ECMWF Report on ERS-2 RA for October 2009

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

By: *Saleh Abdalla*

Date: *10 November 2009*

Overview:

Based on the data received at ECMWF during the whole month, on average, 2496 observations arrived at ECMWF every 6 hours of which 79.34% passed the quality control. As can be seen in Figure 1, there was no data during the 6-hour time windows centred at (all times are UTC):

- from 00:00 to 12:00 on the 2nd (both inclusive),
- 06:00 on the 6th,
- from 00:00 to 12:00 on the 16th (both inclusive), and
- from 00:00 on the 23rd to 18:00 on the 30th (both inclusive) 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 (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:

ESR-2 $\langle s_0 \rangle$ = 11.32 dB (with a main peak at 11.1 dB).

Wind Speed Comparison with ECMWF wind speeds (bias):

ERS-2 global: - 0.110 m/s

ERS-2 northern hemisphere: - 0.103 m/s

ERS-2 tropics: - 0.183 m/s

ERS-2 southern hemisphere: + 0.494 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 October 2009

Wind Speed Comparison with buoy wind speeds (bias):

ERS-2 global: -0.332 m/s

ERS-2 northern hemisphere: -0.227 m/s

ERS-2 tropics (Hawaii): *missing*

Wave Height Comparison with ECMWF wave heights (bias):

ERS-2 global: -0.029 m (lowest waves measured: 0.6m)

ERS-2 northern hemisphere: -0.045 m

ERS-2 tropics: +0.024 m

ERS-2 southern hemisphere: -0.244 m

Wave Height Comparison with buoy wave heights (bias):

ERS-2 global: +0.030 m

ERS-2 northern hemisphere: + 0.044 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 October 2009

- 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 and Jason-2 altimeter significant wave height data are assimilated in the ECMWF wave model.
- ECMWF models were not changed this month. The current operational IFS cycle is CY35R3 (since the 8th of September 2009). The current operational IFS cycle is CY35R3 (since the 8th of September 2009).

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 October 2009.
Figure 2: Distribution of the ERS-2 Altimeter Backscatter after QC for October 2009.
Figure 3: Distribution of the ERS-2 Altimeter wind speeds after QC for October 2009.
Figure 4: Distribution of the ERS-2 Altimeter wind speeds after along track averaging for October 2009.
Figure 5: Global distribution of ECMWF ocean surface wind speeds for October 2009.
Figure 6: Comparison of ECMWF wind speed results with ERS-2 Altimeter wind speed data for October 2009 (global).
Figure 7: Comparison of ECMWF wind speed results with ERS-2 Altimeter wind speed data for October 2009 (northern hemisphere)
Figure 8: Comparison of ECMWF wind speed results with ERS-2 Altimeter wind speed data for October 2009 (tropics)
Figure 9: Comparison of ECMWF wind speed results with ERS-2 Altimeter wind speed data for October 2009 (southern hemisphere)
Figure 10: Comparison of buoy wind speed observations with ERS-2 Altimeter wind speed data for October 2009 (global).
Figure 11: Comparison of buoy wind speed observations with ERS-2 Altimeter wind speed data for October 2009 (northern hemisphere).
Figure 12: Comparison of buoy wind speed observations with ERS-2 Altimeter wind speed data for October 2009 (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 October 2009.

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 October 2009.
Figure 16: Global distribution of ECMWF wave heights for October 2009.
Figure 17: Comparison of ECMWF wave height results with ERS-2 Altimeter wave height data for October 2009 (global).
Figure 18: Comparison of ECMWF wave height results with ERS-2 Altimeter wave height data for October 2009 (northern hemisphere)
Figure 19: Comparison of ECMWF wave height results with ERS-2 Altimeter wave height data for October 2009 (tropics)
Figure 20: Comparison of ECMWF wave height results with ERS-2 Altimeter wave height data for October 2009 (southern hemisphere)
Figure 21: Comparison of buoy wave height observations with ERS-2 Altimeter wave height data for October 2009 (global).
Figure 22: Comparison of buoy wave height observations with ERS-2 Altimeter wave height data for October 2009 (northern hemisphere).
Figure 23: Comparison of buoy wave height observations with ERS-2 Altimeter wave height data for October 2009 (hawaii).
Figure 24: ERS-2 Altimeter wave heights: Timeseries of bias (ERS-2 - model) and scatter index (SI) for October 2009.
Figure 25: ERS-2 Altimeter wave heights: Timeseries of bias (ERS-2 - model) and scatter index (SI) from December 1996 to October 2009.
Figure 26: ERS-2 Altimeter wind speeds: Timeseries of bias (ERS-2 - model) and scatter index (SI) from December 1996 to October 2009.
Figure 27: Significant wave height: Monthly mean difference of ERS-2 altimeter data minus wave model results for October 2009.

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 October 2009

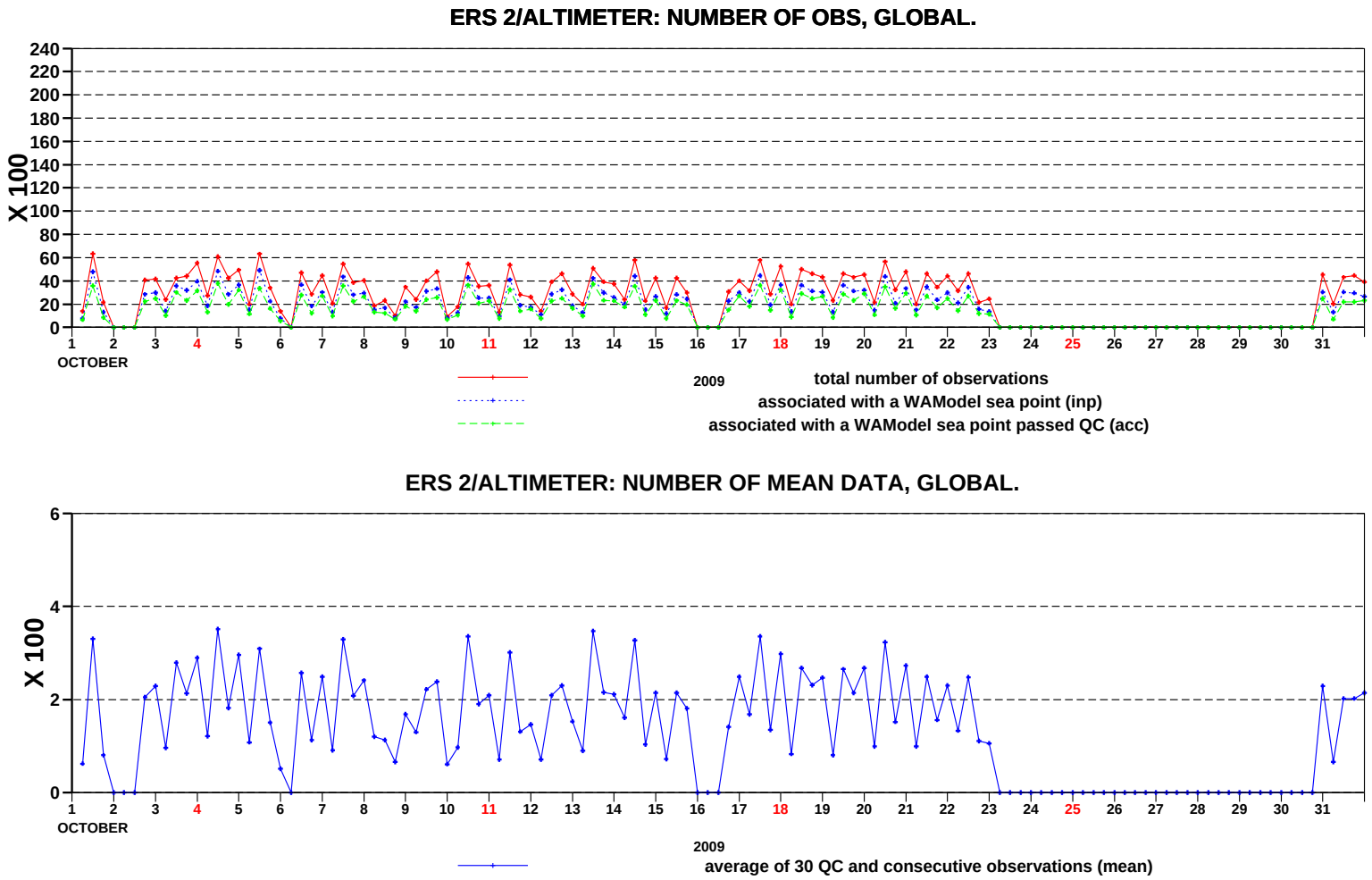


Figure 1:Time series of data reception for ERS-2 Altimeter data for October 2009

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

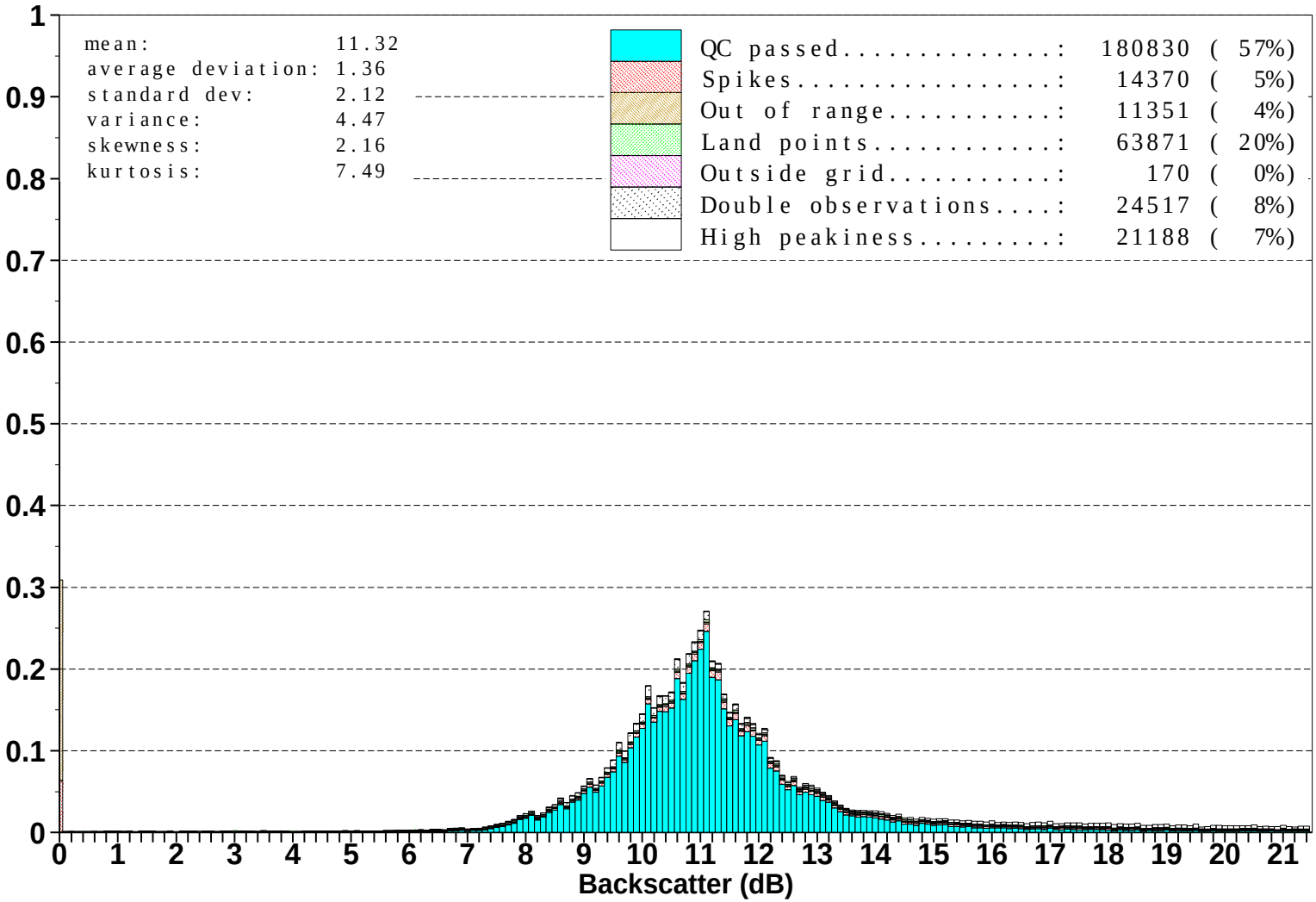


Figure 2: Distribution of the ERS-2 Altimeter backscatter after QC for October 2009

