

■ ECMWF Report on ERS-2 RA for December 2010 ■

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

By: Saleh Abdalla

Date: 26 January 2011

Overview:

Based on the data received at ECMWF during the whole month, on average, 3446 observations arrived at ECMWF every 6 hours of which 73.03% passed the quality control. As can be seen in Figure 1, there was no data during the 6-hour time windows centred at 00:00 UTC on the 25th of the month.

The current data coverage includes: the North Atlantic, the western coast of North America, the eastern and southeastern coasts of Asia, the Southern Ocean and around South Africa (recently no data arrived from this station) as can be seen in Figure 27. The quality of the received data is as good as usual.

Backscatter:

ERS-2 $\langle \sigma_0 \rangle = 10.90$ dB (with a main peak at 11.1 dB).

Wind Speed Comparison with ECMWF wind speeds (bias):

ERS-2 global: +0.30 m/s

ERS-2 northern hemisphere: +0.37 m/s

ERS-2 tropics: +0.13 m/s

ERS-2 southern hemisphere: +1.56 m/s



■ ECMWF Report on ERS-2 RA for December 2010 ■

Wind Speed Comparison with buoy wind speeds (bias):

ERS-2 global: +0.09 m/s

ERS-2 northern hemisphere: +0.18 m/s

ERS-2 tropics (Hawaii): *missing*

Wave Height Comparison with ECMWF wave heights (bias):

ERS-2 global: -0.10 m (lowest waves measured: 0.6 m)

ERS-2 northern hemisphere: -0.16 m

ERS-2 tropics: +0.03 m

ERS-2 southern hemisphere: -0.10 m

Wave Height Comparison with buoy wave heights (bias):

ERS-2 global: -0.12 m

ERS-2 northern hemisphere: -0.15 m

ERS-2 tropics (Hawaii): *missing*

Remarks:

- The quality of Altimeter data, both wind speed and significant wave height, is nominal.
- There is a number of outliers in the comparison against buoy data (Figures 21 and 22). The outliers are mainly due to some buoy problems.



Saleh Abdalla

European Centre for Medium Range Weather Forecasts

Shinfield Park, Reading, Berkshire RG2 9AX, England

Telephone: U.K. (0118) 949 9703, International (+44 118) 949 9703

Telex 984 7908 ECMWF G, Telefax (0118) 986 9450, e-mail: abdalla@ecmwf.int

■ ECMWF Report on ERS-2 RA for December 2010 ■

- Note that the large fluctuations in the Southern Hemispheric (and Tropical) bias in Figures 13 and 24 are basically due to the limited number of daily measurements.
- 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, the Southern Ocean since 4 July 2005, the north eastern parts of the Indian Ocean since 19 October 2006 and around South Africa since 23 May 2008 (no data was received recently from this station). 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 RA-2 Ku-band significant wave height and ASAR Wave Mode Level 1b data as well as Jason-1 (blacklisted since the 1st of April 2010) and Jason-2 altimeter significant wave height data are assimilated in the ECMWF wave model.
- **ENVISAT RA-2 Ku-Band SWH and ASAR Wave Mode Level 1b products have been, temporarily, blacklisted in the ECMWF model since the late hours of the 21st of October 2010. This was a precautionary measure to ensure that the data quality after the orbit shift is as good as before. After it was clear that this is really the case, the RA-2 SWH was white-listed on the 2nd of December 2010. The ASAR WM product is still blacklisted due to the planned changes in configuration.**
- The ECMWF models were not changed during this month. The current operational IFS cycle is CY36R4 (since the 9th of November 2010).

■
Saleh Abdalla

European Centre for Medium Range Weather Forecasts
Shinfield Park, Reading, Berkshire RG2 9AX, England
Telephone: U.K. (0118) 949 9703, International (+44 118) 949 9703
Telex 984 7908 ECMWF G, Telefax (0118) 986 9450, e-mail: abdalla@ecmwf.int

■ ECMWF Report on ERS-2 RA for December 2010 ■

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.

Figure captions:

Figure 1: Time series of data reception for ERS-2 Altimeter data for December 2010.

Figure 2: Distribution of the ERS-2 Altimeter Backscatter after QC for December 2010.

Figure 3: Distribution of the ERS-2 Altimeter wind speeds after QC for December 2010.

Figure 4: Distribution of the ERS-2 Altimeter wind speeds after along track averaging for December 2010.

Figure 5: Global distribution of ECMWF ocean surface wind speeds for December 2010.

Figure 6: Comparison of ECMWF wind speed results with ERS-2 Altimeter wind speed data for December 2010 (global).

Figure 7: Comparison of ECMWF wind speed results with ERS-2 Altimeter wind speed data for December 2010 (northern hemisphere)



■ ECMWF Report on ERS-2 RA for December 2010 ■

- Figure 8: Comparison of ECMWF wind speed results with ERS-2 Altimeter wind speed data for December 2010 (tropics)
- Figure 9: Comparison of ECMWF wind speed results with ERS-2 Altimeter wind speed data for December 2010 (southern hemisphere)
- Figure 10: Comparison of buoy wind speed observations with ERS-2 Altimeter wind speed data for December 2010 (global).
- Figure 11: Comparison of buoy wind speed observations with ERS-2 Altimeter wind speed data for December 2010 (northern hemisphere).
- Figure 12: Comparison of buoy wind speed observations with ERS-2 Altimeter wind speed data for December 2010 (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 2010.
- Figure 15: Distribution of the ERS-2 Altimeter wave heights after along track averaging for December 2010.
- Figure 16: Global distribution of ECMWF wave heights for December 2010.
- Figure 17: Comparison of ECMWF wave height results with ERS-2 Altimeter wave height data for December 2010 (global).
- Figure 18: Comparison of ECMWF wave height results with ERS-2 Altimeter wave height data for December 2010 (northern hemisphere)
- Figure 19: Comparison of ECMWF wave height results with ERS-2 Altimeter wave height data for December 2010 (tropics)
- Figure 20: Comparison of ECMWF wave height results with ERS-2 Altimeter wave height data for December 2010 (southern hemisphere)
- Figure 21: Comparison of buoy wave height observations with ERS-2 Altimeter wave height data for December 2010 (global).
- Figure 22: Comparison of buoy wave height observations with ERS-2 Altimeter wave height data for December 2010 (northern hemisphere).
- Figure 23: Comparison of buoy wave height observations with ERS-2 Altimeter wave height data for December 2010 (hawaii).
- Figure 24: ERS-2 Altimeter wave heights: Timeseries of bias (ERS-2 - model) and scatter index (SI) for December 2010.
- Figure 25: ERS-2 Altimeter wave heights: Timeseries of bias (ERS-2 - model) and scatter index (SI) from December 1996 to December 2010.
- Figure 26: ERS-2 Altimeter wind speeds: Timeseries of bias (ERS-2 - model) and scatter index (SI) from December 1996 to December 2010.
- Figure 27: Significant wave height: Monthly mean difference of ERS-2 altimeter data minus wave model results for December 2010.

■
Saleh Abdalla

European Centre for Medium Range Weather Forecasts
Shinfield Park, Reading, Berkshire RG2 9AX, England
Telephone: U.K. (0118) 949 9703, International (+44 118) 949 9703
Telex 984 7908 ECMWF G, Telefax (0118) 986 9450, e-mail: abdalla@ecmwf.int

■ ECMWF Report on ERS-2 RA for December 2010 ■

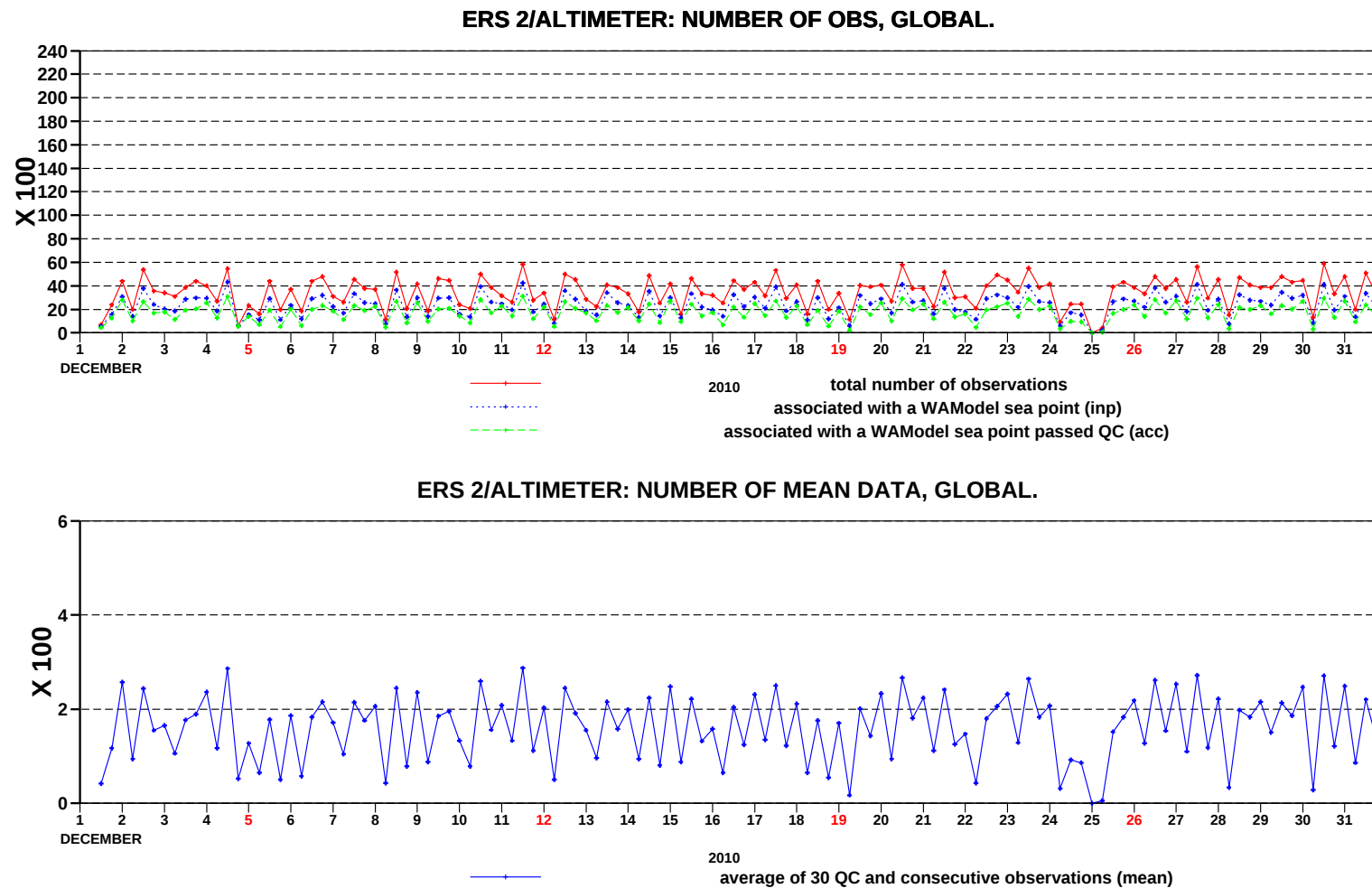


Figure 1: Time series of data reception for ERS-2 Altimeter data for December 2010

■ ECMWF Report on ERS-2 RA for December 2010 ■

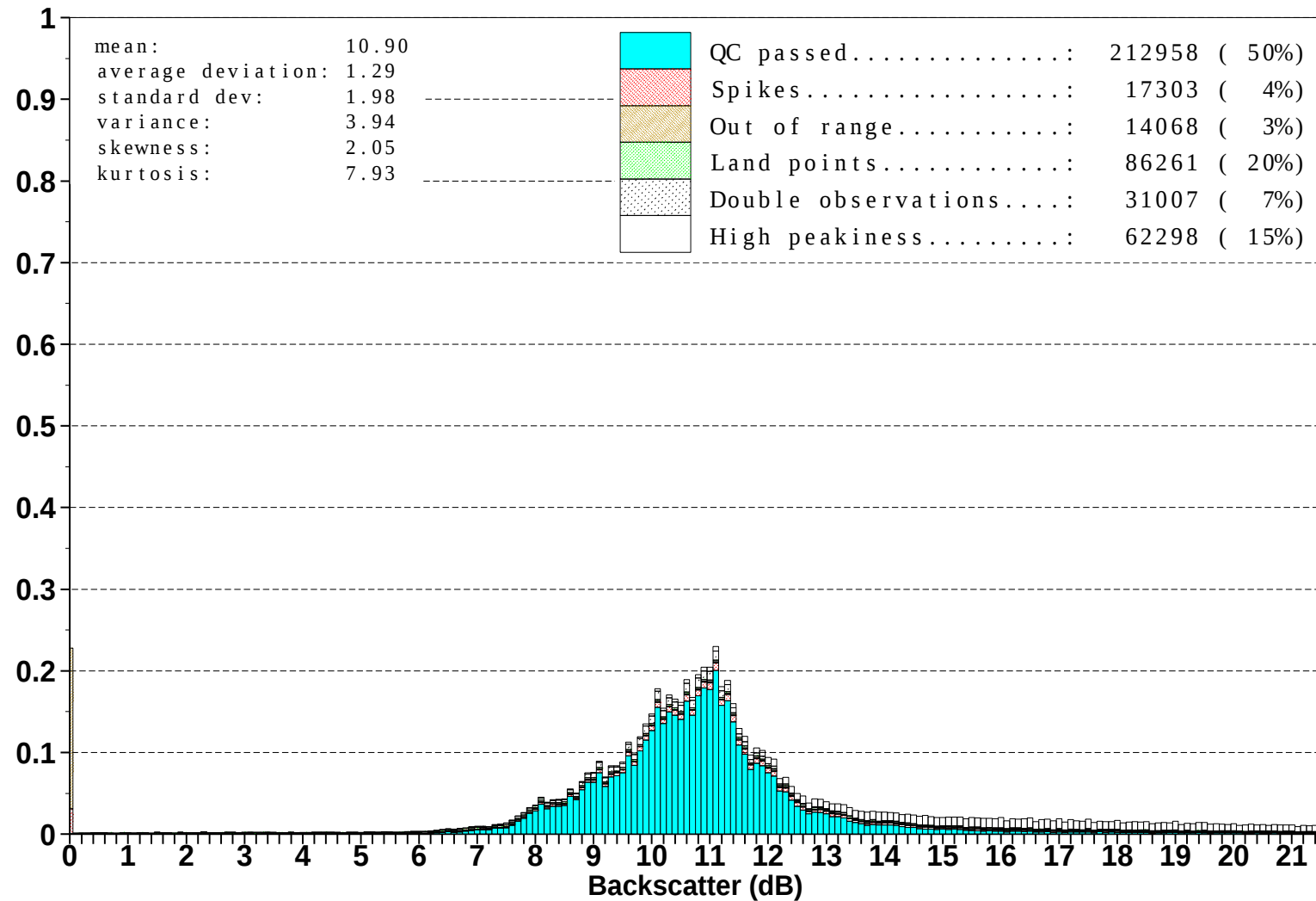


Figure 2: Distribution of the ERS-2 Altimeter backscatter after QC for December 2010

■
Saleh Abdalla

European Centre for Medium Range Weather Forecasts
Shinfield Park, Reading, Berkshire RG2 9AX, England
Telephone: U.K. (0118) 949 9703, International (+44 118) 949 9703
Telex 984 7908 ECMWF G, Telefax (0118) 986 9450, e-mail: abdalla@ecmwf.int

