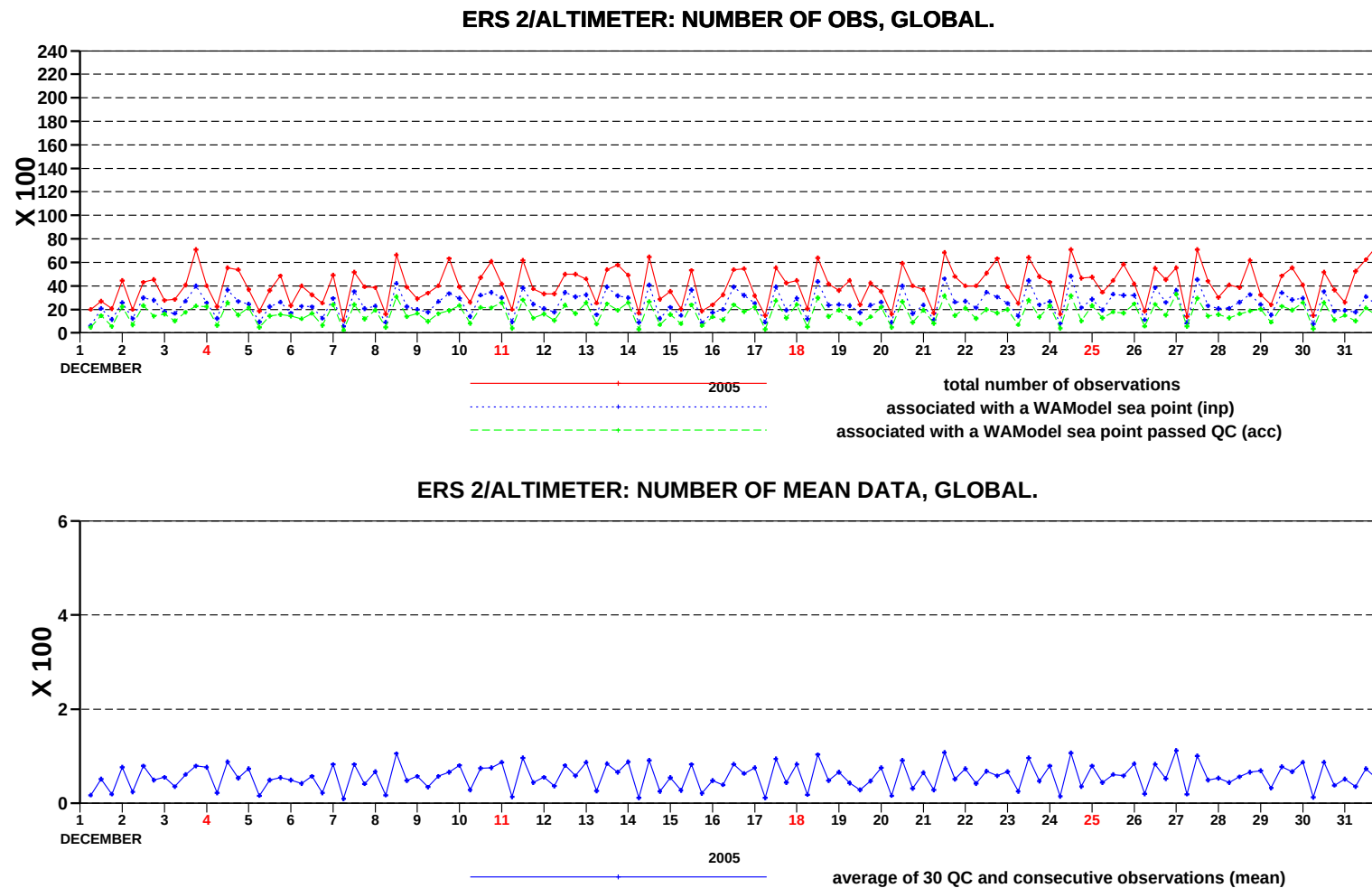


Figure 1: Time series of data reception for ERS-2 Altimeter data for December 2005

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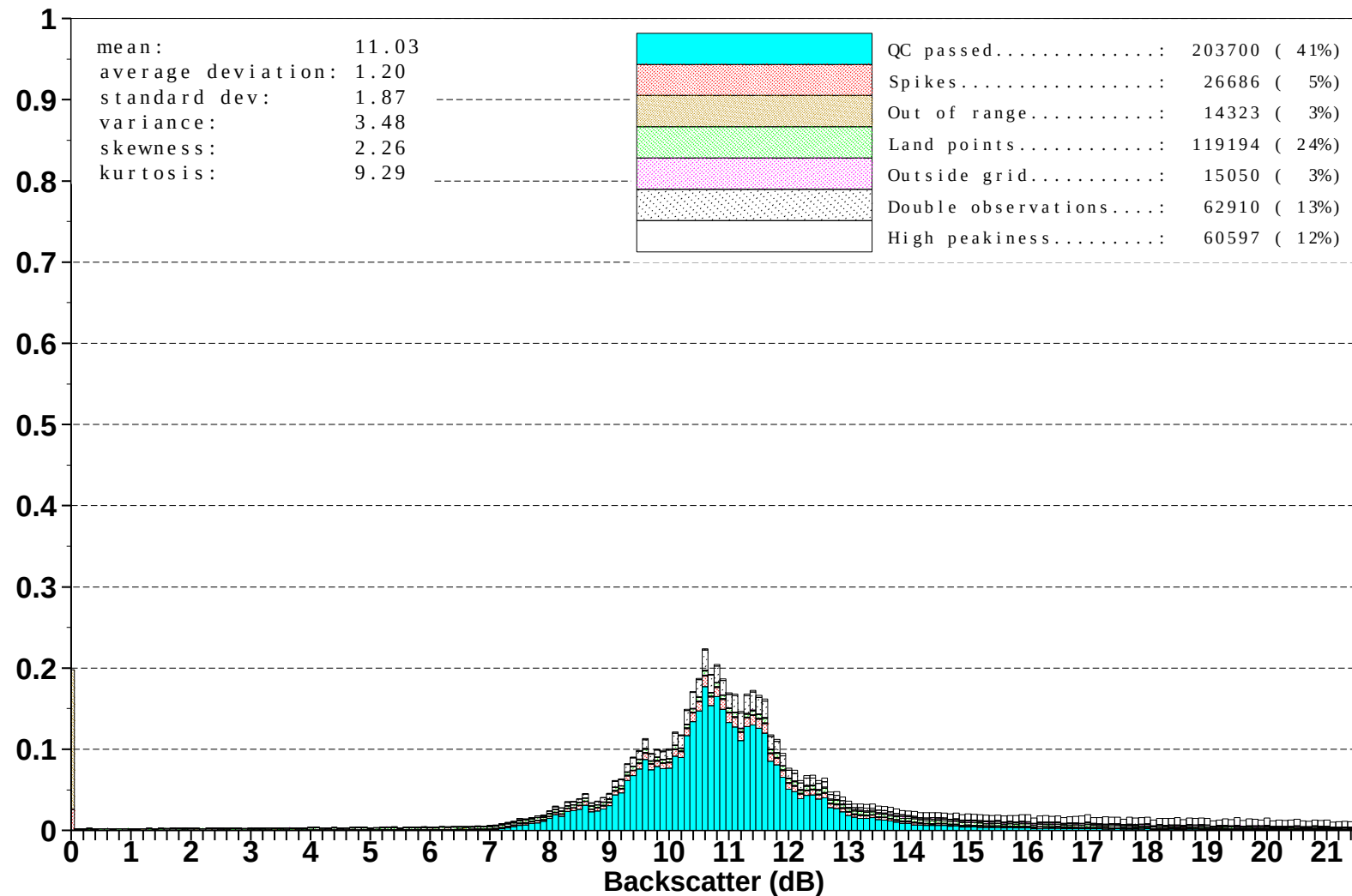


Figure 2: Distribution of the ERS-2 Altimeter backscatter after QC for December 2005

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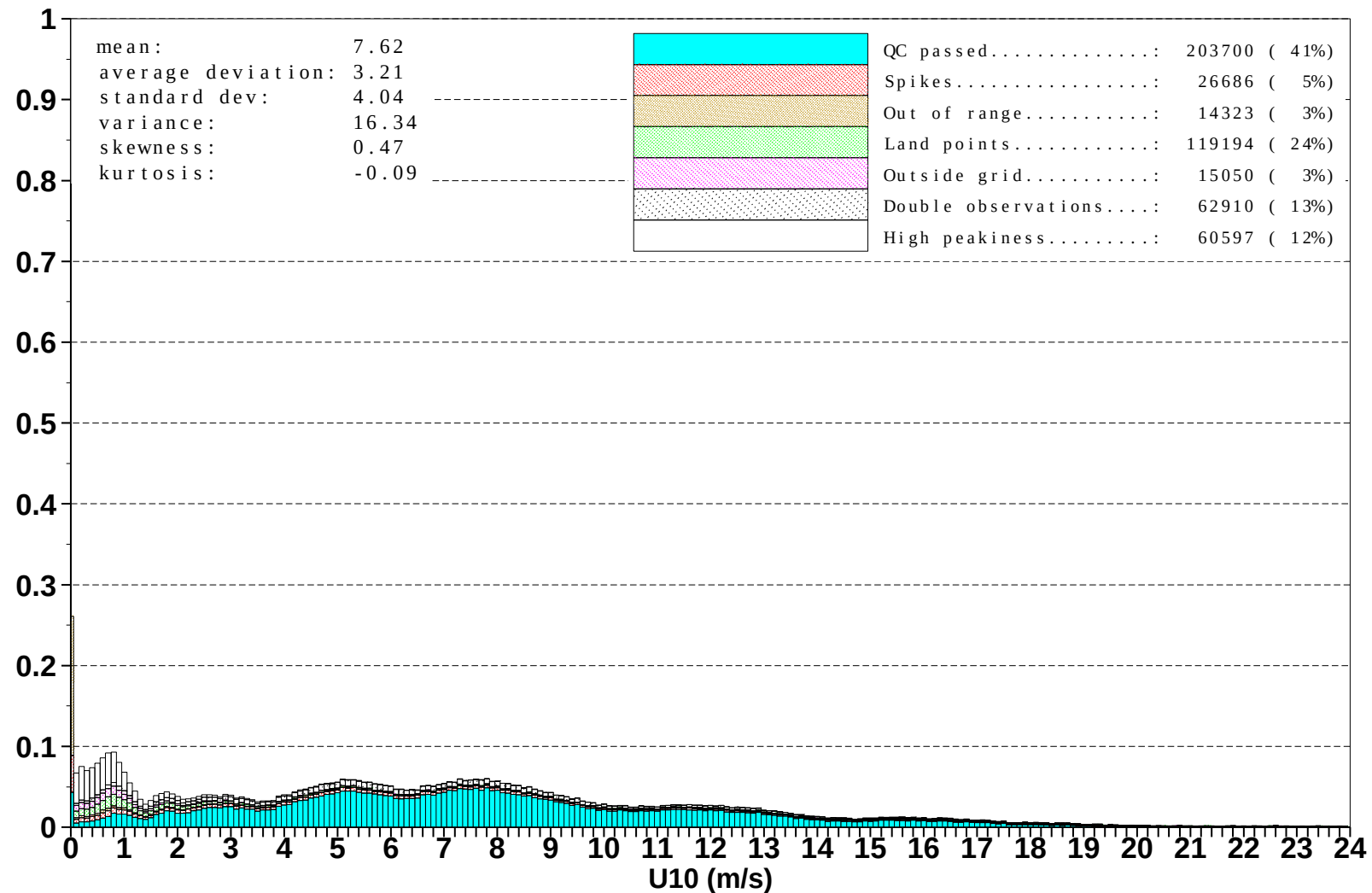


Figure 3: Distribution of the ERS-2 Altimeter wind speeds after QC for December 2005

