ECMWF Report on ERS-2 RA for June 2008

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

By: *Saleh Abdalla*

Date: *17 July 2008*

Overview:

Based on the data received at ECMWF during the whole month, on average, 3864 observations arrived at ECMWF every 6 hours of which 62.78% passed the quality control. As can be seen in Figure 1, there was data gaps at the 6-hour time windows centred at (UTC): 06:00 on the 25th., from 06:00 on the 27th. to 06:00 on the 30th. (both inclusive), and 18:00 on the 30th. of the month. 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, the Southern Ocean, the northeaster parts of the Indian Ocean and **around South Africa (since 23 May 2008)** as can be seen in Figure 27. The quality of the received data is as good as usual.

Backscatter:

ESR-2 $<\sigma_0>$ = 11.62 dB (with one main peak at 11.1 dB and a secondary peak at 11.6 dB).

Wind Speed Comparison with ECMWF wind speeds (bias):

ERS-2 global: - 0.588 m/s

ERS-2 northern hemisphere: - 0.790 m/s

ERS-2 tropics: - 0.263 m/s

ERS-2 southern hemisphere: + 0.289 m/s

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 June 2008

Wind Speed Comparison with buoy wind speeds (bias):

ERS-2 global: - 1.129 m/s

ERS-2 northern hemisphere: - 1.171 m/s

ERS-2 tropics (Hawaii): *missing*

Wave Height Comparison with ECMWF wave heights (bias):

ERS-2 global: - 0.020 m (lowest waves measured: 0.6m)

ERS-2 northern hemisphere: + 0.020 m

ERS-2 tropics: - 0.084 m

ERS-2 southern hemisphere: - 0.199 m

Wave Height Comparison with buoy wave heights (bias):

ERS-2 global: +0.097 m

ERS-2 northern hemisphere: +0.099 m

ERS-2 tropics (Hawaii): *missing*

Remarks:

- The quality of Altimeter data, both wind speed and significant wave height, is nominal.
- 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.

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 June 2008

- 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. 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 and Jason altimeter significant wave height data and ENVISAT ASAR Wave Mode Level 1b data are assimilated in the ECMWF wave model.
- There was ECMWF model change on the 3rd. of this month. In addition to several atmospheric changes, the wave model advection scheme was changed. The current operational IFS cycle is CY33R1 (since 03 June 2008).

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.

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

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 2008.

Figure 2: Distribution of the ERS-2 Altimeter Backscatter after QC for June 2008.

Figure 3: Distribution of the ERS-2 Altimeter wind speeds after QC for June 2008.

Figure 4: Distribution of the ERS-2 Altimeter wind speeds after along track averaging for June 2008.

Figure 5: Global distribution of ECMWF ocean surface wind speeds for June 2008.

Figure 6: Comparison of ECMWF wind speed results with ERS-2 Altimeter wind speed data for June 2008 (global).

Figure 7: Comparison of ECMWF wind speed results with ERS-2 Altimeter wind speed data for June 2008 (northern hemisphere)

Figure 8: Comparison of ECMWF wind speed results with ERS-2 Altimeter wind speed data for June 2008 (tropics)

Figure 9: Comparison of ECMWF wind speed results with ERS-2 Altimeter wind speed data for June 2008 (southern hemisphere)

Figure 10: Comparison of buoy wind speed observations with ERS-2 Altimeter wind speed data for June 2008 (global).

Figure 11: Comparison of buoy wind speed observations with ERS-2 Altimeter wind speed data for June 2008 (northern hemisphere).

Figure 12: Comparison of buoy wind speed observations with ERS-2 Altimeter wind speed data for June 2008 (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 2008.

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

Figure 15: Distribution of the ERS-2 Altimeter wave heights after along track averaging for June 2008.
Figure 16: Global distribution of ECMWF wave heights for June 2008.
Figure 17: Comparison of ECMWF wave height results with ERS-2 Altimeter wave height data for June 2008 (global).
Figure 18: Comparison of ECMWF wave height results with ERS-2 Altimeter wave height data for June 2008 (northern hemisphere)
Figure 19: Comparison of ECMWF wave height results with ERS-2 Altimeter wave height data for June 2008 (tropics)
Figure 20: Comparison of ECMWF wave height results with ERS-2 Altimeter wave height data for June 2008 (southern hemisphere)
Figure 21: Comparison of buoy wave height observations with ERS-2 Altimeter wave height data for June 2008 (global).
Figure 22: Comparison of buoy wave height observations with ERS-2 Altimeter wave height data for June 2008 (northern hemisphere).
Figure 23: Comparison of buoy wave height observations with ERS-2 Altimeter wave height data for June 2008 (hawaii).
Figure 24: ERS-2 Altimeter wave heights: Timeseries of bias (ERS-2 - model) and scatter index (SI) for June 2008.
Figure 25: ERS-2 Altimeter wave heights: Timeseries of bias (ERS-2 - model) and scatter index (SI) from December 1996 to June 2008.
Figure 26: ERS-2 Altimeter wind speeds: Timeseries of bias (ERS-2 - model) and scatter index (SI) from December 1996 to June 2008.
Figure 27: Significant wave height: Monthly mean difference of ERS-2 altimeter data minus wave model results for June 2008.