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

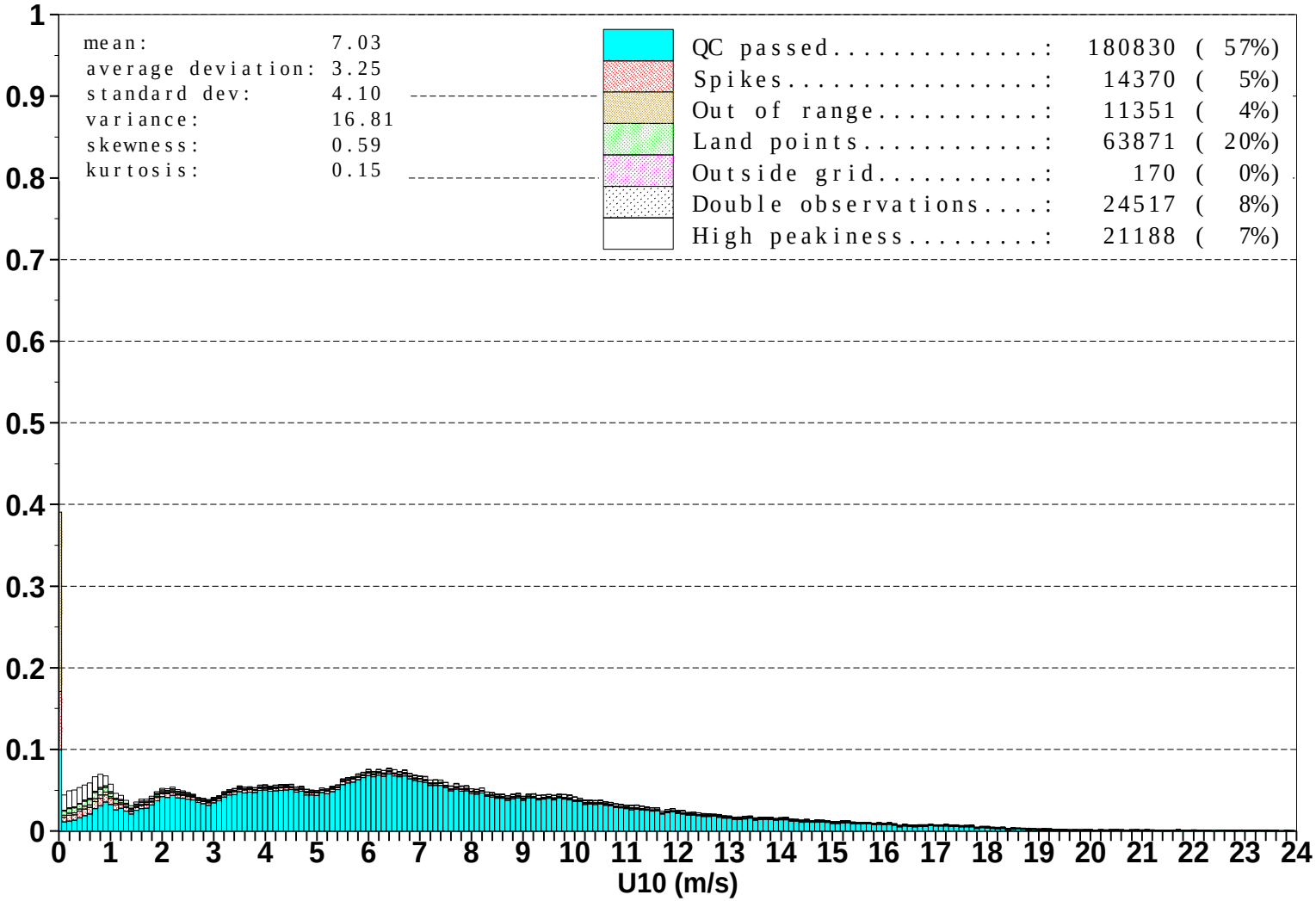


Figure 3: Distribution of the ERS-2 Altimeter wind speeds after QC for October 2009

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

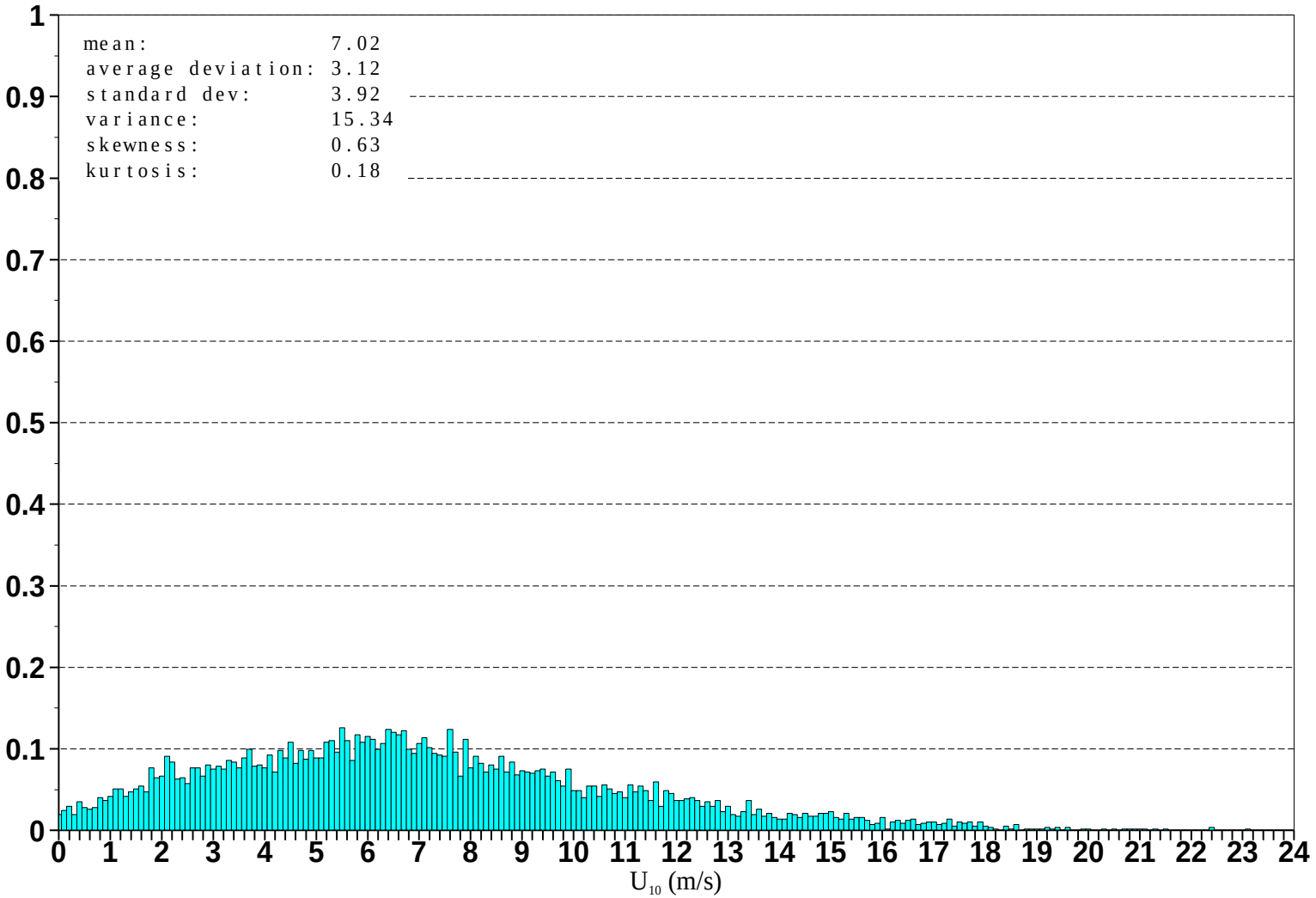


Figure 4: Distribution of ERS-2 Altimeter wind speeds after along track averaging for October 2009

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

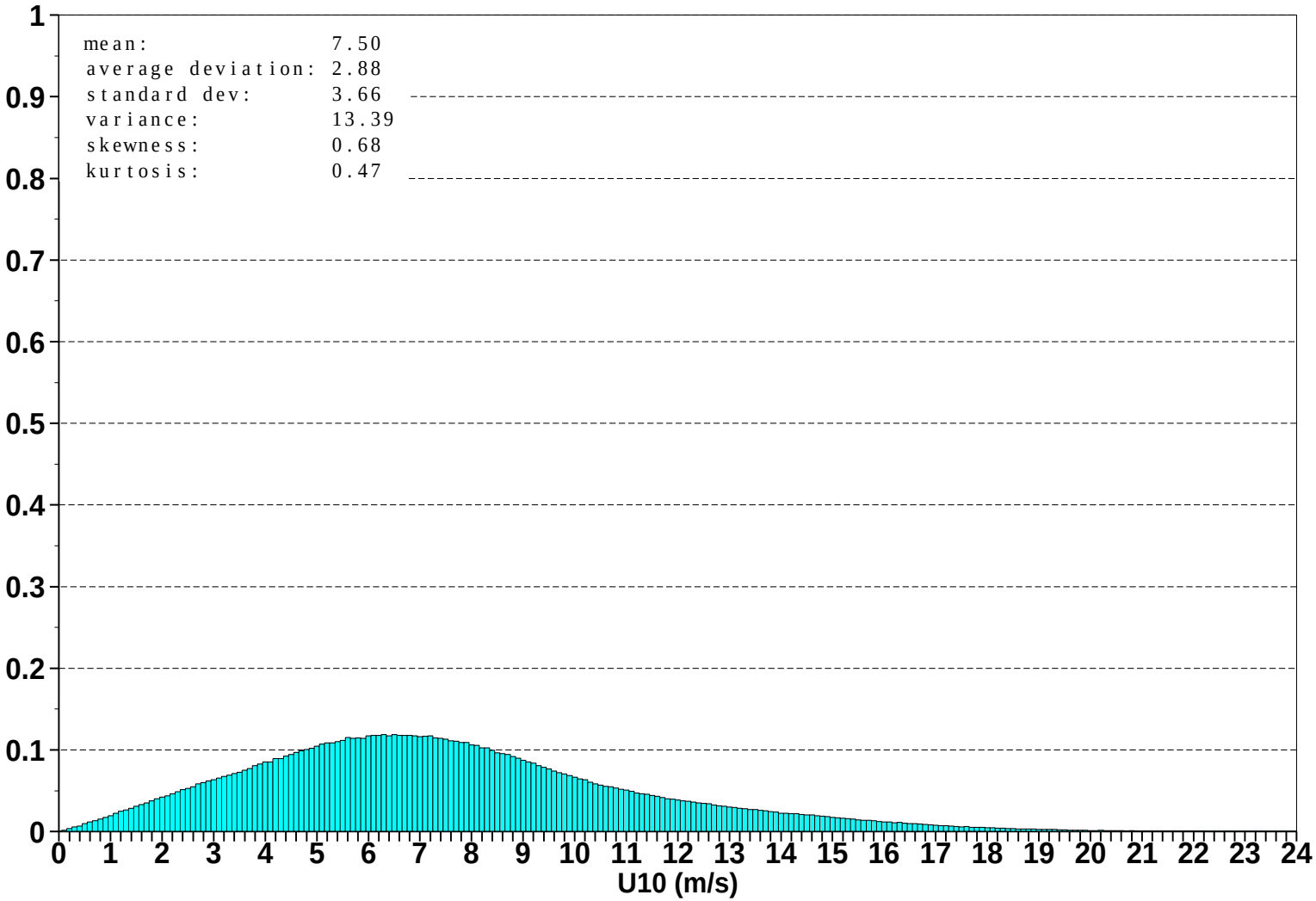
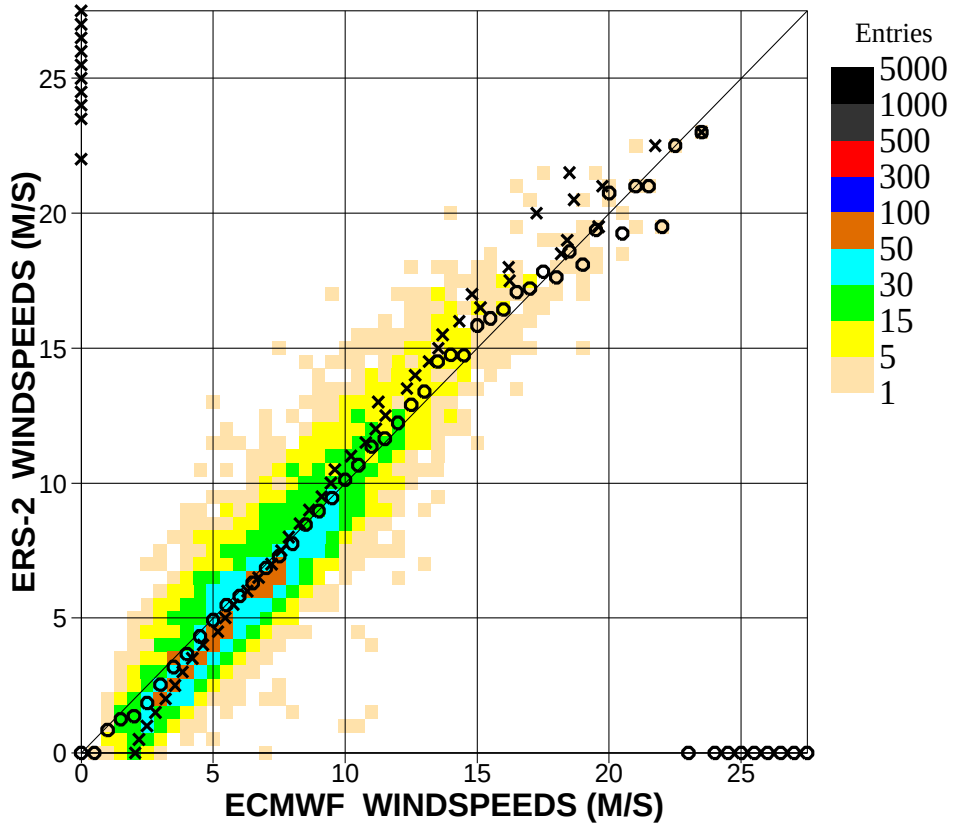