■ ECMWF Report on ERS-2 RA for December 2010 ■

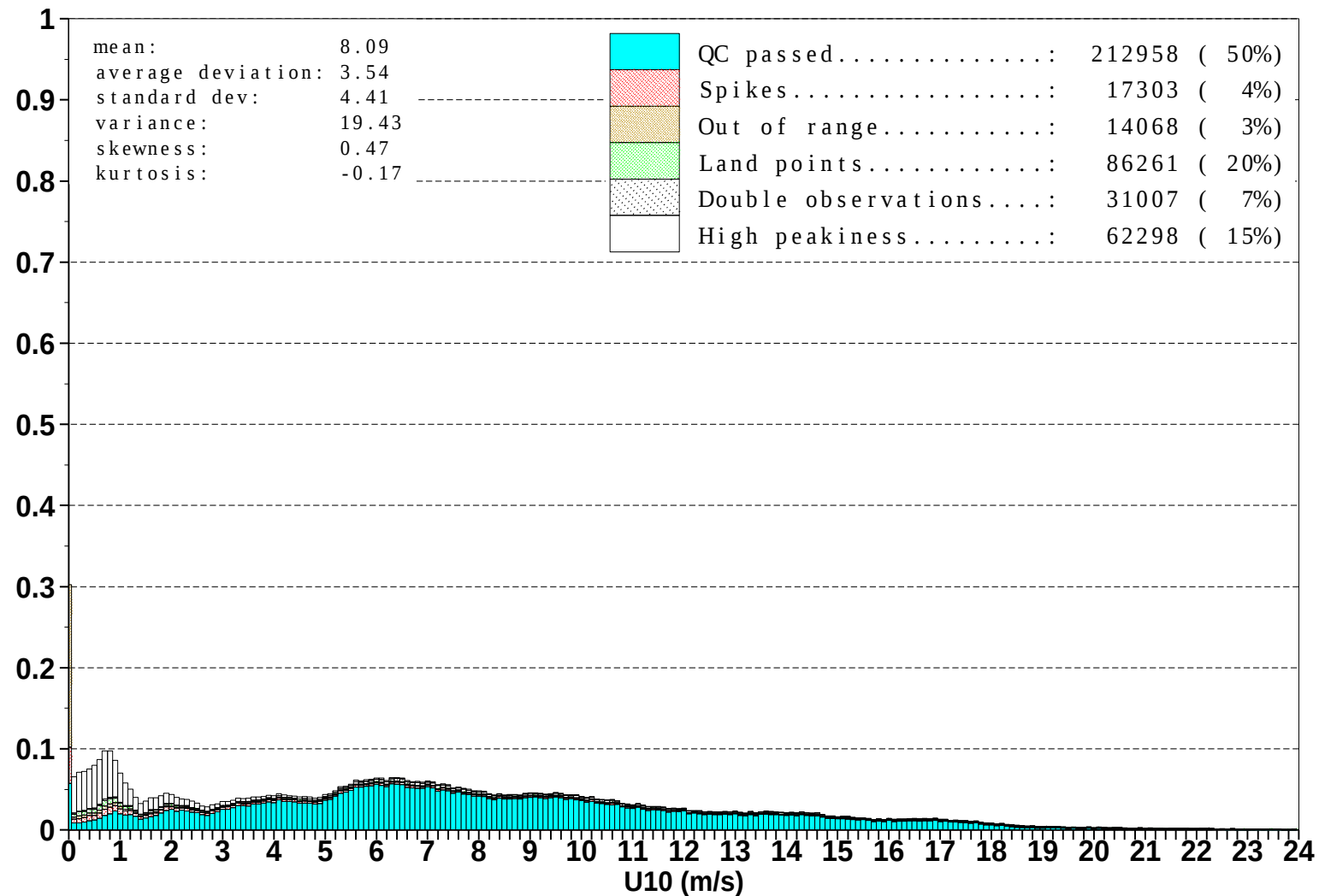


Figure 3: Distribution of the ERS-2 Altimeter wind speeds after QC for December 2010

■
Saleh Abdalla

European Centre for Medium Range Weather Forecasts
Shinfield Park, Reading, Berkshire RG2 9AX, England
Telephone: U.K. (0118) 949 9703, International (+44 118) 949 9703
Telex 984 7908 ECMWF G, Telefax (0118) 986 9450, e-mail: abdalla@ecmwf.int

■ ECMWF Report on ERS-2 RA for December 2010 ■

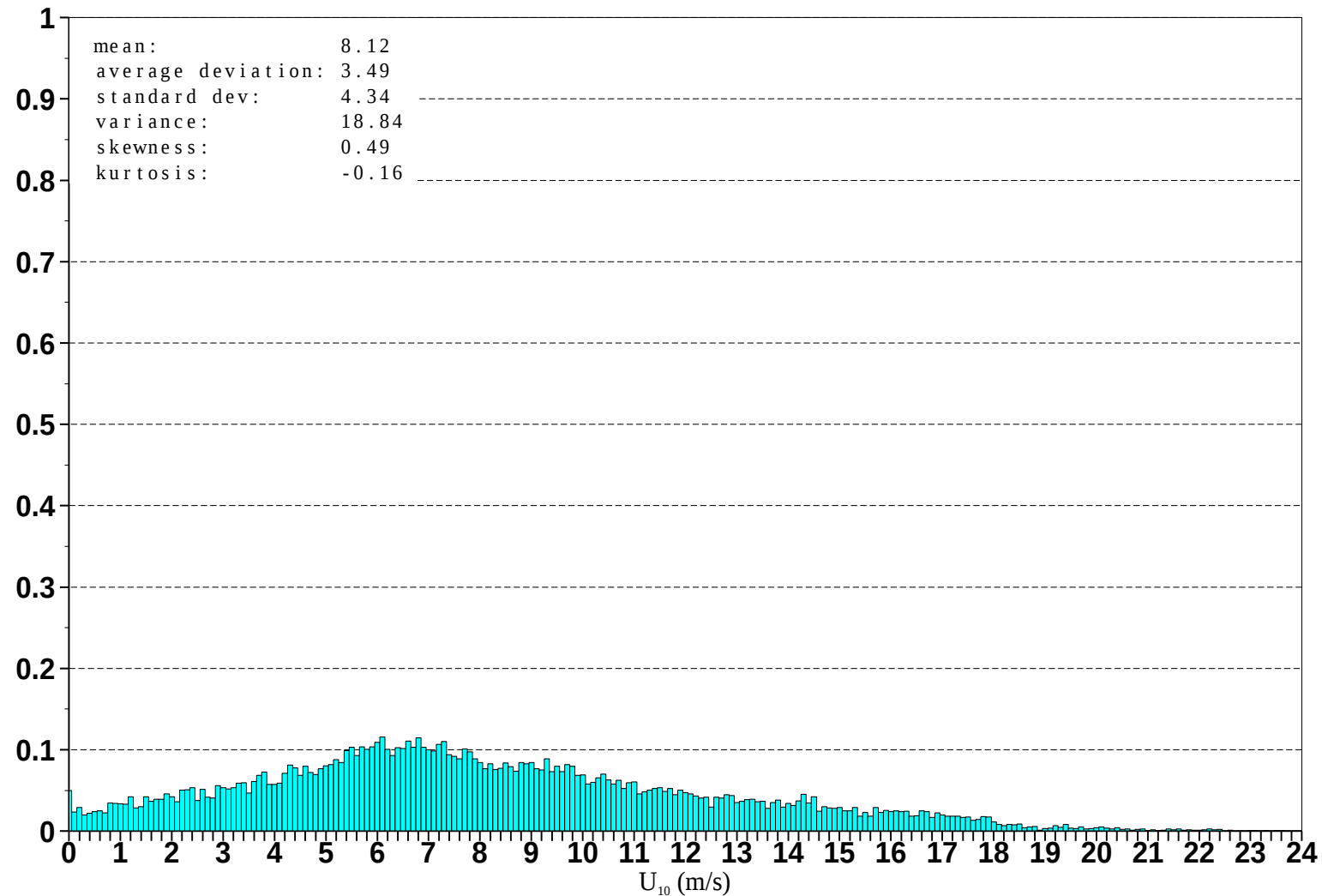


Figure 4: Distribution of ERS-2 Altimeter wind speeds after along track averaging for December 2010

■
 Saleh Abdalla

European Centre for Medium Range Weather Forecasts
 Shinfield Park, Reading, Berkshire RG2 9AX, England
 Telephone: U.K. (0118) 949 9703, International (+44 118) 949 9703
 Telex 984 7908 ECMWF G, Telefax (0118) 986 9450, e-mail: abdalla@ecmwf.int

■ ECMWF Report on ERS-2 RA for December 2010 ■

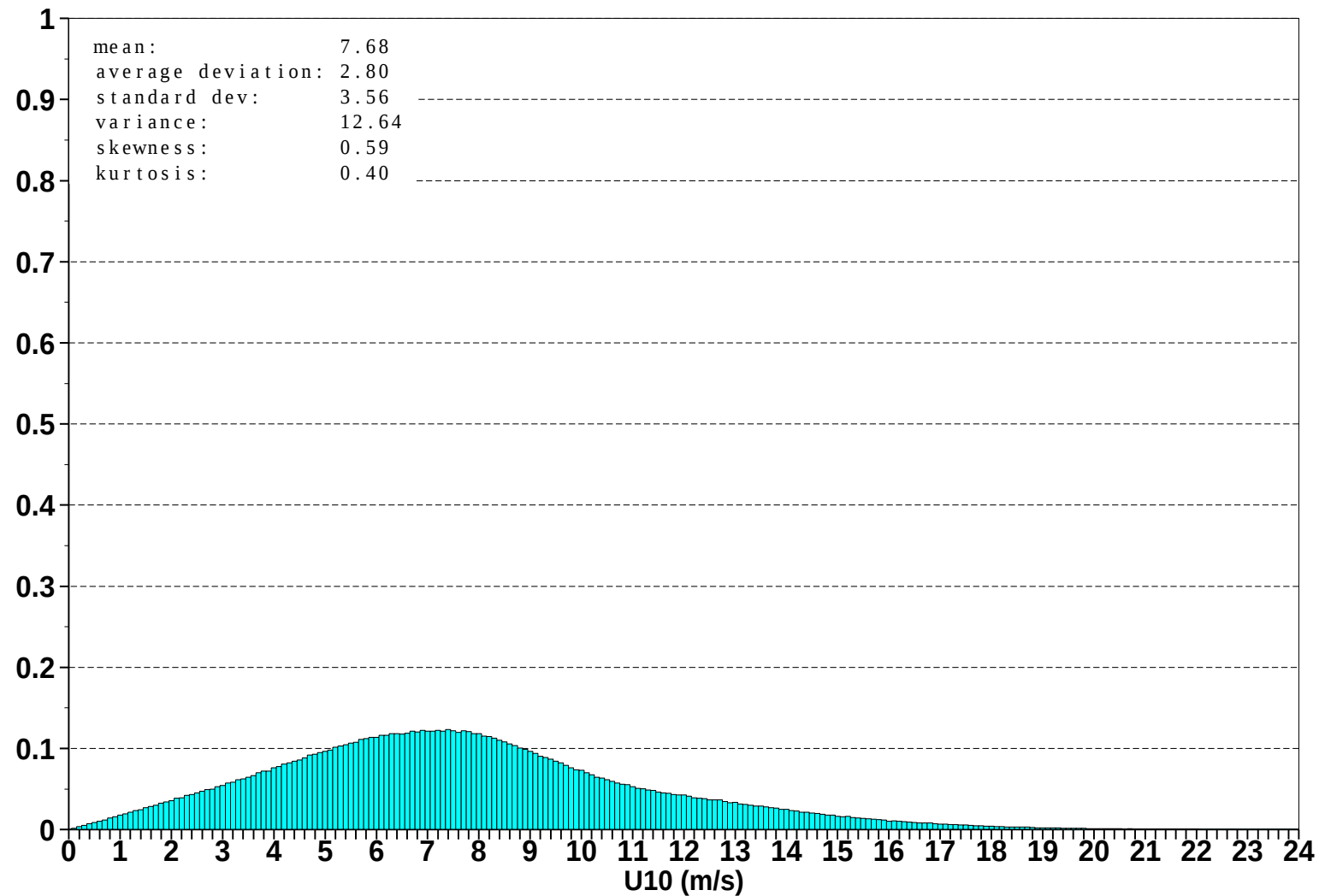


Figure 5: Global distribution of ECMWF ocean surface wind speeds for December 2010

■
Saleh Abdalla

European Centre for Medium Range Weather Forecasts
Shinfield Park, Reading, Berkshire RG2 9AX, England
Telephone: U.K. (0118) 949 9703, International (+44 118) 949 9703
Telex 984 7908 ECMWF G, Telefax (0118) 986 9450, e-mail: abdalla@ecmwf.int

■ ECMWF Report on ERS-2 RA for December 2010 ■

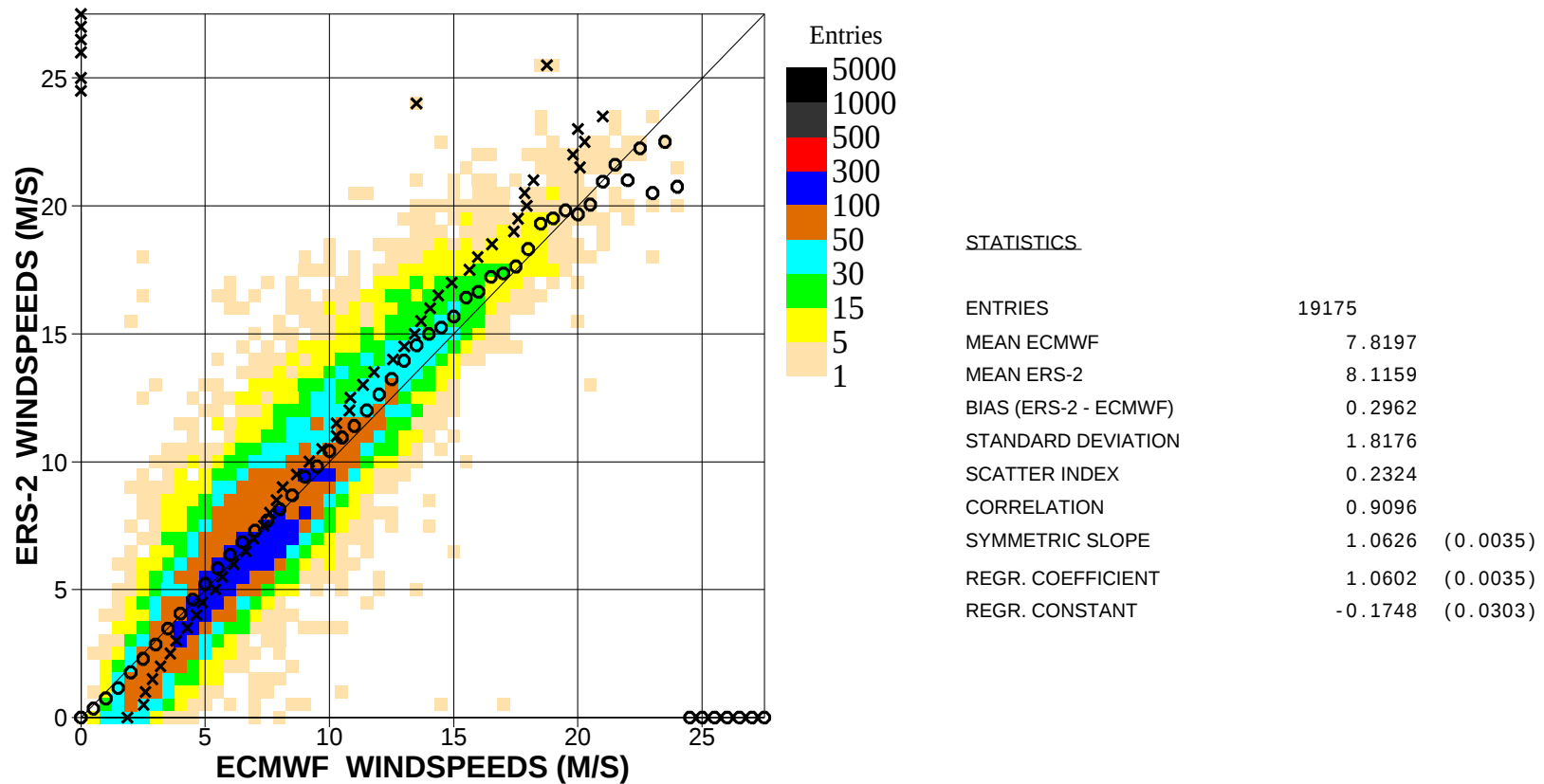


Figure 6. Comparison of ECMWF wind speed results with ERS2 Altimeter wind speed data for December 2010 (global)