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

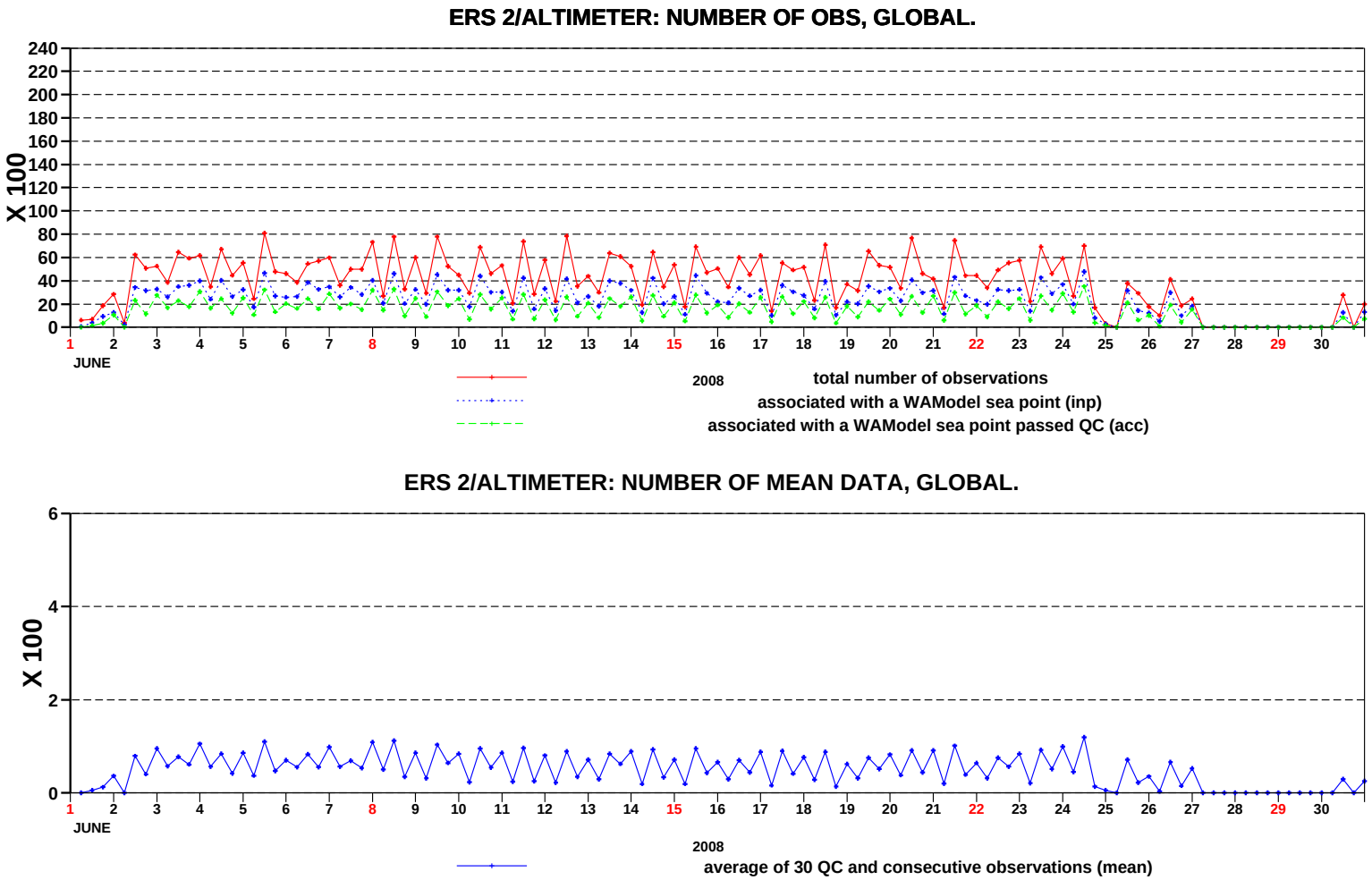


Figure 1:Time series of data reception for ERS-2 Altimeter data for June 2008

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 June 2008

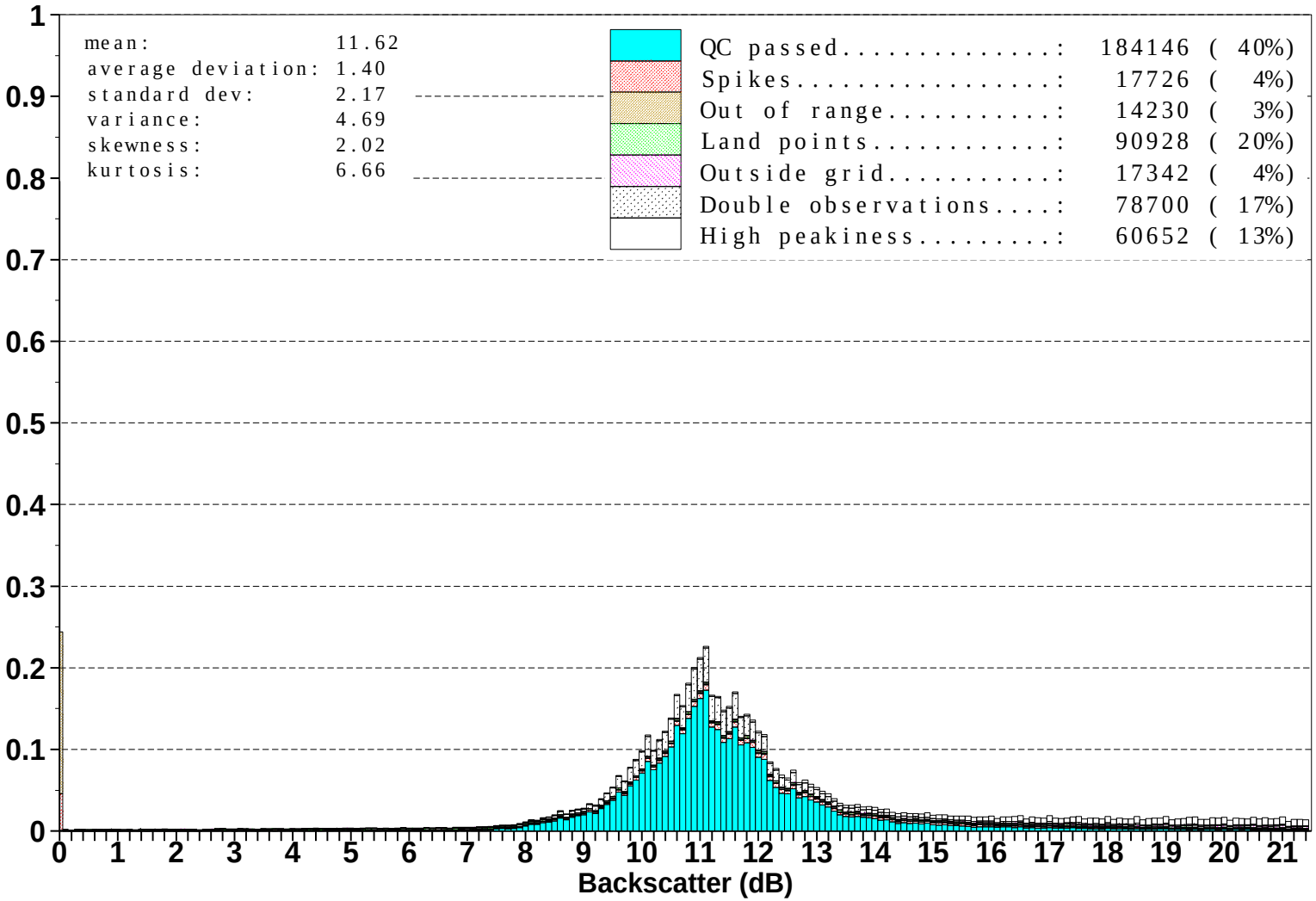


Figure 2: Distribution of the ERS-2 Altimeter backscatter after QC for June 2008

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 June 2008

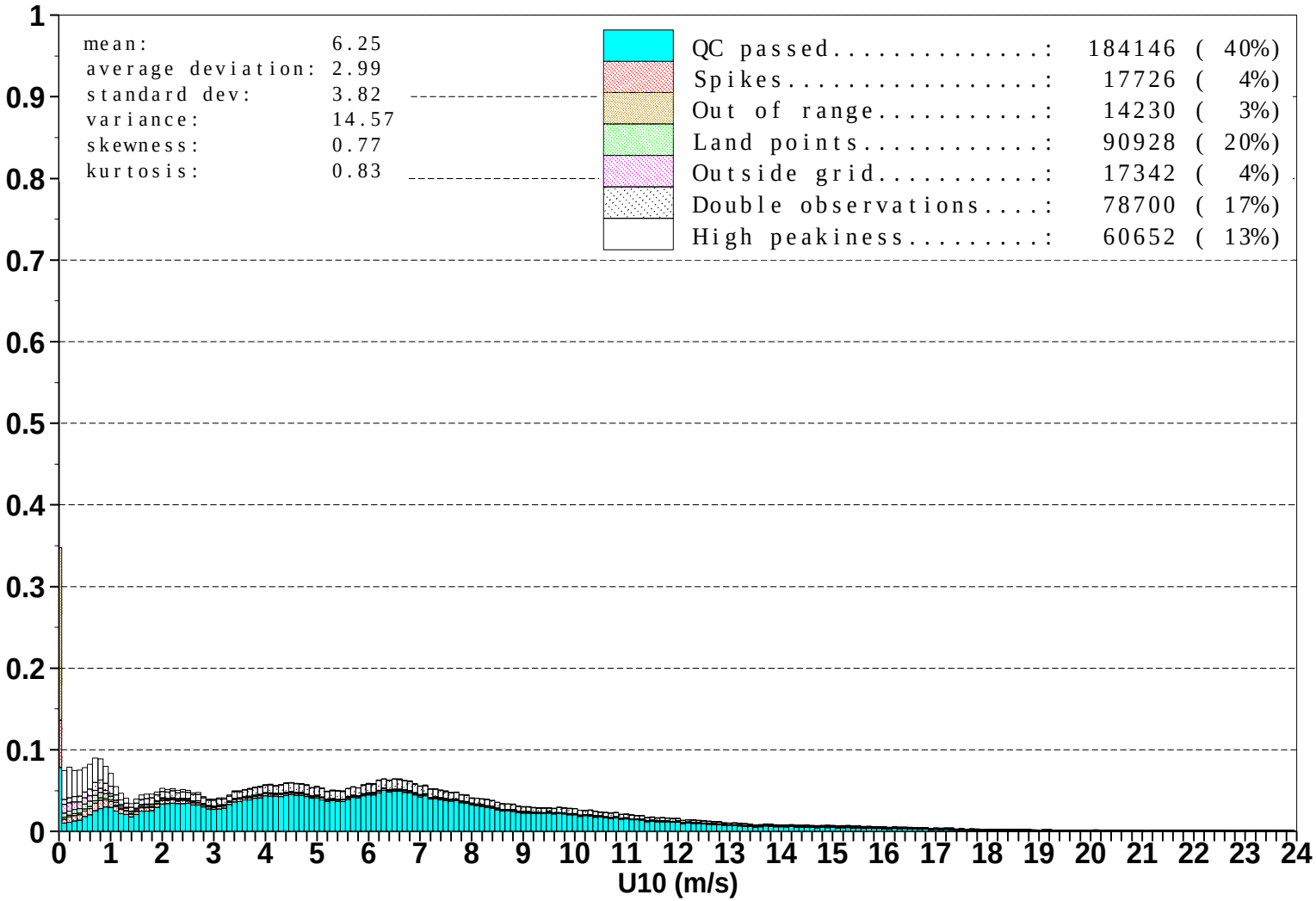


Figure 3: Distribution of the ERS-2 Altimeter wind speeds after QC for June 2008

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

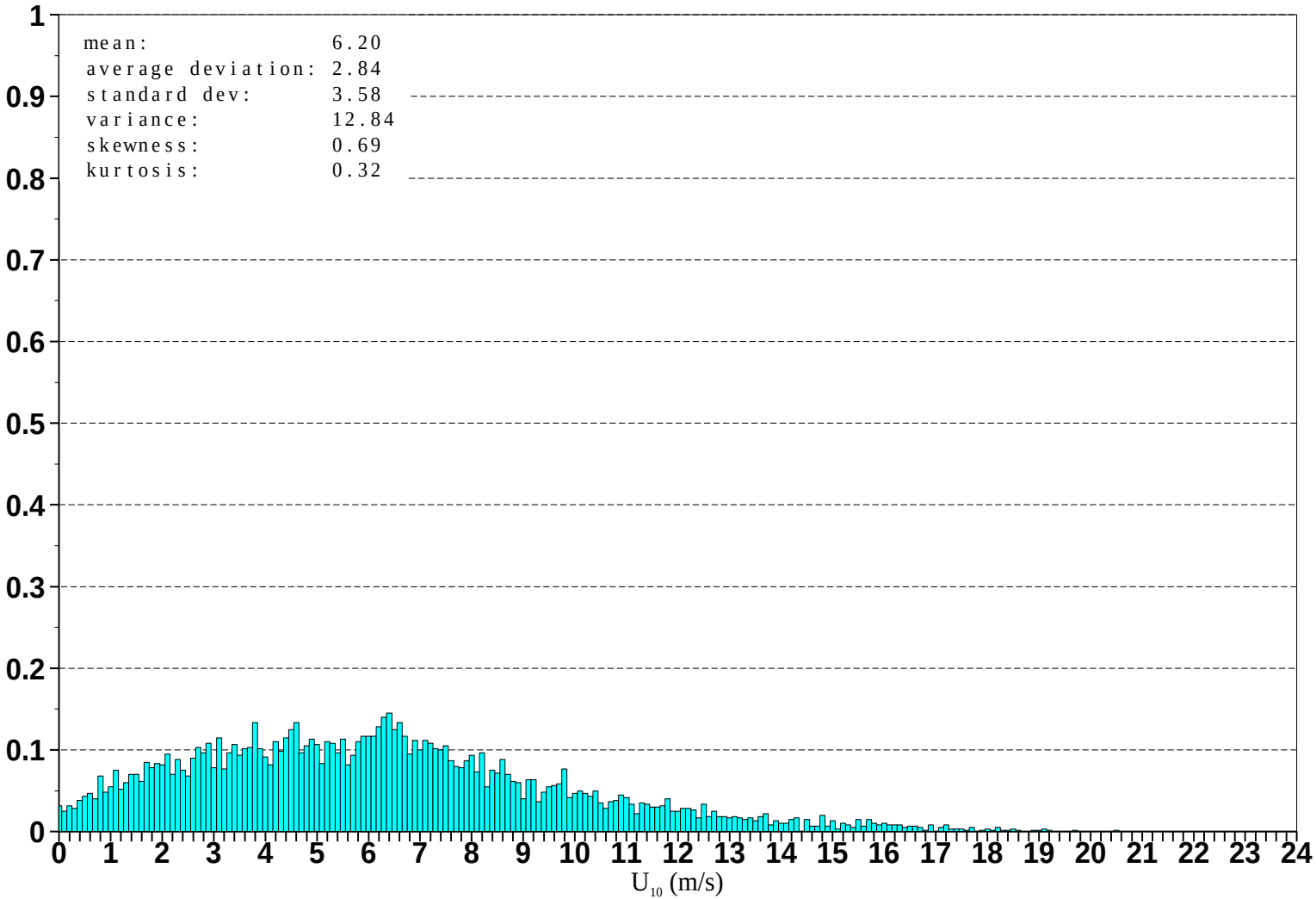


Figure 4: Distribution of ERS-2 Altimeter wind speeds after along track averaging for June 2008

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

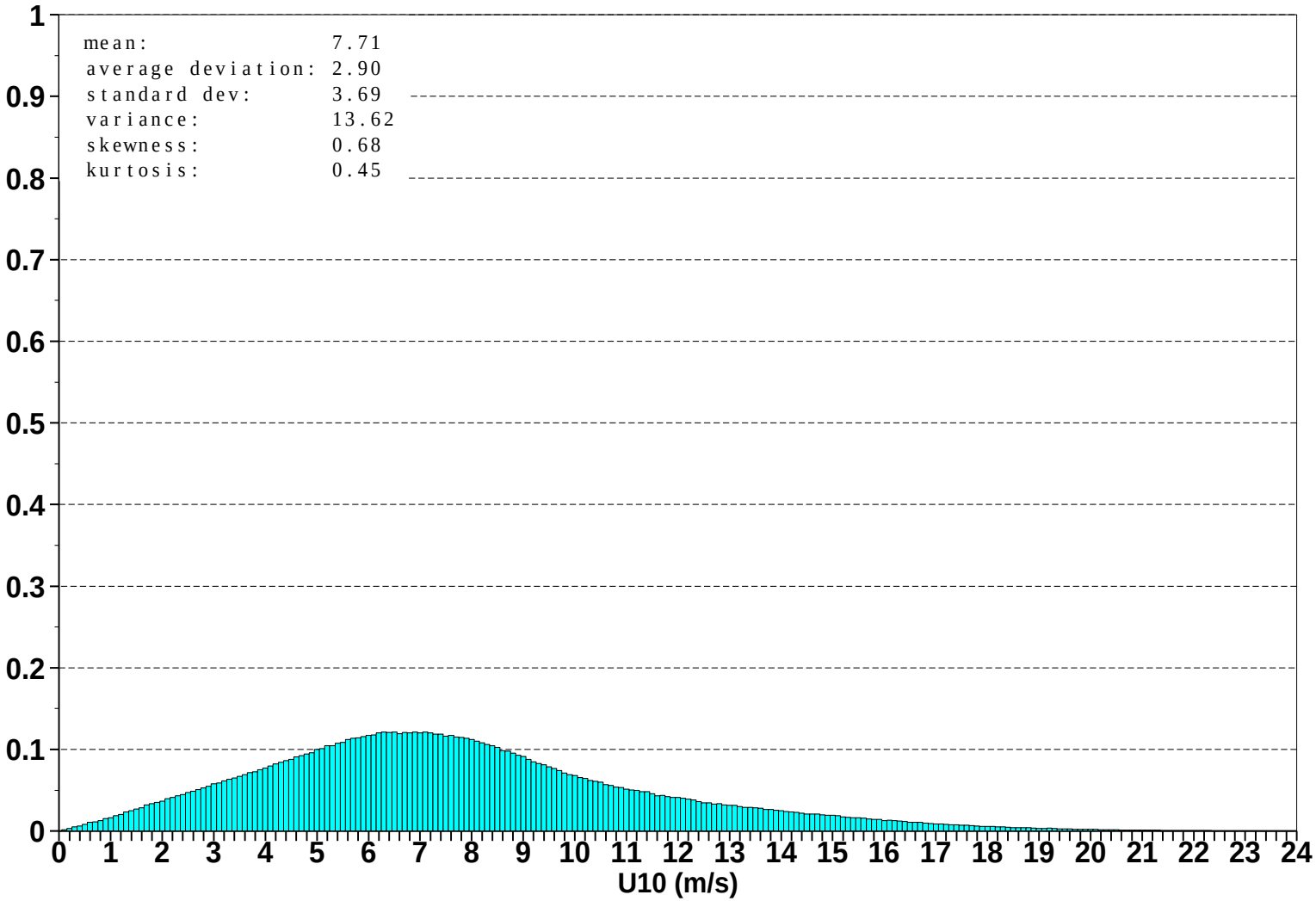
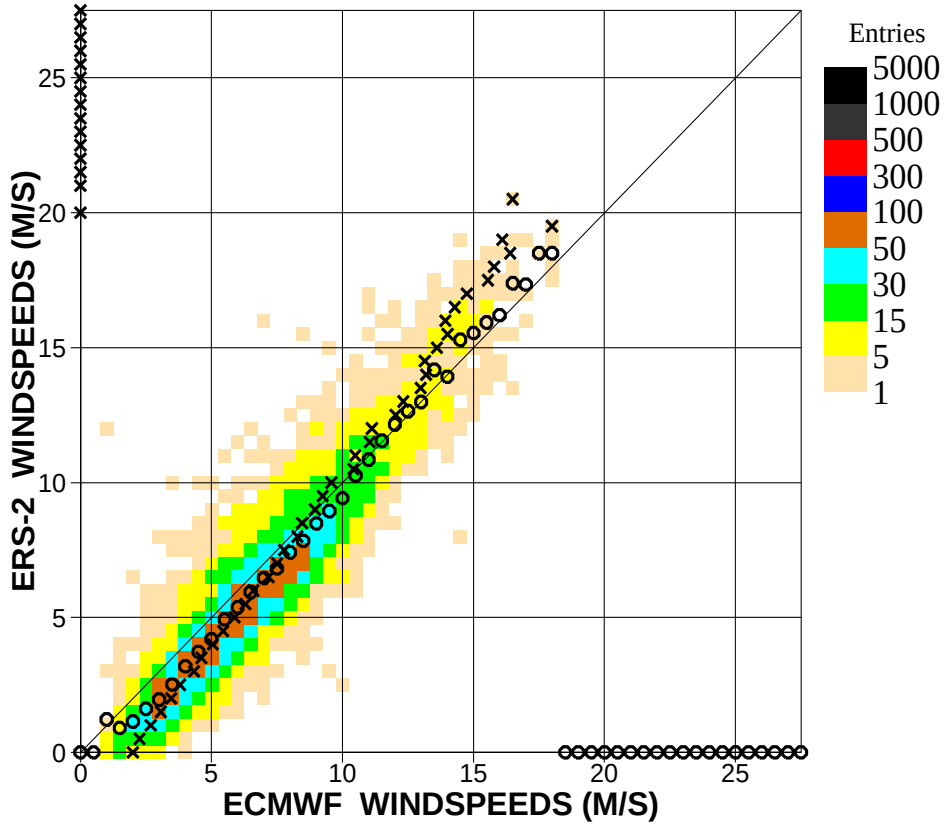