Figure 5: Global distribution of ECMWF ocean surface wind speeds for October 2009

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



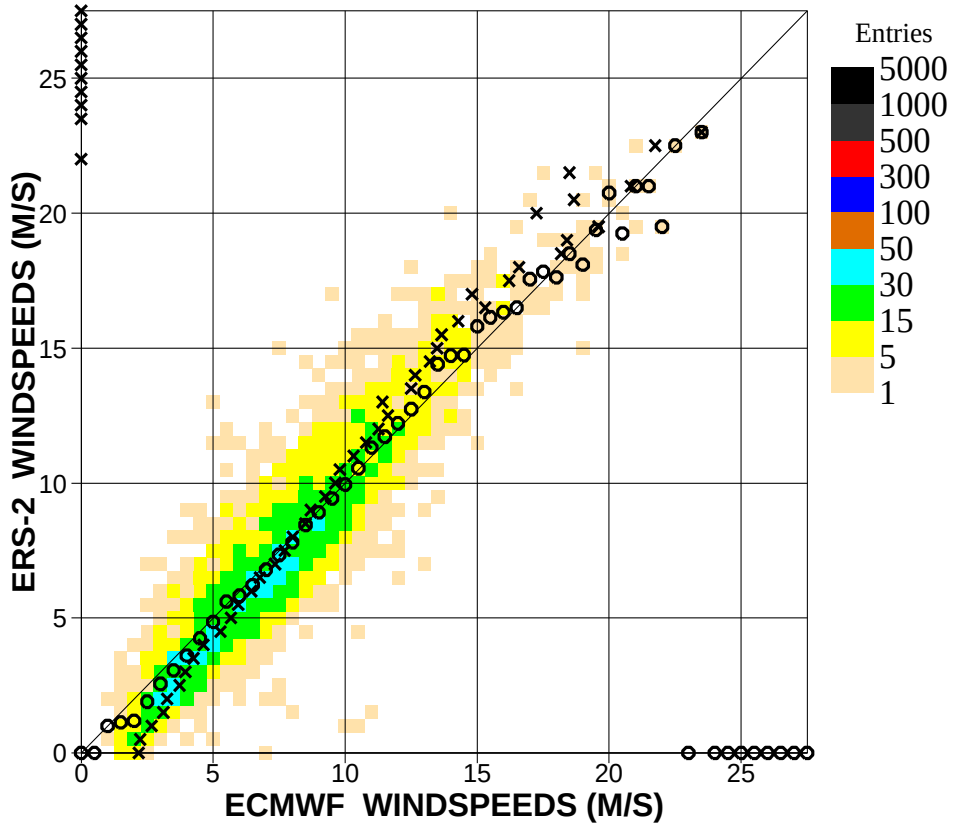
STATISTICS

ENTRIES	5727	
MEAN ECMWF	7.1292	
MEAN ERS-2	7.0191	
BIAS (ERS-2 - ECMWF)	-0.1100	
STANDARD DEVIATION	1.5070	
SCATTER INDEX	0.2114	
CORRELATION	0.9248	
SYMMETRIC SLOPE	1.0178	(0.0059)
REGR. COEFFICIENT	1.0658	(0.0058)
REGR. CONSTANT	-0.5795	(0.0458)

Figure 6. Comparison of ECMWF wind speed results with ERS2 Altimeter wind speed data for October 2009 (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 October 2009

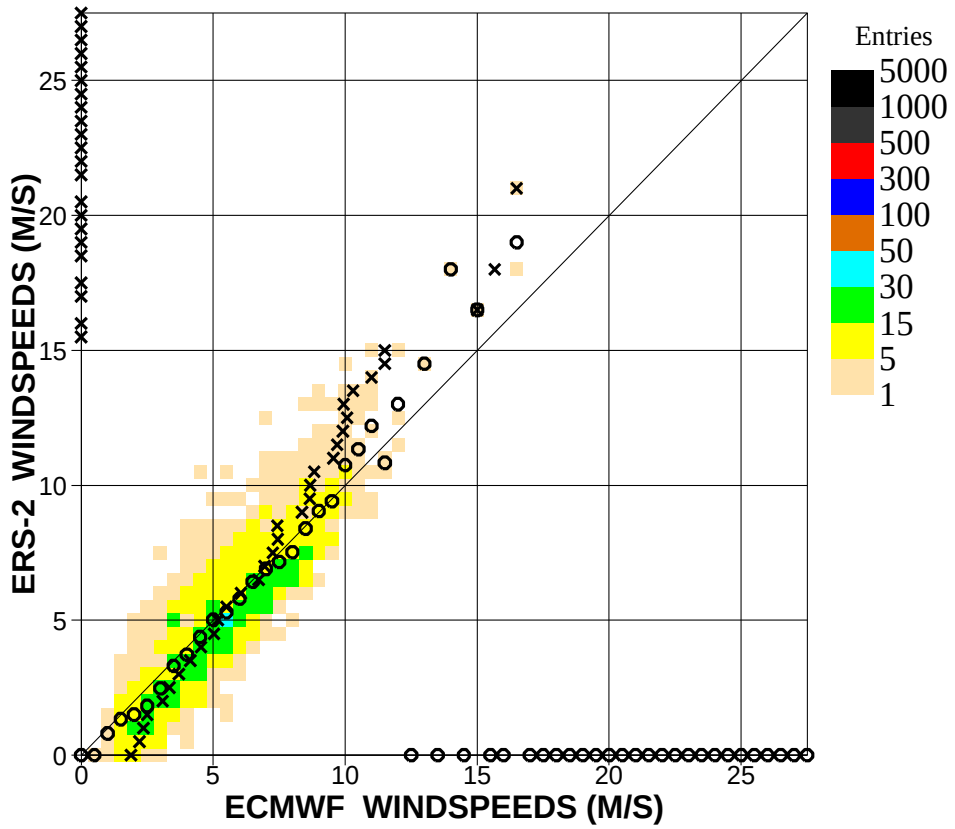


STATISTICS

ENTRIES	3916	
MEAN ECMWF	7.7350	
MEAN ERS-2	7.6323	
BIAS (ERS-2 - ECMWF)	-0.1027	
STANDARD DEVIATION	1.5465	
SCATTER INDEX	0.1999	
CORRELATION	0.9241	
SYMMETRIC SLOPE	1.0162	(0.0071)
REGR. COEFFICIENT	1.0632	(0.0070)
REGR. CONSTANT	-0.5917	(0.0596)

Figure 7. Comparison of ECMWF wind speed results with ERS2 Altimeter wind speed data for October 2009 (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



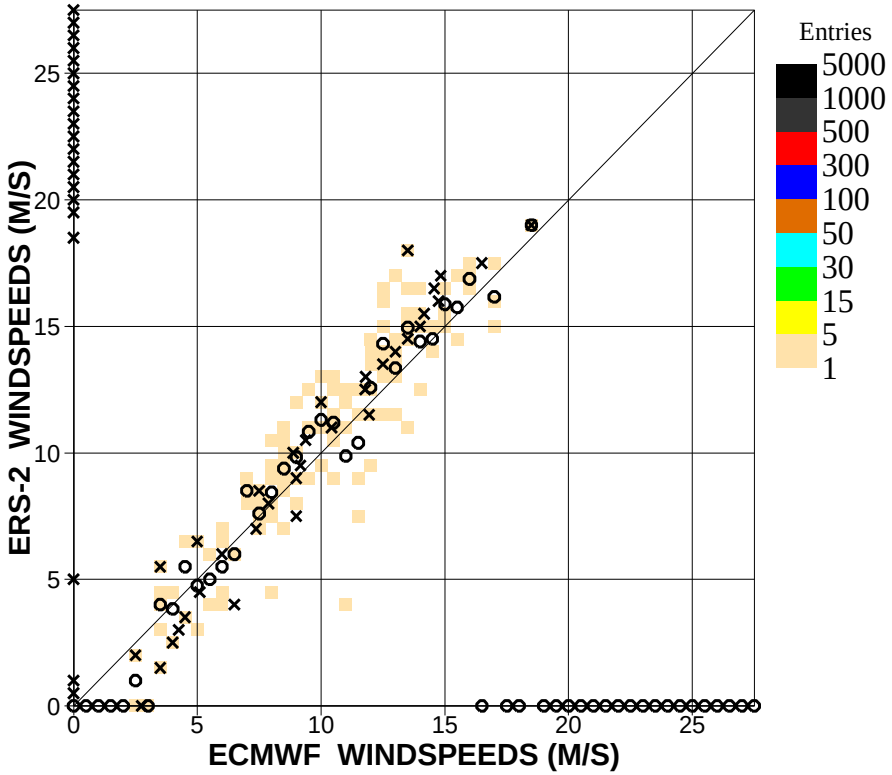
STATISTICS

ENTRIES	1715	
MEAN ECMWF	5.4947	
MEAN ERS-2	5.3120	
BIAS (ERS-2 - ECMWF)	-0.1827	
STANDARD DEVIATION	1.3816	
SCATTER INDEX	0.2514	
CORRELATION	0.8838	
SYMMETRIC SLOPE	1.0121	(0.0142)
REGR. COEFFICIENT	1.0829	(0.0139)
REGR. CONSTANT	-0.6381	(0.0830)

Figure 8. Comparison of ECMWF wind speed results with ERS2 Altimeter wind speed data for October 2009 (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 October 2009