■
Saleh Abdalla

European Centre for Medium Range Weather Forecasts
Shinfield Park, Reading, Berkshire RG2 9AX, England
Telephone: U.K. (0118) 949 9703, International (+44 118) 949 9703
Telex 984 7908 ECMWF G, Telefax (0118) 986 9450, e-mail: abdalla@ecmwf.int

■ ECMWF Report on ERS-2 RA for December 2010 ■

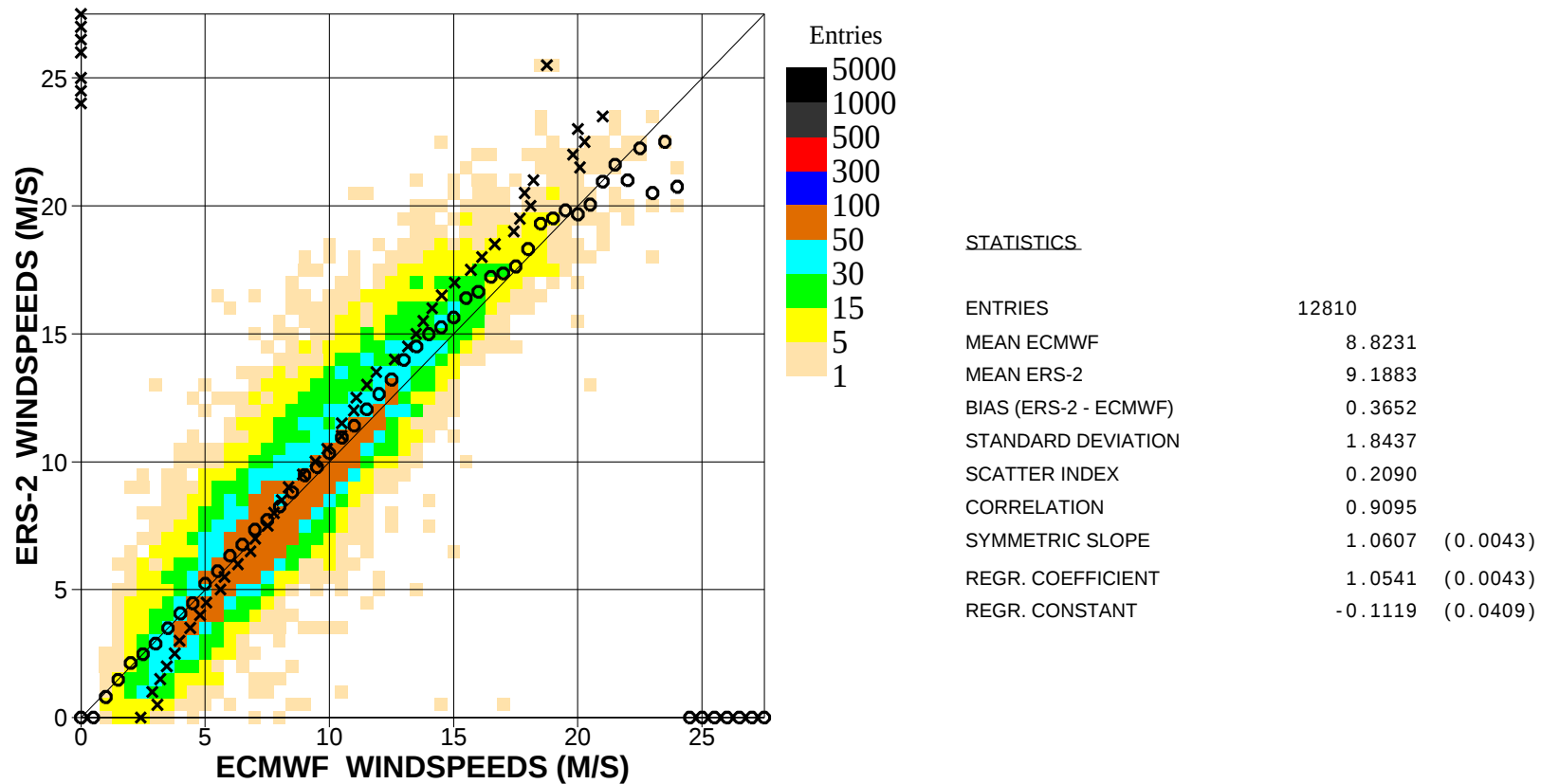


Figure 7. Comparison of ECMWF wind speed results with ERS2 Altimeter wind speed data for December 2010 (n.hem.)

■
Saleh Abdalla

European Centre for Medium Range Weather Forecasts
Shinfield Park, Reading, Berkshire RG2 9AX, England
Telephone: U.K. (0118) 949 9703, International (+44 118) 949 9703
Telex 984 7908 ECMWF G, Telefax (0118) 986 9450, e-mail: abdalla@ecmwf.int

■ ECMWF Report on ERS-2 RA for December 2010 ■

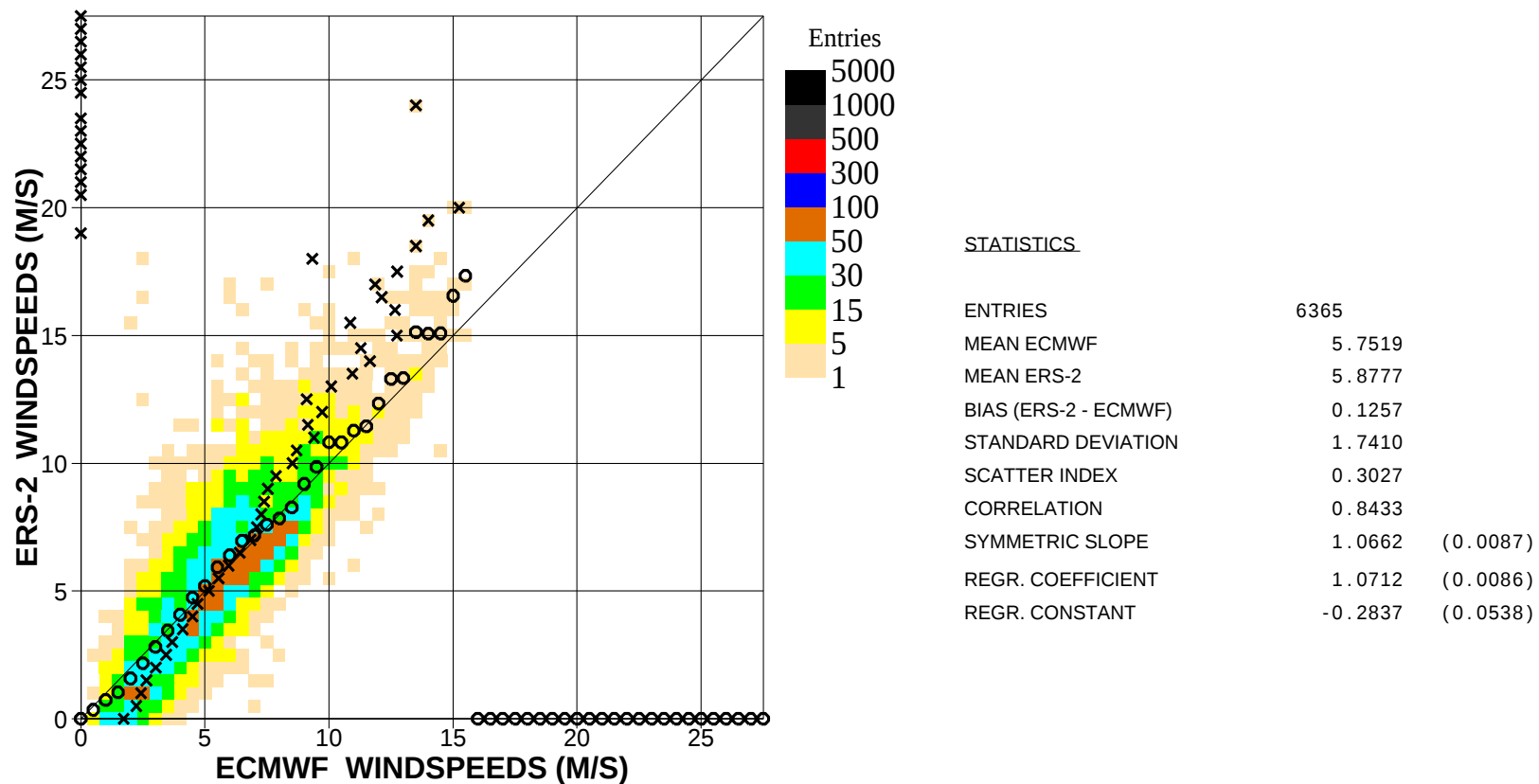


Figure 8. Comparison of ECMWF wind speed results with ERS2 Altimeter wind speed data for December 2010 (tropics)

■
Saleh Abdalla

European Centre for Medium Range Weather Forecasts
Shinfield Park, Reading, Berkshire RG2 9AX, England
Telephone: U.K. (0118) 949 9703, International (+44 118) 949 9703
Telex 984 7908 ECMWF G, Telefax (0118) 986 9450, e-mail: abdalla@ecmwf.int

■ ECMWF Report on ERS-2 RA for December 2010 ■

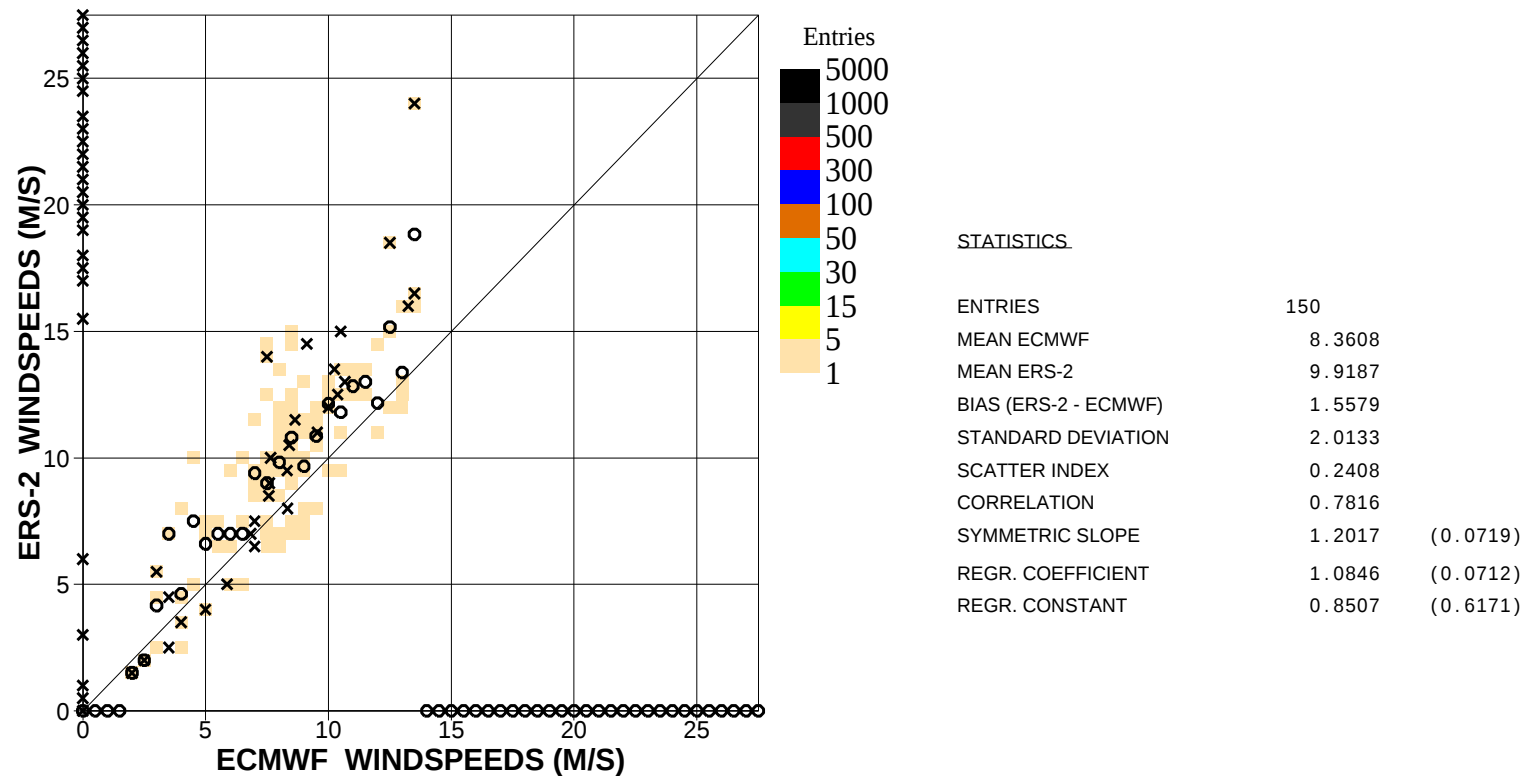


Figure 9. Comparison of ECMWF wind speed results with ERS2 Altimeter wind speed data for December 2010 (s.hem.)