Figure 5: Global distribution of ECMWF ocean surface wind speeds for June 2008

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 June 2008



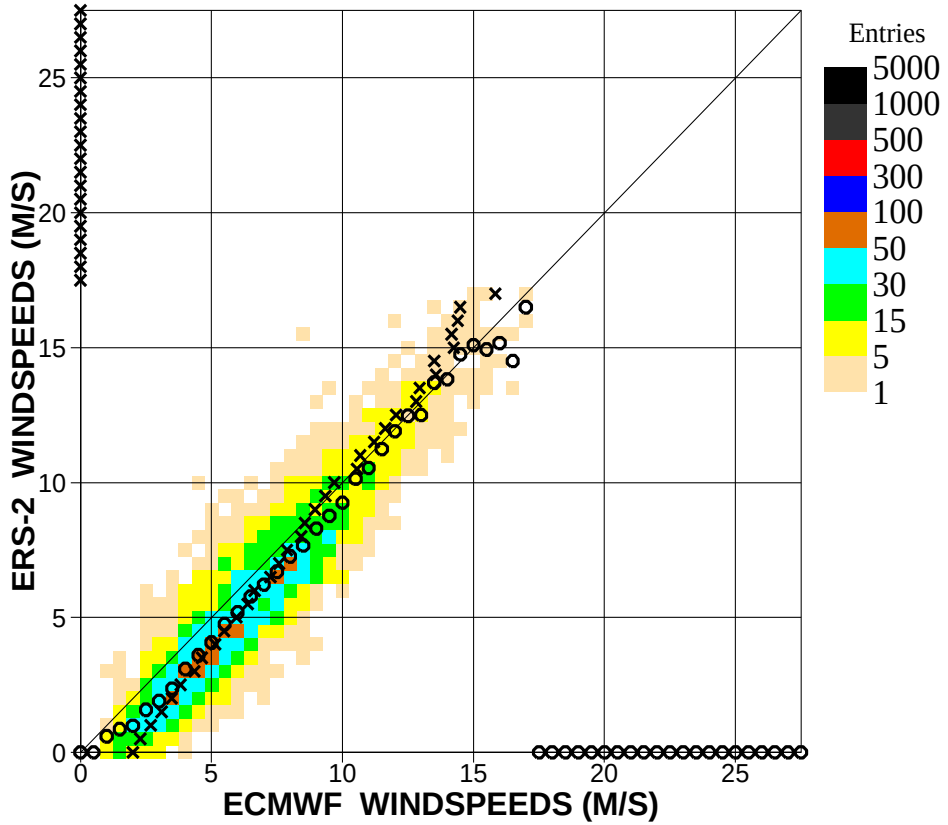
STATISTICS

ENTRIES	6004	
MEAN ECMWF	6.7870	
MEAN ERS-2	6.1994	
BIAS (ERS-2 - ECMWF)	-0.5876	
STANDARD DEVIATION	1.3840	
SCATTER INDEX	0.2039	
CORRELATION	0.9257	
SYMMETRIC SLOPE	0.9630	(0.0062)
REGR. COEFFICIENT	1.0919	(0.0058)
REGR. CONSTANT	-1.2114	(0.0428)

Figure 6. Comparison of ECMWF wind speed results with ERS2 Altimeter wind speed data for June 2008 (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 June 2008

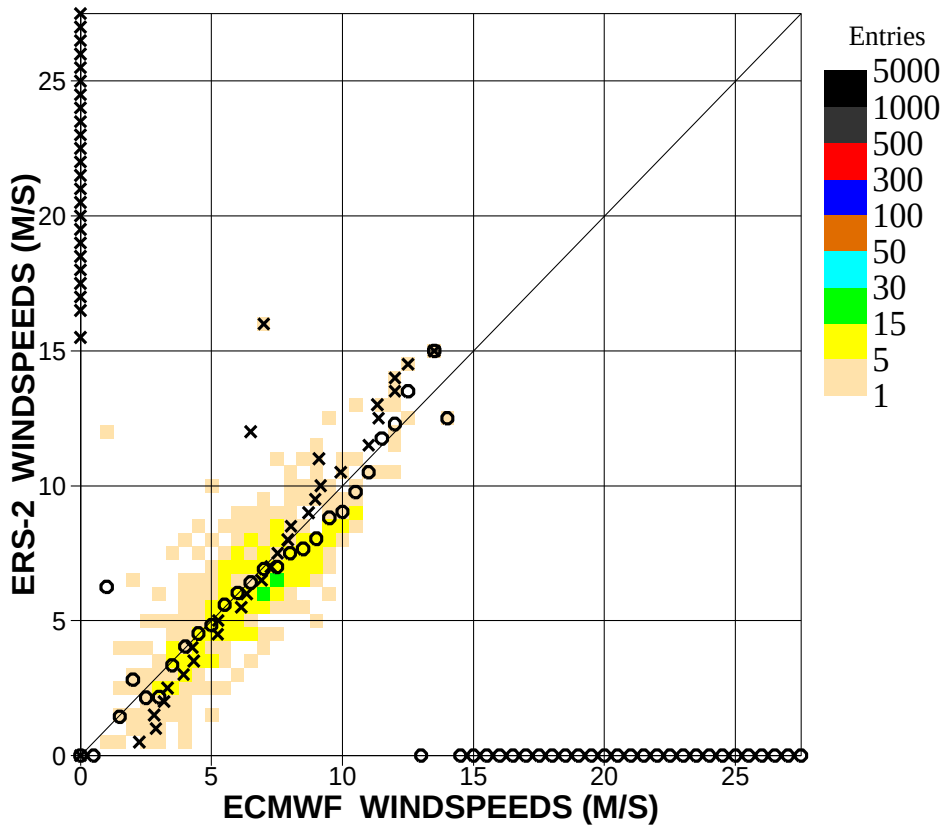


STATISTICS

ENTRIES	4570	
MEAN ECMWF	6.4041	
MEAN ERS-2	5.6142	
BIAS (ERS-2 - ECMWF)	-0.7899	
STANDARD DEVIATION	1.2315	
SCATTER INDEX	0.1923	
CORRELATION	0.9267	
SYMMETRIC SLOPE	0.9262	(0.0069)
REGR. COEFFICIENT	1.0633	(0.0064)
REGR. CONSTANT	-1.1954	(0.0447)

Figure 7. Comparison of ECMWF wind speed results with ERS2 Altimeter wind speed data for June 2008 (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

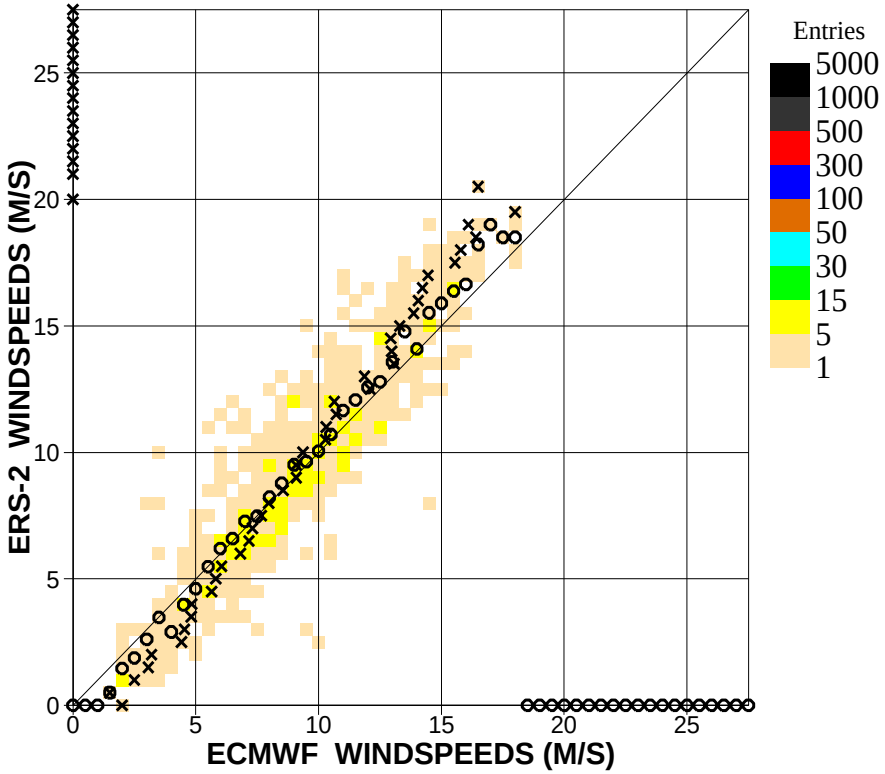


STATISTICS

ENTRIES	682	
MEAN ECMWF	6.4056	
MEAN ERS-2	6.1430	
BIAS (ERS-2 - ECMWF)	-0.2626	
STANDARD DEVIATION	1.4148	
SCATTER INDEX	0.2209	
CORRELATION	0.8239	
SYMMETRIC SLOPE	0.9758	(0.0242)
REGR. COEFFICIENT	0.9095	(0.0240)
REGR. CONSTANT	0.3173	(0.1628)

Figure 8. Comparison of ECMWF wind speed results with ERS2 Altimeter wind speed data for June 2008 (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

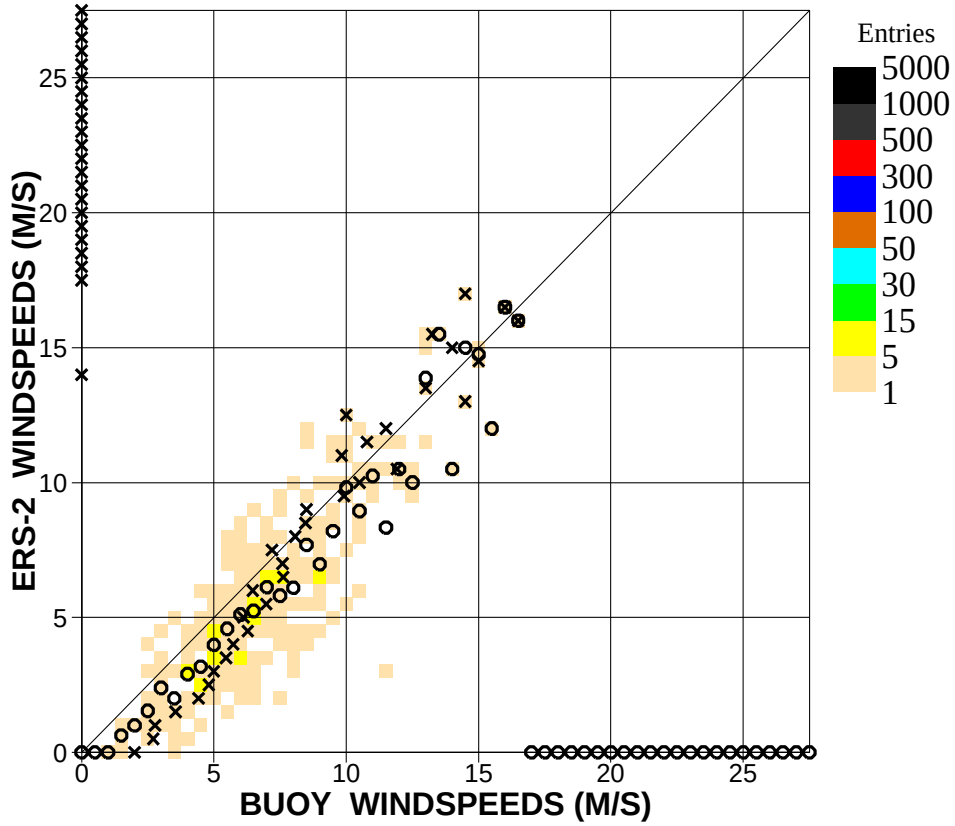


STATISTICS

ENTRIES	783	
MEAN ECMWF	9.3911	
MEAN ERS-2	9.6801	
BIAS (ERS-2 - ECMWF)	0.2890	
STANDARD DEVIATION	1.7475	
SCATTER INDEX	0.1861	
CORRELATION	0.9146	
SYMMETRIC SLOPE	1.0539	(0.0177)
REGR. COEFFICIENT	1.1045	(0.0175)
REGR. CONSTANT	-0.6921	(0.1751)