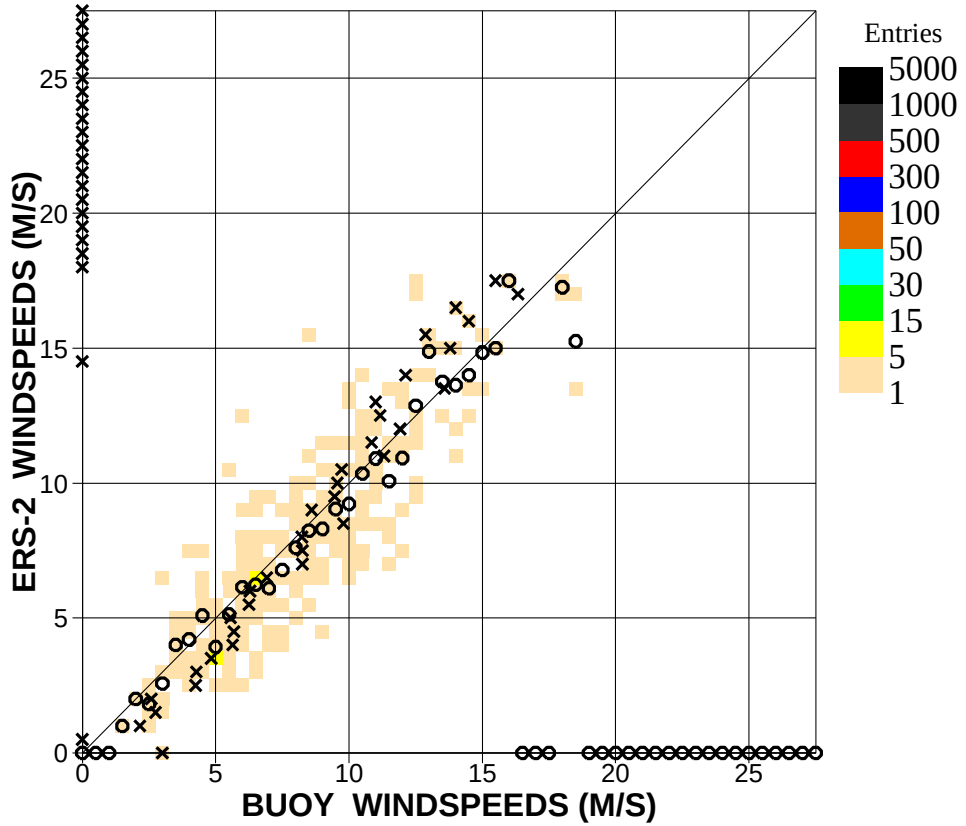


STATISTICS

ENTRIES	135	
MEAN ECMWF	10.2315	
MEAN ERS-2	10.7259	
BIAS (ERS-2 - ECMWF)	0.4944	
STANDARD DEVIATION	1.6700	
SCATTER INDEX	0.1632	
CORRELATION	0.9212	
SYMMETRIC SLOPE	1.0607	(0.0390)
REGR. COEFFICIENT	1.0608	(0.0388)
REGR. CONSTANT	-0.1277	(0.4223)

Figure 9. Comparison of ECMWF wind speed results with ERS2 Altimeter wind speed data for October 2009 (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

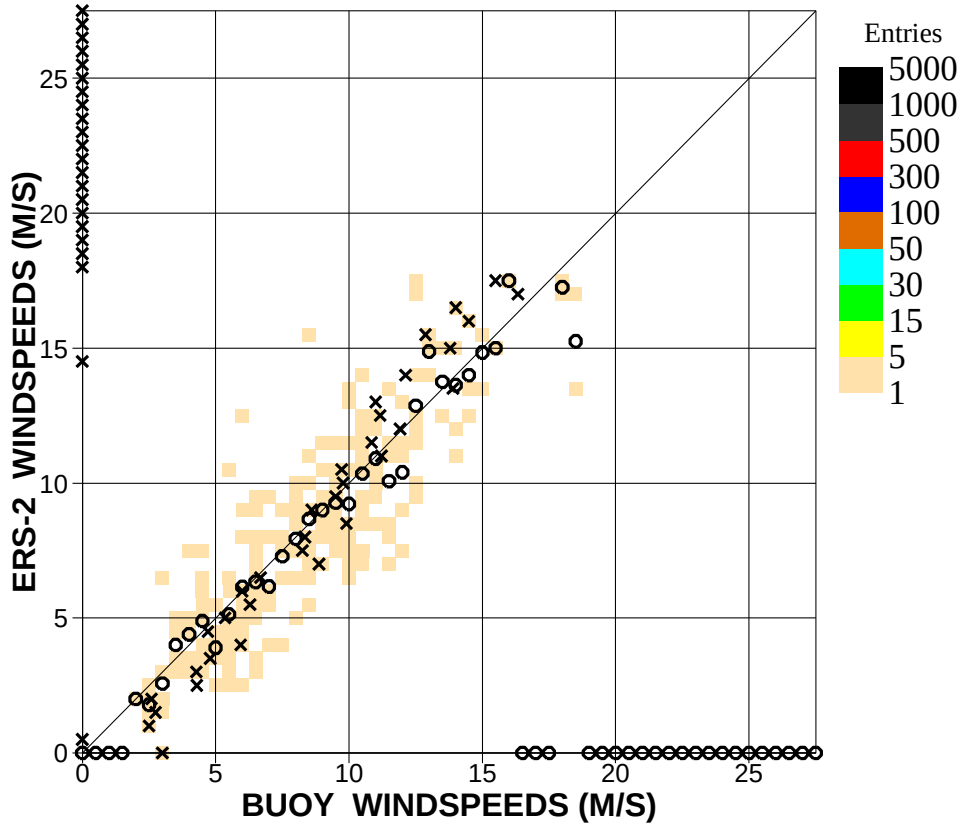


STATISTICS

ENTRIES	287	
MEAN BUOY	8.1818	
MEAN ERS-2	7.8498	
BIAS (ERS-2 - BUOY)	-0.3320	
STANDARD DEVIATION	1.7538	
SCATTER INDEX	0.2144	
CORRELATION	0.8786	
SYMMETRIC SLOPE	0.9837	(0.0320)
REGR. COEFFICIENT	0.9884	(0.0318)
REGR. CONSTANT	-0.2367	(0.2803)

Figure 10. Comparison of buoy wind speed observations with ERS2 Altimeter wind speed data for October 2009 (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	229	
MEAN BUOY	8.4754	
MEAN ERS-2	8.2480	
BIAS (ERS-2 - BUOY)	-0.2273	
STANDARD DEVIATION	1.8464	
SCATTER INDEX	0.2178	
CORRELATION	0.8797	
SYMMETRIC SLOPE	0.9957	(0.0356)
REGR. COEFFICIENT	0.9871	(0.0354)
REGR. CONSTANT	-0.1179	(0.3240)

Figure 11. Comparison of buoy wind speed observations with ERS2 Altimeter wind speed data for October 2009 (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

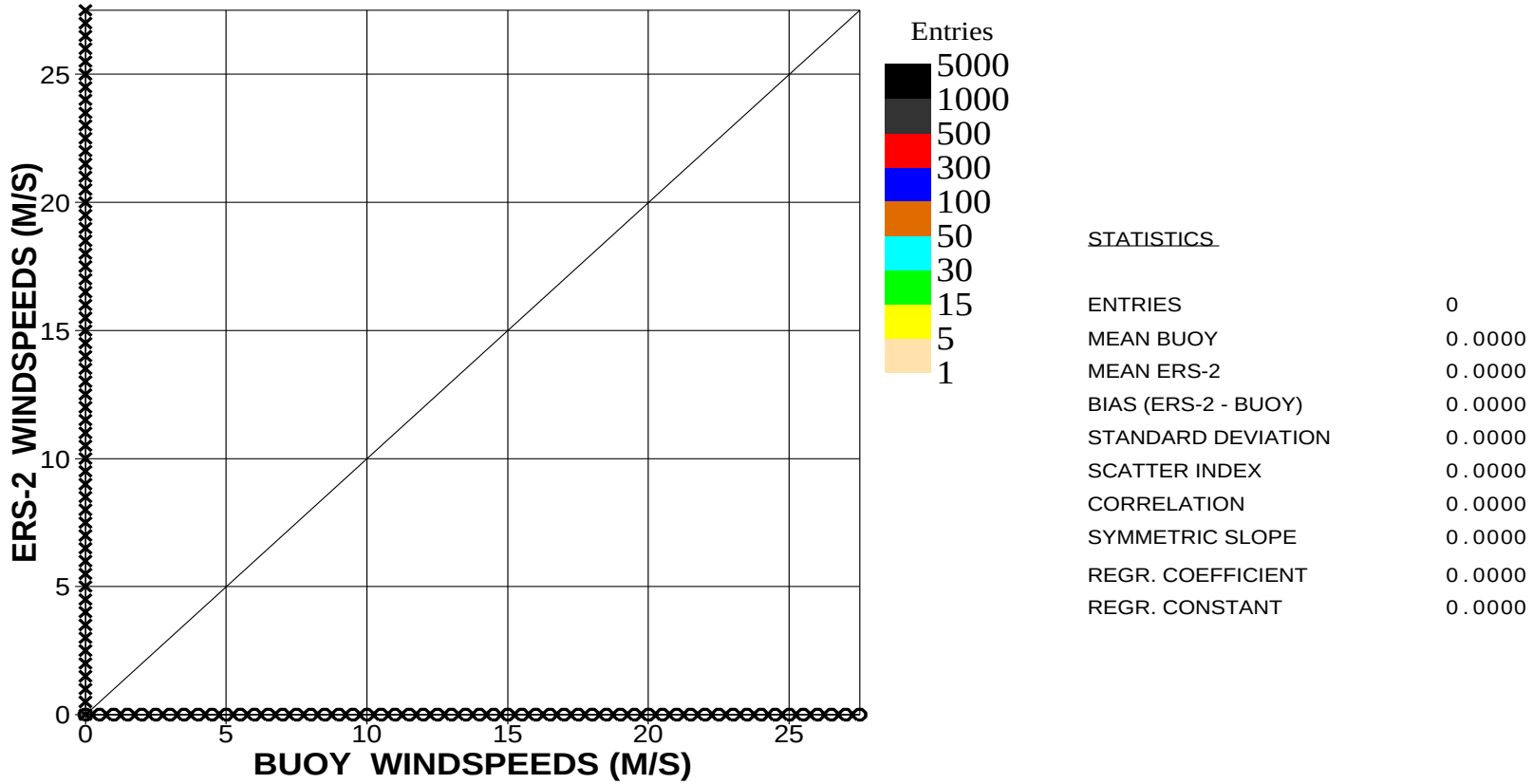


Figure 12. Comparison of buoy wind speed observations with ERS2 Altimeter wind speed data for October 2009 (hawaii)