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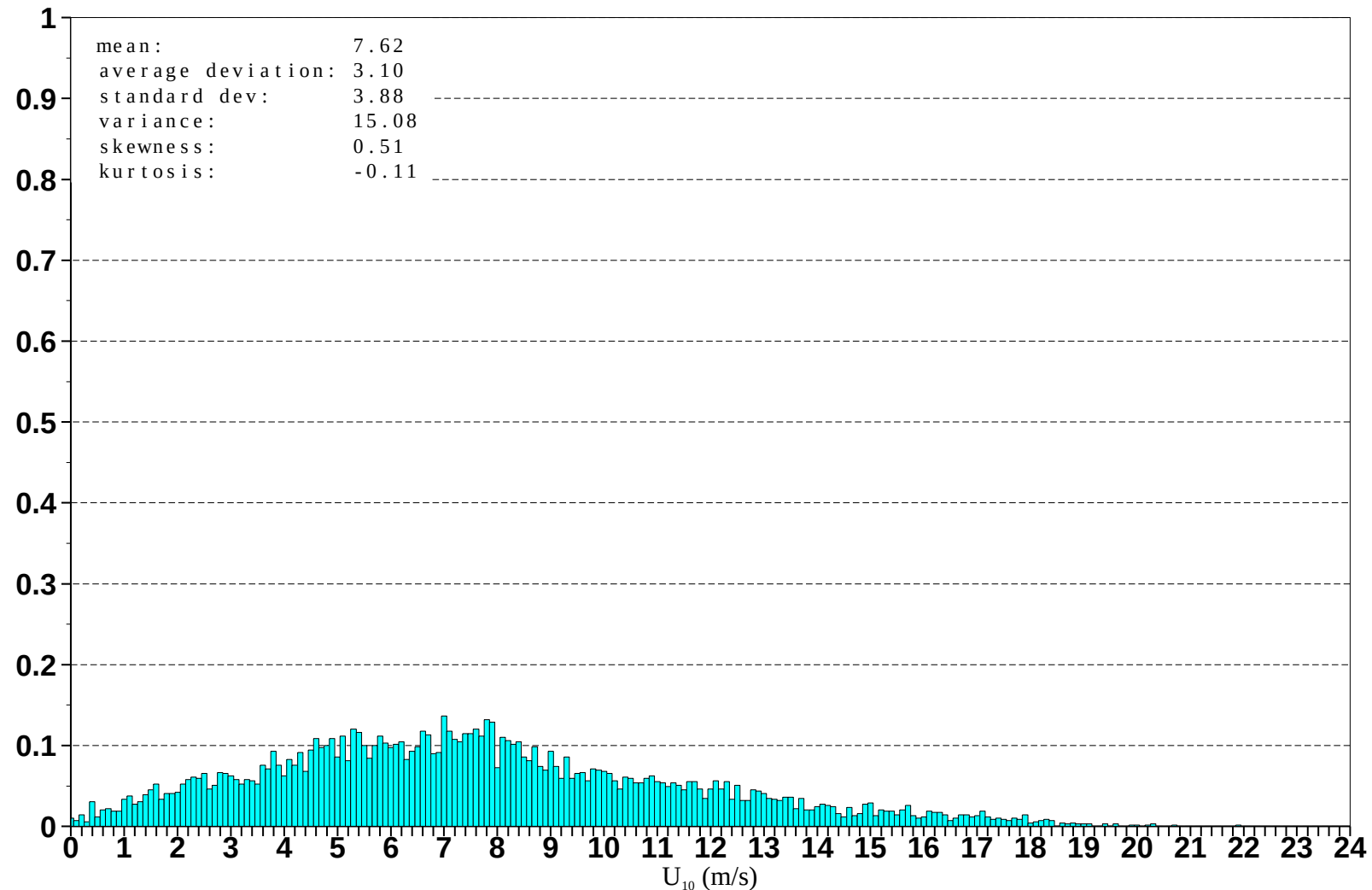


Figure 4: Distribution of ERS-2 Altimeter wind speeds after along track averaging for December 2005



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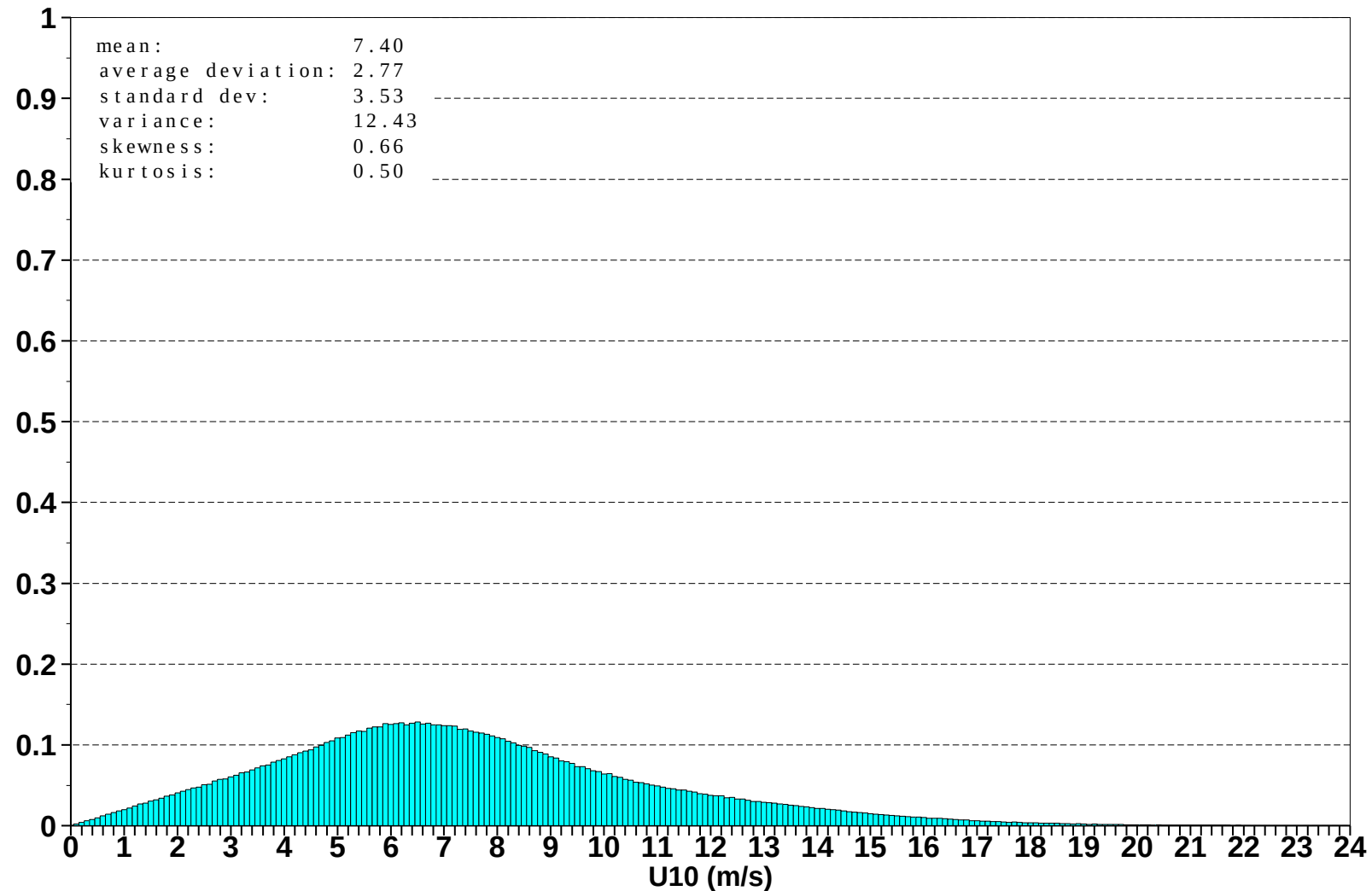


Figure 5: Global distribution of ECMWF ocean surface wind speeds for December 2005



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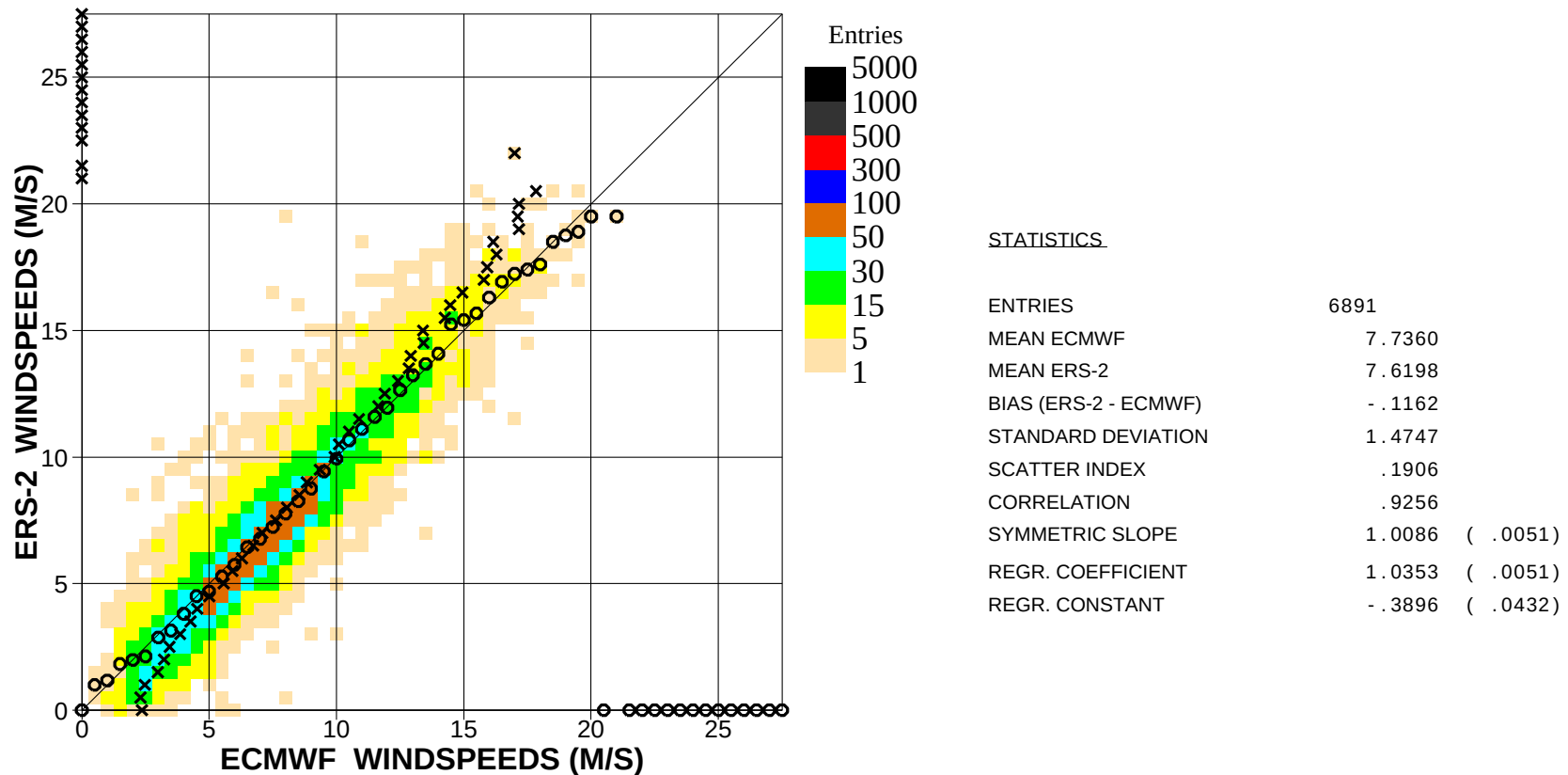


Figure 6. Comparison of ECMWF wind speed results with ERS2 Altimeter wind speed data for December 2005 (global)

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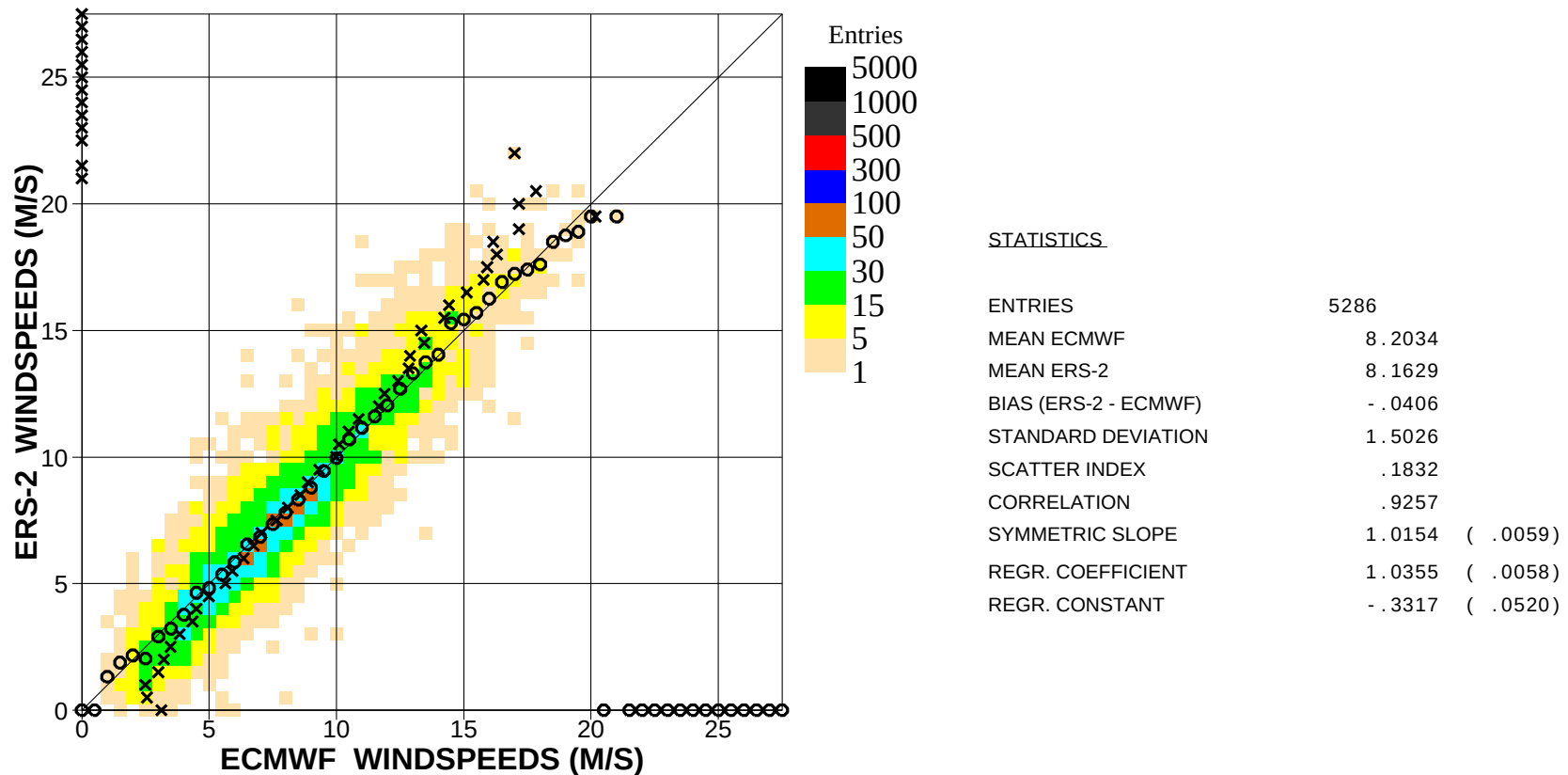


Figure 7. Comparison of ECMWF wind speed results with ERS2 Altimeter wind speed data for December 2005 (n.hem.)