Figure 9. Comparison of ECMWF wind speed results with ERS2 Altimeter wind speed data for June 2008 (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

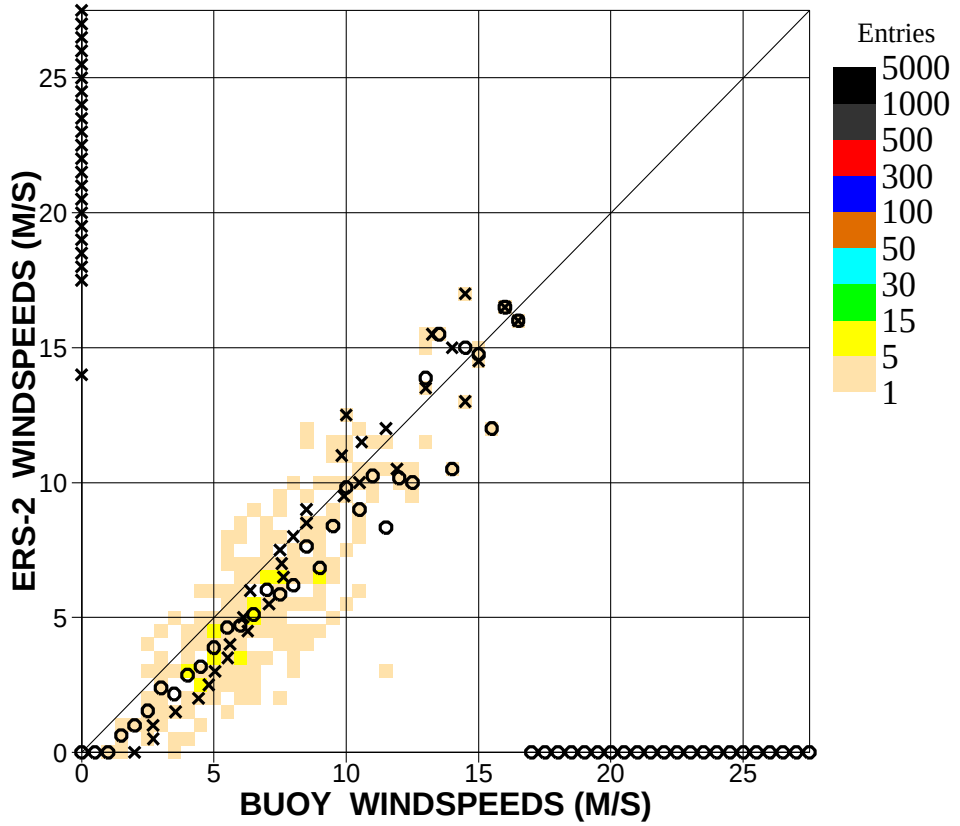


STATISTICS

ENTRIES	352	
MEAN BUOY	6.7776	
MEAN ERS-2	5.6491	
BIAS (ERS-2 - BUOY)	-1.1285	
STANDARD DEVIATION	1.6433	
SCATTER INDEX	0.2425	
CORRELATION	0.8587	
SYMMETRIC SLOPE	0.8874	(0.0331)
REGR. COEFFICIENT	0.9967	(0.0318)
REGR. CONSTANT	-1.1060	(0.2327)

Figure 10. Comparison of buoy wind speed observations with ERS2 Altimeter wind speed data for June 2008 (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

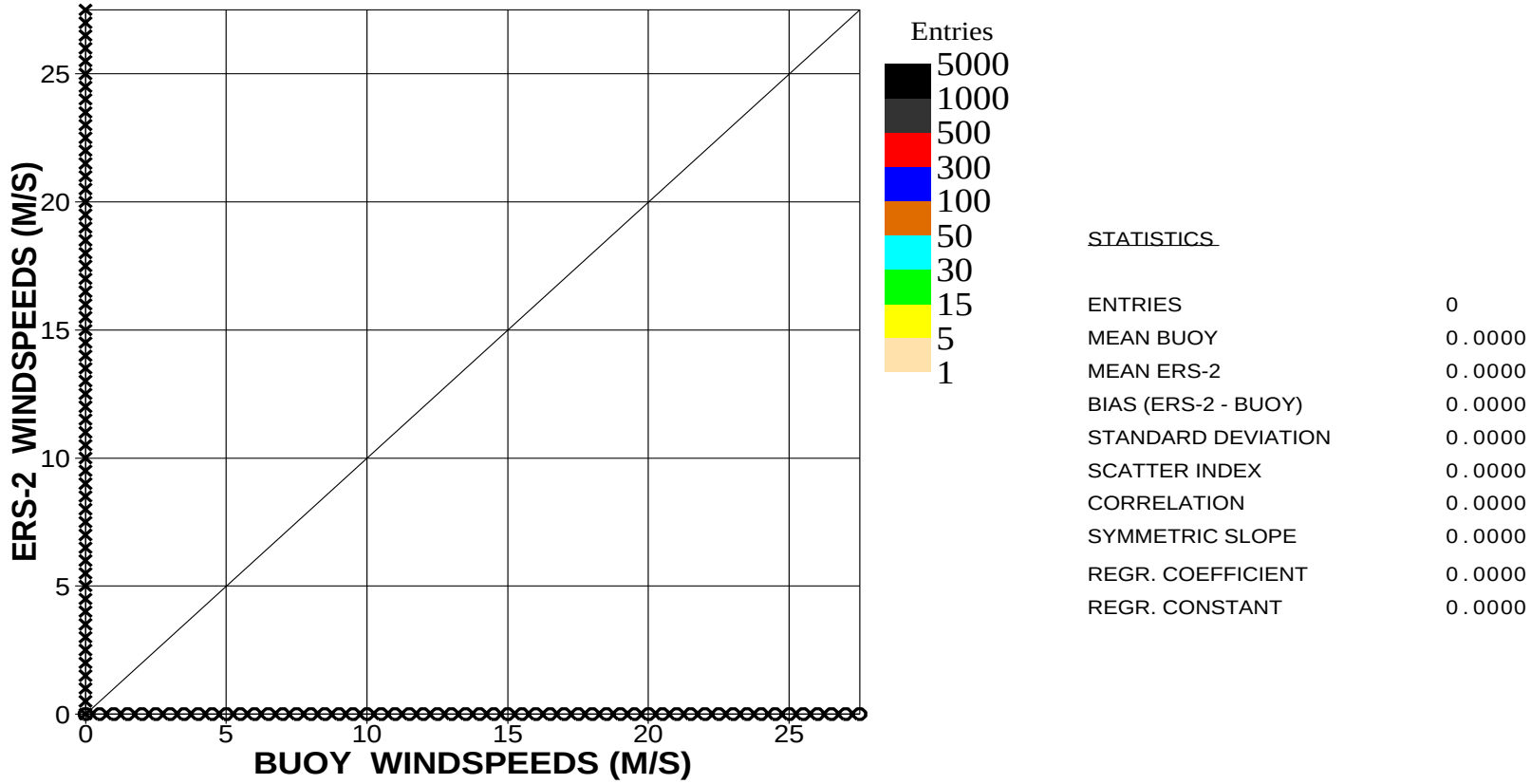


STATISTICS

ENTRIES	323	
MEAN BUOY	6.7674	
MEAN ERS-2	5.5966	
BIAS (ERS-2 - BUOY)	-1.1708	
STANDARD DEVIATION	1.6547	
SCATTER INDEX	0.2445	
CORRELATION	0.8636	
SYMMETRIC SLOPE	0.8845	(0.0342)
REGR. COEFFICIENT	1.0025	(0.0327)
REGR. CONSTANT	-1.1877	(0.2395)

Figure 11. Comparison of buoy wind speed observations with ERS2 Altimeter wind speed data for June 2008 (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



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 2008 (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

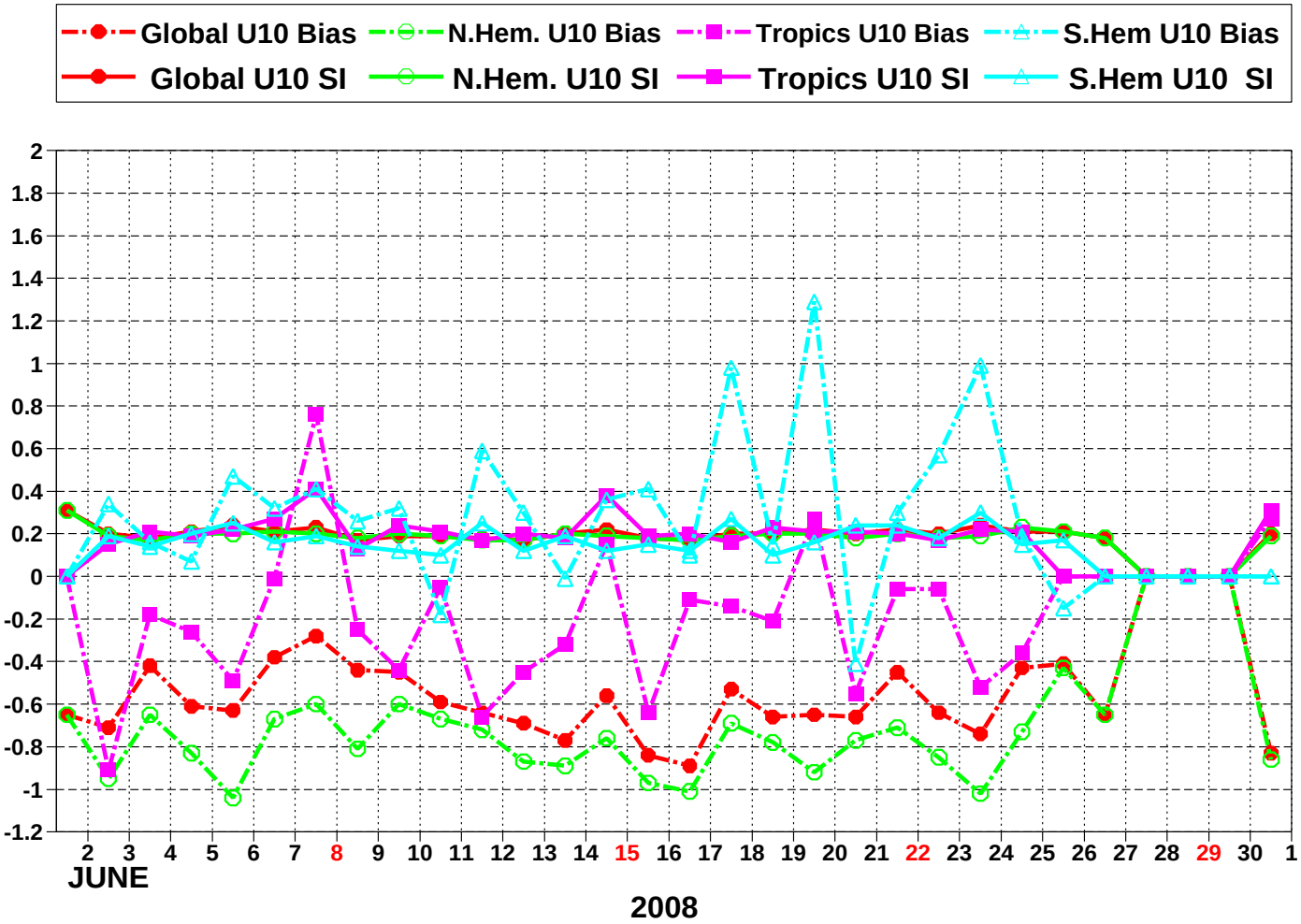


Figure 13: ERS-2 Altimeter wind speeds: Timeseries of bias (ERS-2 - model) and scatter index (SI)