■
Saleh Abdalla

European Centre for Medium Range Weather Forecasts
Shinfield Park, Reading, Berkshire RG2 9AX, England
Telephone: U.K. (0118) 949 9703, International (+44 118) 949 9703
Telex 984 7908 ECMWF G, Telefax (0118) 986 9450, e-mail: abdalla@ecmwf.int

■ ECMWF Report on ERS-2 RA for December 2010 ■

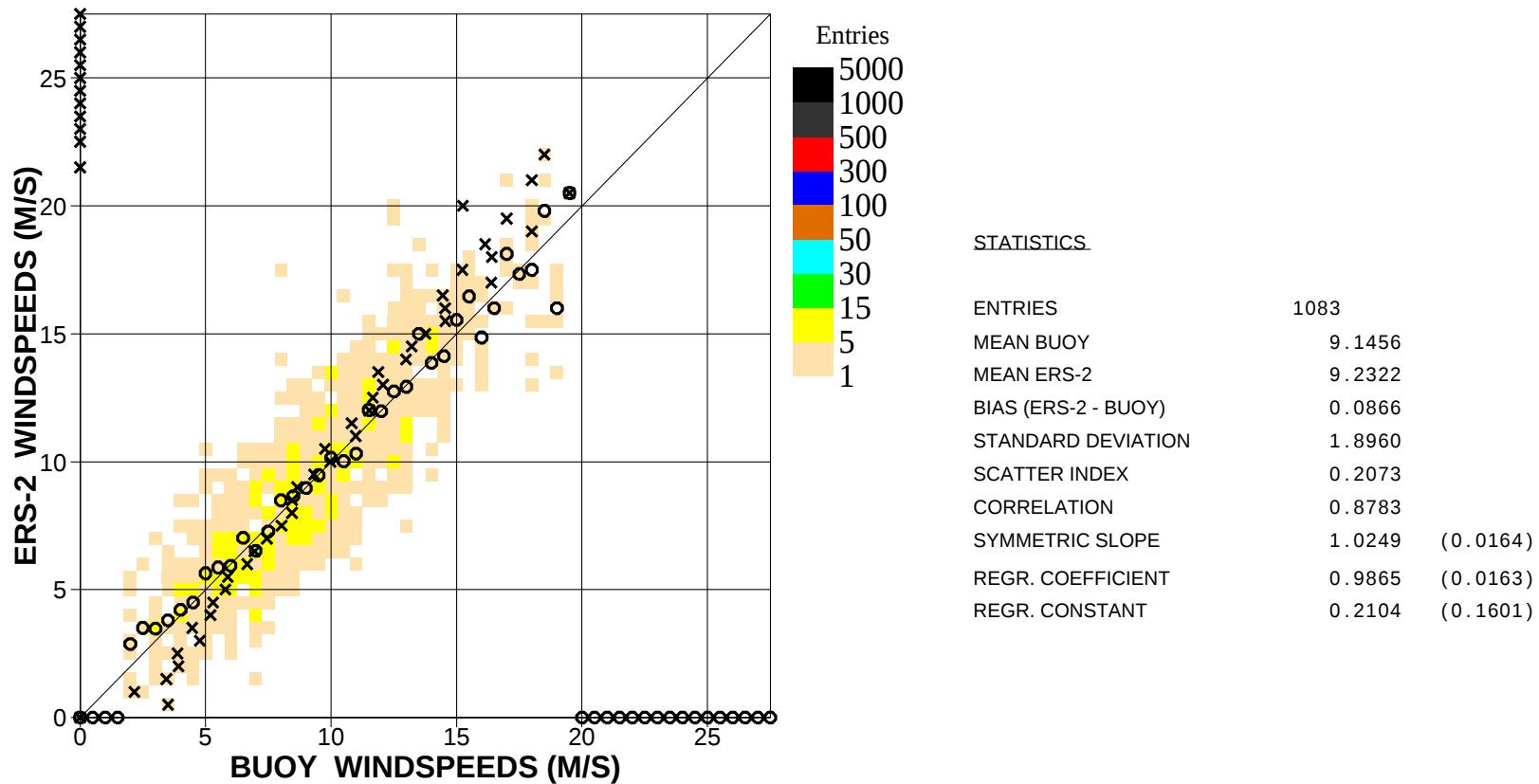


Figure 10. Comparison of buoy wind speed observations with ERS2 Altimeter wind speed data for December 2010 (global)

■
Saleh Abdalla

European Centre for Medium Range Weather Forecasts
Shinfield Park, Reading, Berkshire RG2 9AX, England
Telephone: U.K. (0118) 949 9703, International (+44 118) 949 9703
Telex 984 7908 ECMWF G, Telefax (0118) 986 9450, e-mail: abdalla@ecmwf.int

■ ECMWF Report on ERS-2 RA for December 2010 ■

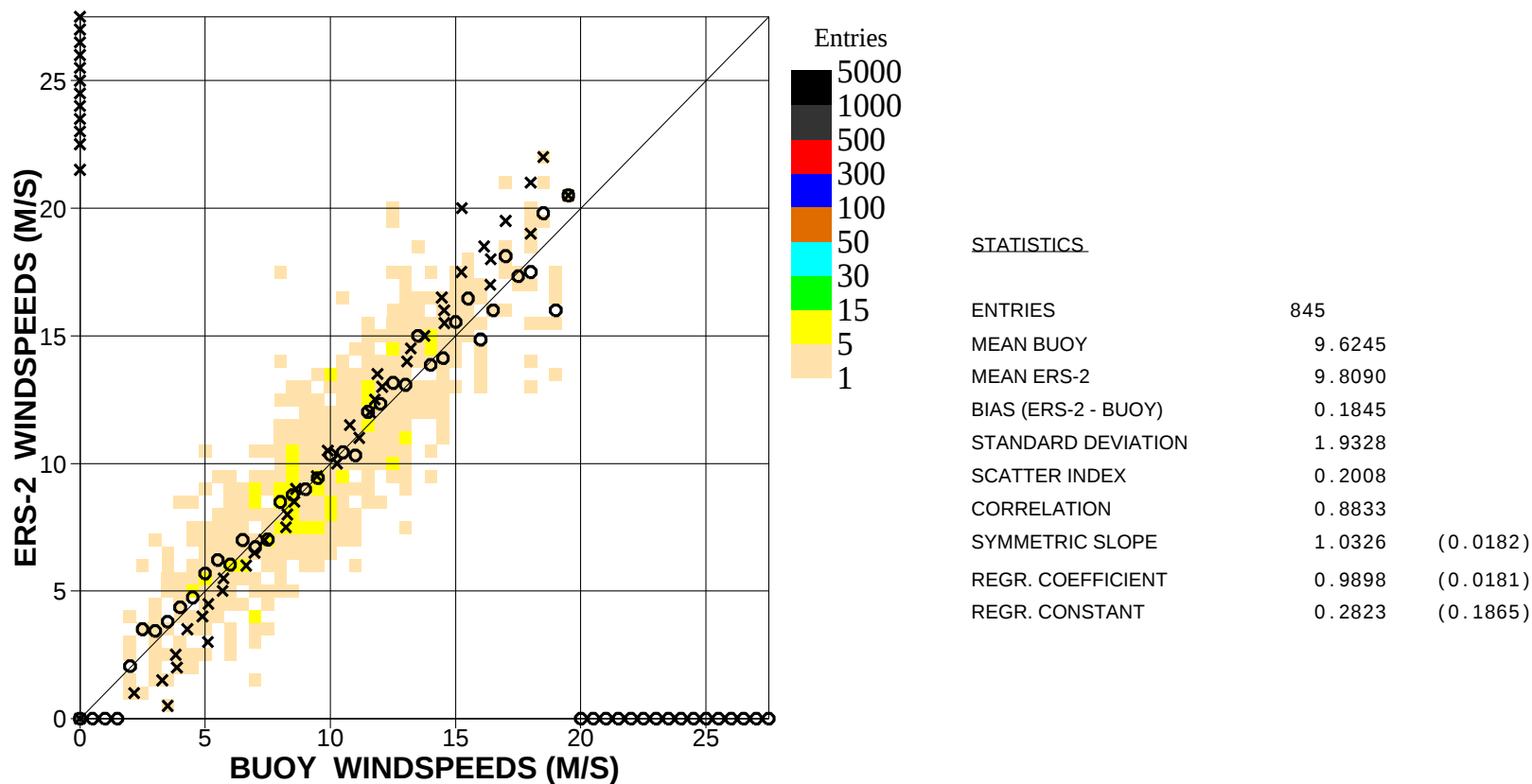


Figure 11. Comparison of buoy wind speed observations with ERS2 Altimeter wind speed data for December 2010 (n.hem.)

■
Saleh Abdalla

European Centre for Medium Range Weather Forecasts
Shinfield Park, Reading, Berkshire RG2 9AX, England
Telephone: U.K. (0118) 949 9703, International (+44 118) 949 9703
Telex 984 7908 ECMWF G, Telefax (0118) 986 9450, e-mail: abdalla@ecmwf.int

■ ECMWF Report on ERS-2 RA for December 2010 ■

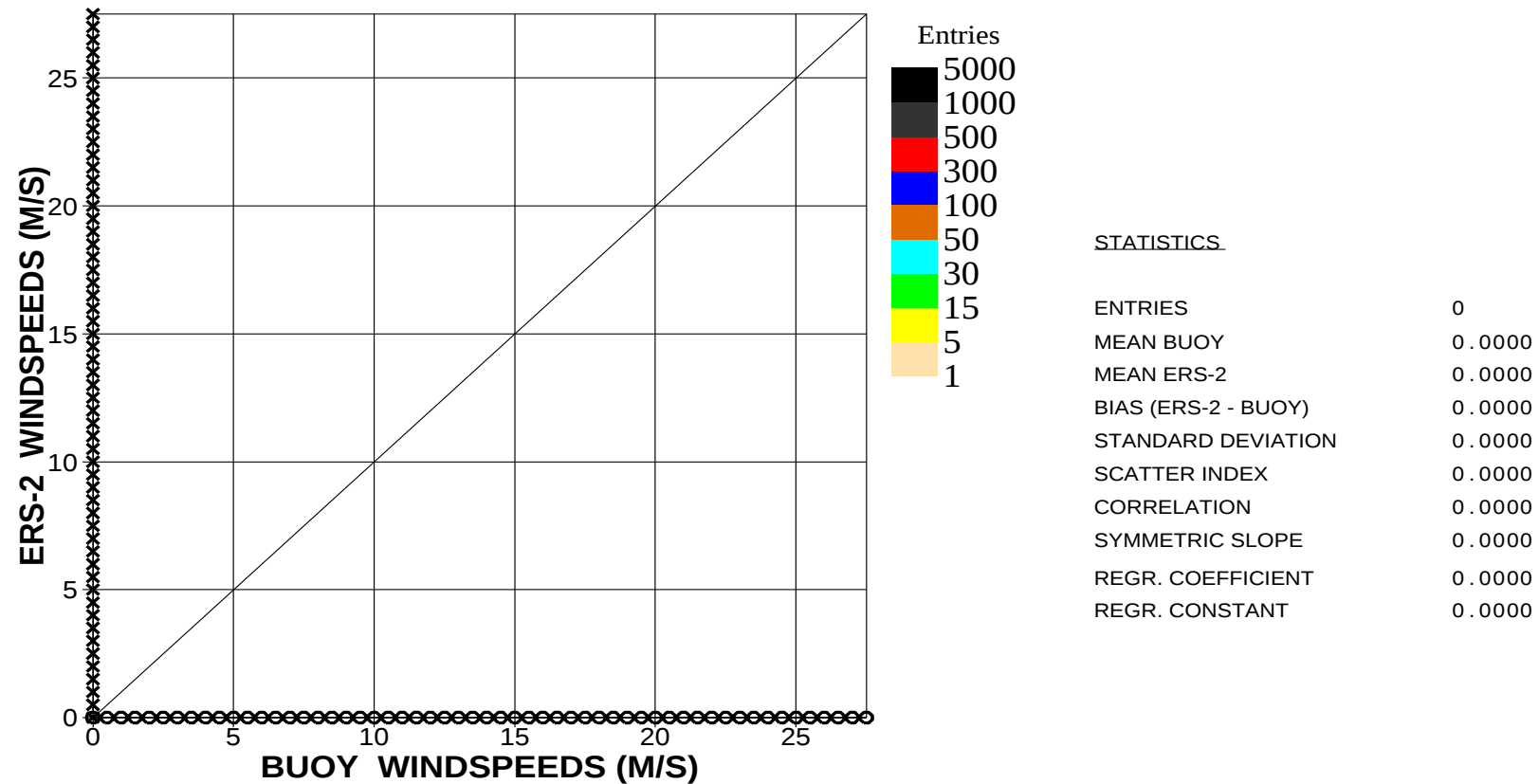


Figure 12. Comparison of buoy wind speed observations with ERS2 Altimeter wind speed data for December 2010 (hawaii)

■
Saleh Abdalla

European Centre for Medium Range Weather Forecasts
Shinfield Park, Reading, Berkshire RG2 9AX, England
Telephone: U.K. (0118) 949 9703, International (+44 118) 949 9703
Telex 984 7908 ECMWF G, Telefax (0118) 986 9450, e-mail: abdalla@ecmwf.int

■ ECMWF Report on ERS-2 RA for December 2010 ■

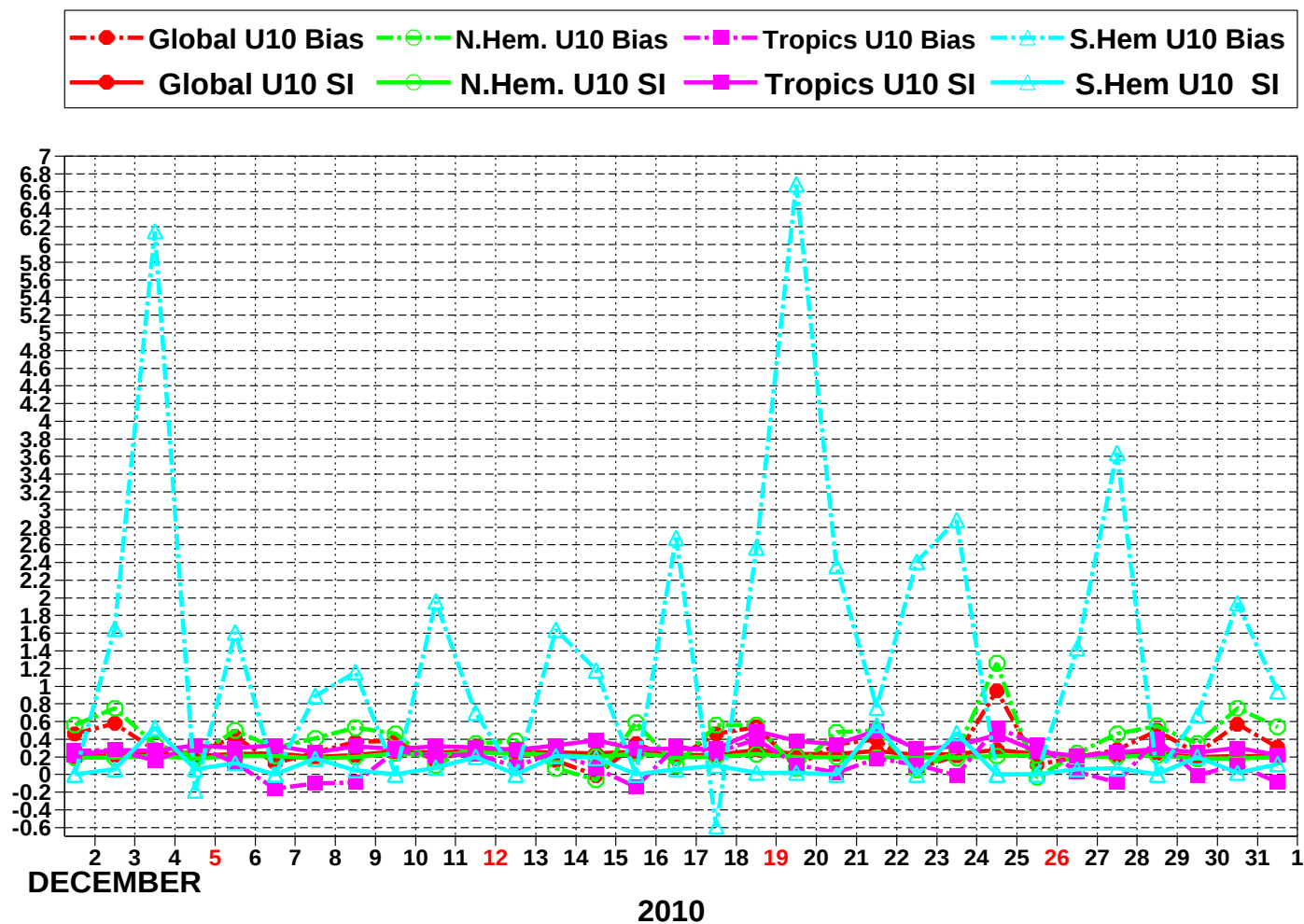


Figure 13: ERS-2 Altimeter wind speeds: Timeseries of bias (ERS-2 - model) and scatter index (SI)