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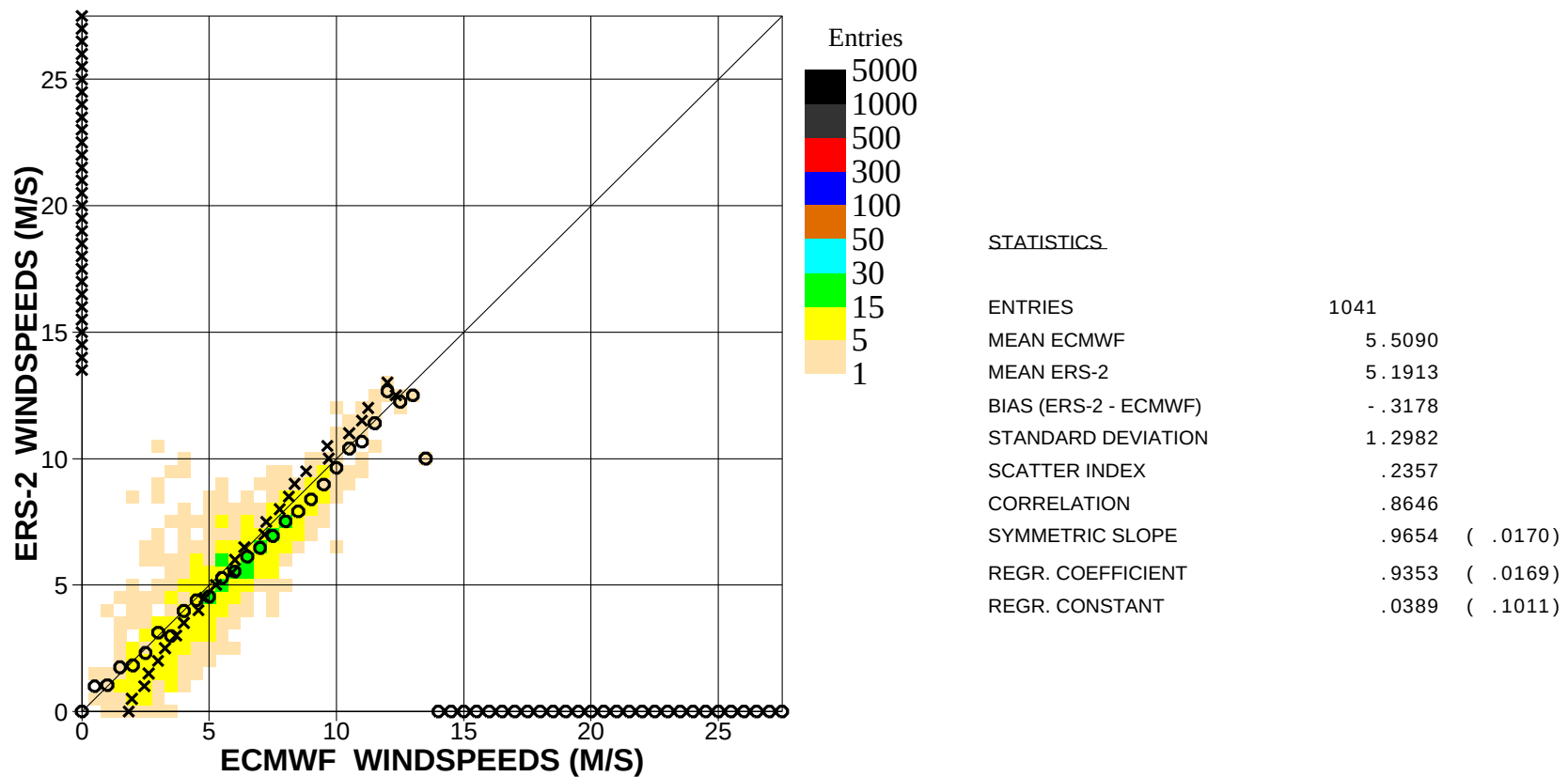


Figure 8. Comparison of ECMWF wind speed results with ERS2 Altimeter wind speed data for December 2005 (tropics)

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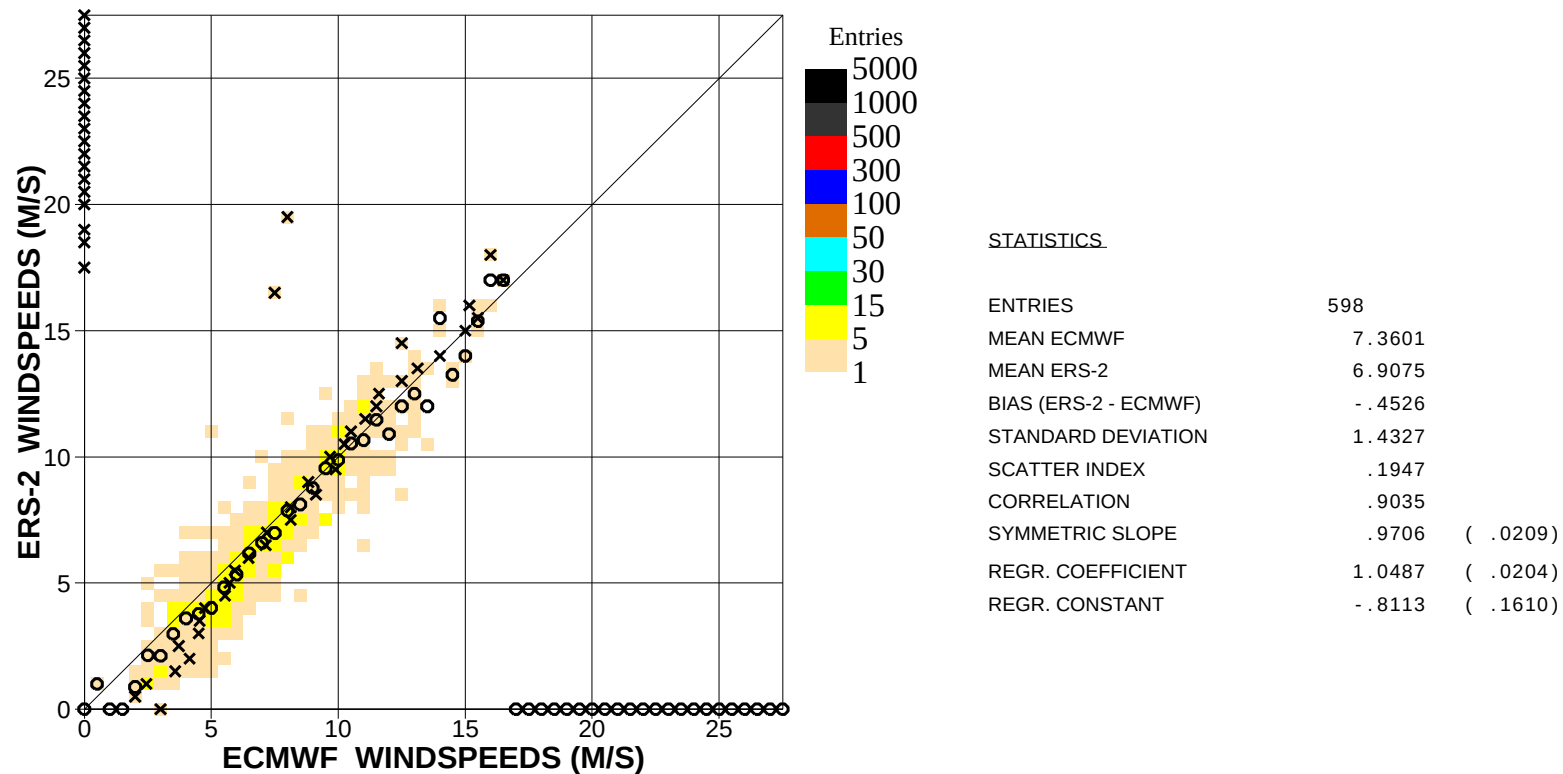


Figure 9. Comparison of ECMWF wind speed results with ERS2 Altimeter wind speed data for December 2005 (s.hem.)

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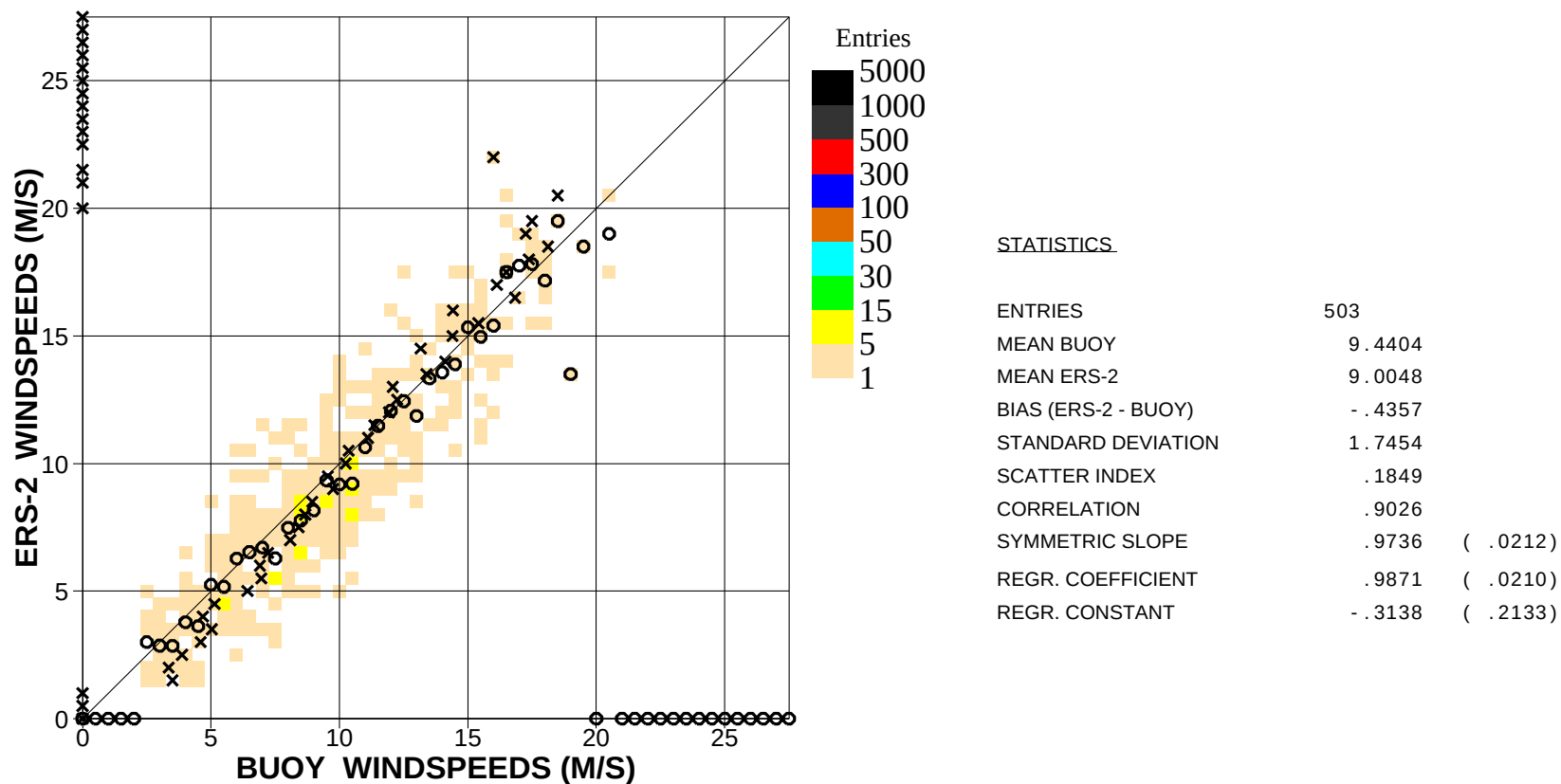


Figure 10. Comparison of buoy wind speed observations with ERS2 Altimeter wind speed data for December 2005 (global)