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

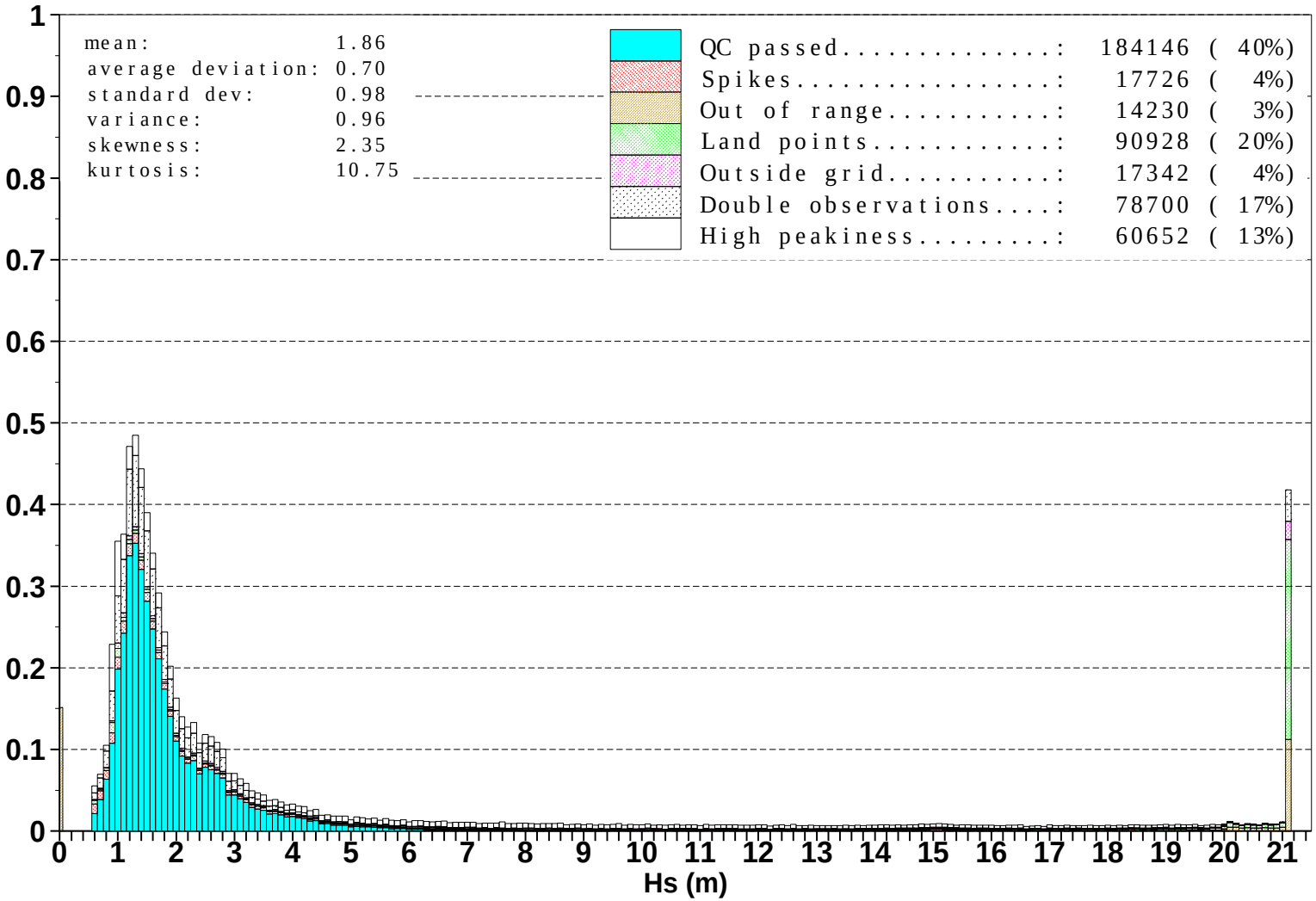


Figure 14: Distribution of the ERS-2 Altimeter wave heights after QC for June 2008

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

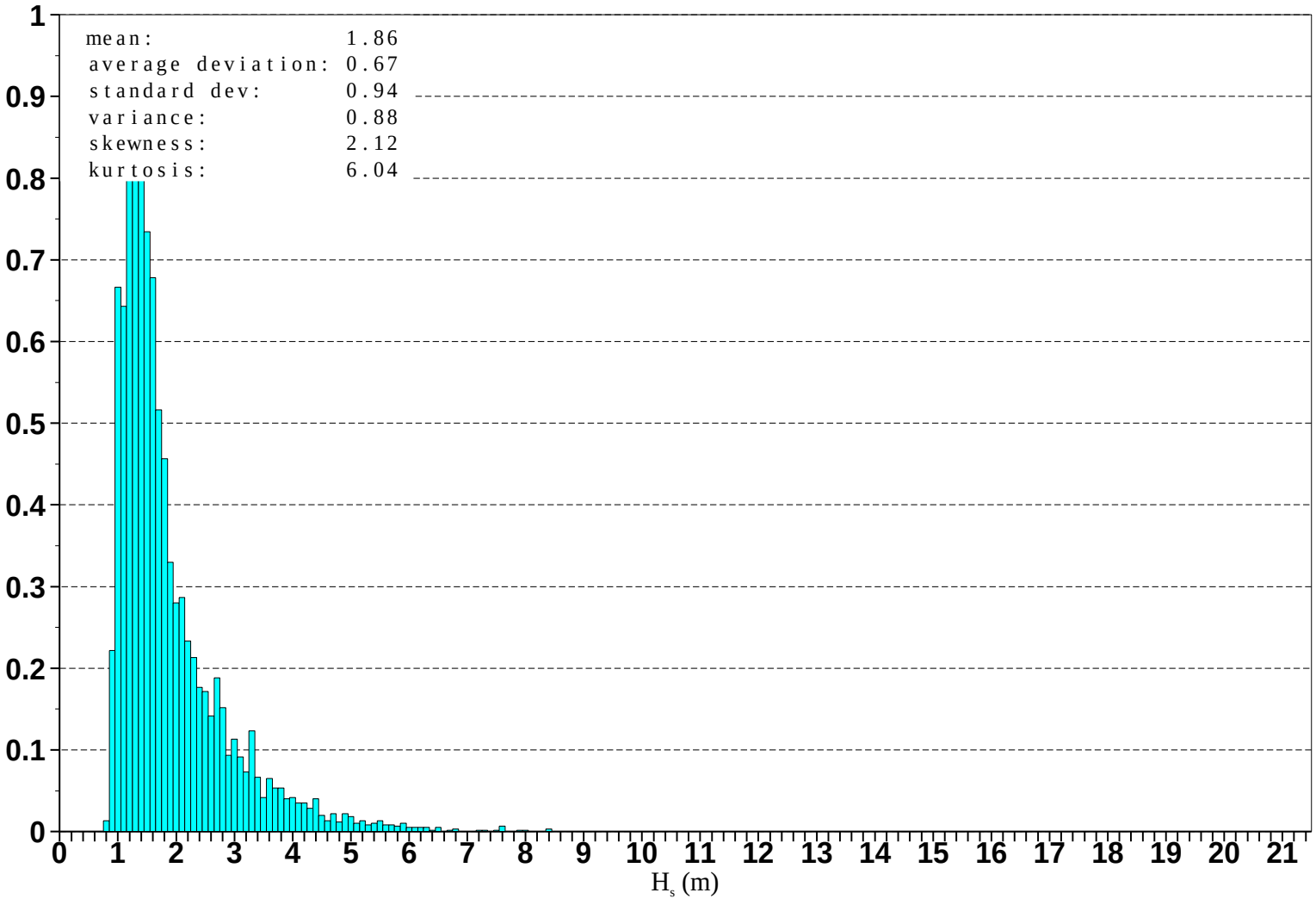


Figure 15: Distribution of ERS-2 Altimeter wave heights after along track averaging for June 2008

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

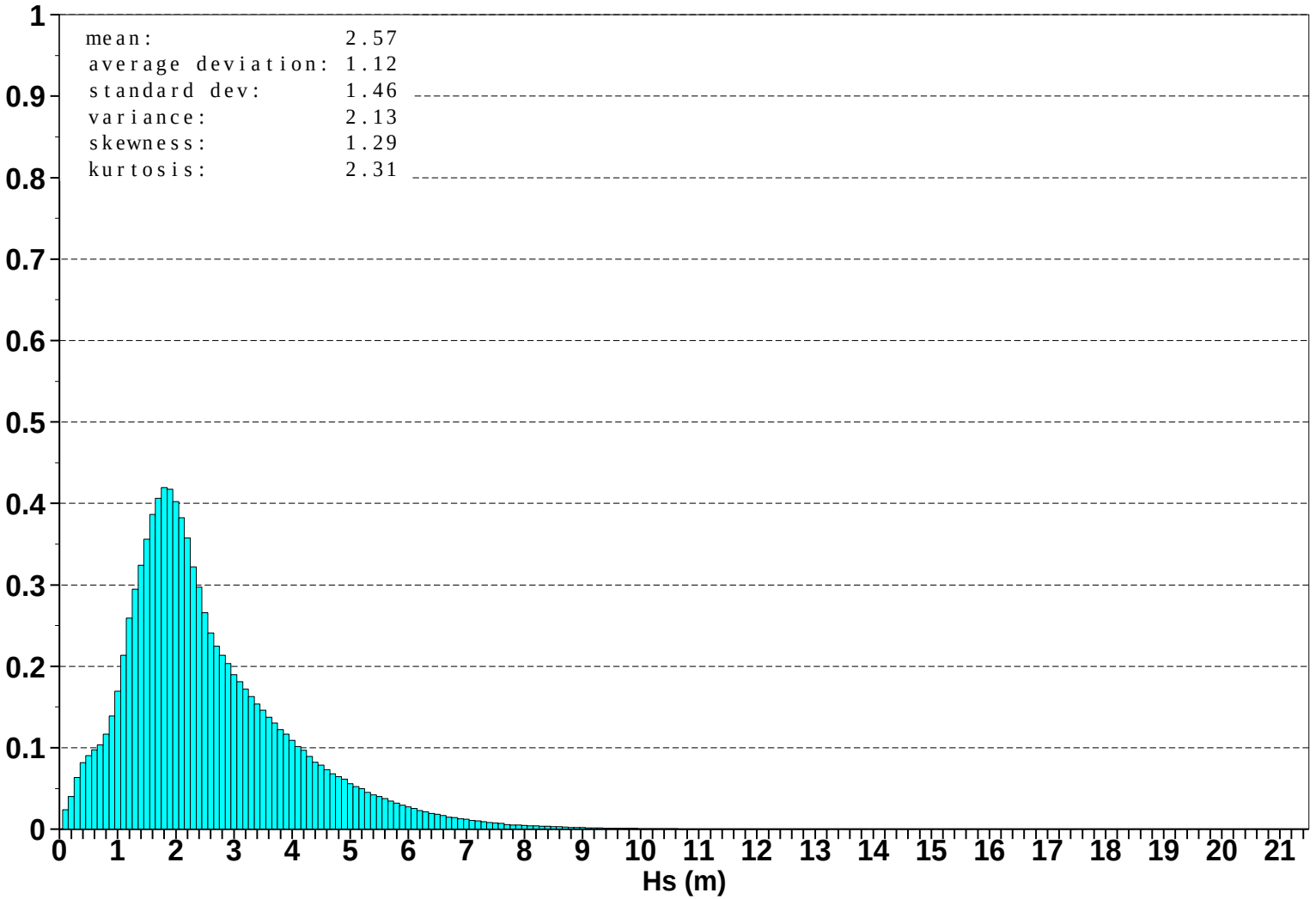
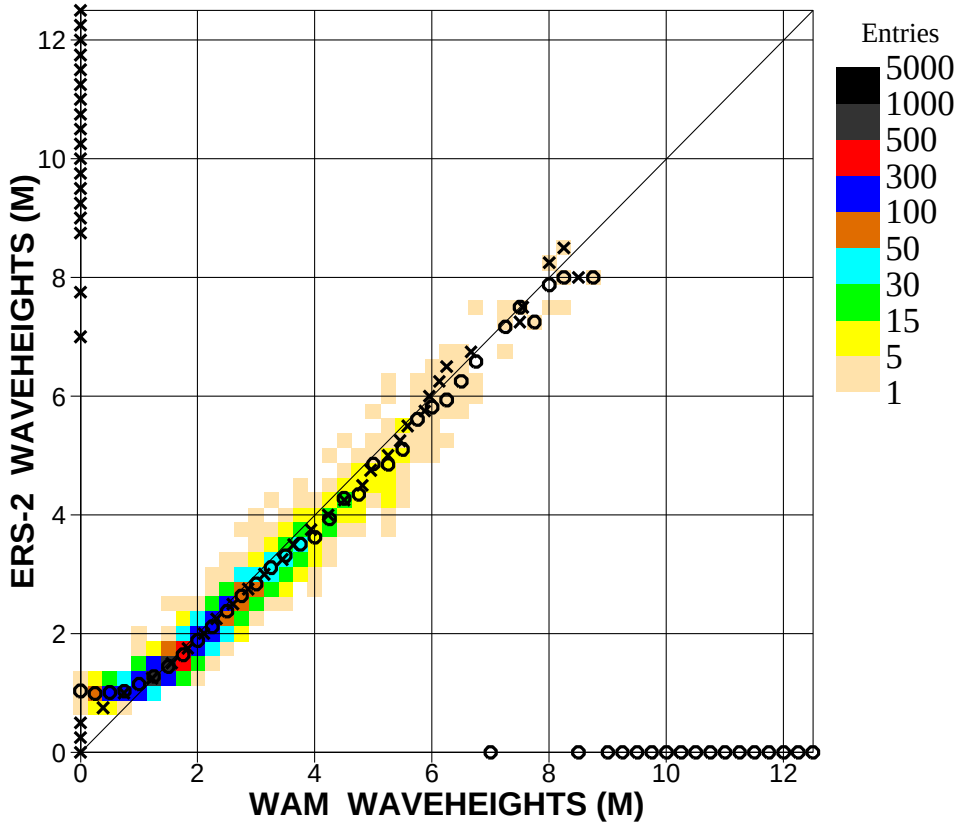