■
Saleh Abdalla

European Centre for Medium Range Weather Forecasts
Shinfield Park, Reading, Berkshire RG2 9AX, England
Telephone: U.K. (0118) 949 9703, International (+44 118) 949 9703
Telex 984 7908 ECMWF G, Telefax (0118) 986 9450, e-mail: abdalla@ecmwf.int

■ ECMWF Report on ERS-2 RA for December 2010 ■

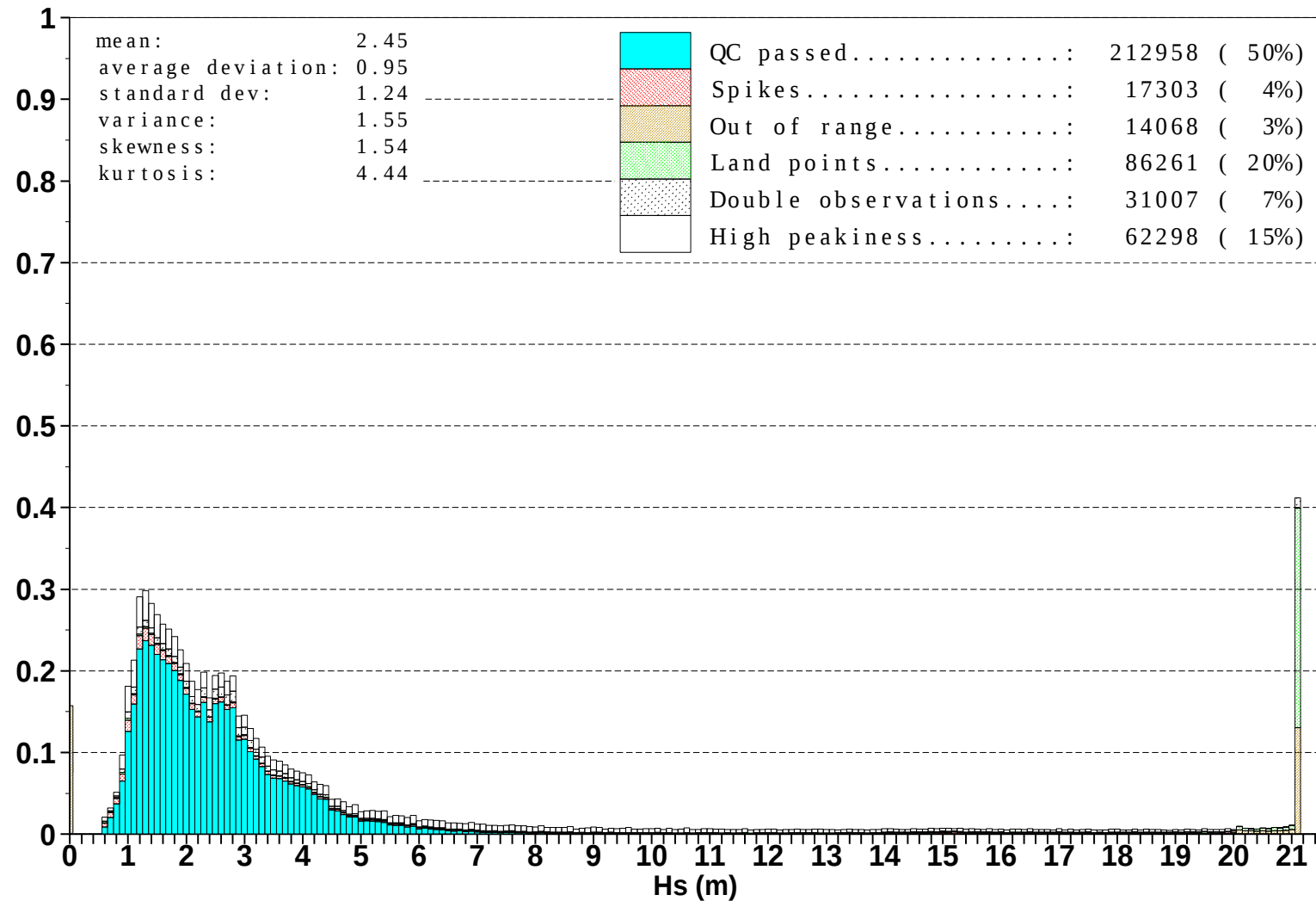


Figure 14: Distribution of the ERS-2 Altimeter wave heights after QC for December 2010

■
Saleh Abdalla

European Centre for Medium Range Weather Forecasts
Shinfield Park, Reading, Berkshire RG2 9AX, England
Telephone: U.K. (0118) 949 9703, International (+44 118) 949 9703
Telex 984 7908 ECMWF G, Telefax (0118) 986 9450, e-mail: abdalla@ecmwf.int

■ ECMWF Report on ERS-2 RA for December 2010 ■

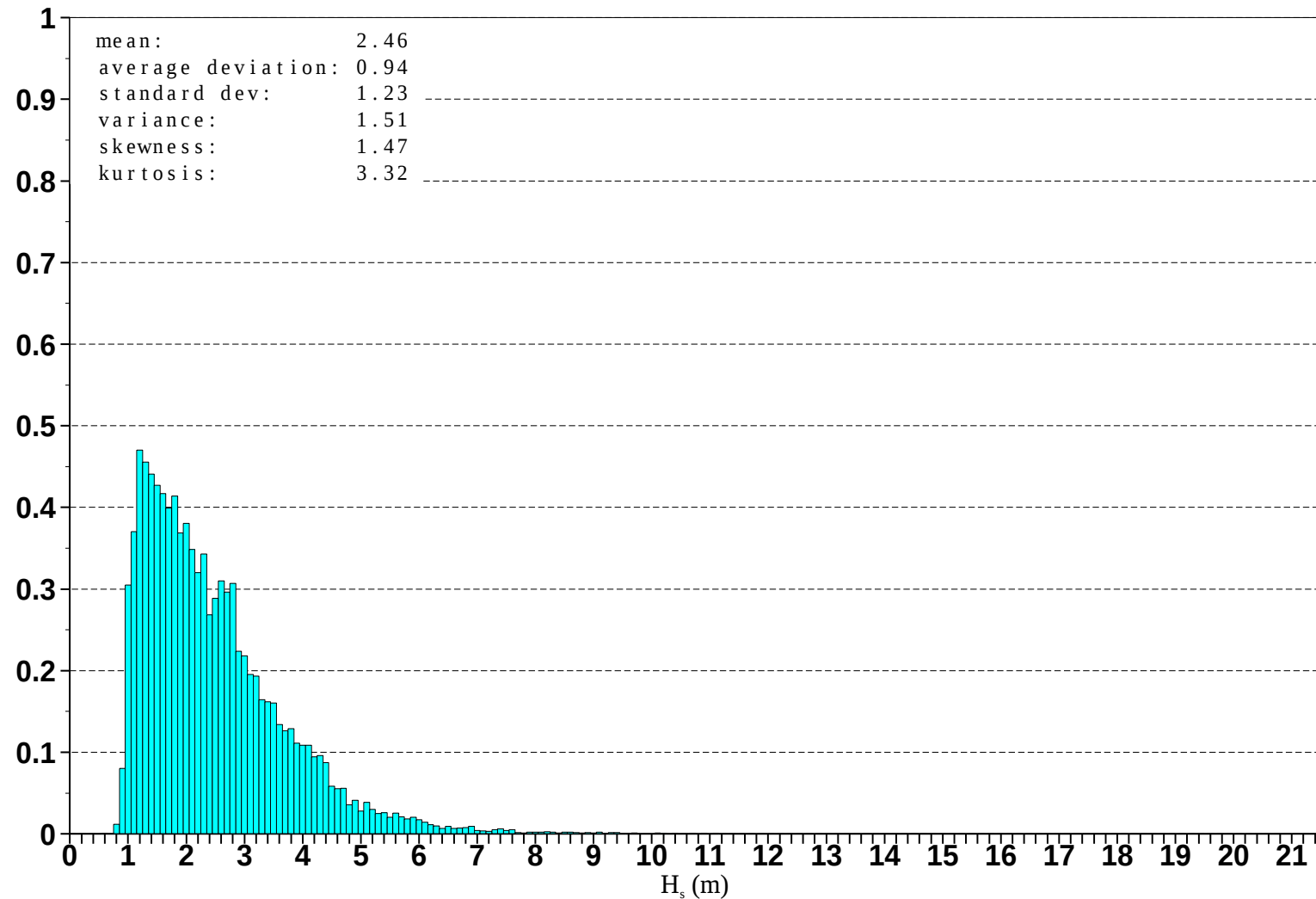


Figure 15: Distribution of ERS-2 Altimeter wave heights after along track averaging for December 2010

■
Saleh Abdalla

European Centre for Medium Range Weather Forecasts
Shinfield Park, Reading, Berkshire RG2 9AX, England
Telephone: U.K. (0118) 949 9703, International (+44 118) 949 9703
Telex 984 7908 ECMWF G, Telefax (0118) 986 9450, e-mail: abdalla@ecmwf.int

■ ECMWF Report on ERS-2 RA for December 2010 ■

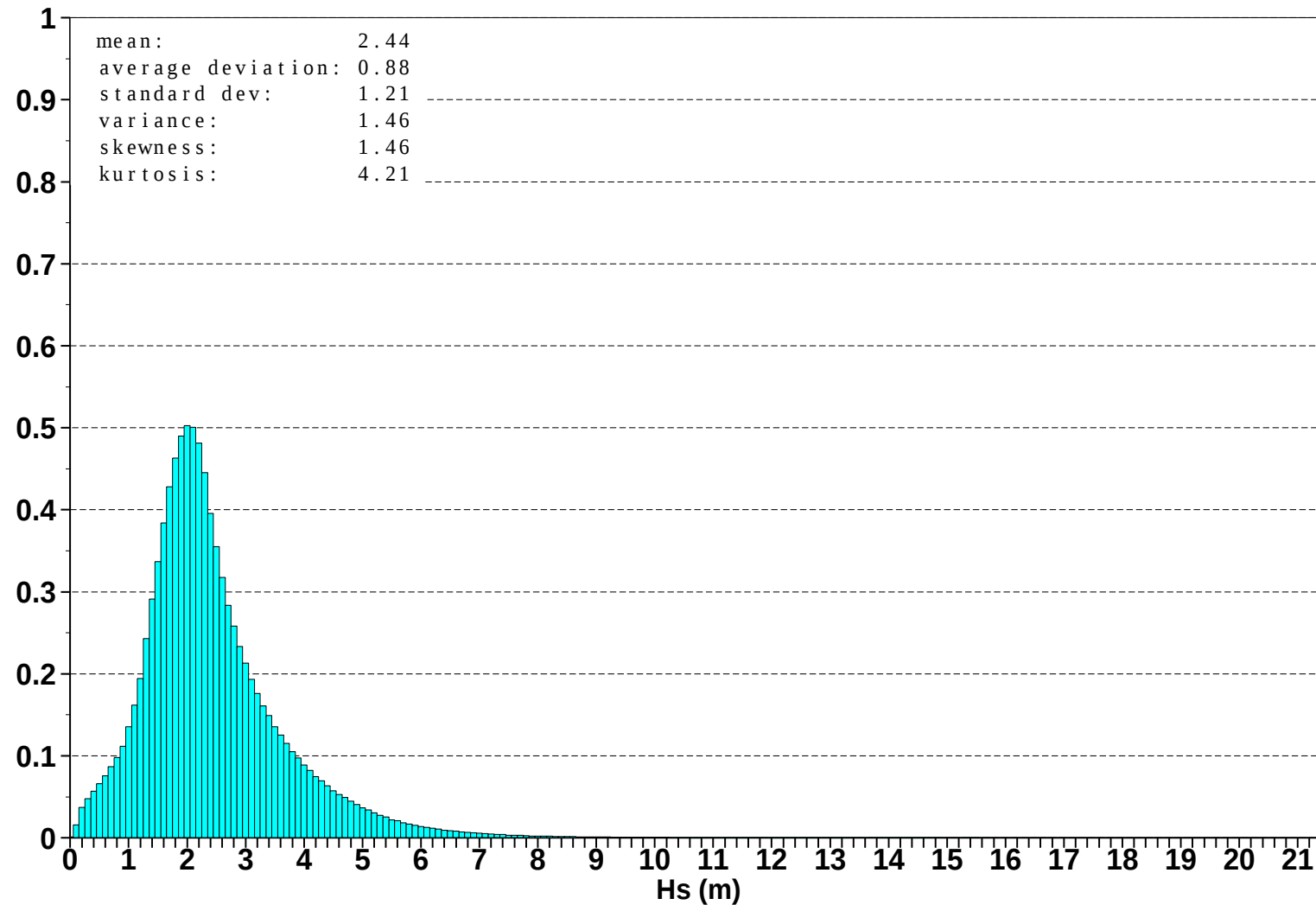


Figure 16: Global distribution of ECMWF wave heights for December 2010

■
Saleh Abdalla

European Centre for Medium Range Weather Forecasts
Shinfield Park, Reading, Berkshire RG2 9AX, England
Telephone: U.K. (0118) 949 9703, International (+44 118) 949 9703
Telex 984 7908 ECMWF G, Telefax (0118) 986 9450, e-mail: abdalla@ecmwf.int