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

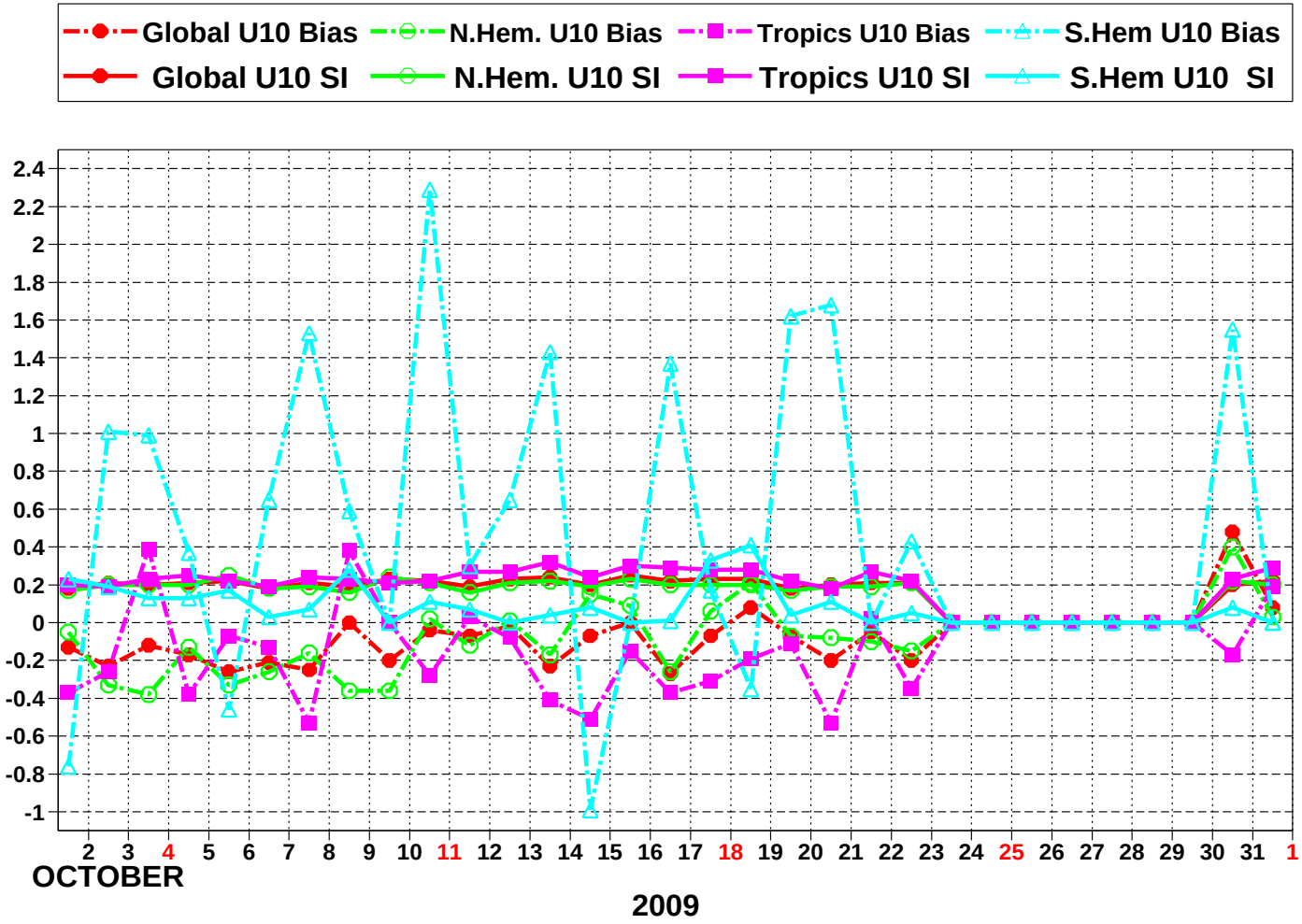


Figure 13: ERS-2 Altimeter wind speeds: Timeseries of bias (ERS-2 - model) and scatter index (SI)

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

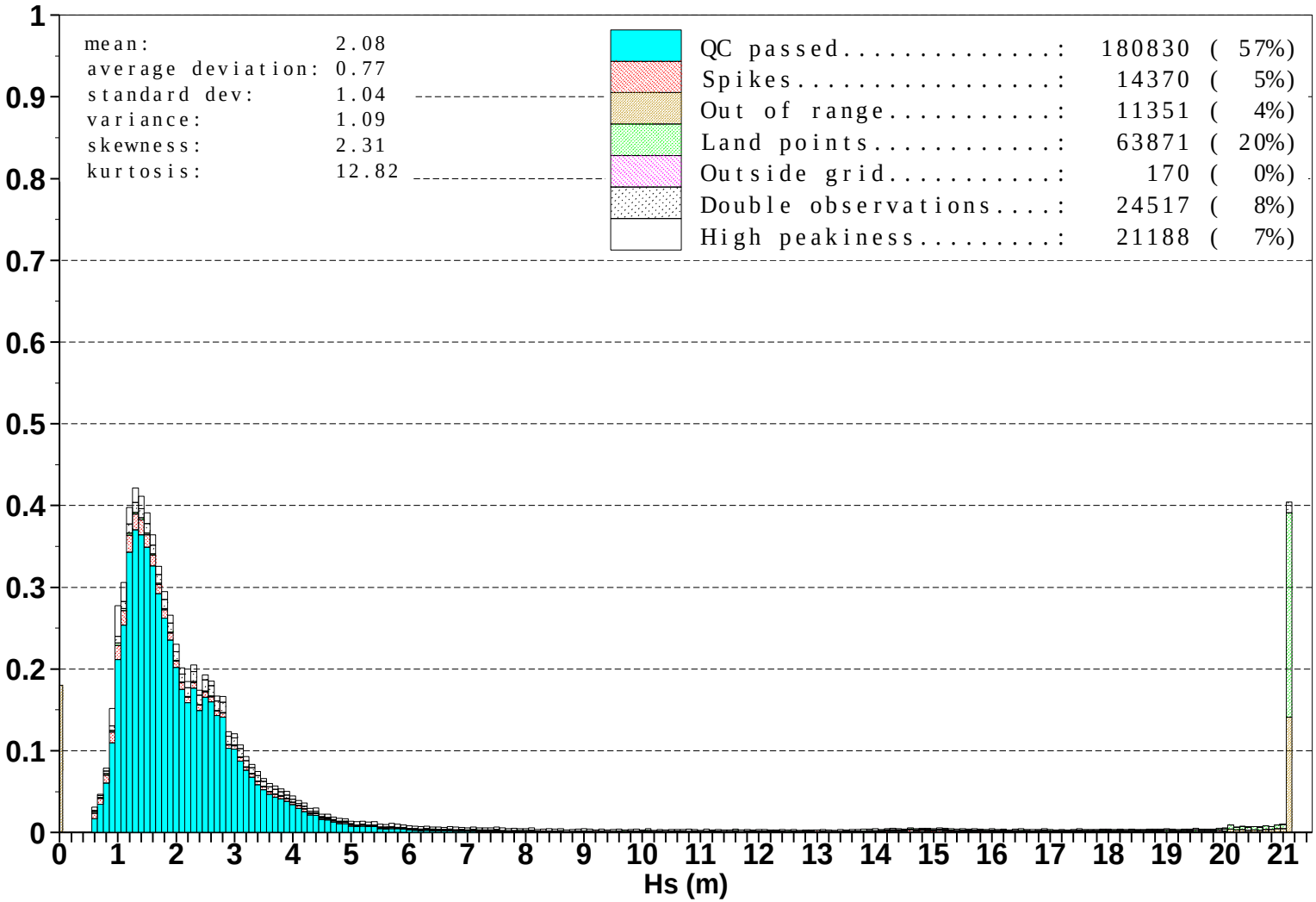


Figure 14: Distribution of the ERS-2 Altimeter wave heights after QC for October 2009

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

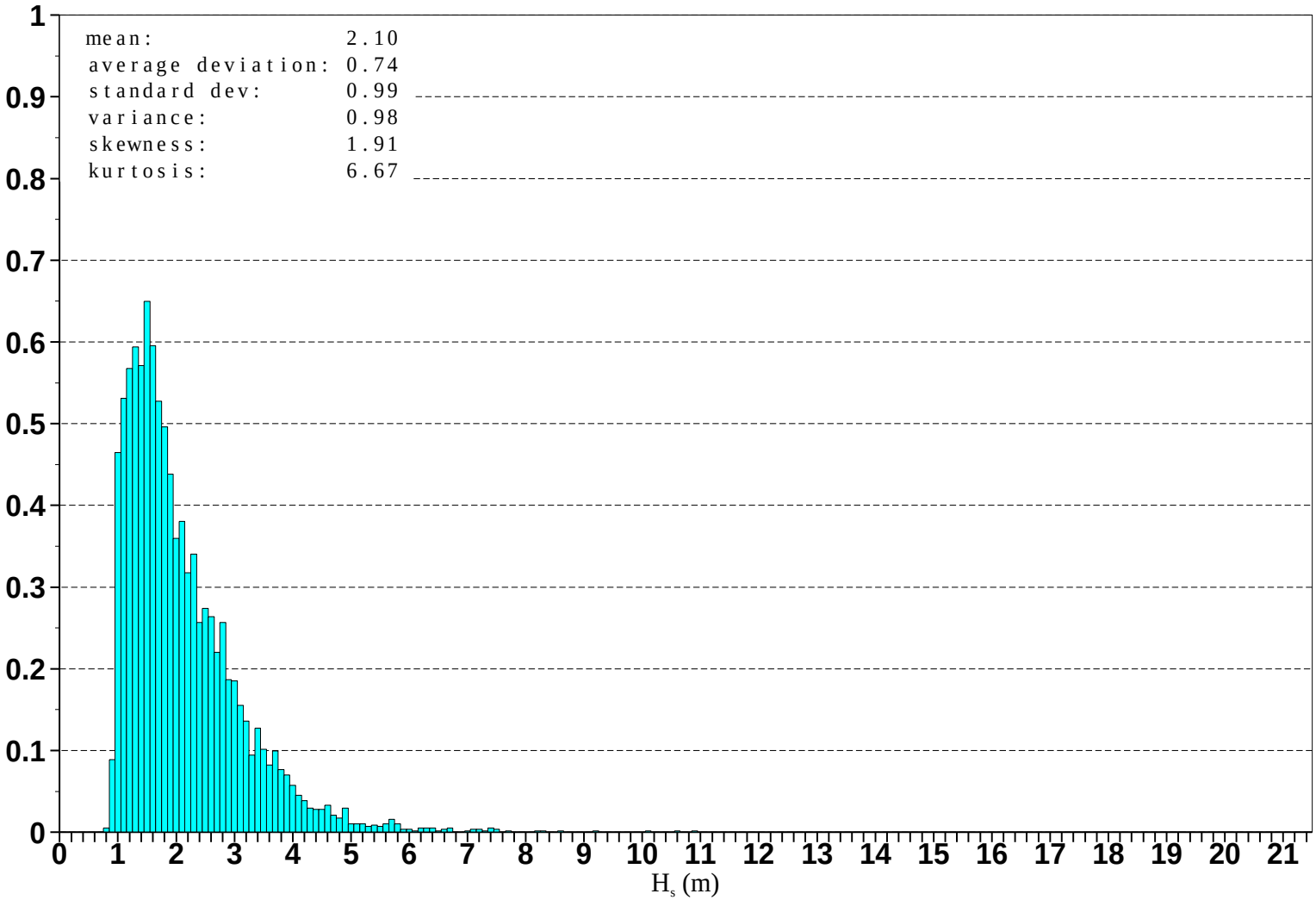


Figure 15: Distribution of ERS-2 Altimeter wave heights after along track averaging for October 2009