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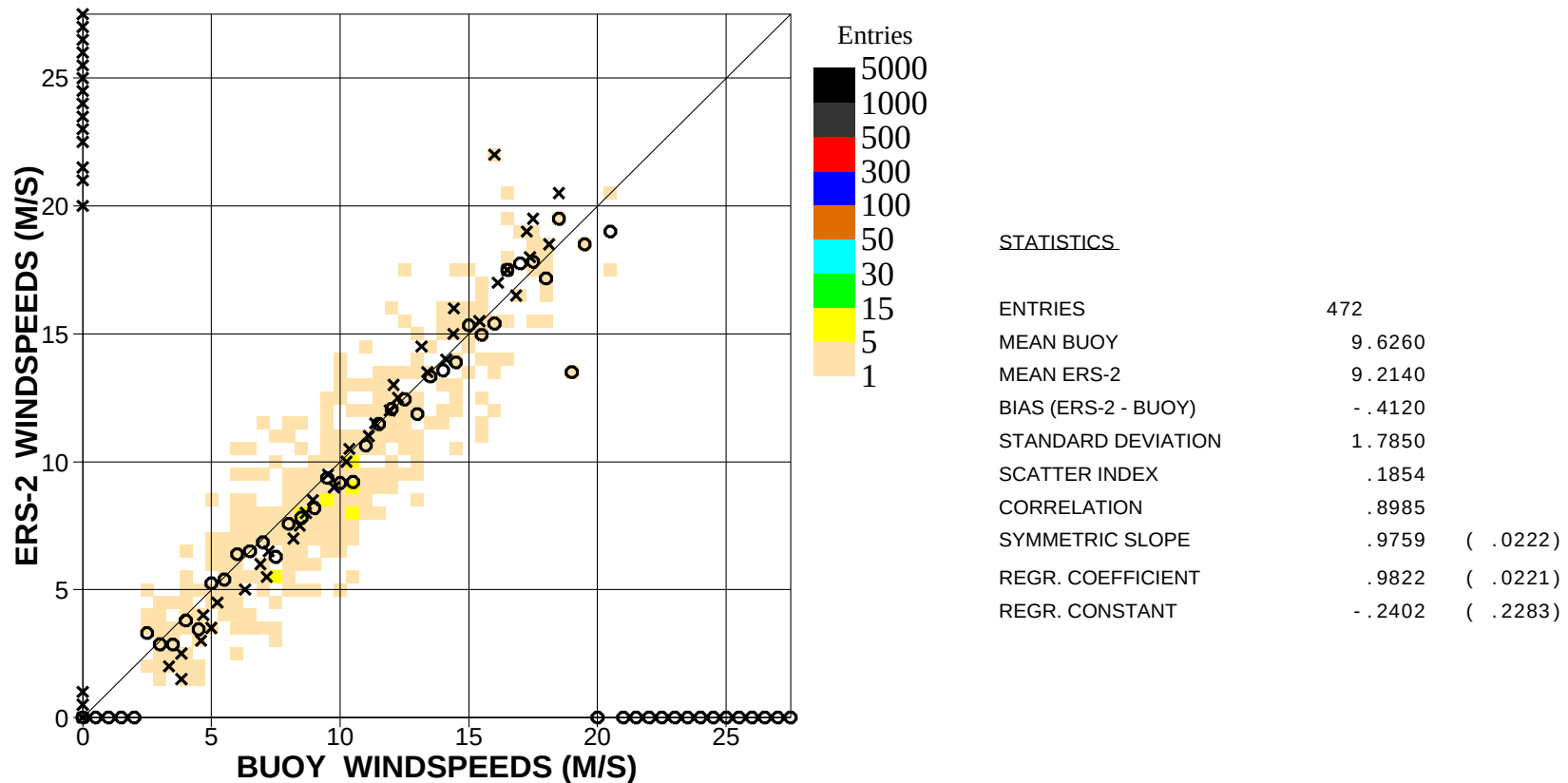


Figure 11. Comparison of buoy wind speed observations with ERS2 Altimeter wind speed data for December 2005 (n.hem.)

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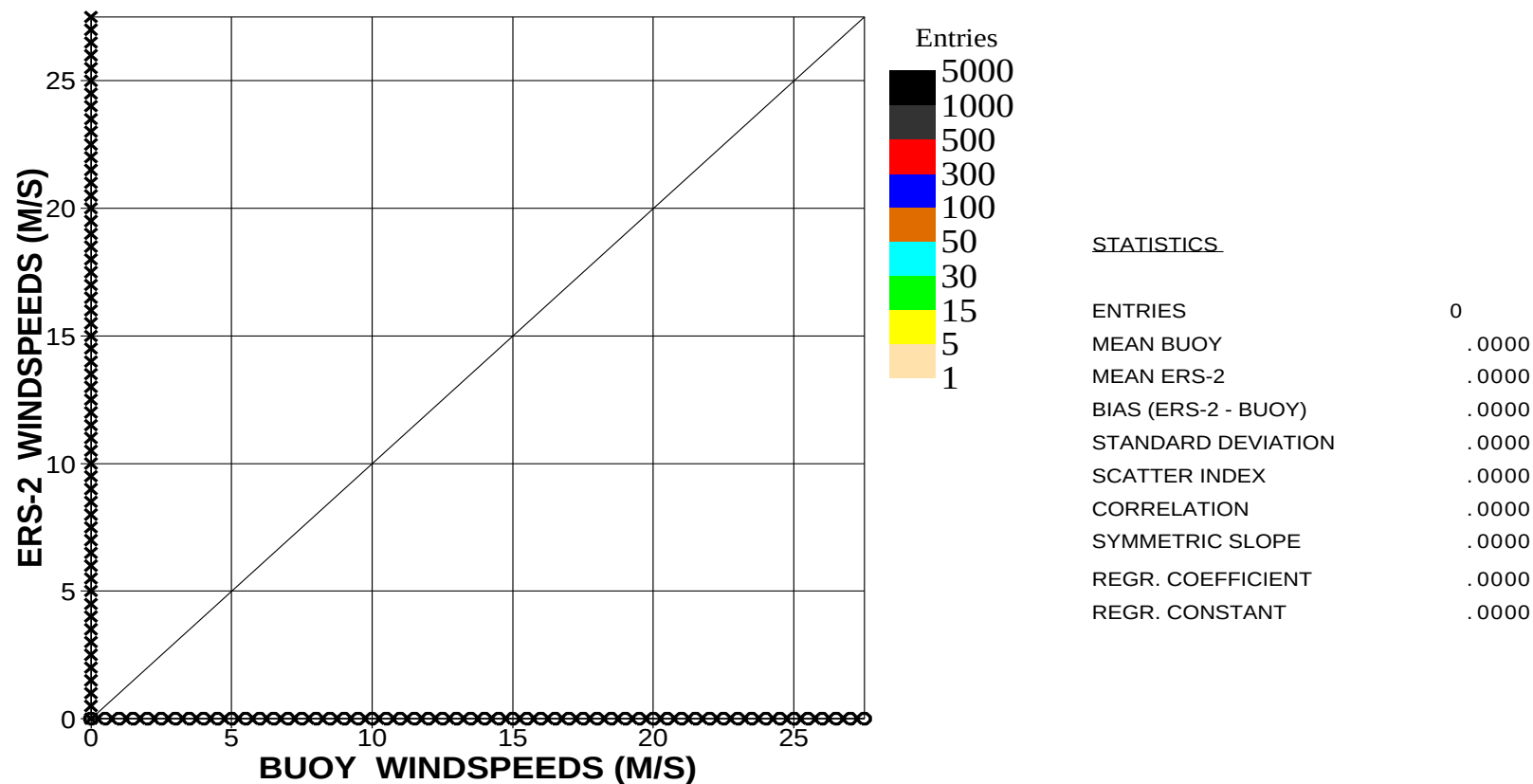


Figure 12. Comparison of buoy wind speed observations with ERS2 Altimeter wind speed data for December 2005 (hawaii)



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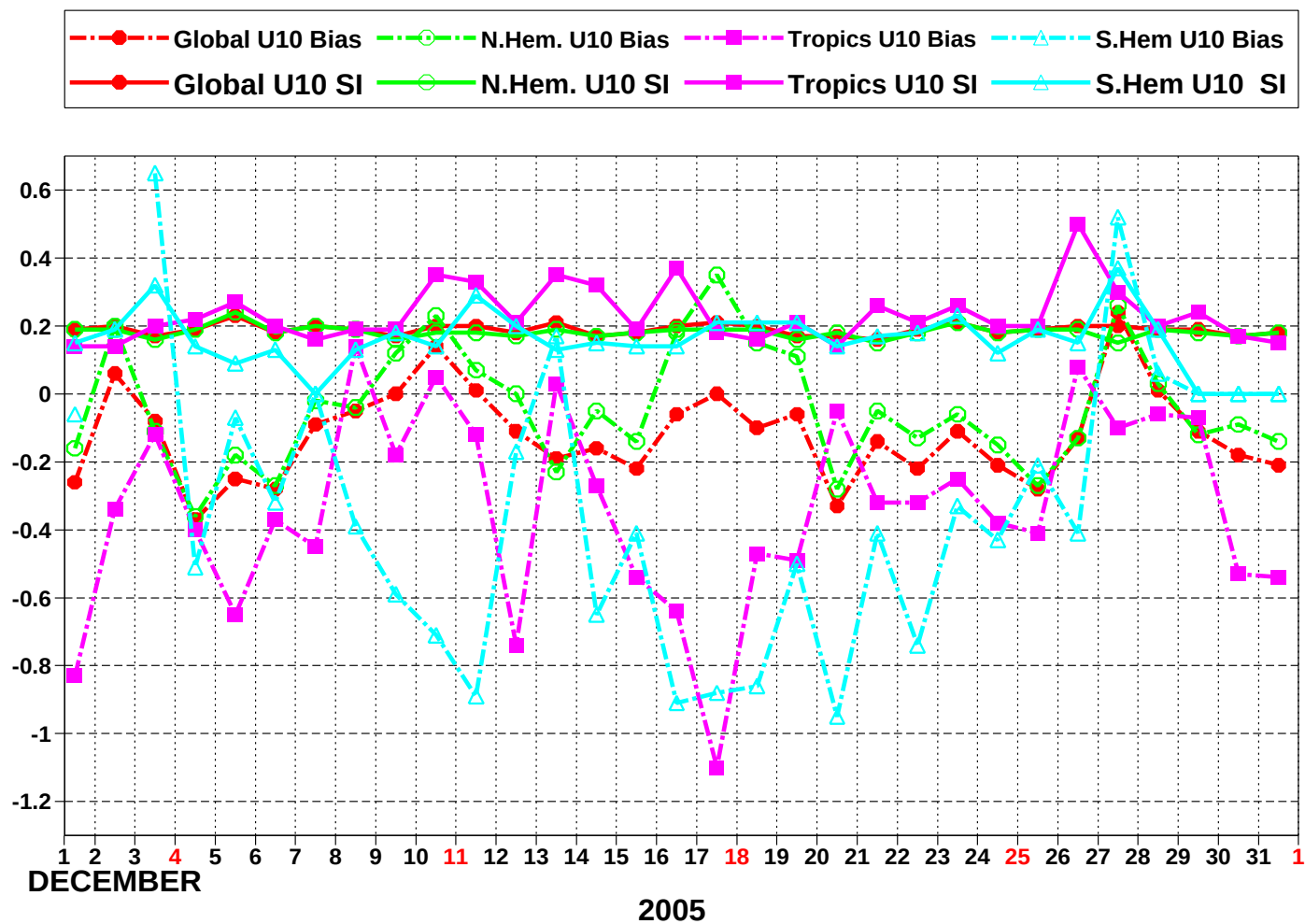


Figure 13: ERS-2 Altimeter wind speeds: Timeseries of bias (ERS-2 - model) and scatter index (SI)

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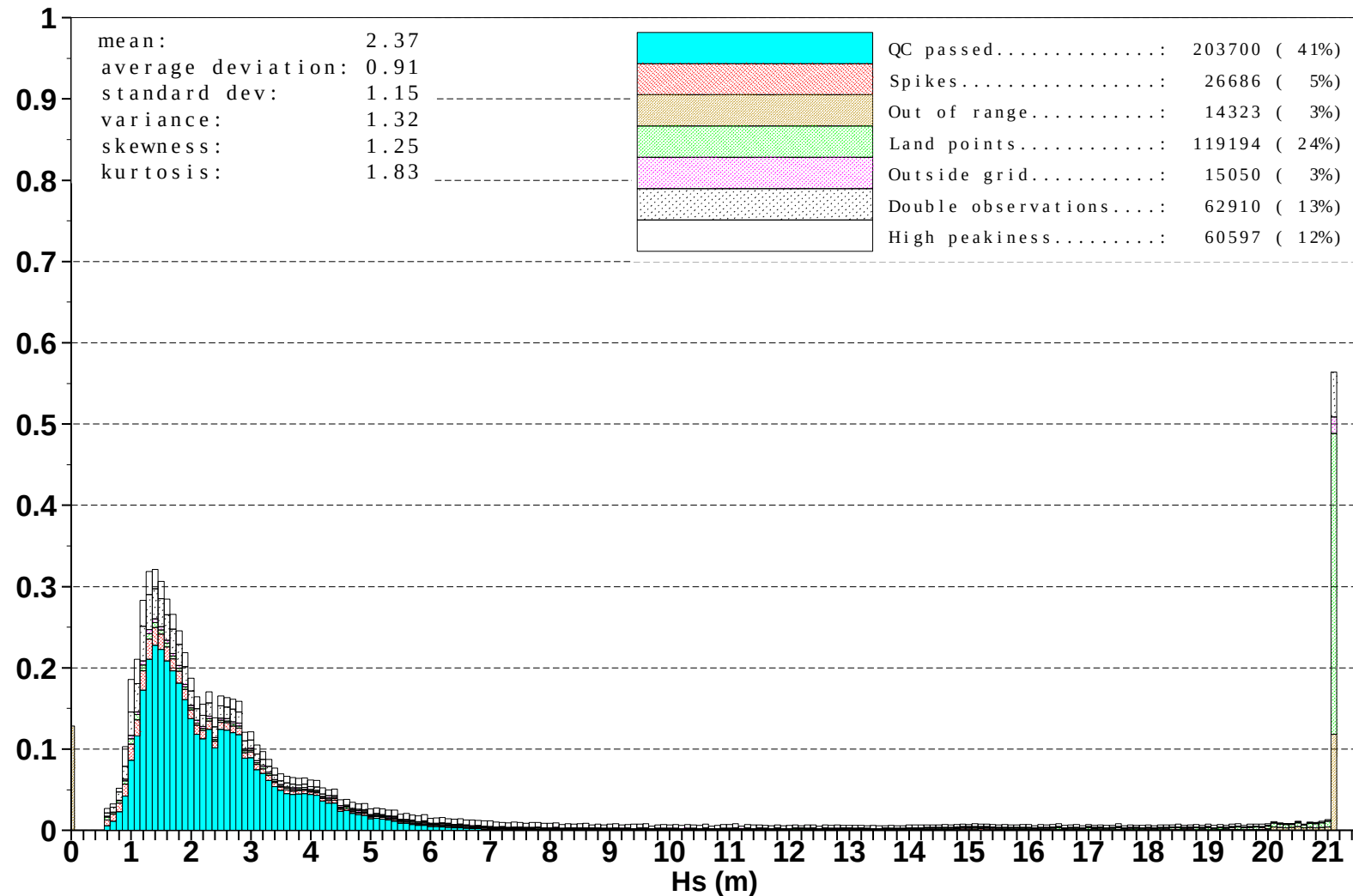