■ ECMWF Report on ERS-2 RA for December 2010 ■

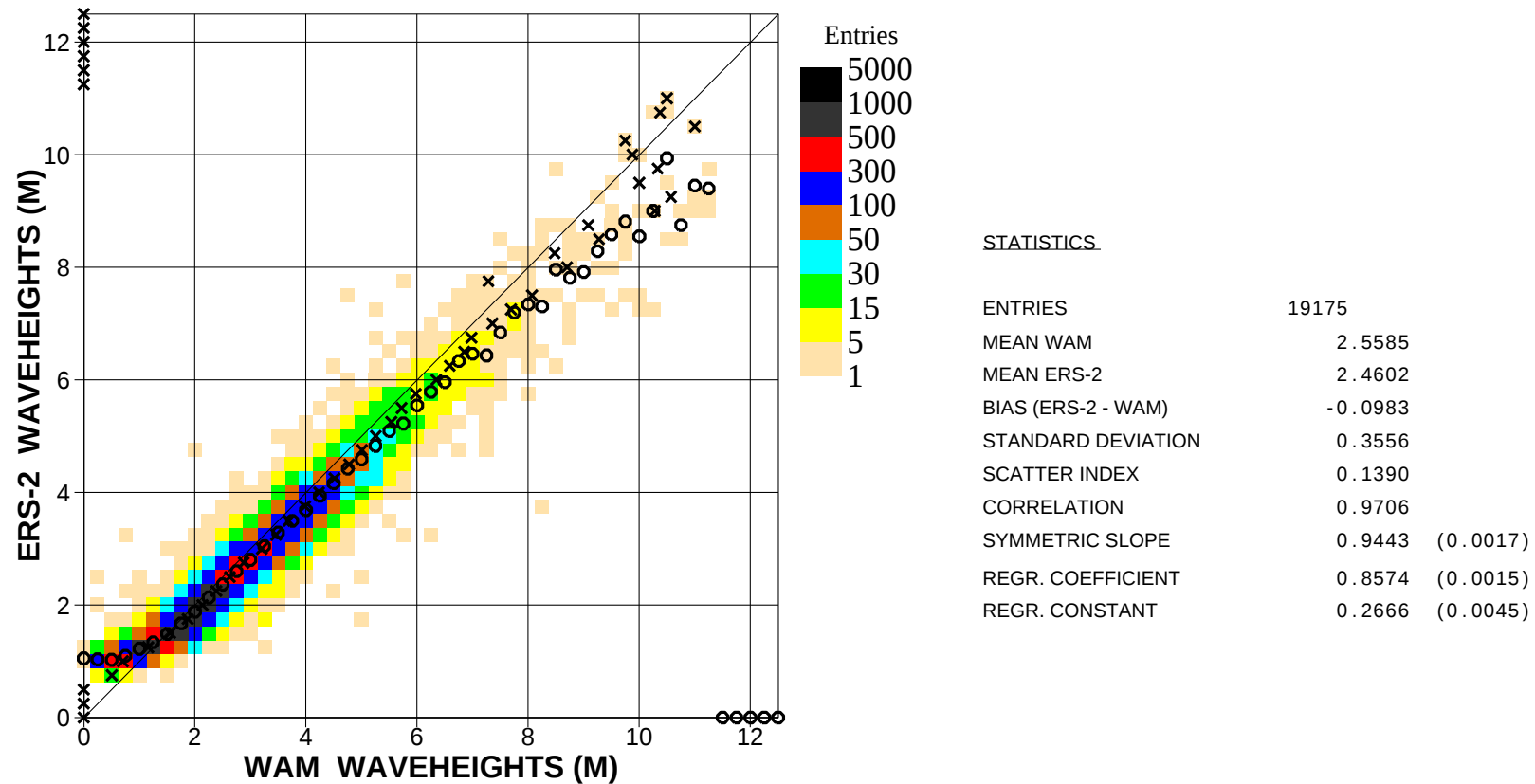


Figure 17. Comparison of ECMWF wave height results with ERS2 Altimeter wave height data for December 2010 (global)

■
Saleh Abdalla

European Centre for Medium Range Weather Forecasts
Shinfield Park, Reading, Berkshire RG2 9AX, England
Telephone: U.K. (0118) 949 9703, International (+44 118) 949 9703
Telex 984 7908 ECMWF G, Telefax (0118) 986 9450, e-mail: abdalla@ecmwf.int

■ ECMWF Report on ERS-2 RA for December 2010 ■

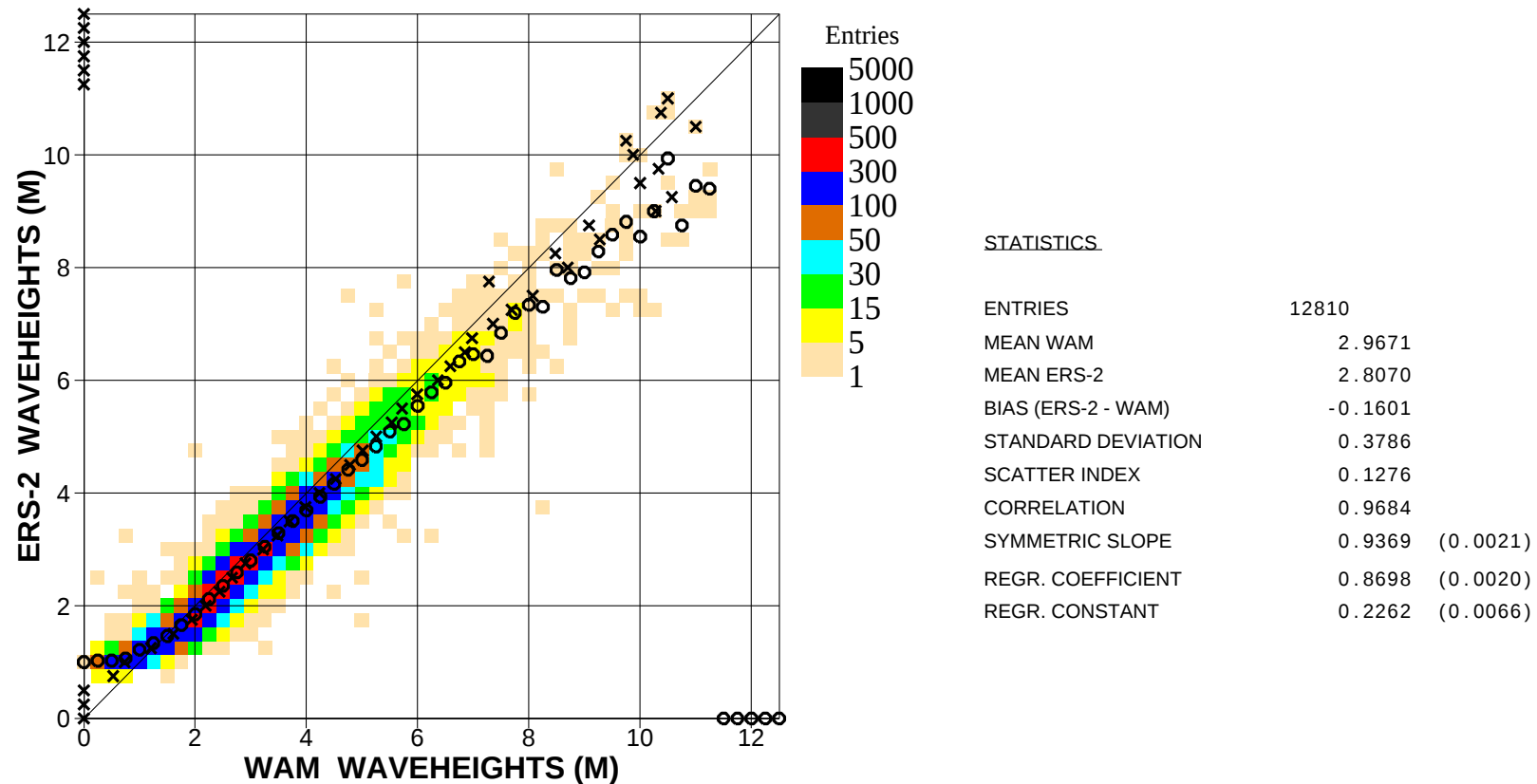


Figure 18. Comparison of ECMWF wave height results with ERS2 Altimeter wave height data for December 2010 (n.hem.)

■
Saleh Abdalla

European Centre for Medium Range Weather Forecasts
Shinfield Park, Reading, Berkshire RG2 9AX, England
Telephone: U.K. (0118) 949 9703, International (+44 118) 949 9703
Telex 984 7908 ECMWF G, Telefax (0118) 986 9450, e-mail: abdalla@ecmwf.int

■ ECMWF Report on ERS-2 RA for December 2010 ■

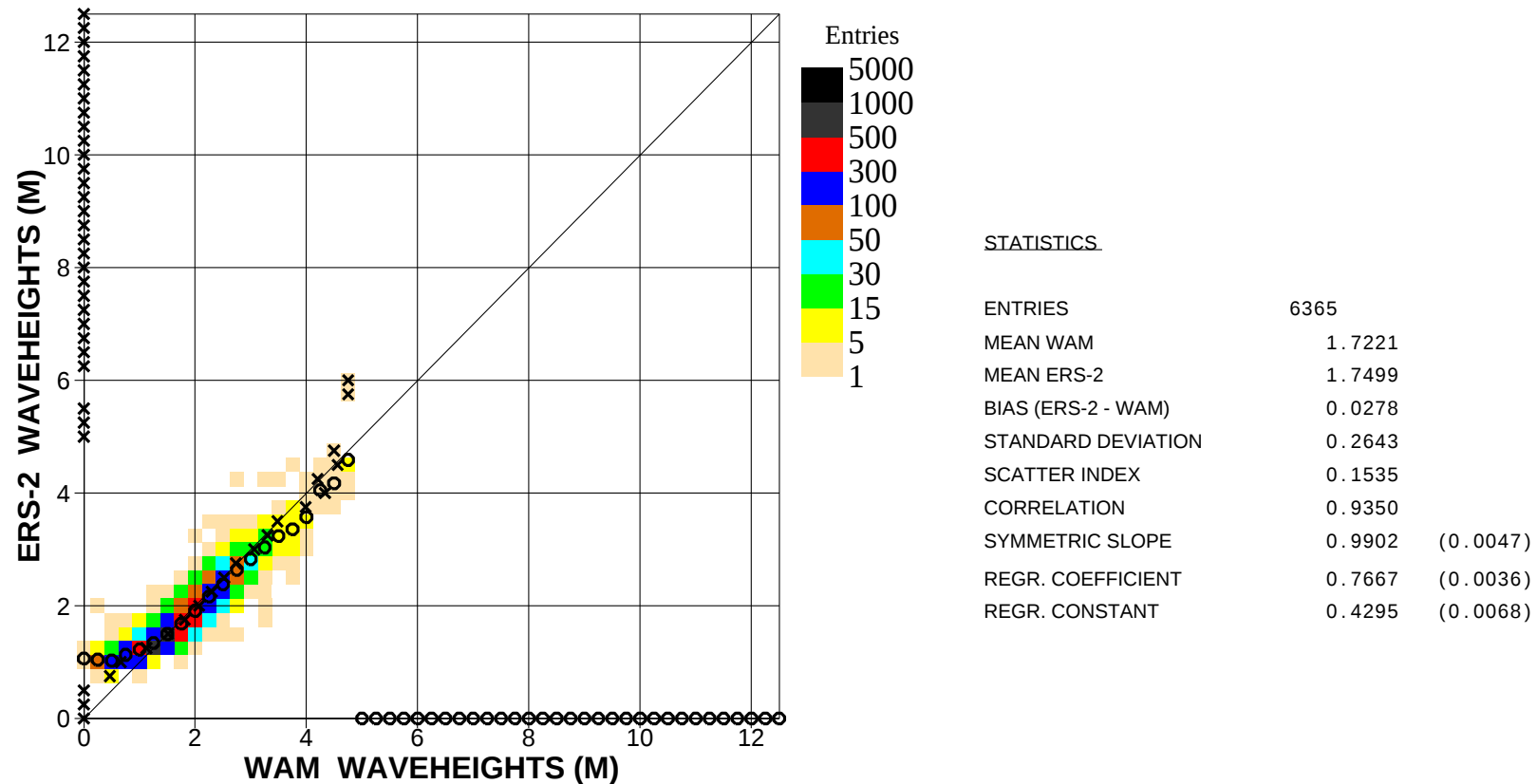


Figure 19. Comparison of ECMWF wave height results with ERS2 Altimeter wave height data for December 2010 (tropics)

■
Saleh Abdalla

European Centre for Medium Range Weather Forecasts
Shinfield Park, Reading, Berkshire RG2 9AX, England
Telephone: U.K. (0118) 949 9703, International (+44 118) 949 9703
Telex 984 7908 ECMWF G, Telefax (0118) 986 9450, e-mail: abdalla@ecmwf.int

■ ECMWF Report on ERS-2 RA for December 2010 ■

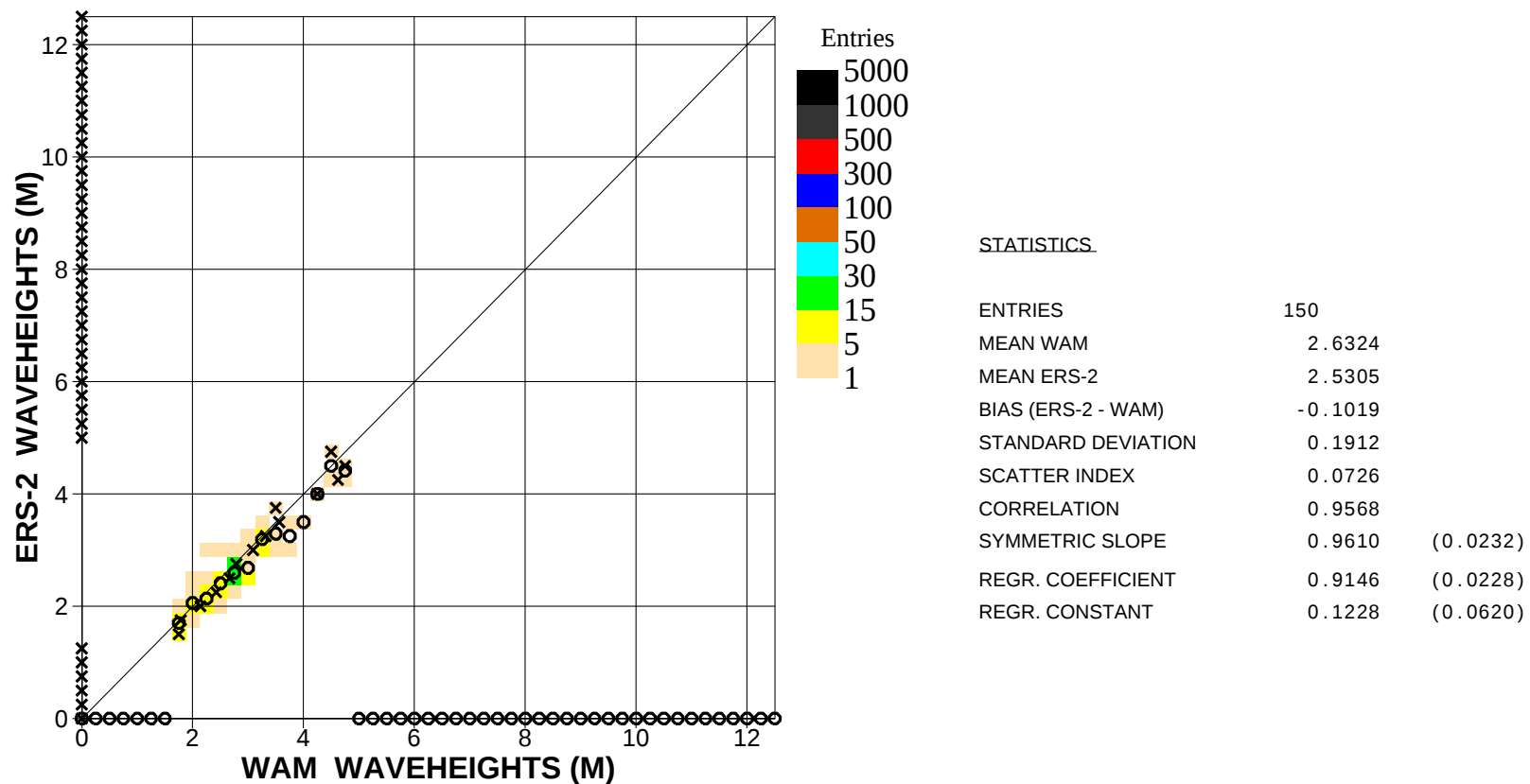


Figure 20. Comparison of ECMWF wave height results with ERS2 Altimeter wave height data for December 2010 (s.hem.)