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

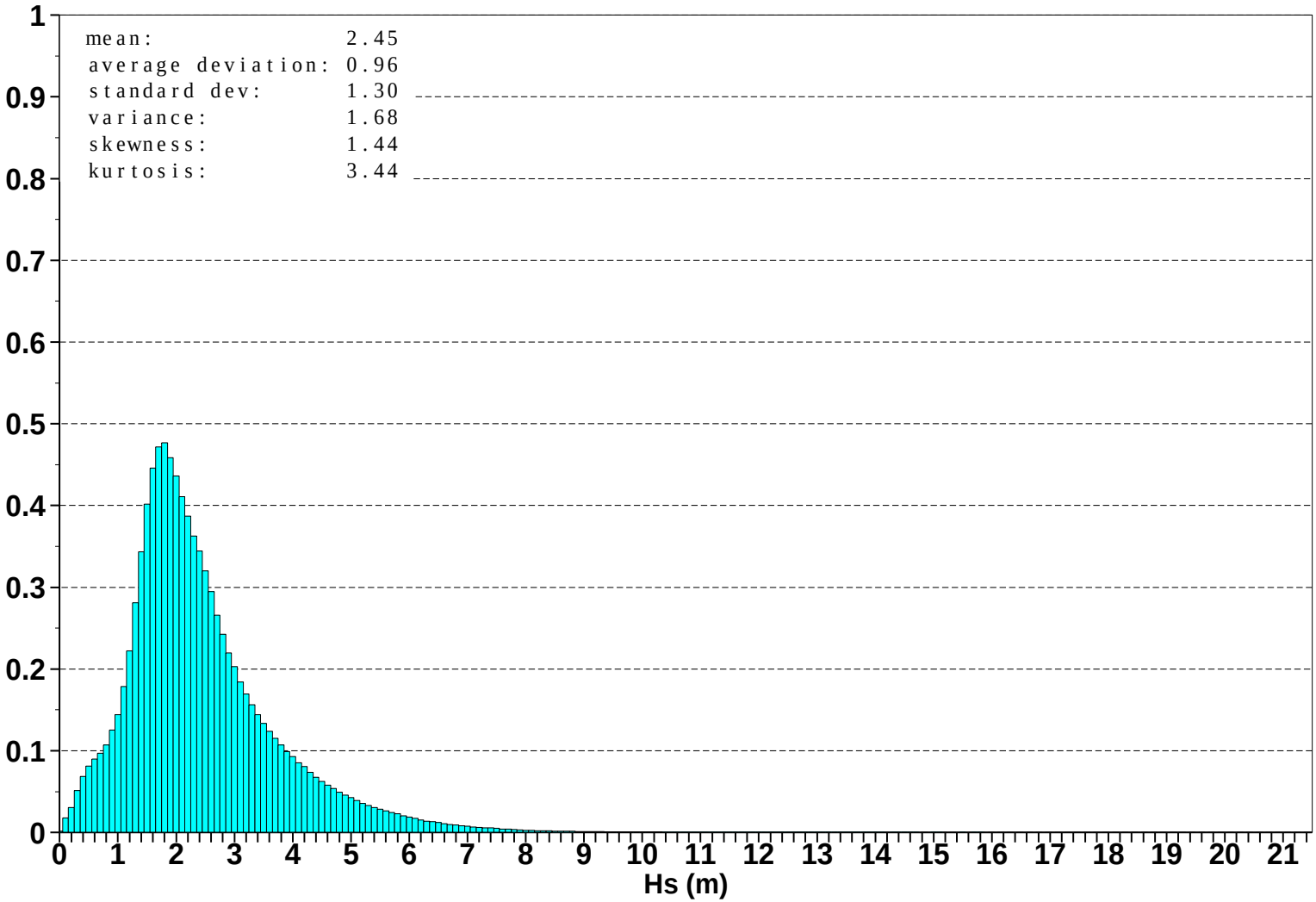
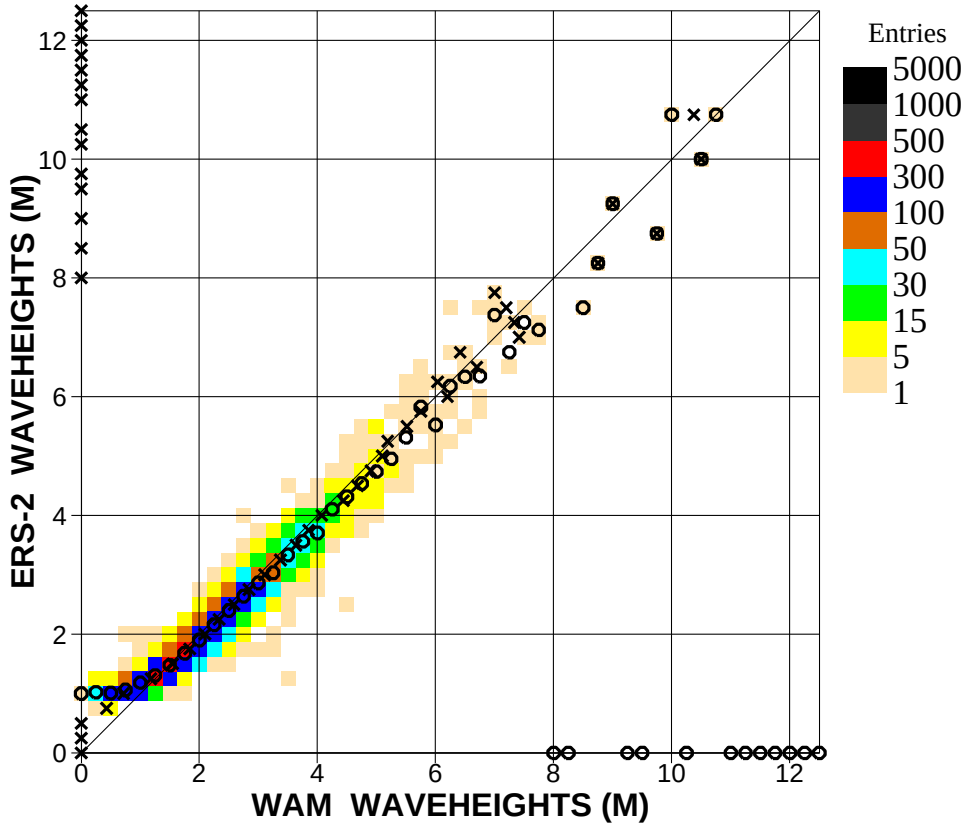


Figure 16: Global distribution of ECMWF wave heights for October 2009

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

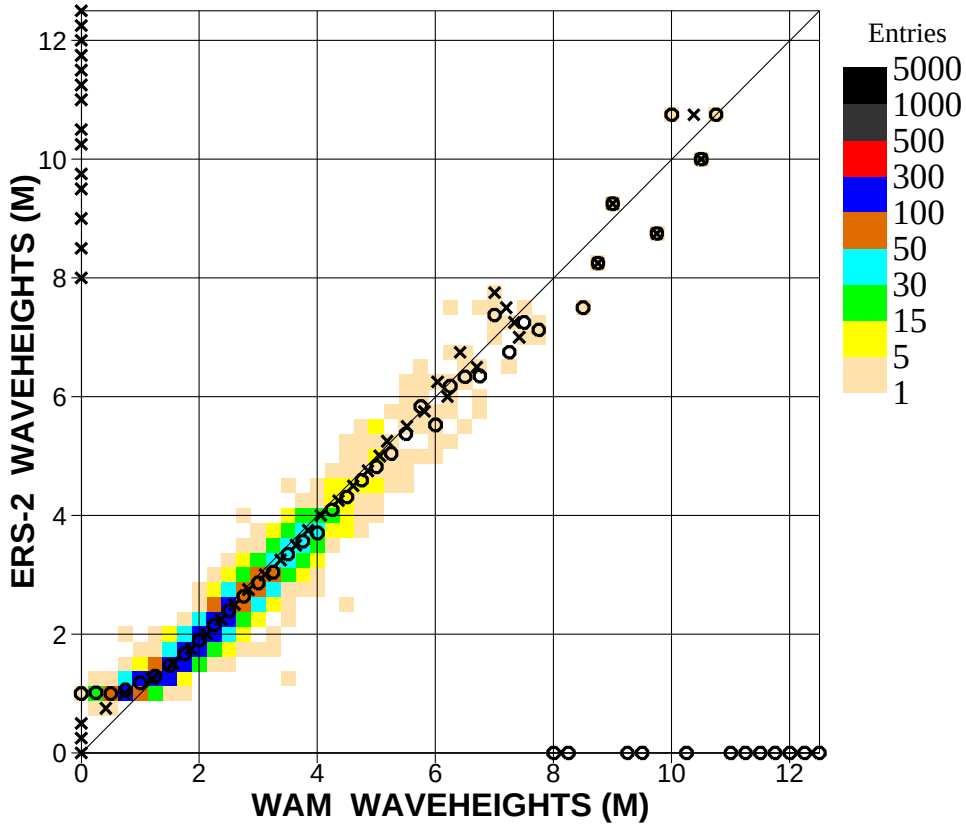


STATISTICS

ENTRIES	5727	
MEAN WAM	2.1250	
MEAN ERS-2	2.0959	
BIAS (ERS-2 - WAM)	-0.0292	
STANDARD DEVIATION	0.2657	
SCATTER INDEX	0.1250	
CORRELATION	0.9724	
SYMMETRIC SLOPE	0.9700	(0.0031)
REGR. COEFFICIENT	0.8811	(0.0028)
REGR. CONSTANT	0.2235	(0.0067)

Figure 17. Comparison of ECMWF wave height results with ERS2 Altimeter wave height data for October 2009 (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

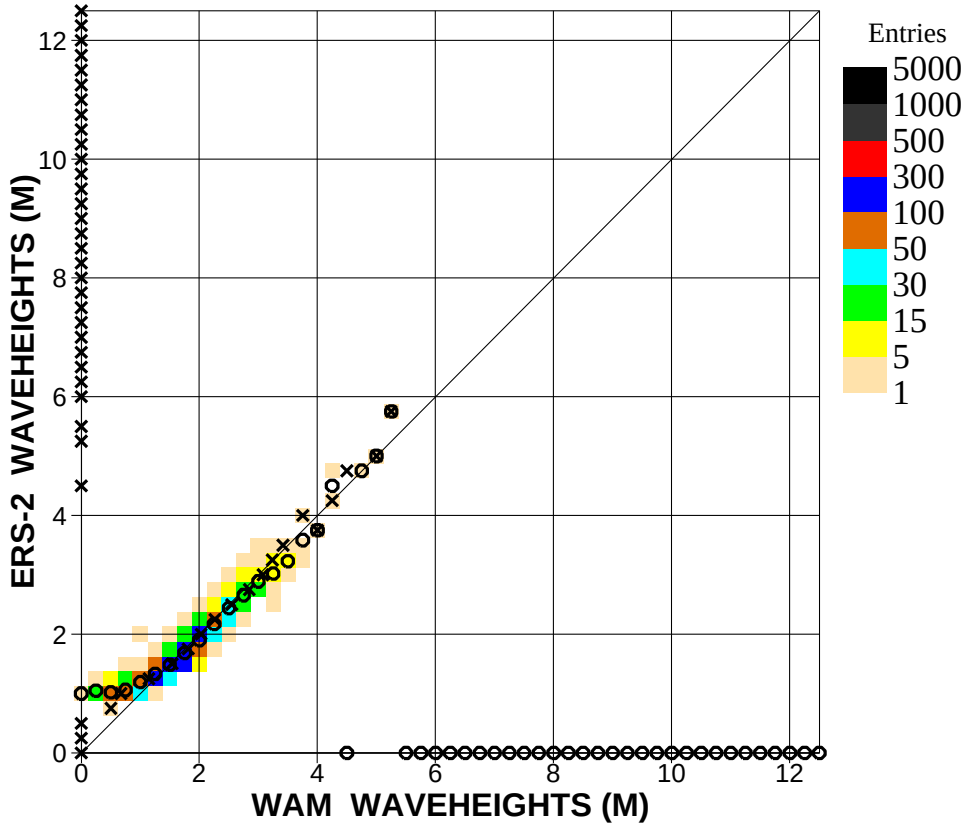


STATISTICS

ENTRIES	3916	
MEAN WAM	2.2584	
MEAN ERS-2	2.2137	
BIAS (ERS-2 - WAM)	-0.0447	
STANDARD DEVIATION	0.2780	
SCATTER INDEX	0.1231	
CORRELATION	0.9722	
SYMMETRIC SLOPE	0.9680	(0.0037)
REGR. COEFFICIENT	0.8949	(0.0034)
REGR. CONSTANT	0.1926	(0.0087)

Figure 18. Comparison of ECMWF wave height results with ERS2 Altimeter wave height data for October 2009 (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