Figure 16: Global distribution of ECMWF wave heights for June 2008

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

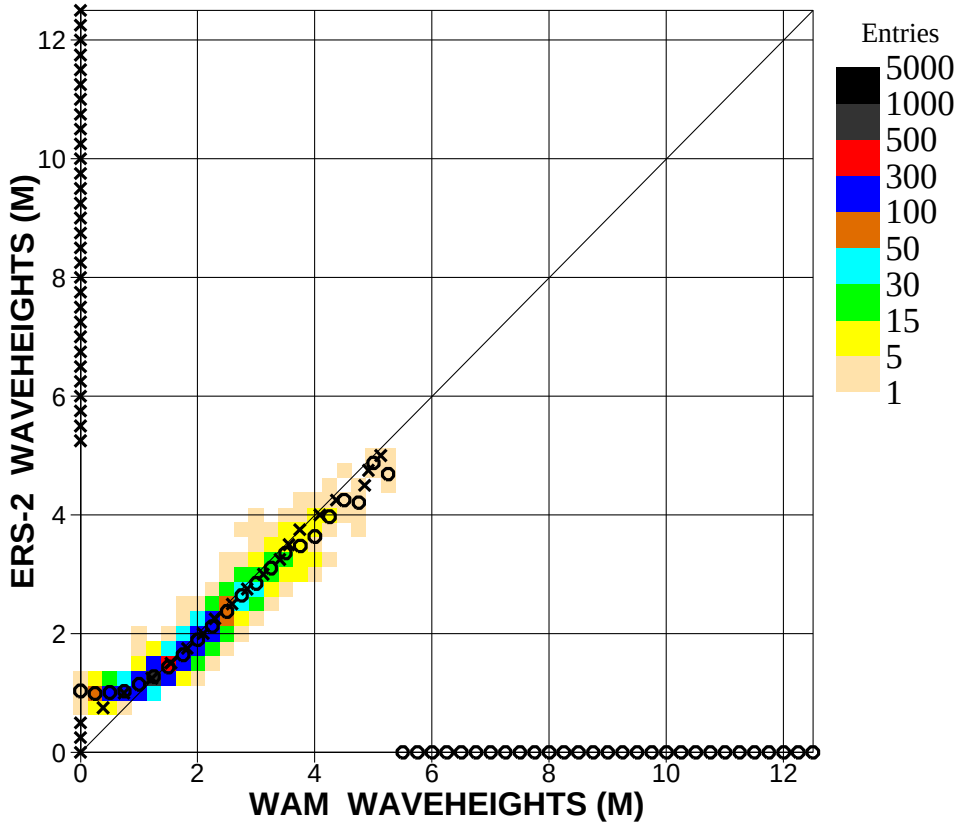


STATISTICS

ENTRIES	6004	
MEAN WAM	1.8805	
MEAN ERS-2	1.8606	
BIAS (ERS-2 - WAM)	-0.0199	
STANDARD DEVIATION	0.2500	
SCATTER INDEX	0.1329	
CORRELATION	0.9753	
SYMMETRIC SLOPE	0.9663	(0.0029)
REGR. COEFFICIENT	0.8665	(0.0025)
REGR. CONSTANT	0.2312	(0.0055)

Figure 17. Comparison of ECMWF wave height results with ERS2 Altimeter wave height data for June 2008 (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

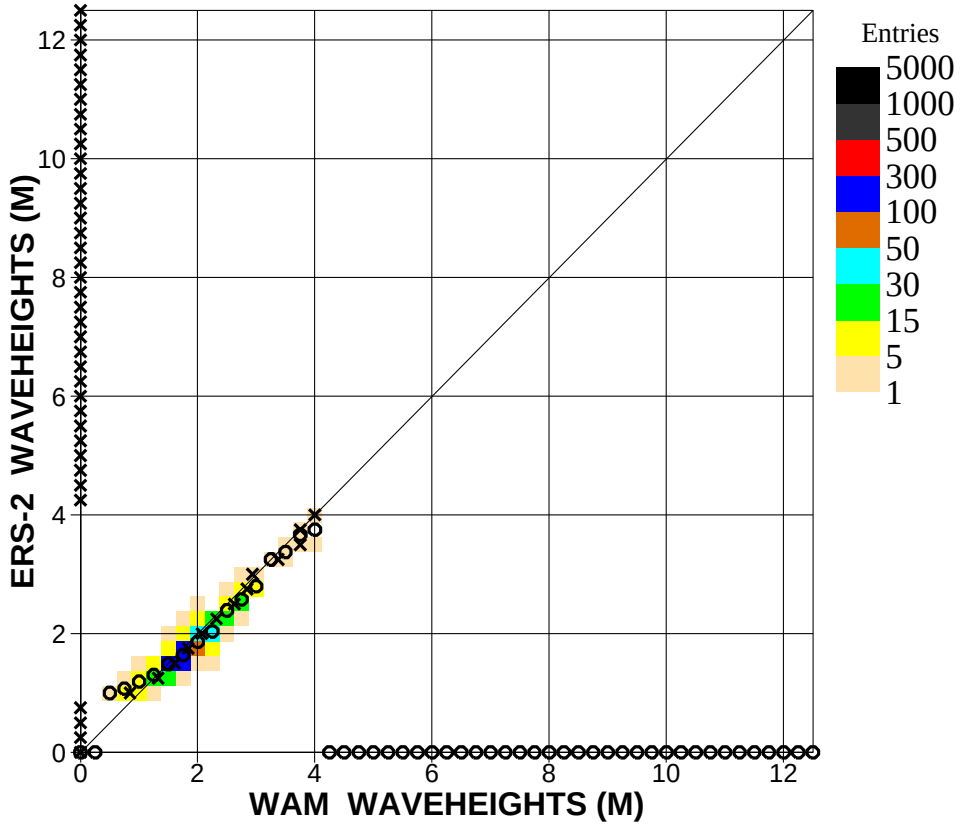


STATISTICS

ENTRIES	4570	
MEAN WAM	1.5905	
MEAN ERS-2	1.6104	
BIAS (ERS-2 - WAM)	0.0199	
STANDARD DEVIATION	0.2325	
SCATTER INDEX	0.1462	
CORRELATION	0.9582	
SYMMETRIC SLOPE	0.9833	(0.0045)
REGR. COEFFICIENT	0.8047	(0.0036)
REGR. CONSTANT	0.3306	(0.0063)

Figure 18. Comparison of ECMWF wave height results with ERS2 Altimeter wave height data for June 2008 (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

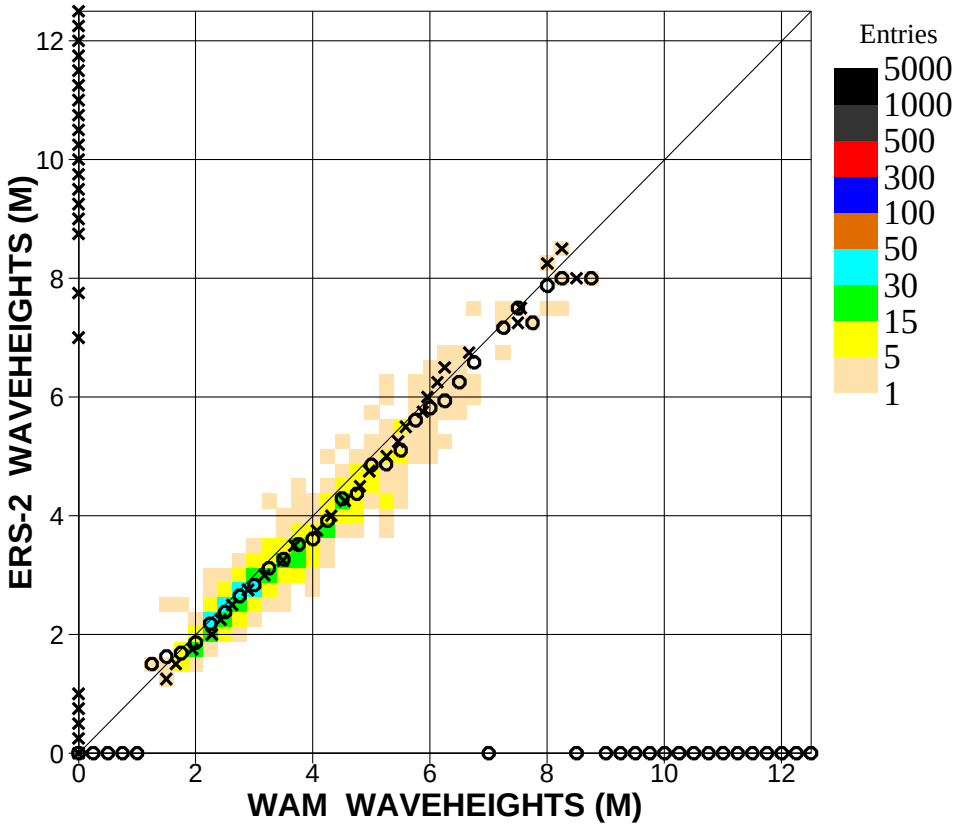


STATISTICS

ENTRIES	682	
MEAN WAM	1.8580	
MEAN ERS-2	1.7740	
BIAS (ERS-2 - WAM)	-0.0839	
STANDARD DEVIATION	0.1514	
SCATTER INDEX	0.0815	
CORRELATION	0.9464	
SYMMETRIC SLOPE	0.9522	(0.0118)
REGR. COEFFICIENT	0.8600	(0.0113)
REGR. CONSTANT	0.1761	(0.0216)

Figure 19. Comparison of ECMWF wave height results with ERS2 Altimeter wave height data for June 2008 (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