■
Saleh Abdalla

European Centre for Medium Range Weather Forecasts
Shinfield Park, Reading, Berkshire RG2 9AX, England
Telephone: U.K. (0118) 949 9703, International (+44 118) 949 9703
Telex 984 7908 ECMWF G, Telefax (0118) 986 9450, e-mail: abdalla@ecmwf.int

■ ECMWF Report on ERS-2 RA for December 2010 ■

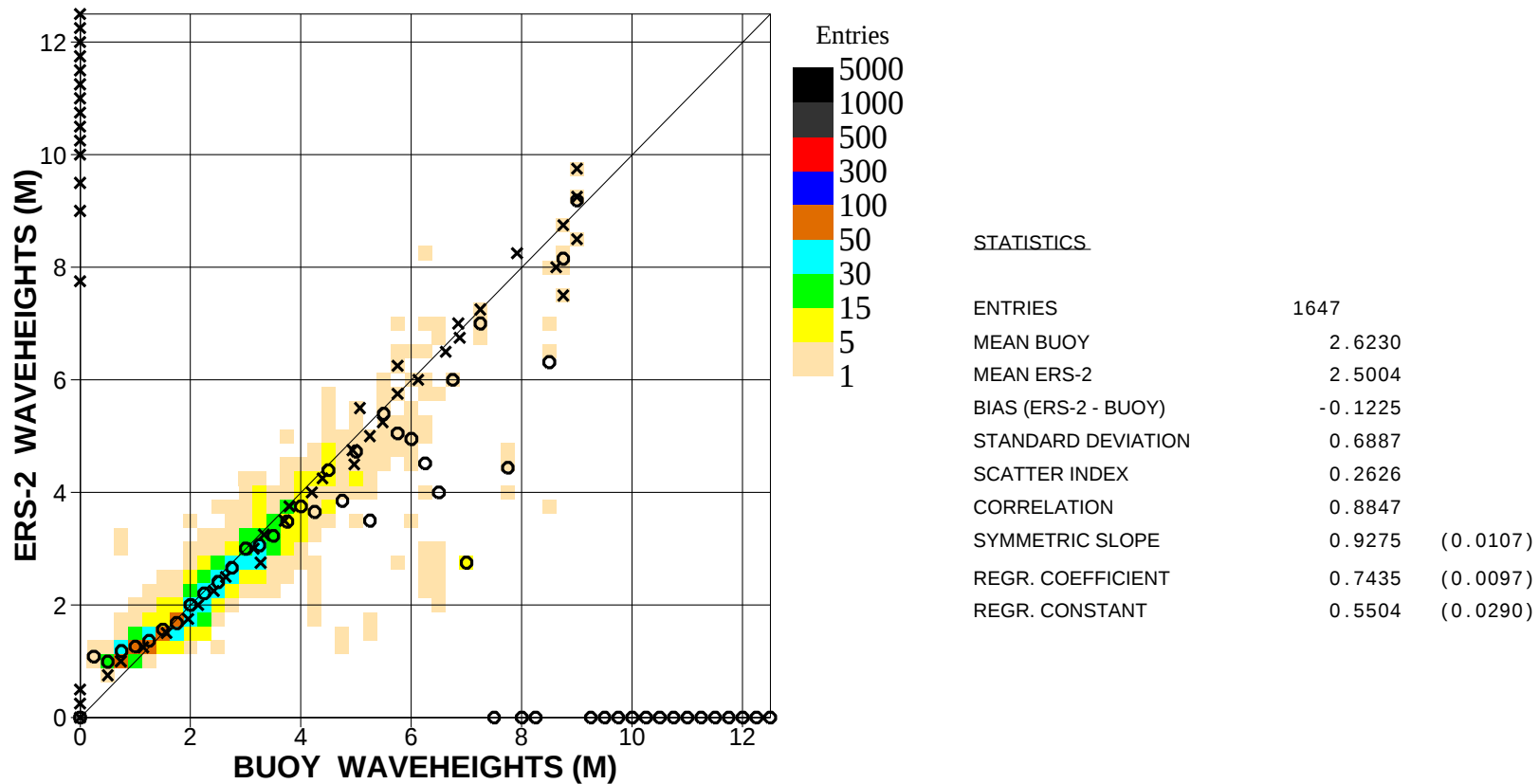


Figure 21. Comparison of buoy wave height observations with ERS2 Altimeter wave height data for December 2010 (global)

■
Saleh Abdalla

European Centre for Medium Range Weather Forecasts
Shinfield Park, Reading, Berkshire RG2 9AX, England
Telephone: U.K. (0118) 949 9703, International (+44 118) 949 9703
Telex 984 7908 ECMWF G, Telefax (0118) 986 9450, e-mail: abdalla@ecmwf.int

■ ECMWF Report on ERS-2 RA for December 2010 ■

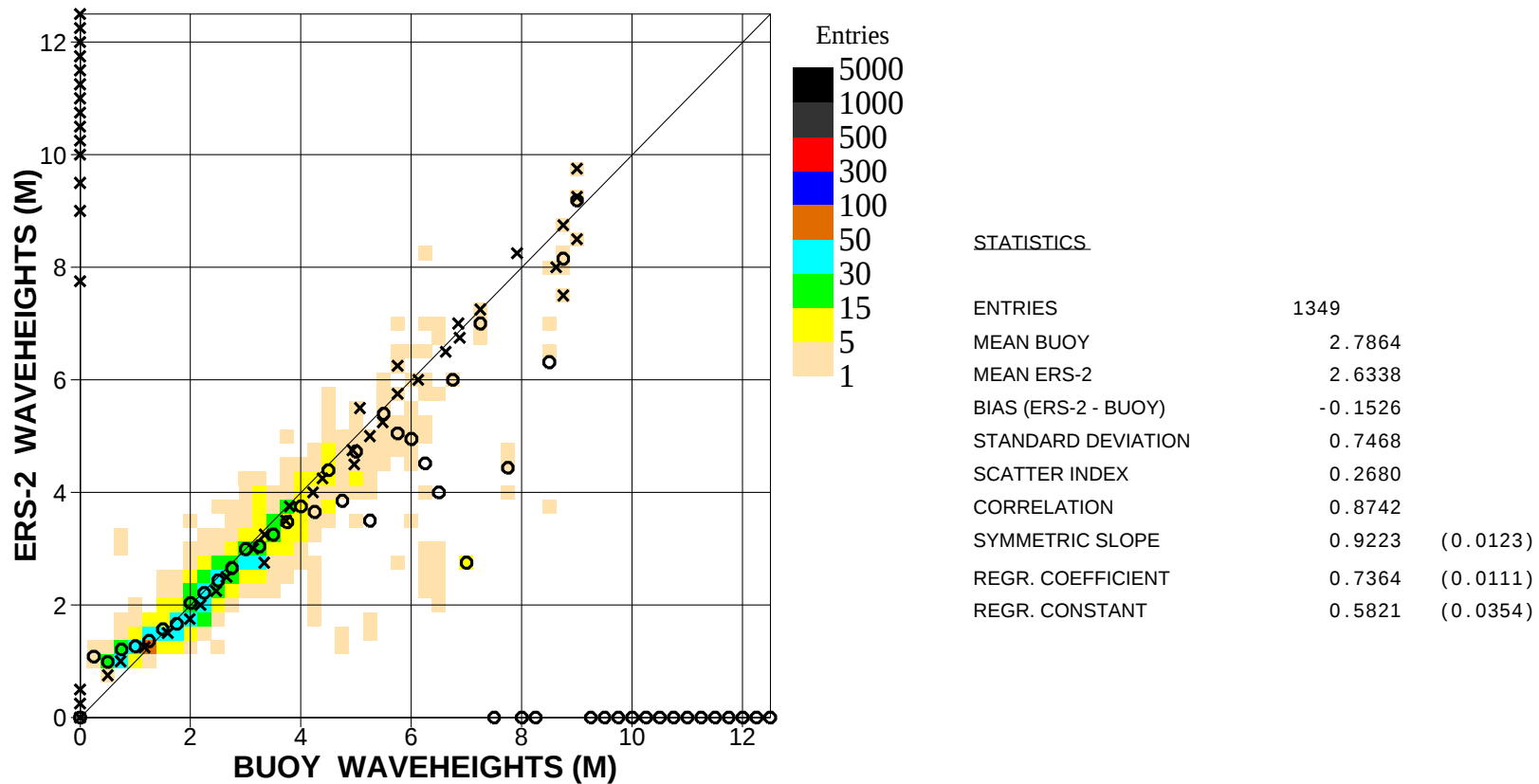


Figure 22. Comparison of buoy wave height observations with ERS2 Altimeter wave height data for December 2010 (n.hem.)

■
Saleh Abdalla

European Centre for Medium Range Weather Forecasts
Shinfield Park, Reading, Berkshire RG2 9AX, England
Telephone: U.K. (0118) 949 9703, International (+44 118) 949 9703
Telex 984 7908 ECMWF G, Telefax (0118) 986 9450, e-mail: abdalla@ecmwf.int

■ ECMWF Report on ERS-2 RA for December 2010 ■

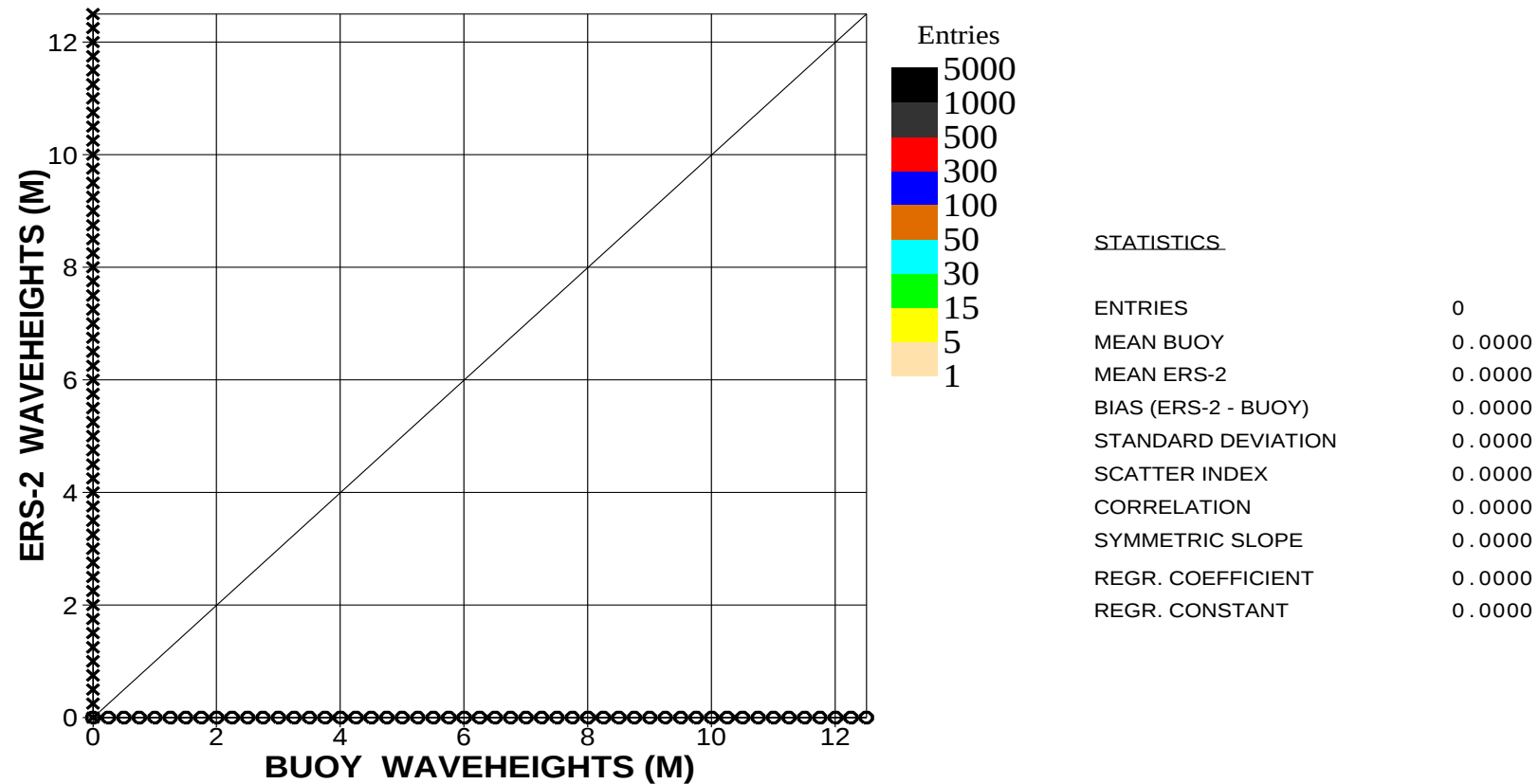


Figure 23. Comparison of buoy wave height observations with ERS2 Altimeter wave height data for December 2010 (hawaii)

■
Saleh Abdalla

European Centre for Medium Range Weather Forecasts
Shinfield Park, Reading, Berkshire RG2 9AX, England
Telephone: U.K. (0118) 949 9703, International (+44 118) 949 9703
Telex 984 7908 ECMWF G, Telefax (0118) 986 9450, e-mail: abdalla@ecmwf.int