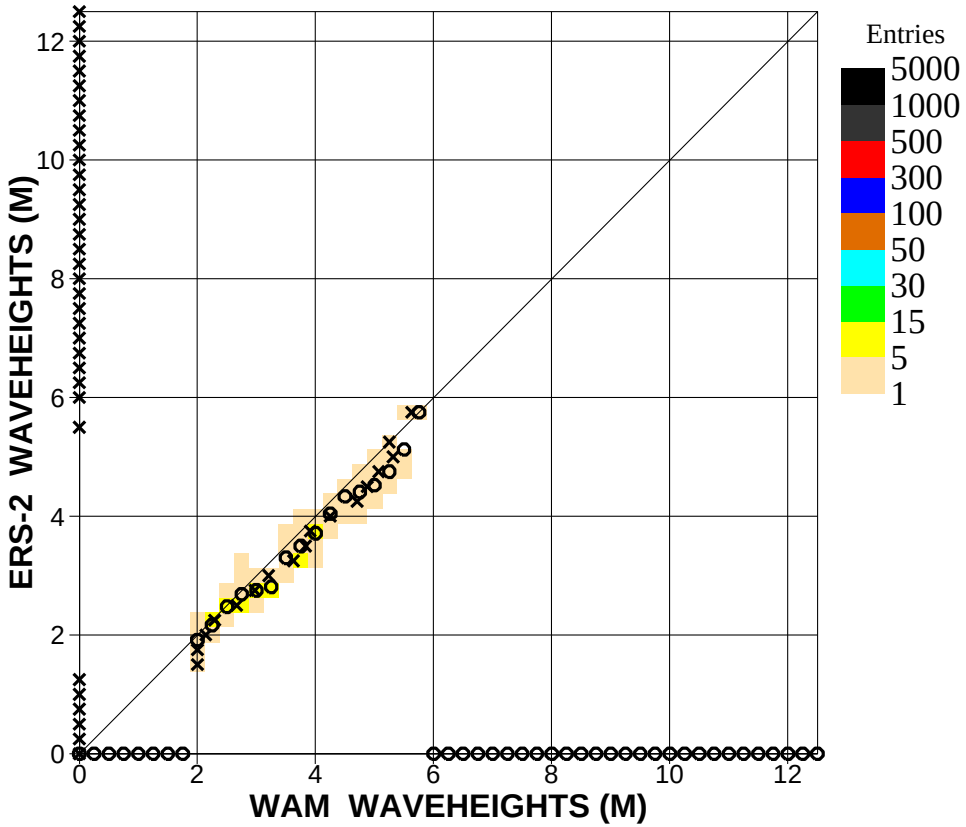


STATISTICS

ENTRIES	1715	
MEAN WAM	1.6913	
MEAN ERS-2	1.7150	
BIAS (ERS-2 - WAM)	0.0236	
STANDARD DEVIATION	0.2218	
SCATTER INDEX	0.1311	
CORRELATION	0.9505	
SYMMETRIC SLOPE	0.9913	(0.0080)
REGR. COEFFICIENT	0.7885	(0.0062)
REGR. CONSTANT	0.3814	(0.0113)

Figure 19. Comparison of ECMWF wave height results with ERS2 Altimeter wave height data for October 2009 (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

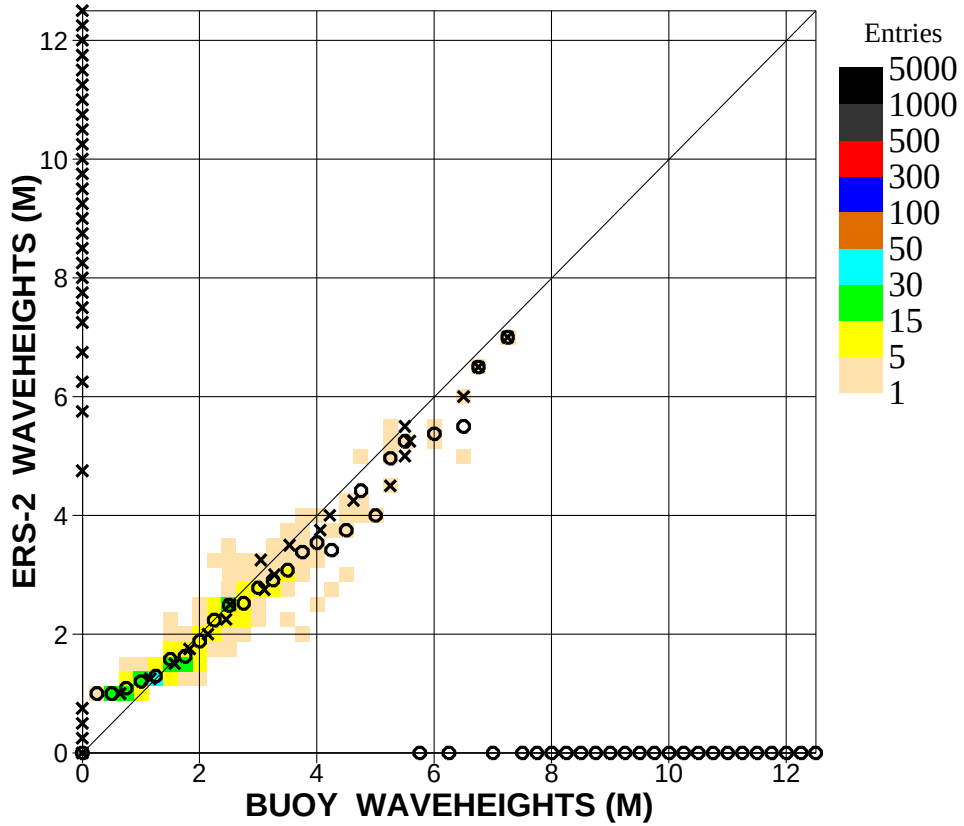


STATISTICS

ENTRIES	135	
MEAN WAM	3.6900	
MEAN ERS-2	3.4465	
BIAS (ERS-2 - WAM)	-0.2435	
STANDARD DEVIATION	0.2435	
SCATTER INDEX	0.0660	
CORRELATION	0.9747	
SYMMETRIC SLOPE	0.9328	(0.0181)
REGR. COEFFICIENT	0.8942	(0.0178)
REGR. CONSTANT	0.1470	(0.0683)

Figure 20. Comparison of ECMWF wave height results with ERS2 Altimeter wave height data for October 2009 (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

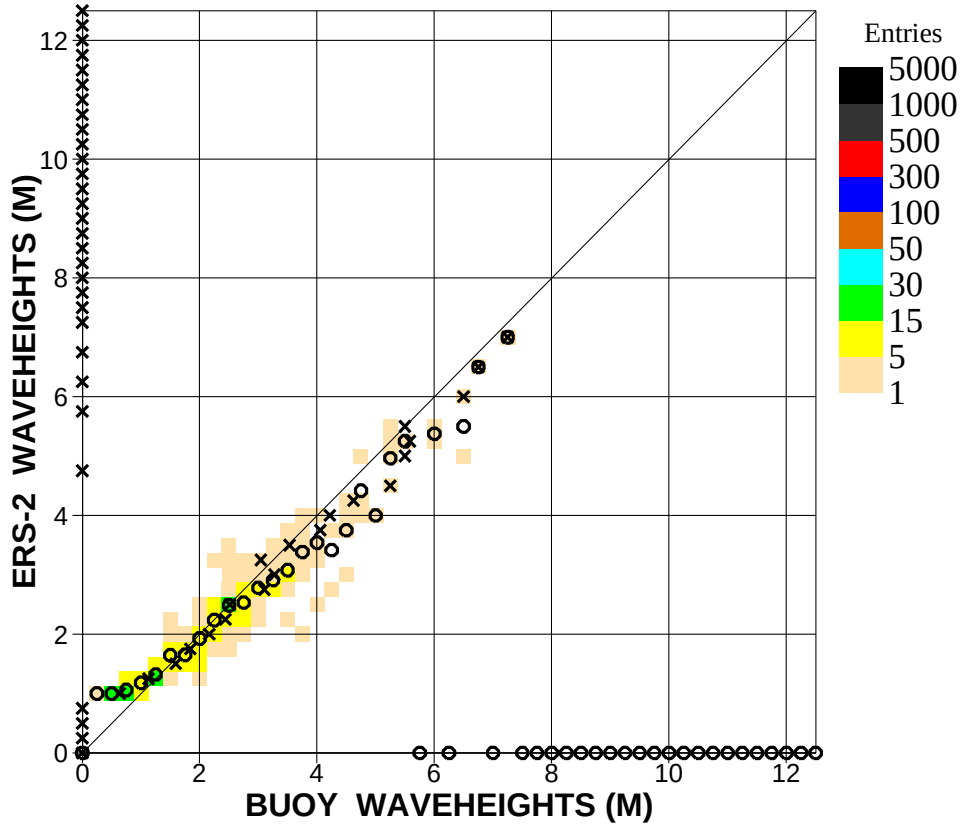


STATISTICS

ENTRIES	417	
MEAN BUOY	2.0978	
MEAN ERS-2	2.0679	
BIAS (ERS-2 - BUOY)	-0.0299	
STANDARD DEVIATION	0.3852	
SCATTER INDEX	0.1836	
CORRELATION	0.9561	
SYMMETRIC SLOPE	0.9506	(0.0144)
REGR. COEFFICIENT	0.8006	(0.0121)
REGR. CONSTANT	0.3884	(0.0292)

Figure 21. Comparison of buoy wave height observations with ERS2 Altimeter wave height data for October 2009 (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	346	
MEAN BUOY	2.2513	
MEAN ERS-2	2.2076	
BIAS (ERS-2 - BUOY)	-0.0437	
STANDARD DEVIATION	0.4065	
SCATTER INDEX	0.1806	
CORRELATION	0.9549	
SYMMETRIC SLOPE	0.9476	(0.0159)
REGR. COEFFICIENT	0.7975	(0.0134)
REGR. CONSTANT	0.4122	(0.0345)

Figure 22. Comparison of buoy wave height observations with ERS2 Altimeter wave height data for October 2009 (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

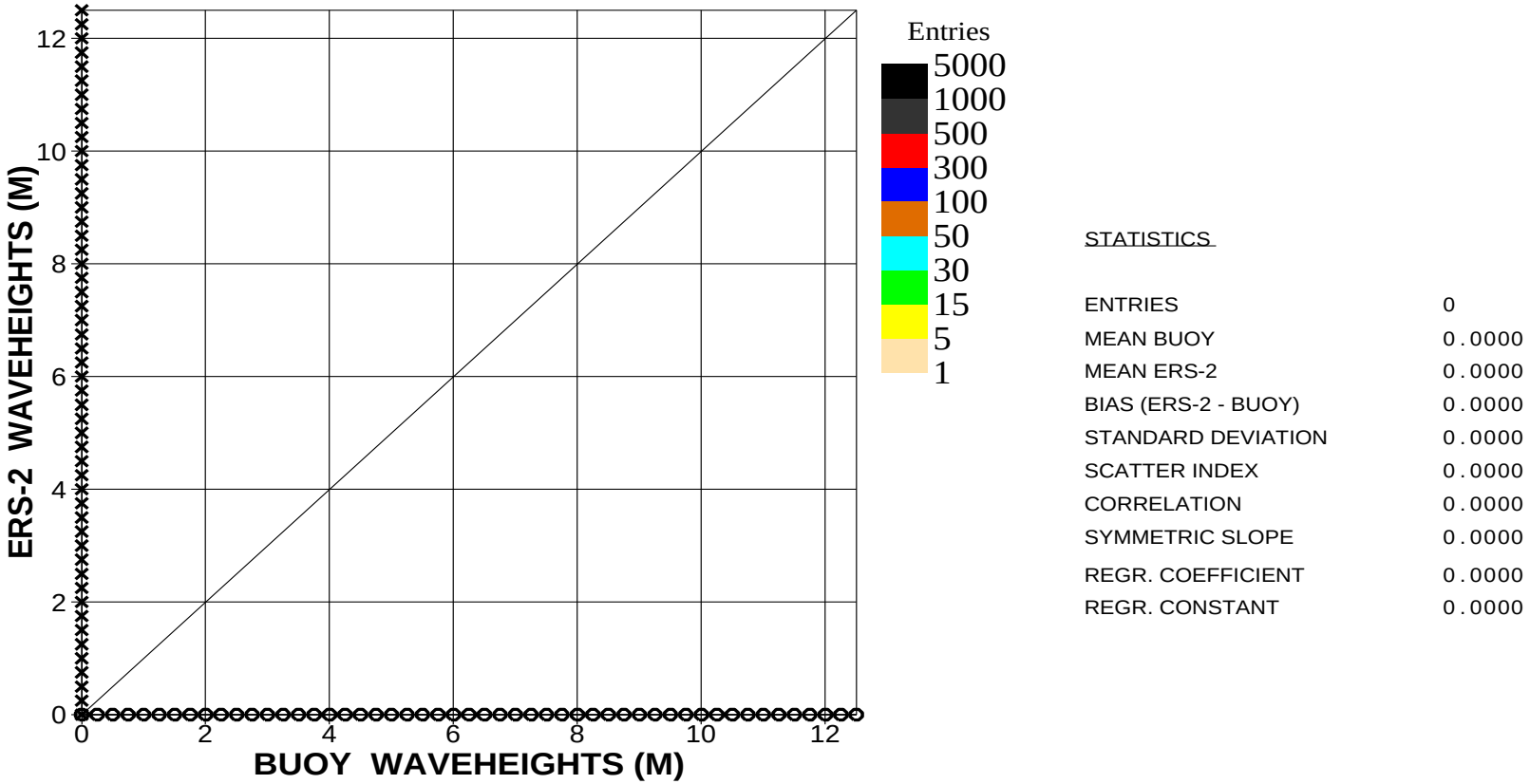


Figure 23. Comparison of buoy wave height observations with ERS2 Altimeter wave height data for October 2009 (hawaii)