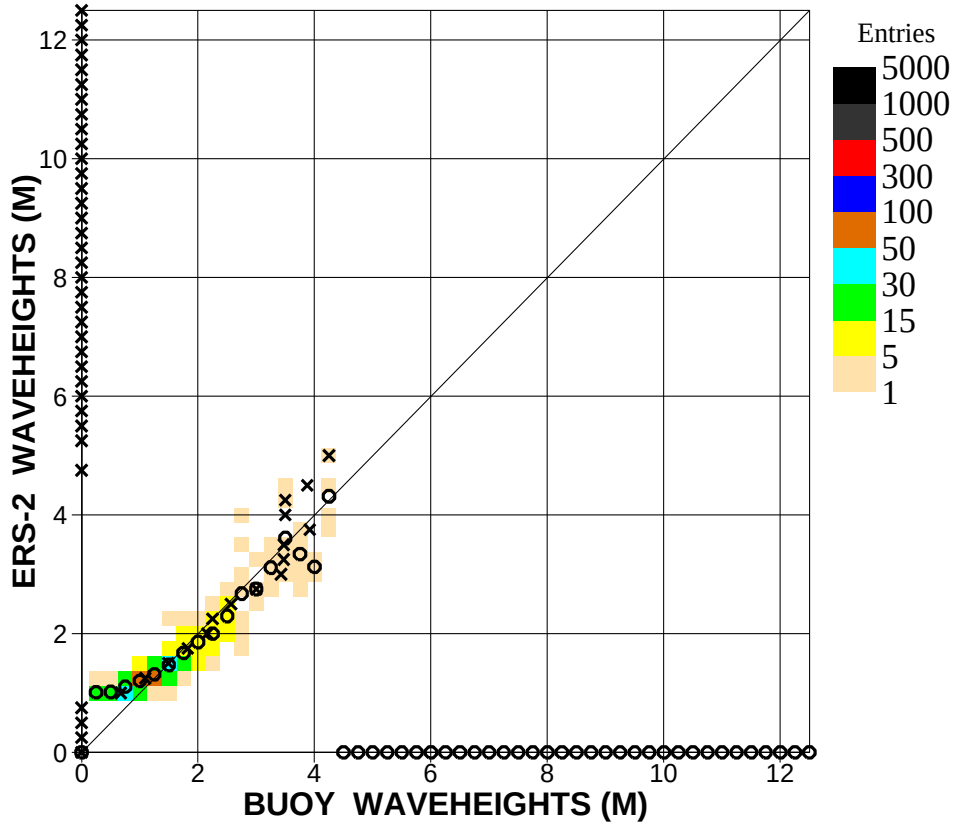


STATISTICS

ENTRIES	783	
MEAN WAM	3.5889	
MEAN ERS-2	3.3897	
BIAS (ERS-2 - WAM)	-0.1991	
STANDARD DEVIATION	0.3169	
SCATTER INDEX	0.0883	
CORRELATION	0.9688	
SYMMETRIC SLOPE	0.9475	(0.0086)
REGR. COEFFICIENT	0.9405	(0.0086)
REGR. CONSTANT	0.0145	(0.0328)

Figure 20. Comparison of ECMWF wave height results with ERS2 Altimeter wave height data for June 2008 (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

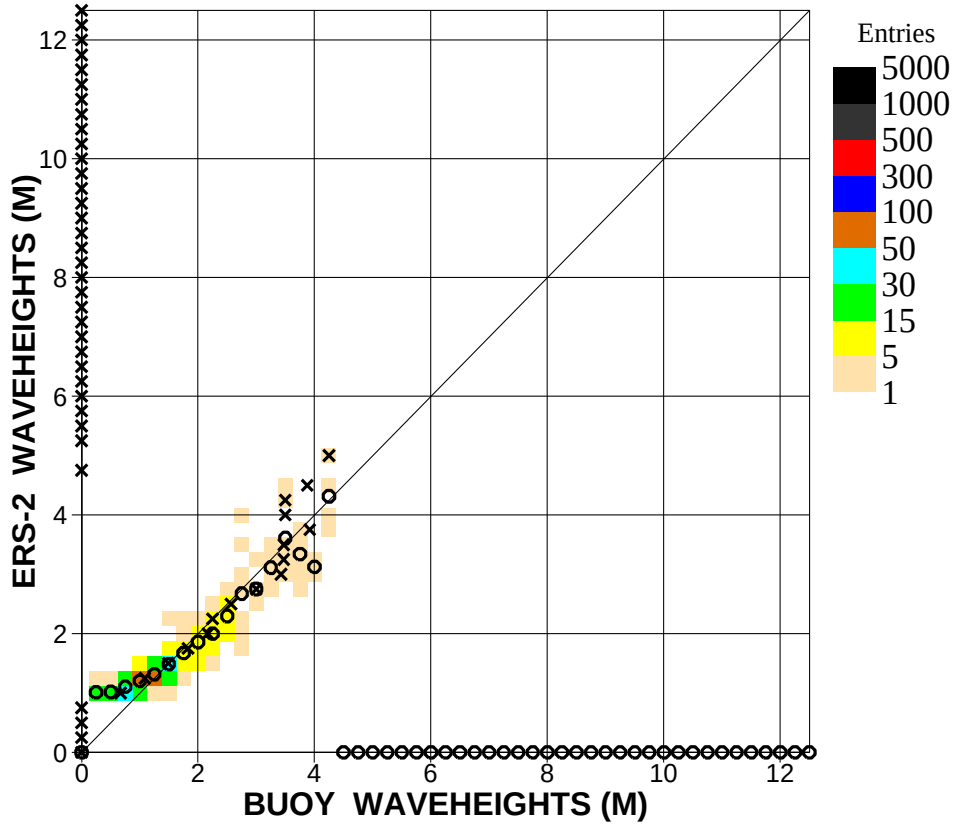


STATISTICS

ENTRIES	539	
MEAN BUOY	1.4795	
MEAN ERS-2	1.5765	
BIAS (ERS-2 - BUOY)	0.0970	
STANDARD DEVIATION	0.3076	
SCATTER INDEX	0.2079	
CORRELATION	0.9377	
SYMMETRIC SLOPE	1.0103	(0.0168)
REGR. COEFFICIENT	0.7599	(0.0122)
REGR. CONSTANT	0.4522	(0.0206)

Figure 21. Comparison of buoy wave height observations with ERS2 Altimeter wave height data for June 2008 (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



STATISTICS

ENTRIES	507	
MEAN BUOY	1.4938	
MEAN ERS-2	1.5927	
BIAS (ERS-2 - BUOY)	0.0989	
STANDARD DEVIATION	0.3135	
SCATTER INDEX	0.2099	
CORRELATION	0.9387	
SYMMETRIC SLOPE	1.0094	(0.0172)
REGR. COEFFICIENT	0.7601	(0.0124)
REGR. CONSTANT	0.4573	(0.0214)

Figure 22. Comparison of buoy wave height observations with ERS2 Altimeter wave height data for June 2008 (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

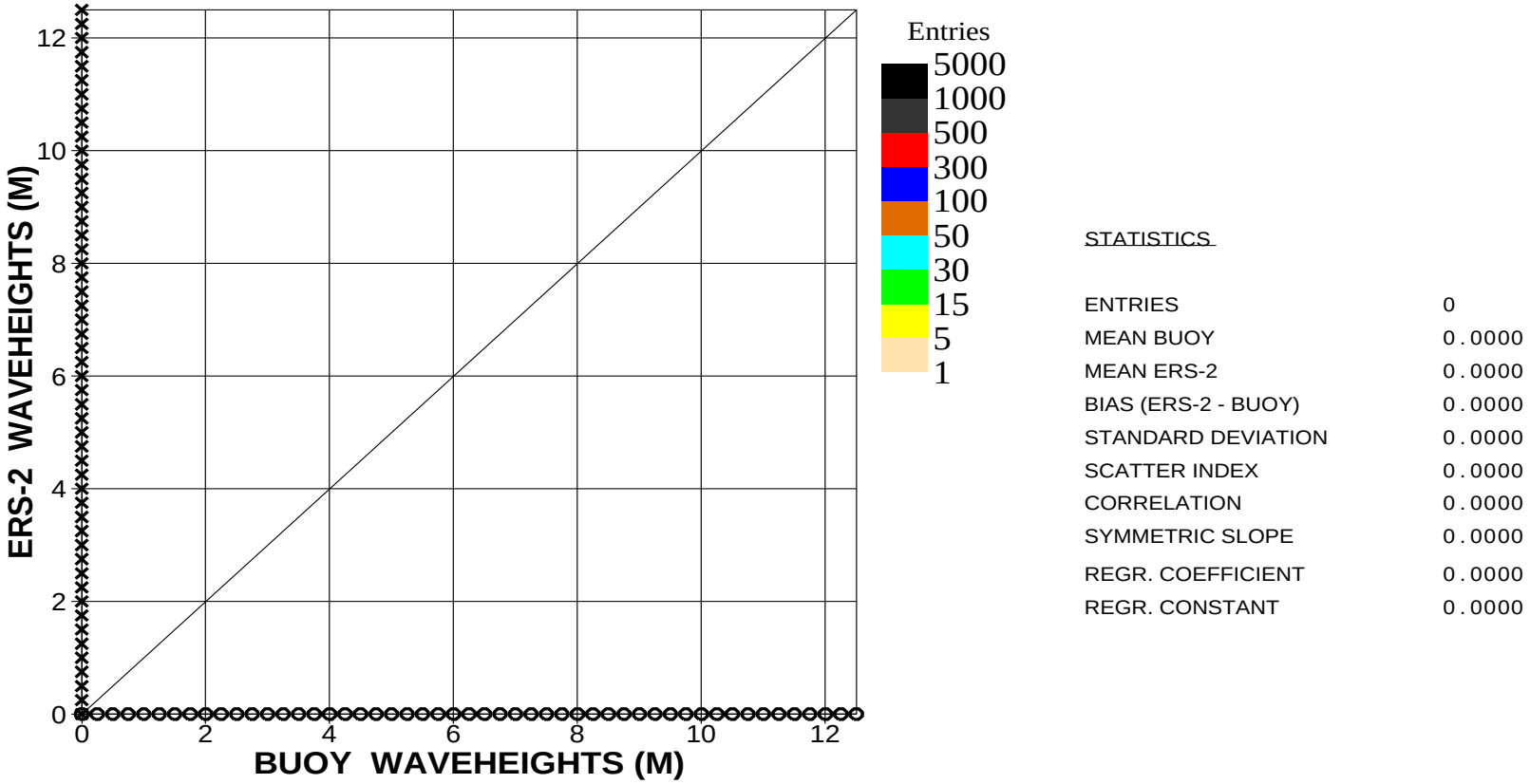


Figure 23. Comparison of buoy wave height observations with ERS2 Altimeter wave height data for June 2008 (hawaii)

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

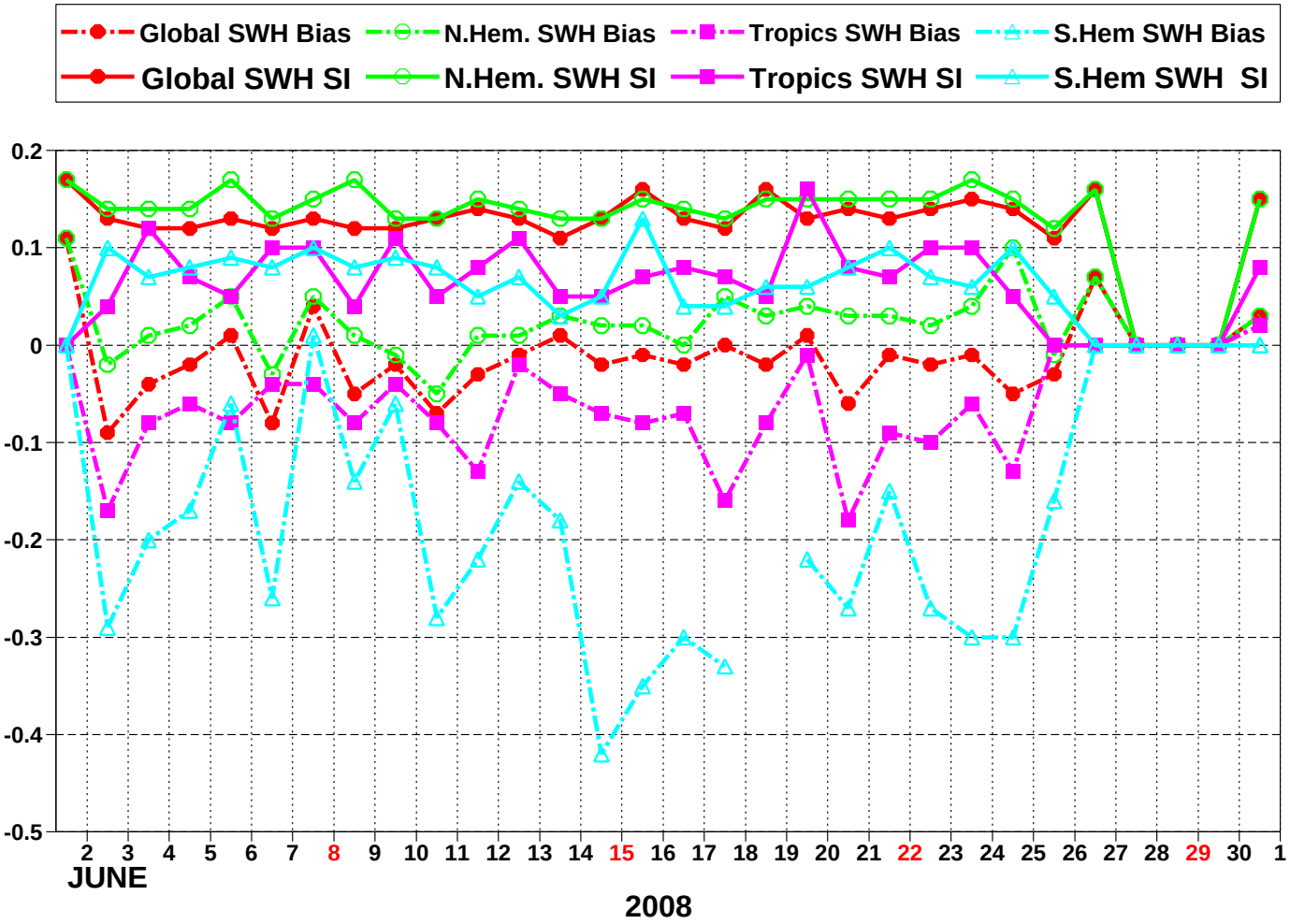


Figure 24: ERS-2 Altimeter wave heights: Timeseries of bias (ERS-2 - model) and scatter index (SI)