ECMWF Report on ERS-2 RA for December 2010

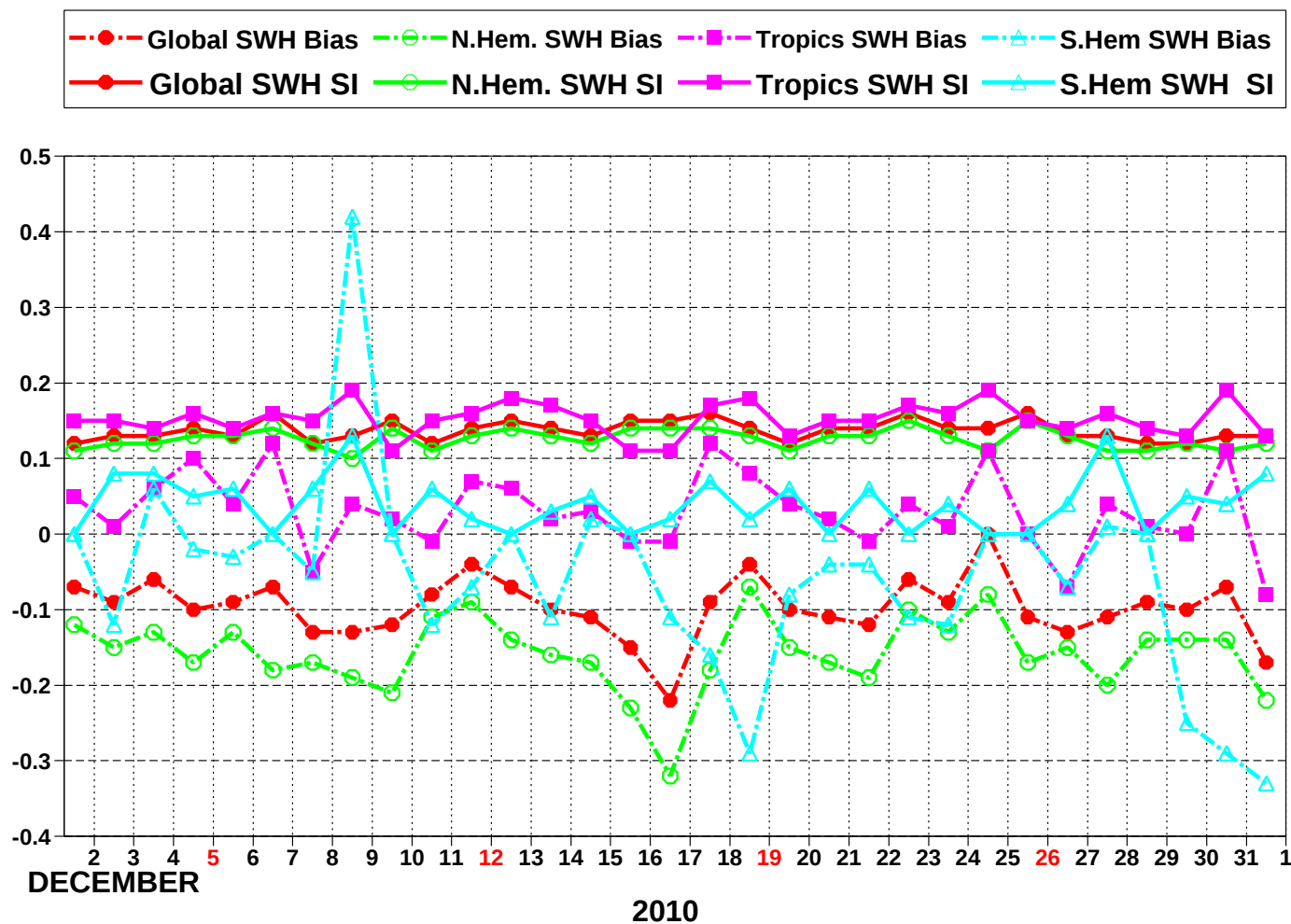


Figure 24: ERS-2 Altimeter wave heights: Timeseries of bias (ERS-2 - model) and scatter index (SI)

Saleh Abdalla

European Centre for Medium Range Weather Forecasts
Shinfield Park, Reading, Berkshire RG2 9AX, England
Telephone: U.K. (0118) 949 9703, International (+44 118) 949 9703
Telex 984 7908 ECMWF G, Telefax (0118) 986 9450, e-mail: abdalla@ecmwf.int

■ ECMWF Report on ERS-2 RA for December 2010 ■

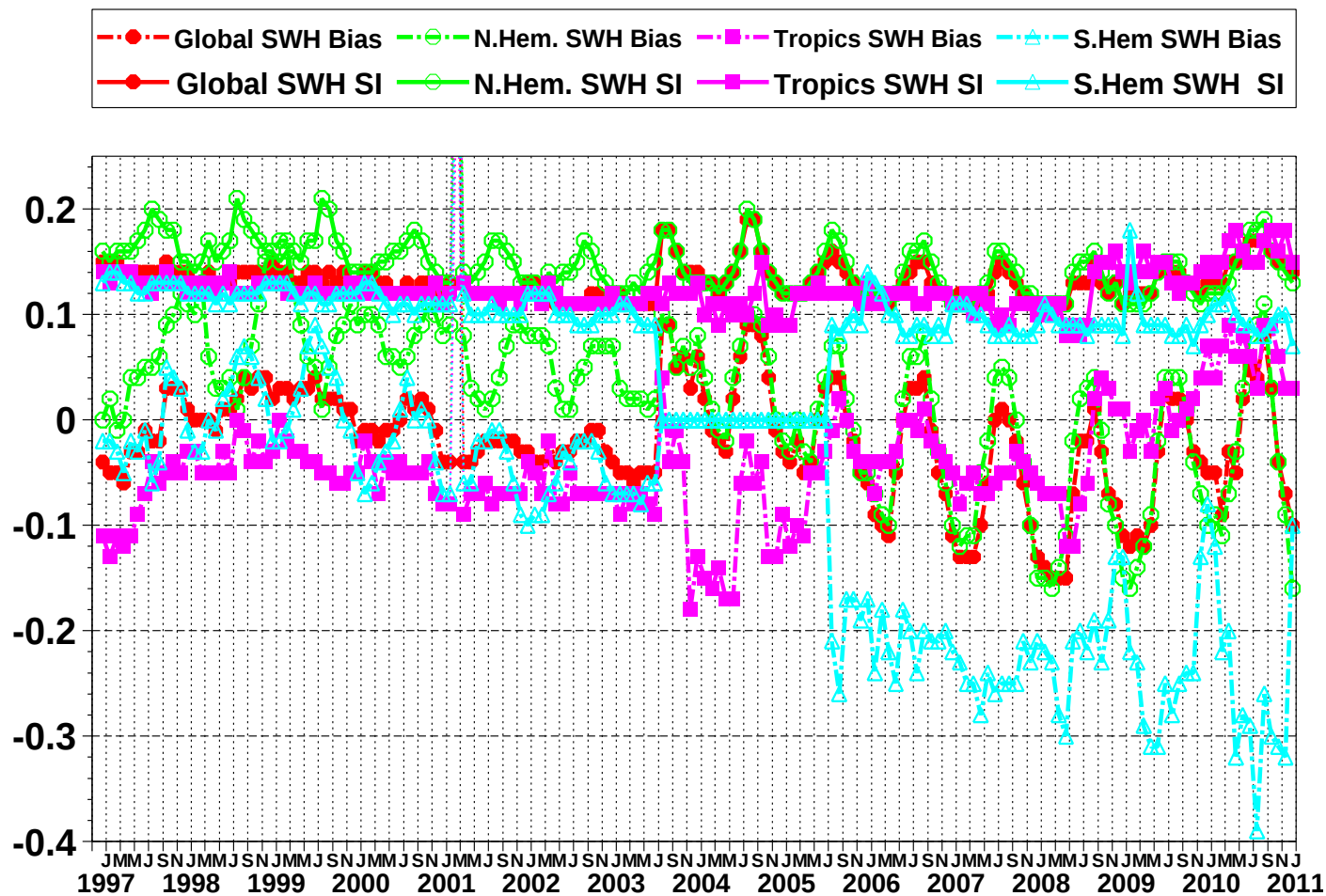


Figure 25: ERS-2 Altimeter wave heights: Timeseries of bias (ERS-2 - model) and scatter index (SI)

■
Saleh Abdalla

European Centre for Medium Range Weather Forecasts
Shinfield Park, Reading, Berkshire RG2 9AX, England
Telephone: U.K. (0118) 949 9703, International (+44 118) 949 9703
Telex 984 7908 ECMWF G, Telefax (0118) 986 9450, e-mail: abdalla@ecmwf.int

■ ECMWF Report on ERS-2 RA for December 2010 ■

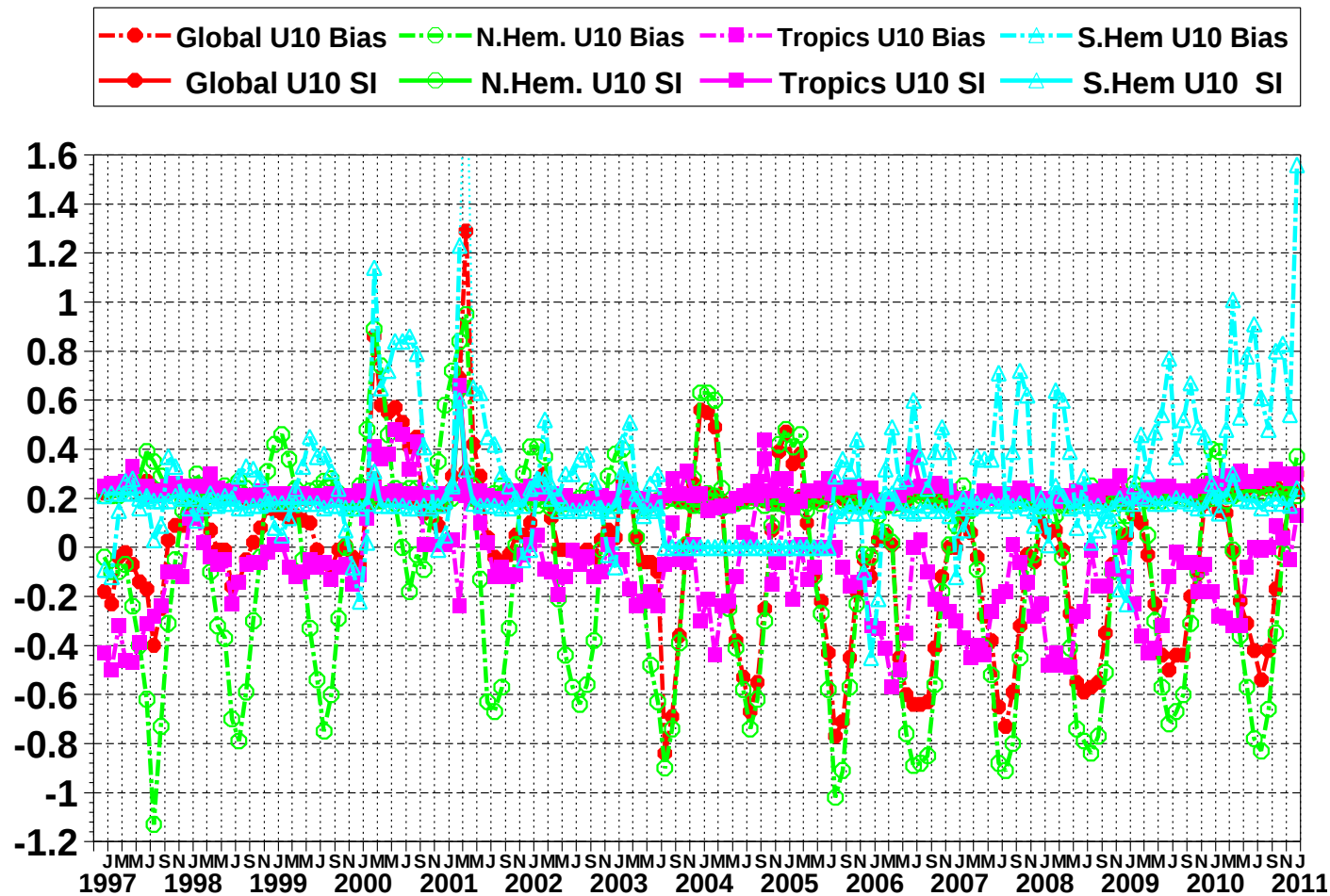


Figure 26: ERS-2 Altimeter wind speeds: Timeseries of bias (ERS-2 - model) and scatter index (SI)

■
Saleh Abdalla

European Centre for Medium Range Weather Forecasts
Shinfield Park, Reading, Berkshire RG2 9AX, England
Telephone: U.K. (0118) 949 9703, International (+44 118) 949 9703
Telex 984 7908 ECMWF G, Telefax (0118) 986 9450, e-mail: abdalla@ecmwf.int

■ ECMWF Report on ERS-2 RA for December 2010 ■

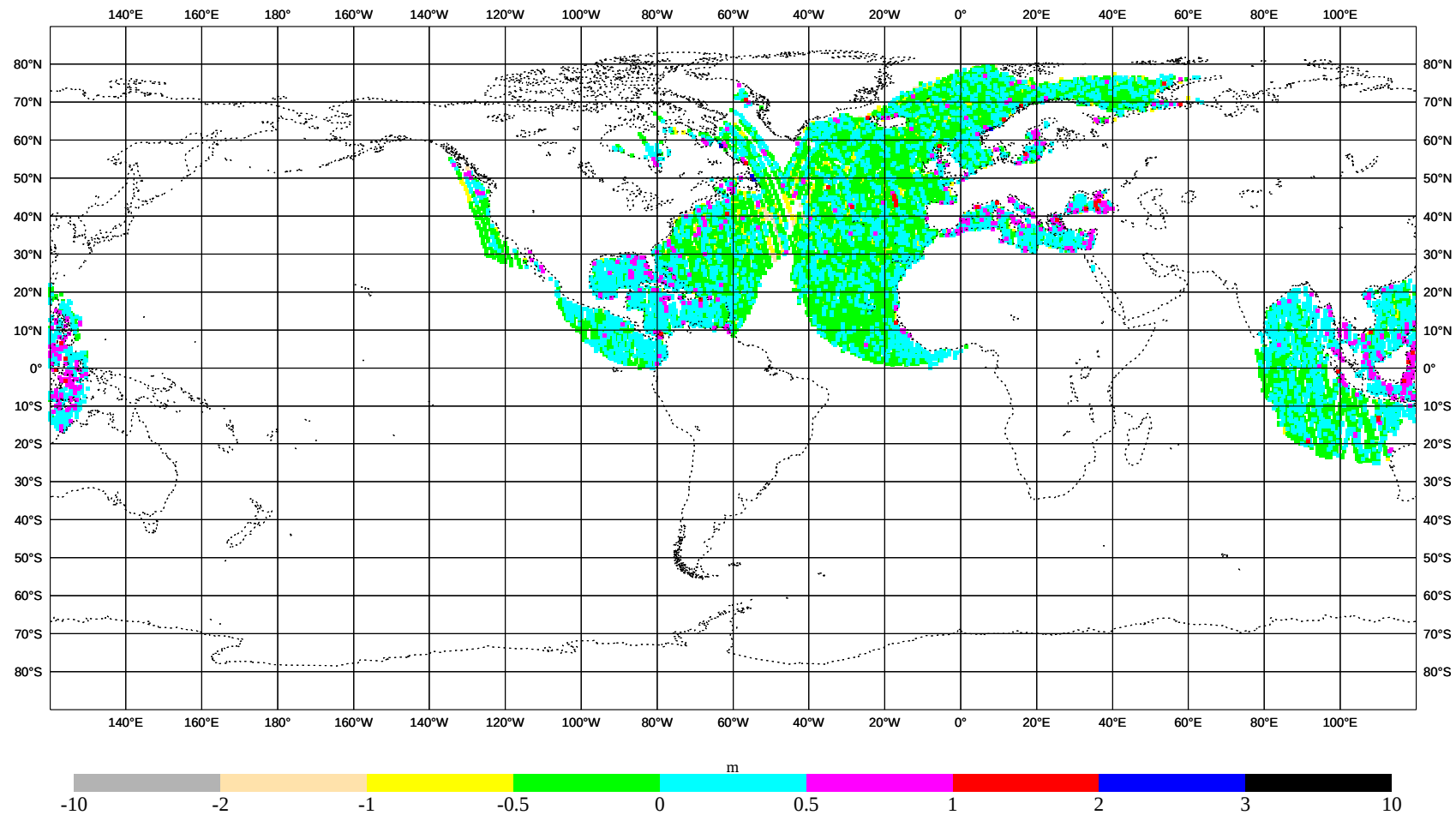


Figure 27: Significant wave height: Monthly mean difference of ERS-2 altimeter data minus wave model results for December 2010.