Figure 14: Distribution of the ERS-2 Altimeter wave heights after QC for December 2005

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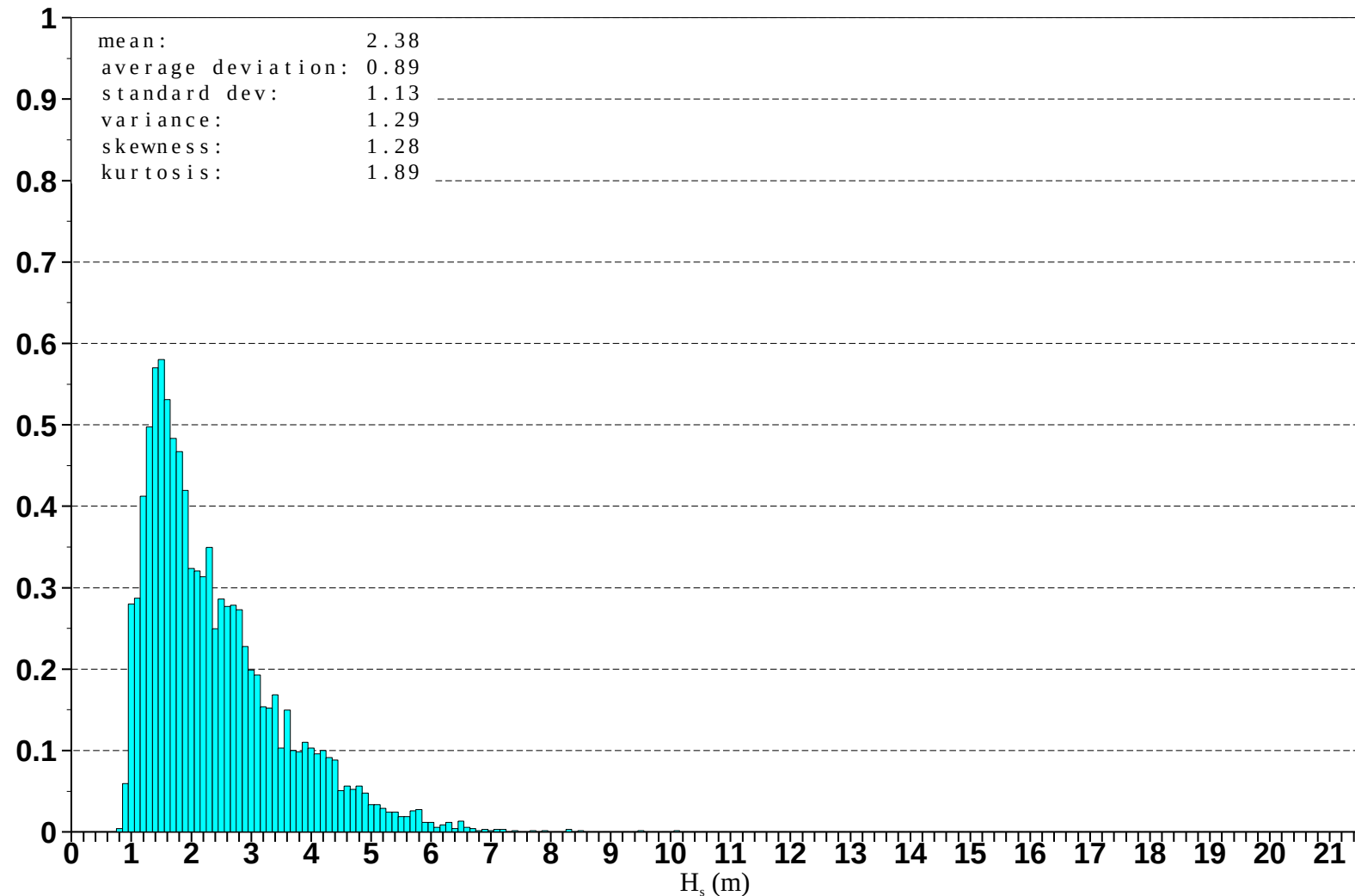


Figure 15: Distribution of ERS-2 Altimeter wave heights after along track averaging for December 2005



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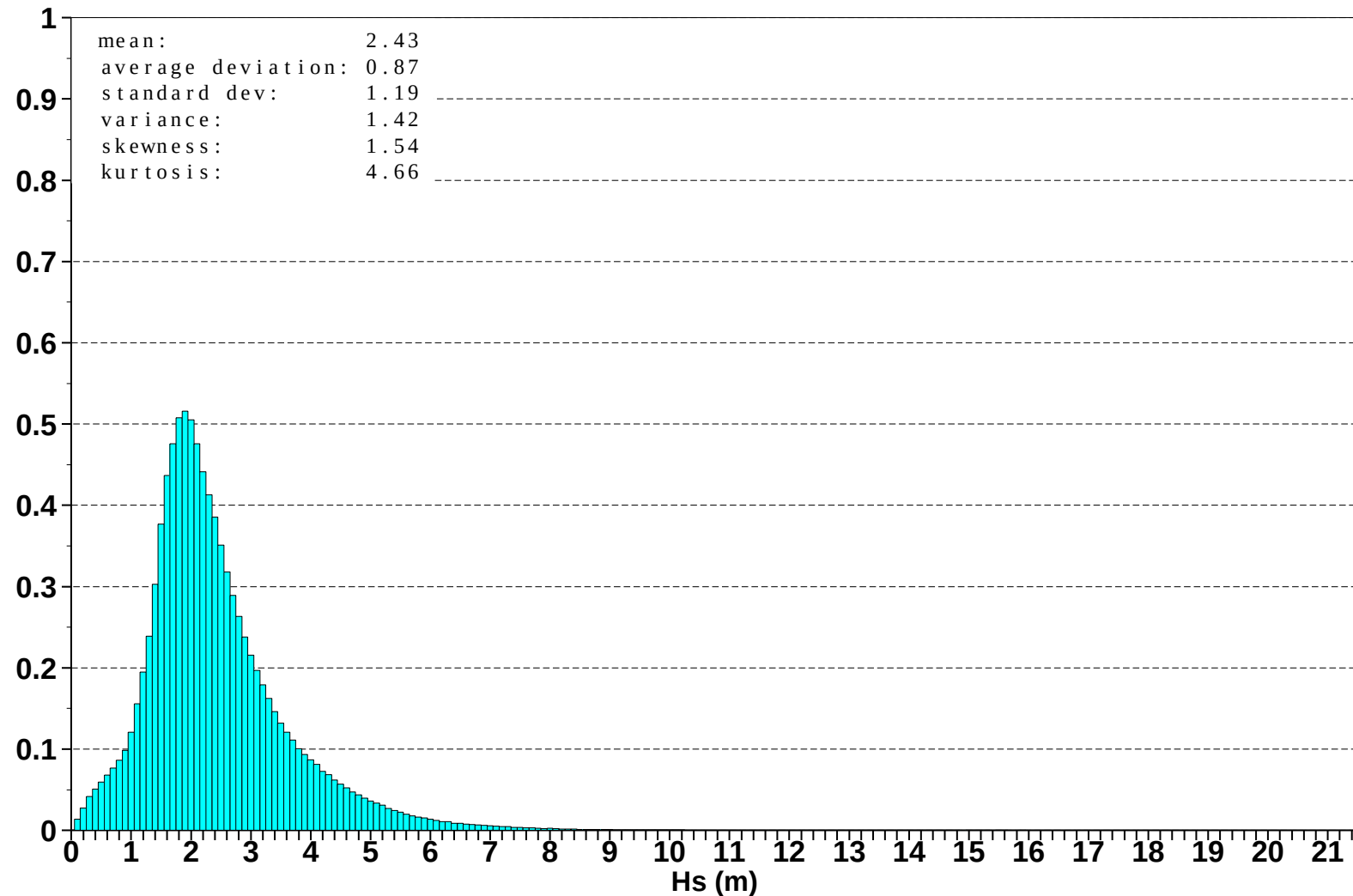


Figure 16: Global distribution of ECMWF wave heights for December 2005



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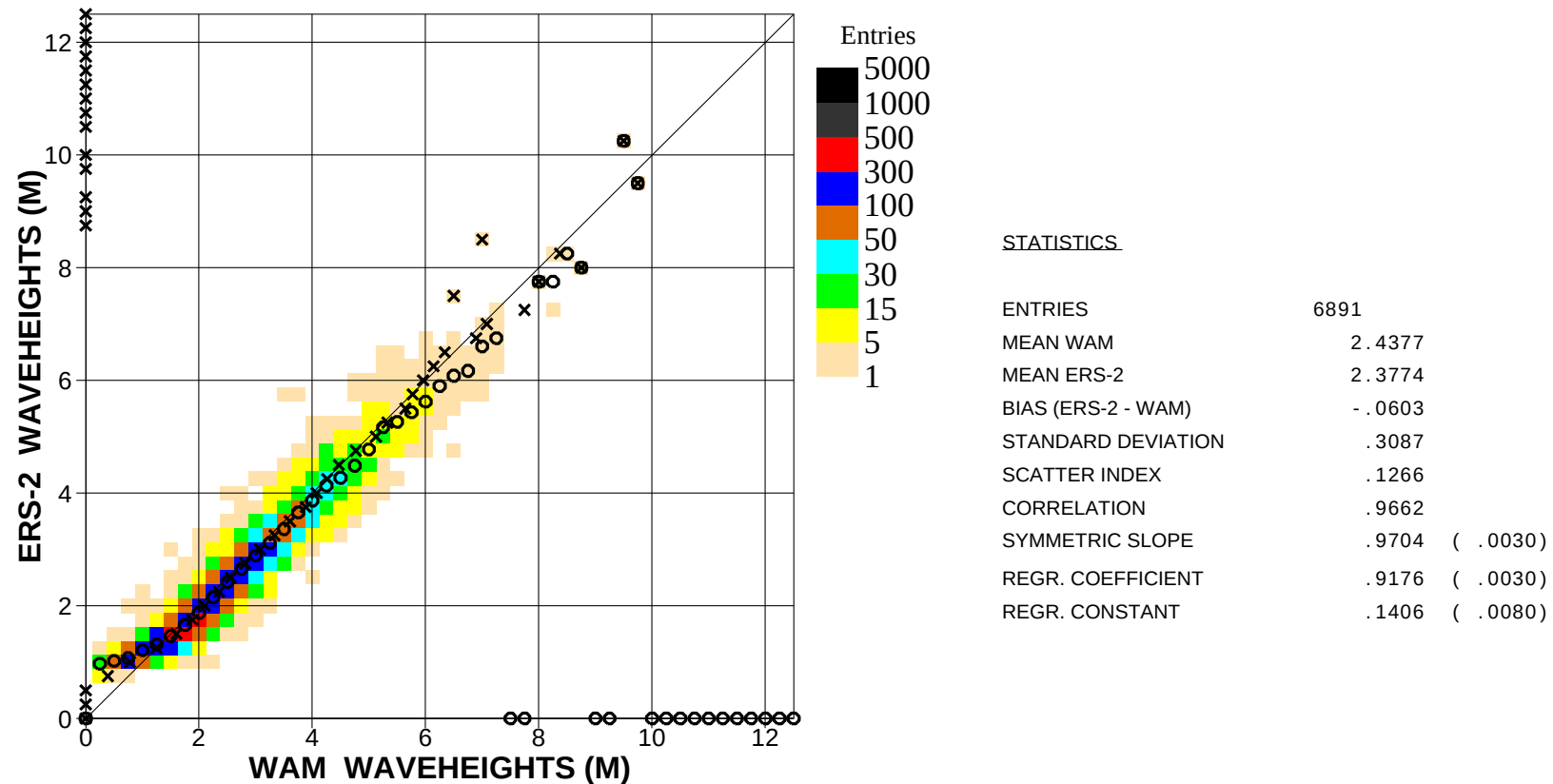