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

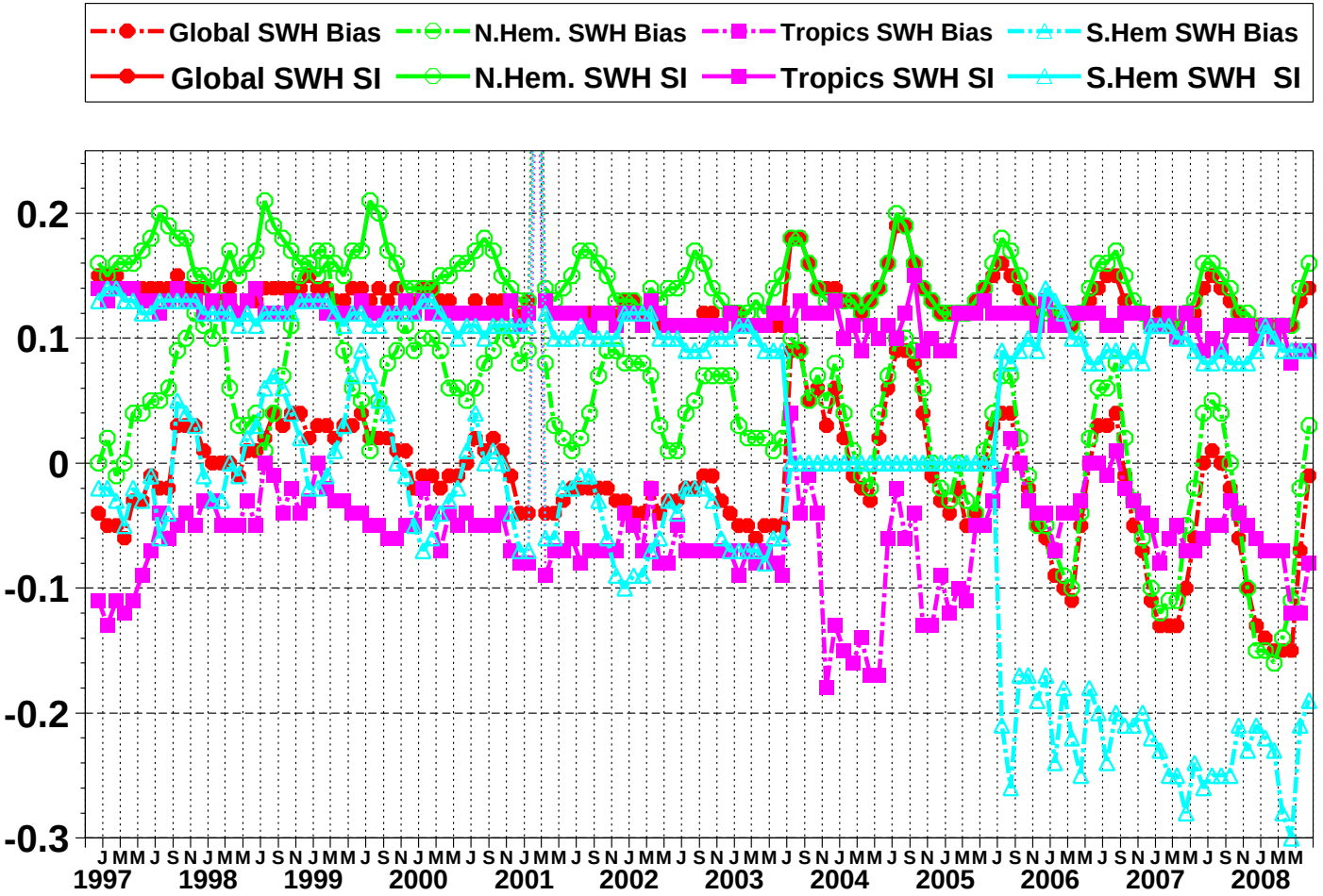


Figure 25: ERS-2 Altimeter wave heights: Timeseries of bias (ERS-2 - model) and scatter index (SI)

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

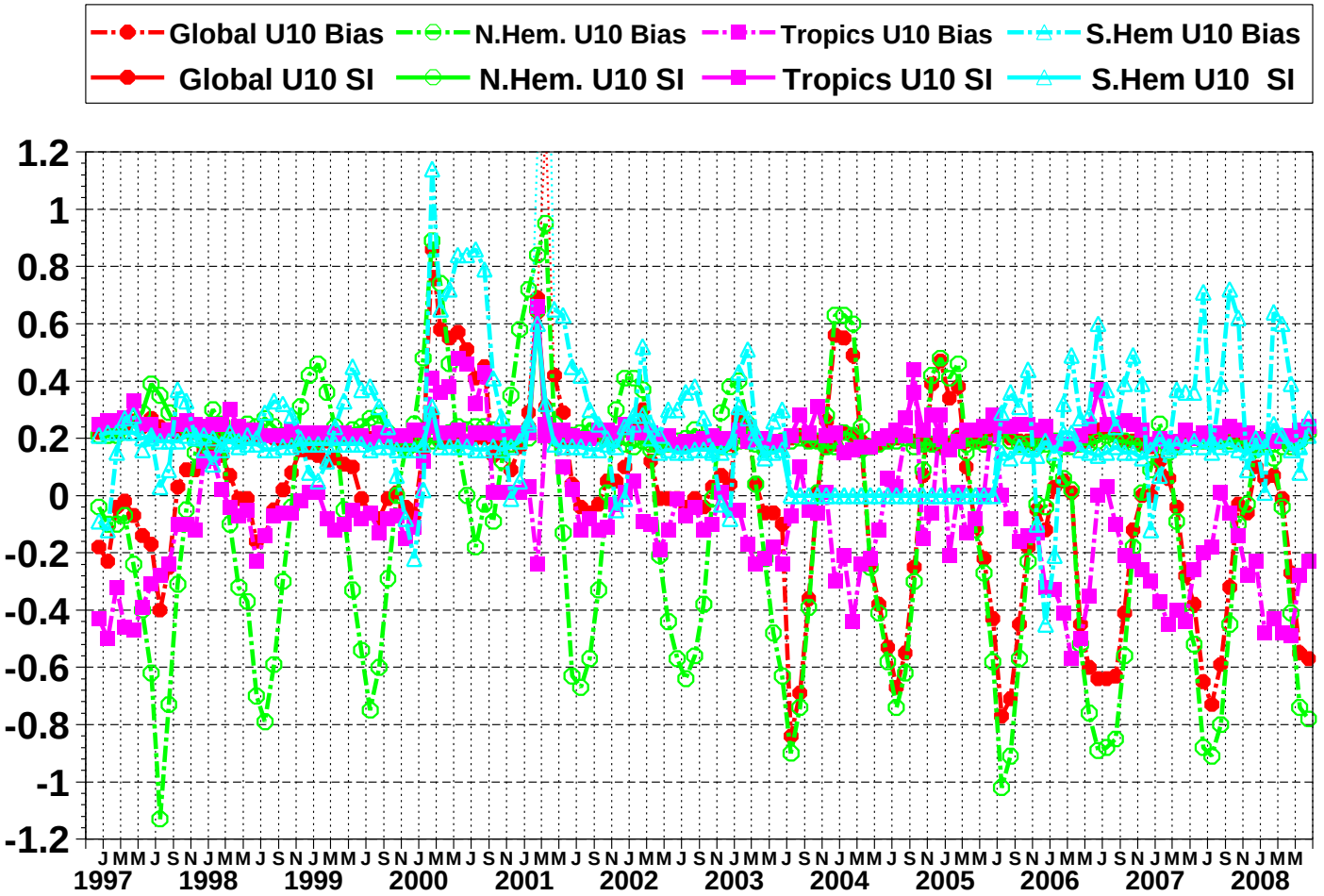


Figure 26: ERS-2 Altimeter wind speeds: Timeseries of bias (ERS-2 - model) and scatter index (SI)

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

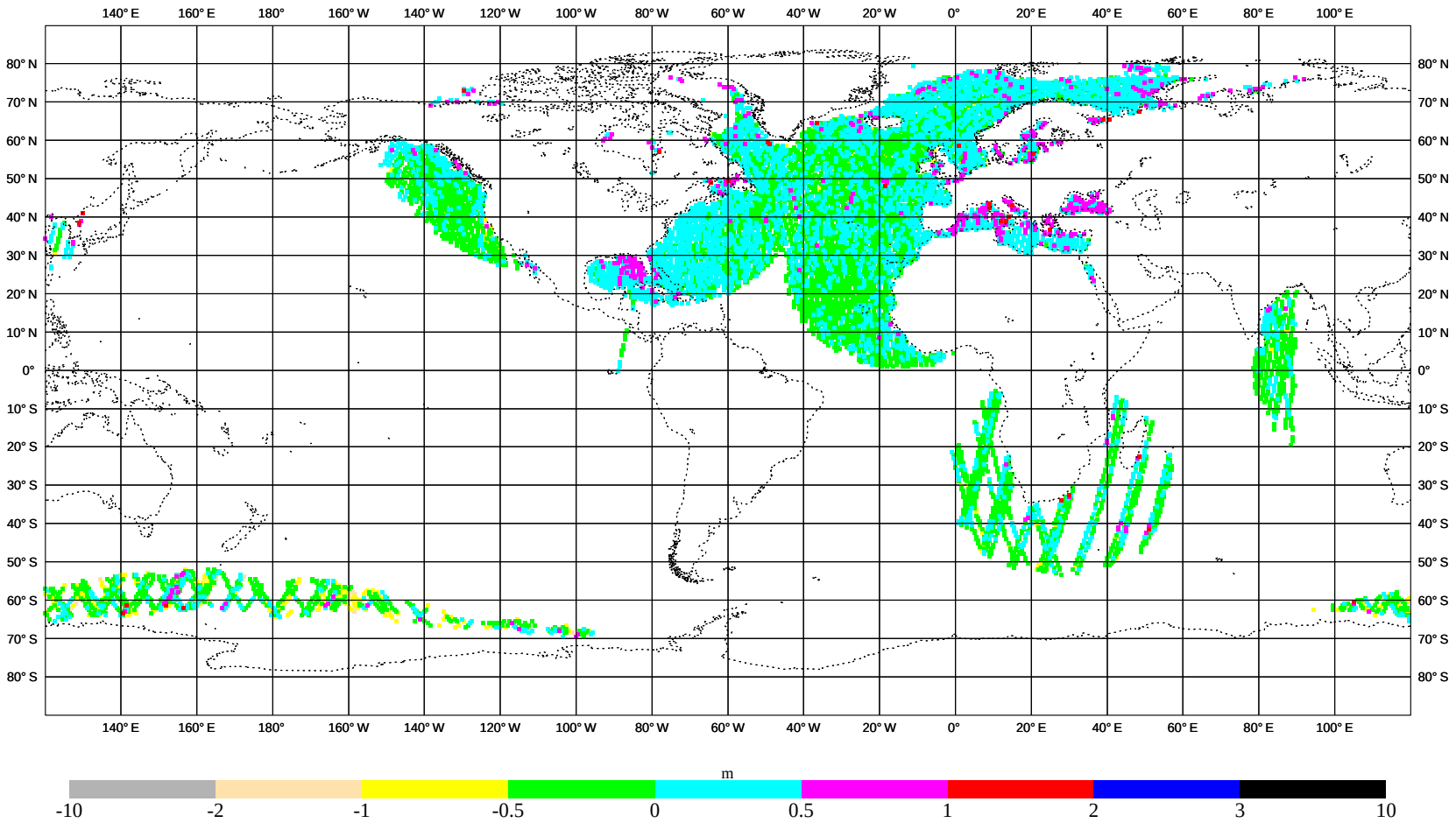


Figure 27: Significant wave height: Monthly mean difference of ERS-2 altimeter data minus wave model results for June 2008

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