Figure 17. Comparison of ECMWF wave height results with ERS2 Altimeter wave height data for December 2005 (global)

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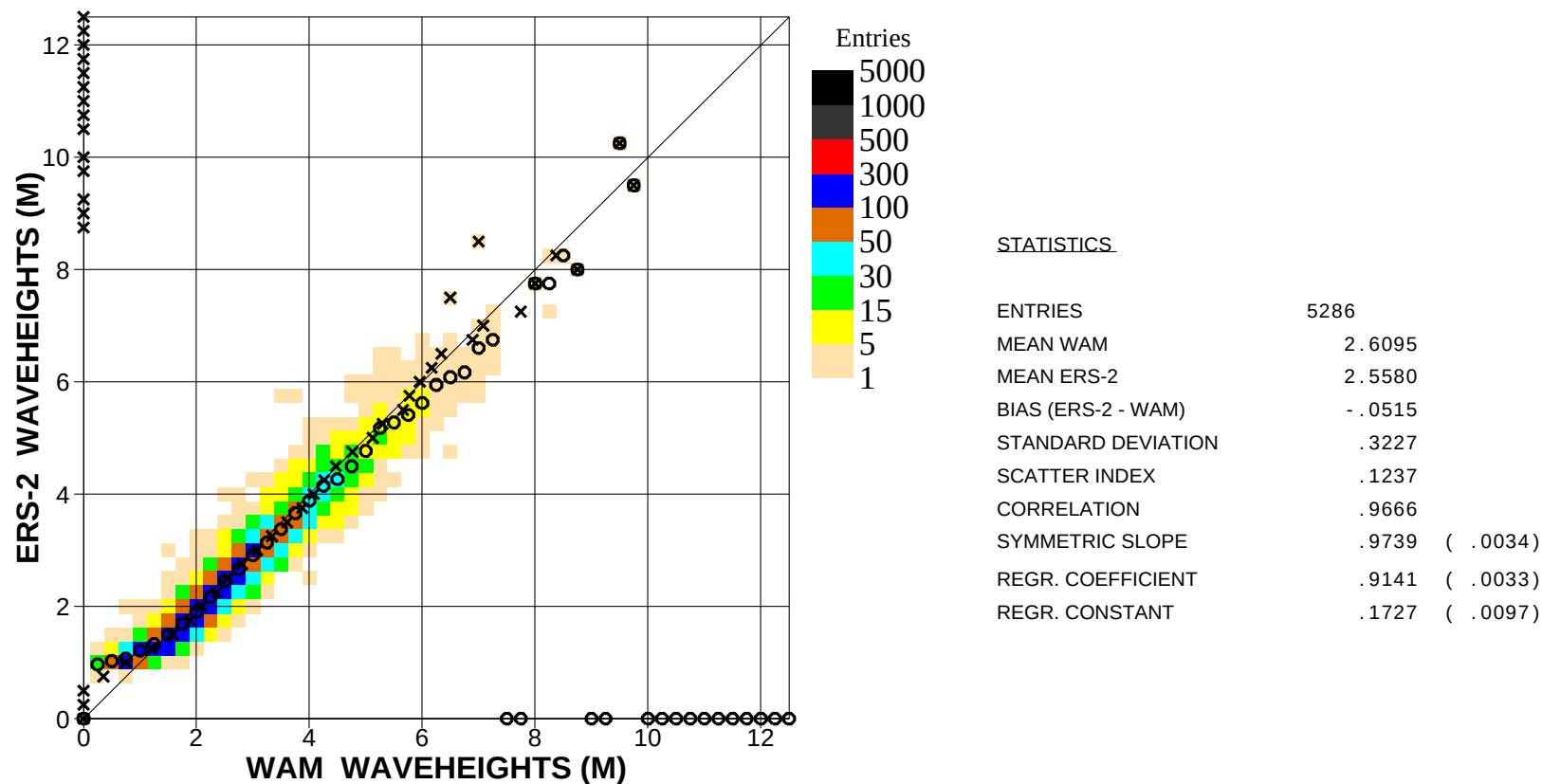


Figure 18. Comparison of ECMWF wave height results with ERS2 Altimeter wave height data for December 2005 (n.hem.)

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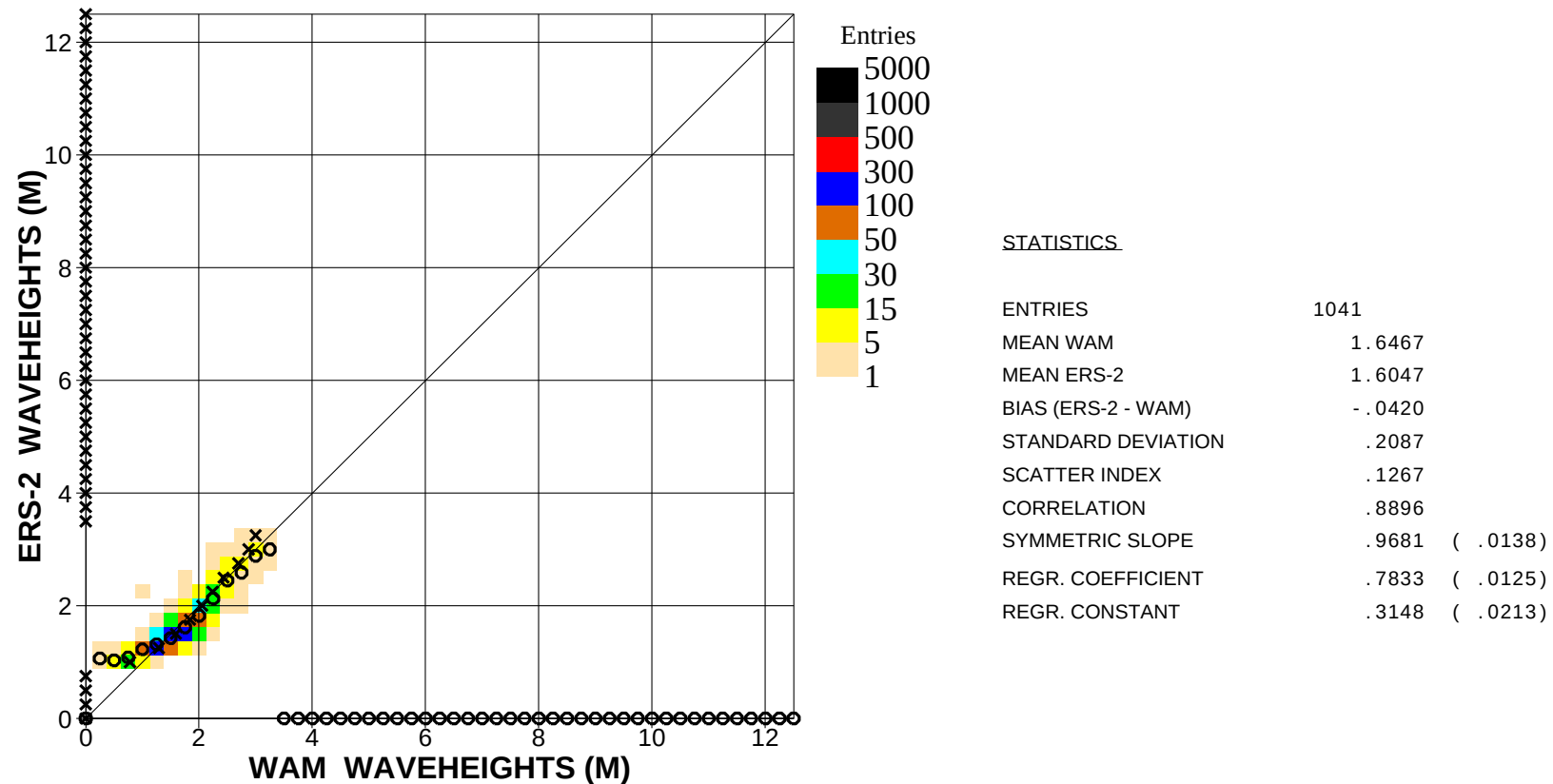


Figure 19. Comparison of ECMWF wave height results with ERS2 Altimeter wave height data for December 2005 (tropics)

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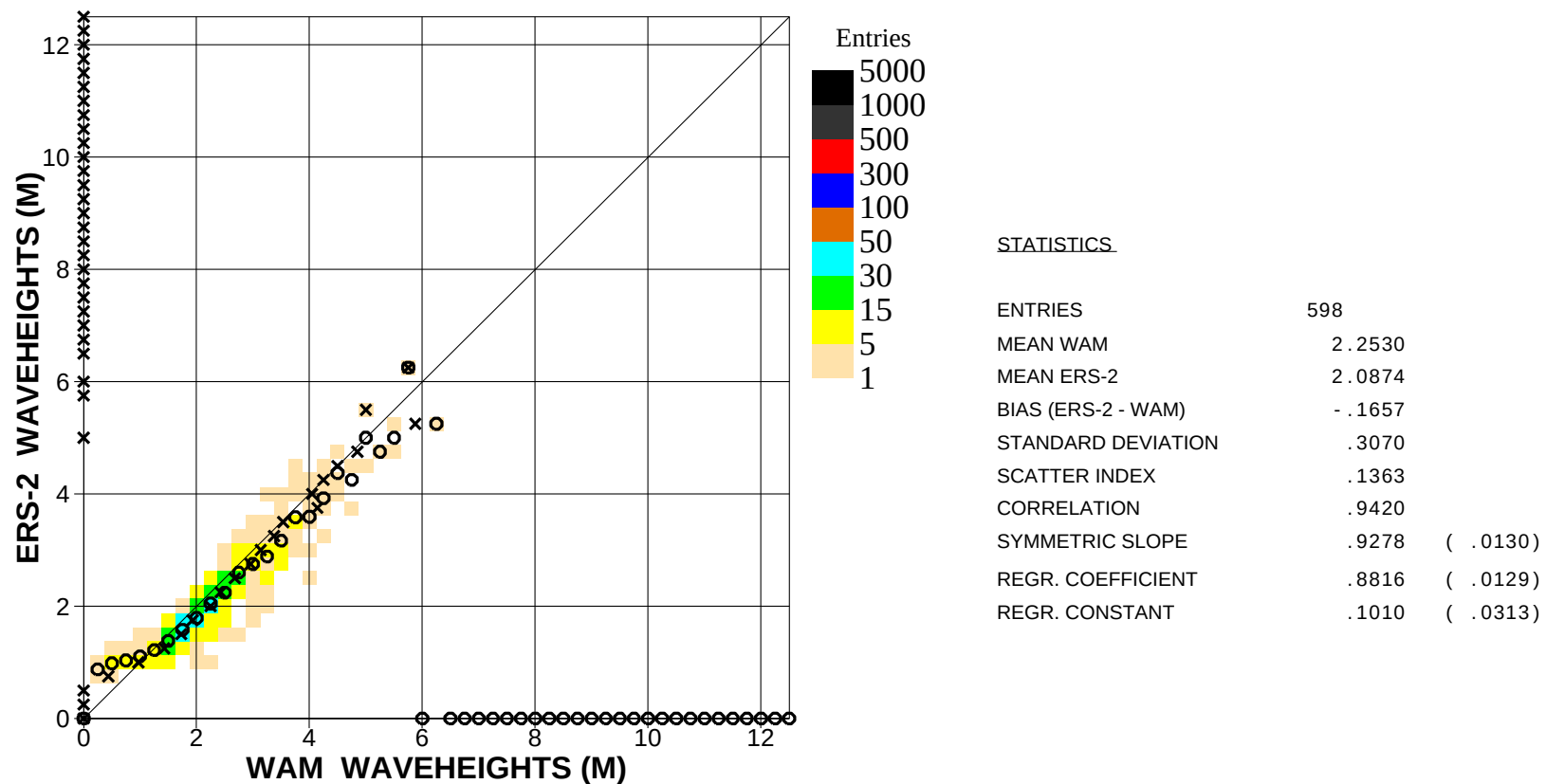


Figure 20. Comparison of ECMWF wave height results with ERS2 Altimeter wave height data for December 2005 (s.hem.)

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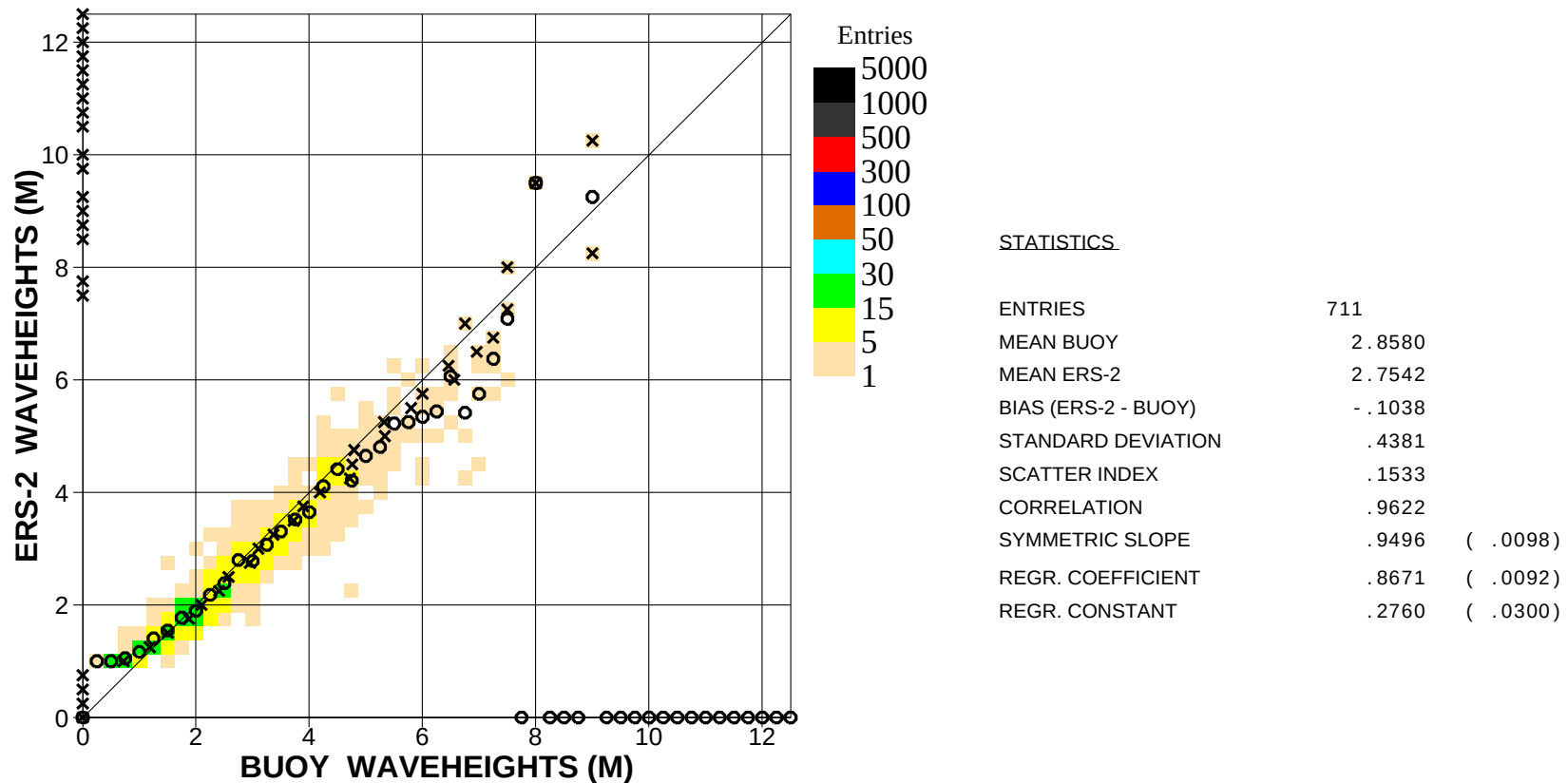


Figure 21. Comparison of buoy wave height observations with ERS2 Altimeter wave height data for December 2005 (global)

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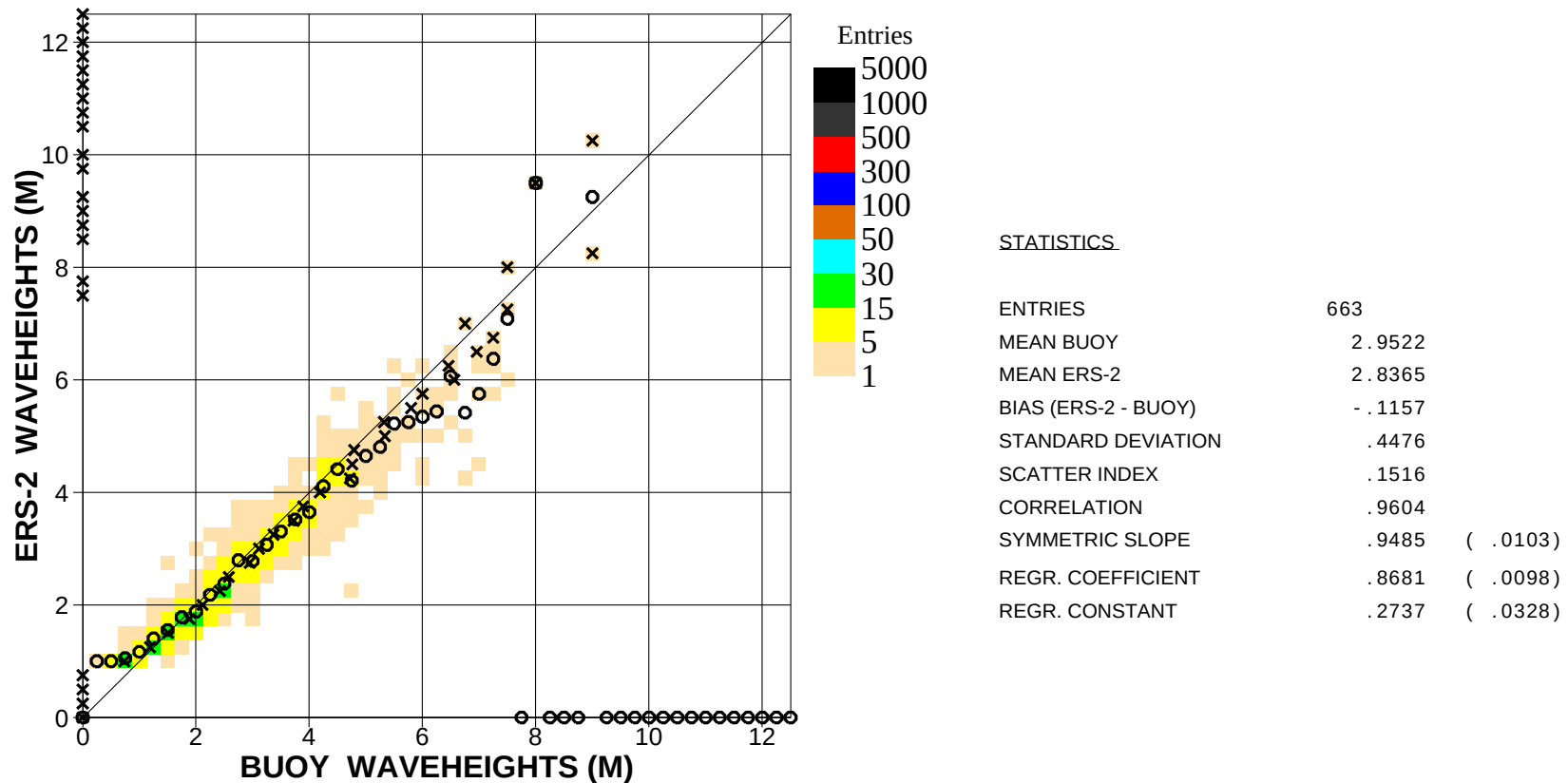


Figure 22. Comparison of buoy wave height observations with ERS2 Altimeter wave height data for December 2005 (n.hem.)

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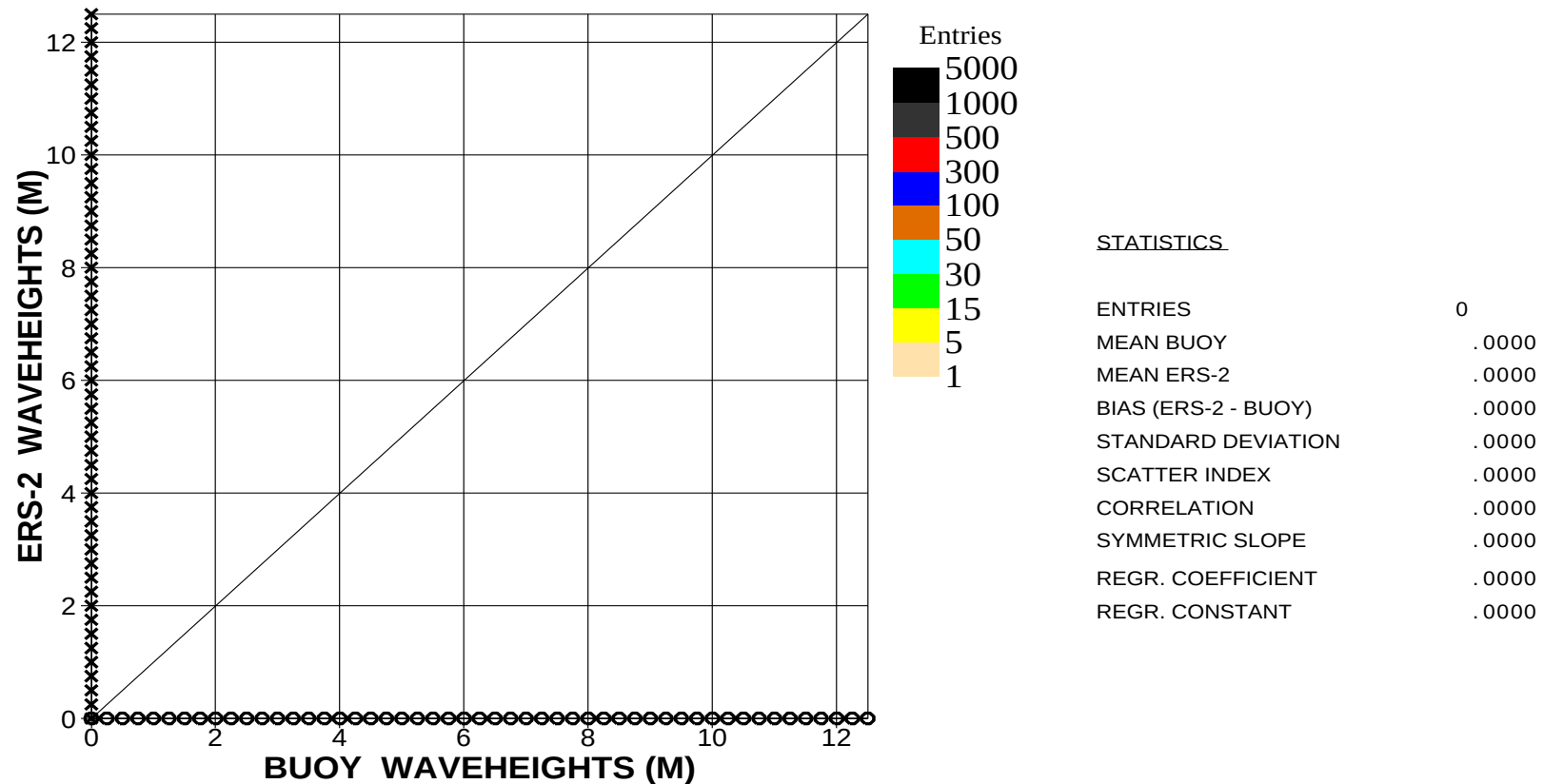


Figure 23. Comparison of buoy wave height observations with ERS2 Altimeter wave height data for December 2005 (hawaii)



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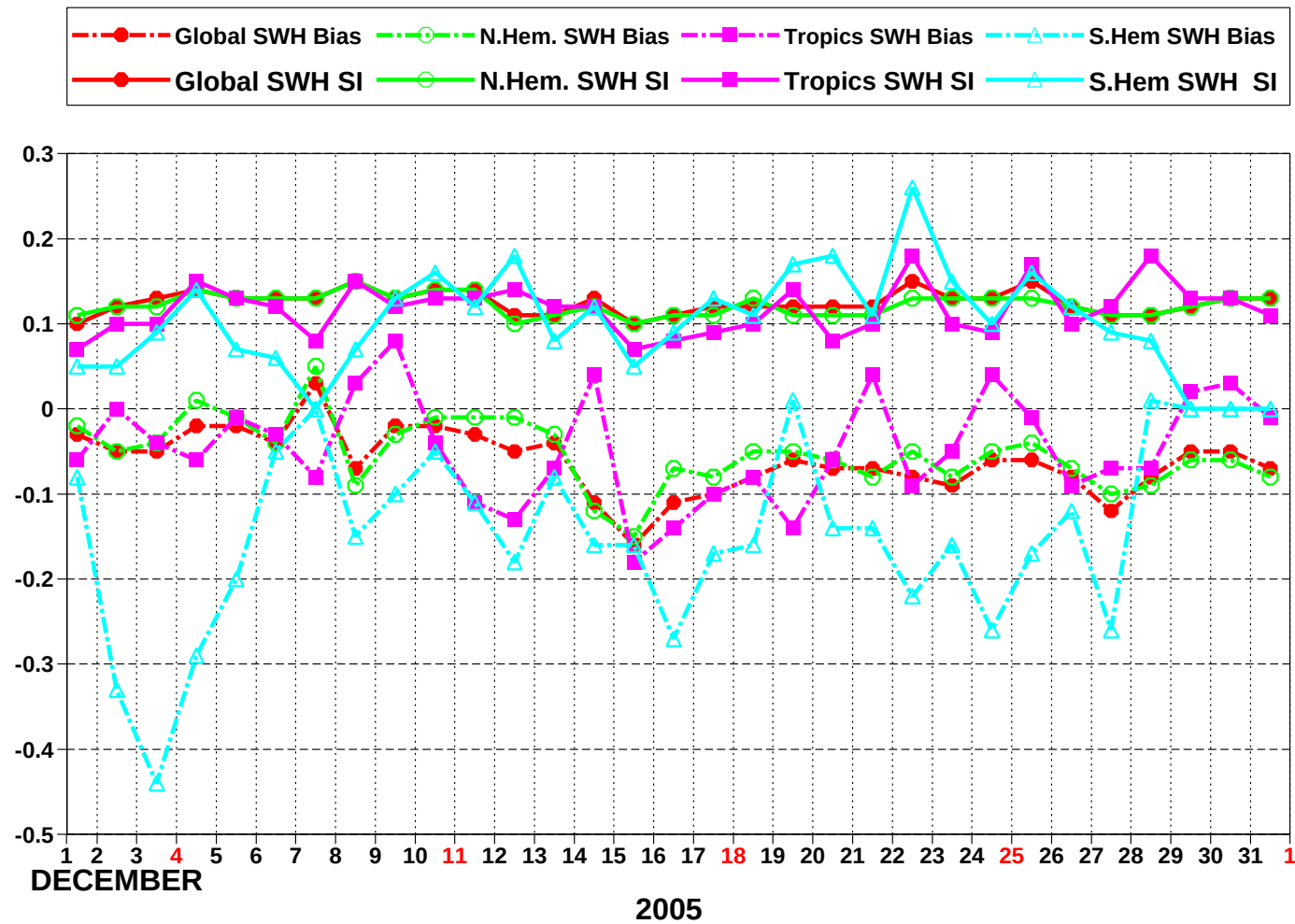


Figure 24: ERS-2 Altimeter wave heights: Timeseries of bias (ERS-2 - model) and scatter index (SI)

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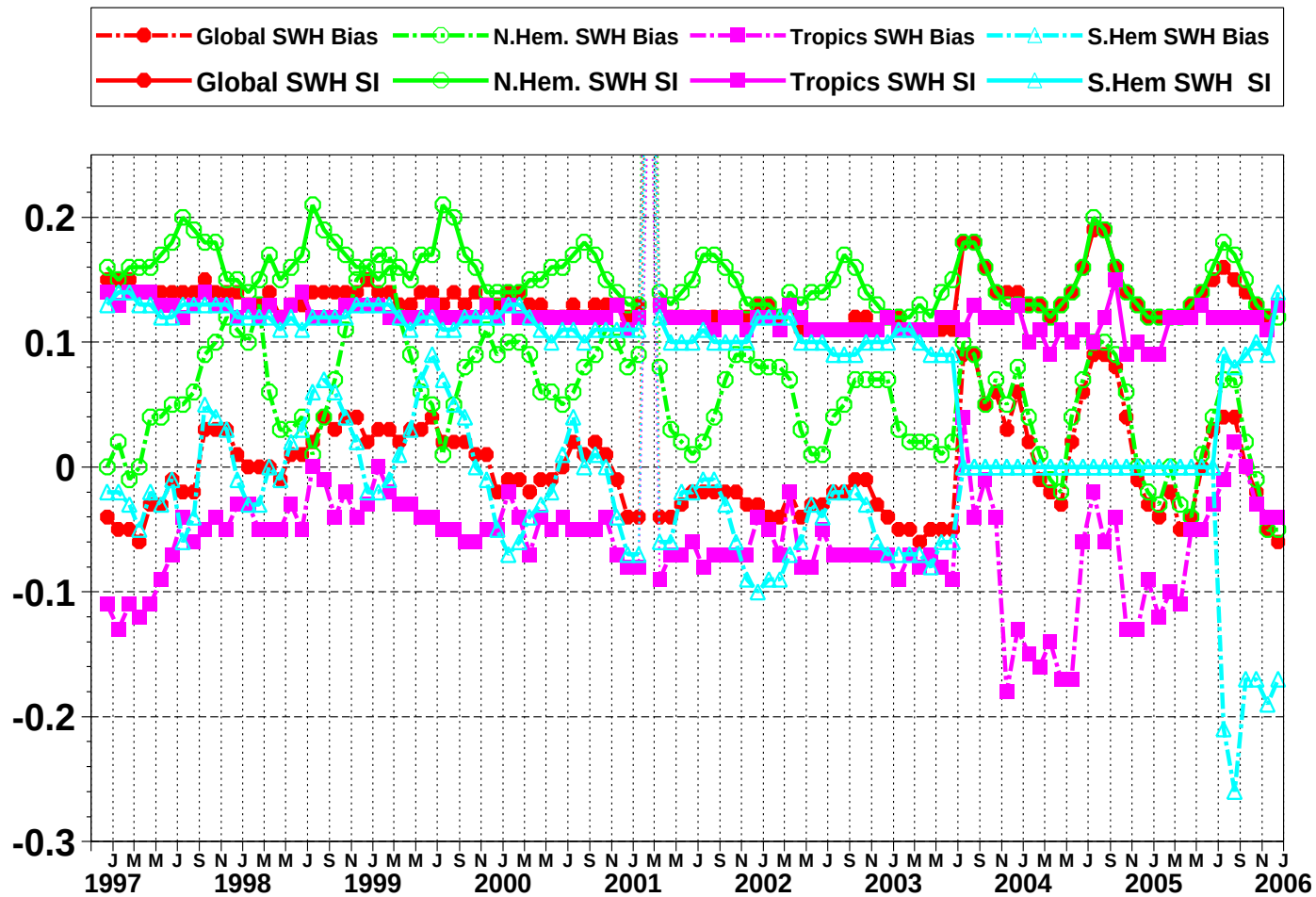


Figure 25: ERS-2 Altimeter wave heights: Timeseries of bias (ERS-2 - model) and scatter index (SI)

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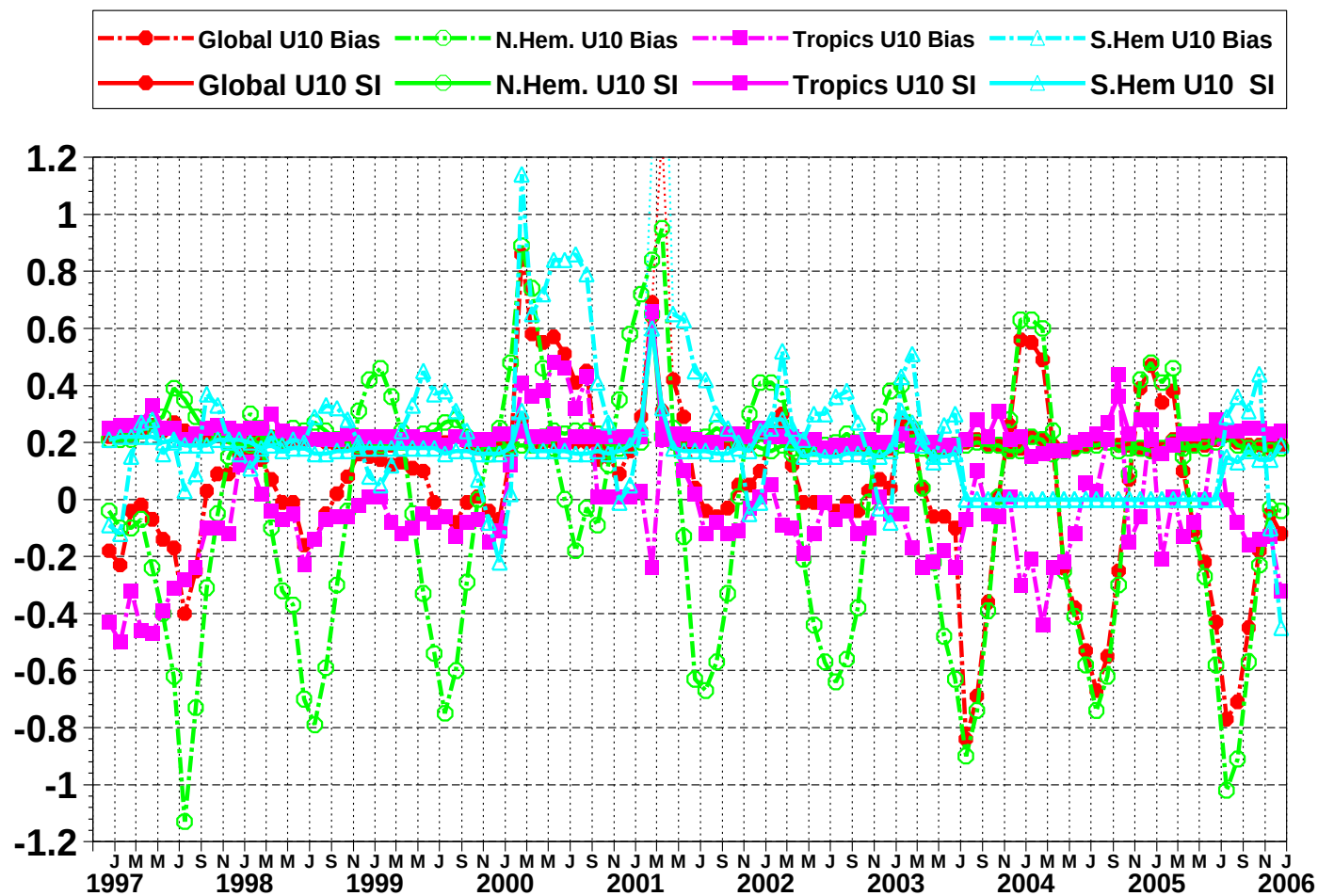


Figure 26: ERS-2 Altimeter wind speeds: Timeseries of bias (ERS-2 - model) and scatter index (SI)

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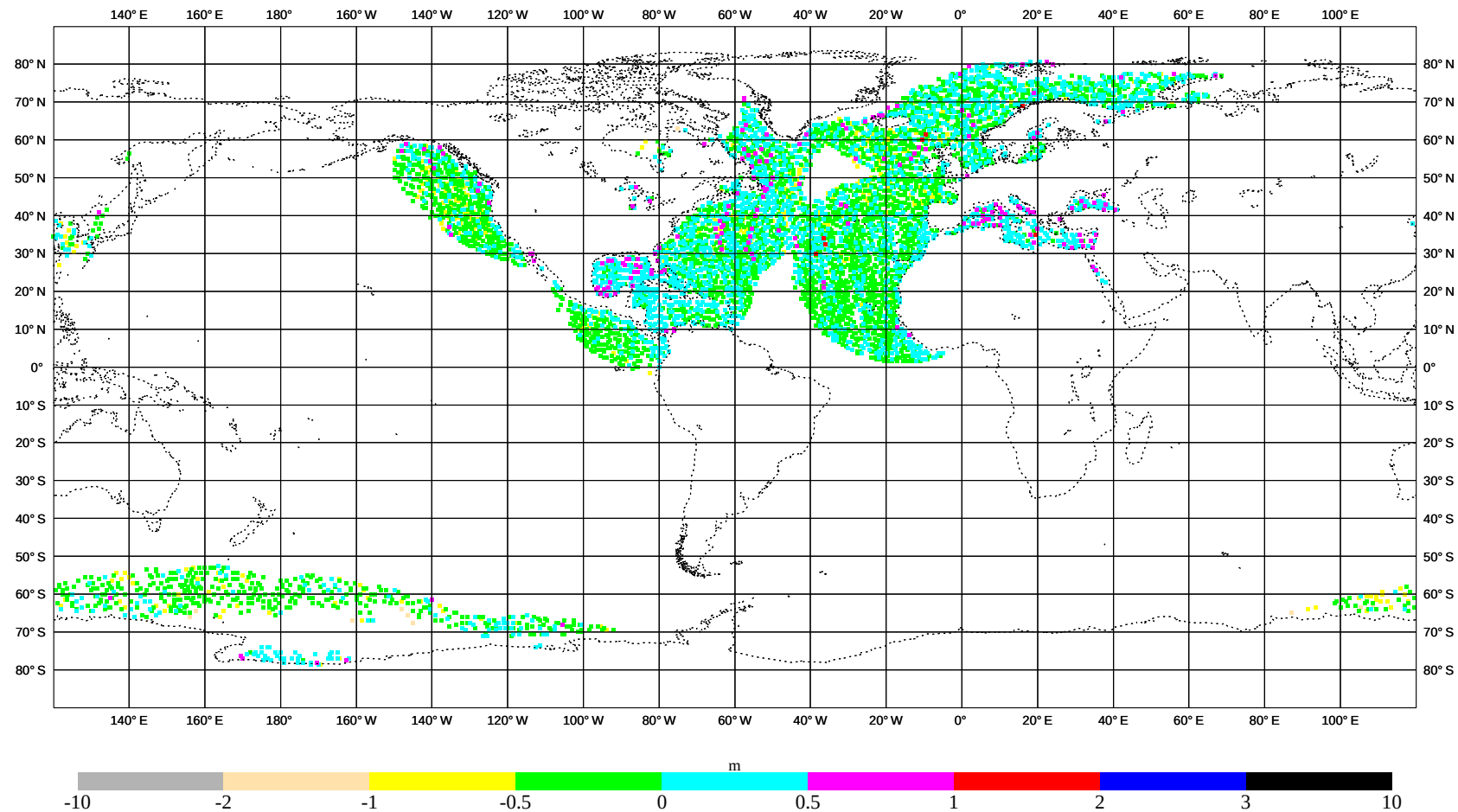


Figure 27: Significant wave height: Monthly mean difference of ERS-2 altimeter data minus wave model results for December 2005.