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

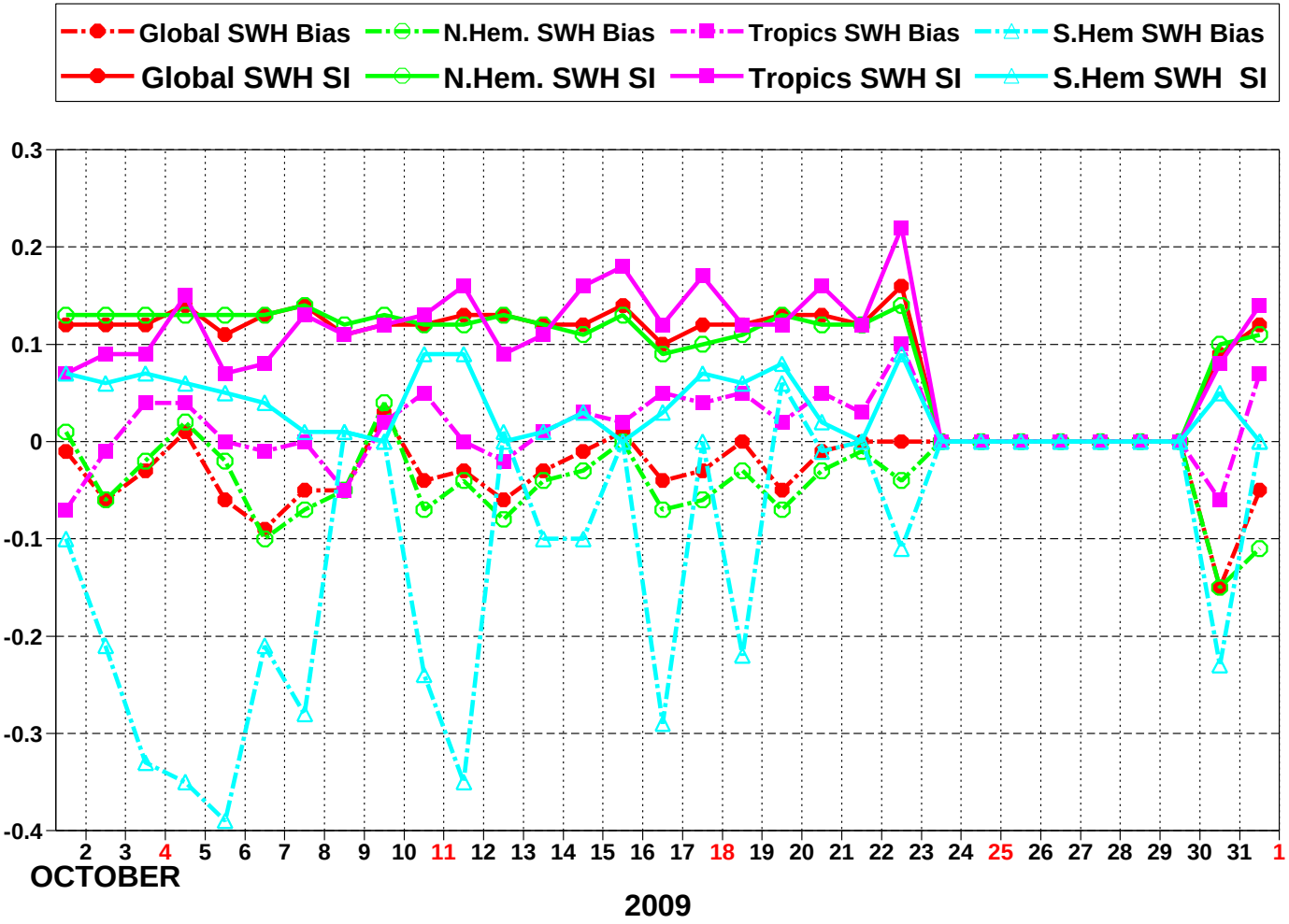


Figure 24: ERS-2 Altimeter wave heights: Timeseries of bias (ERS-2 - model) and scatter index (SI)

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

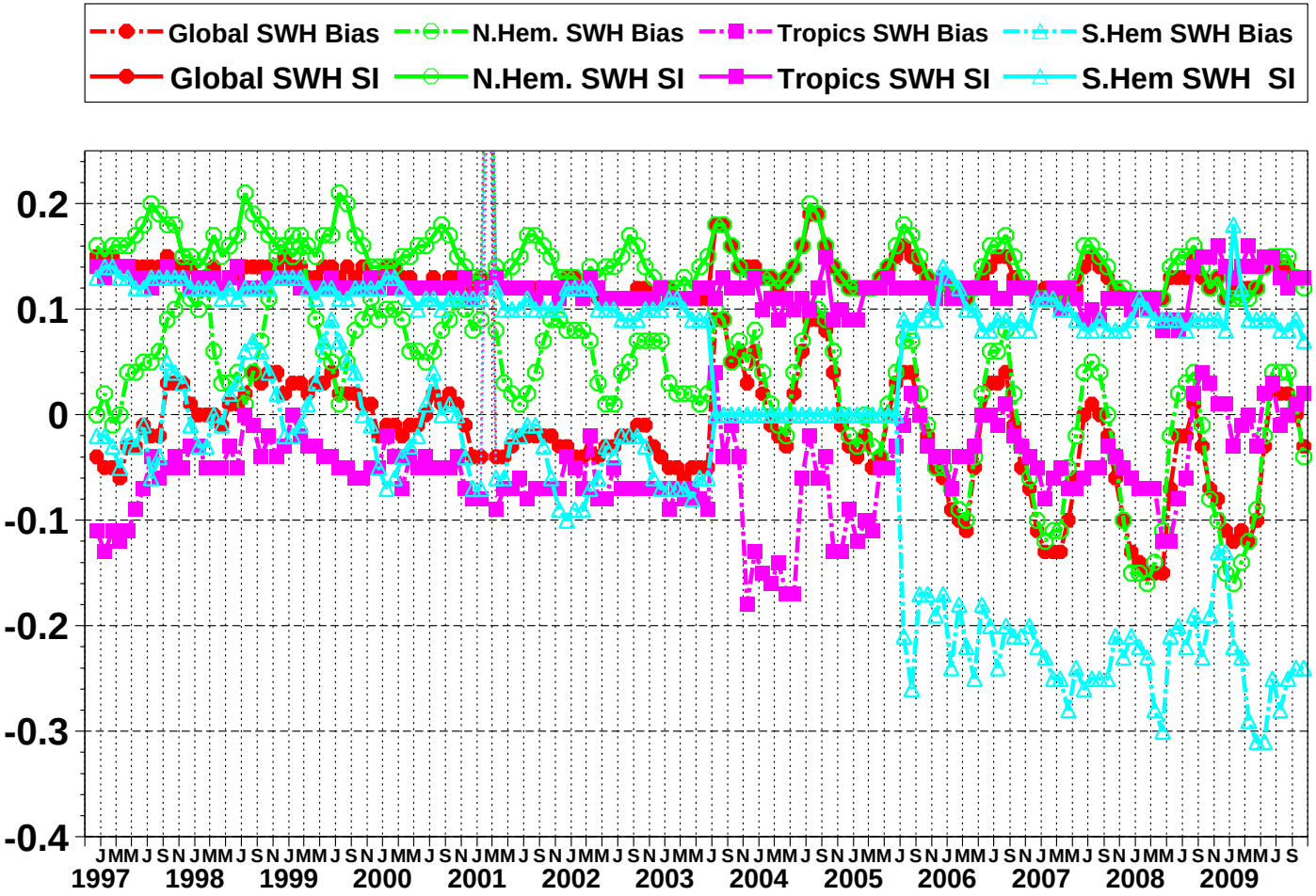


Figure 25: ERS-2 Altimeter wave heights: Timeseries of bias (ERS-2 - model) and scatter index (SI)

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

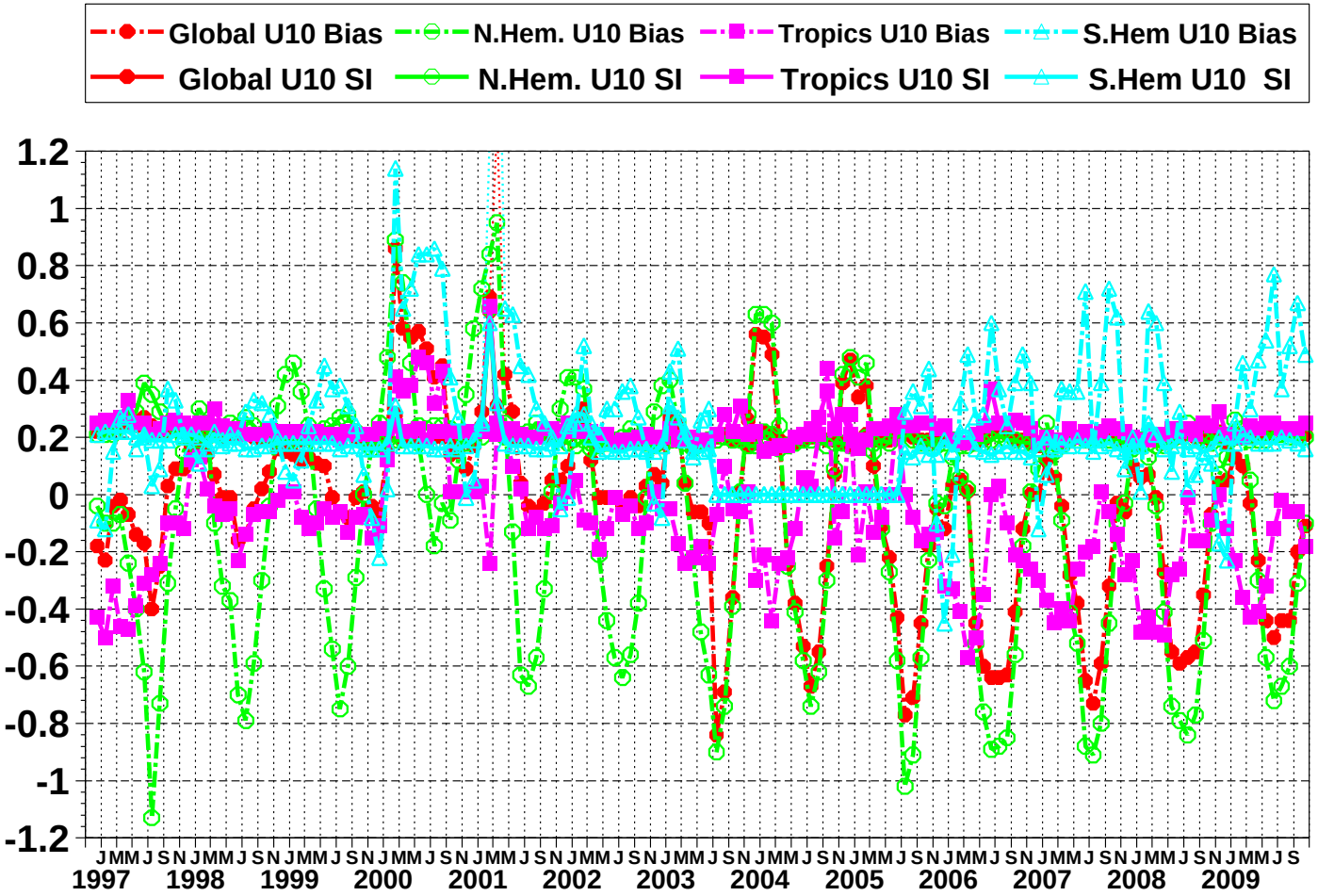


Figure 26: ERS-2 Altimeter wind speeds: Timeseries of bias (ERS-2 - model) and scatter index (SI)

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

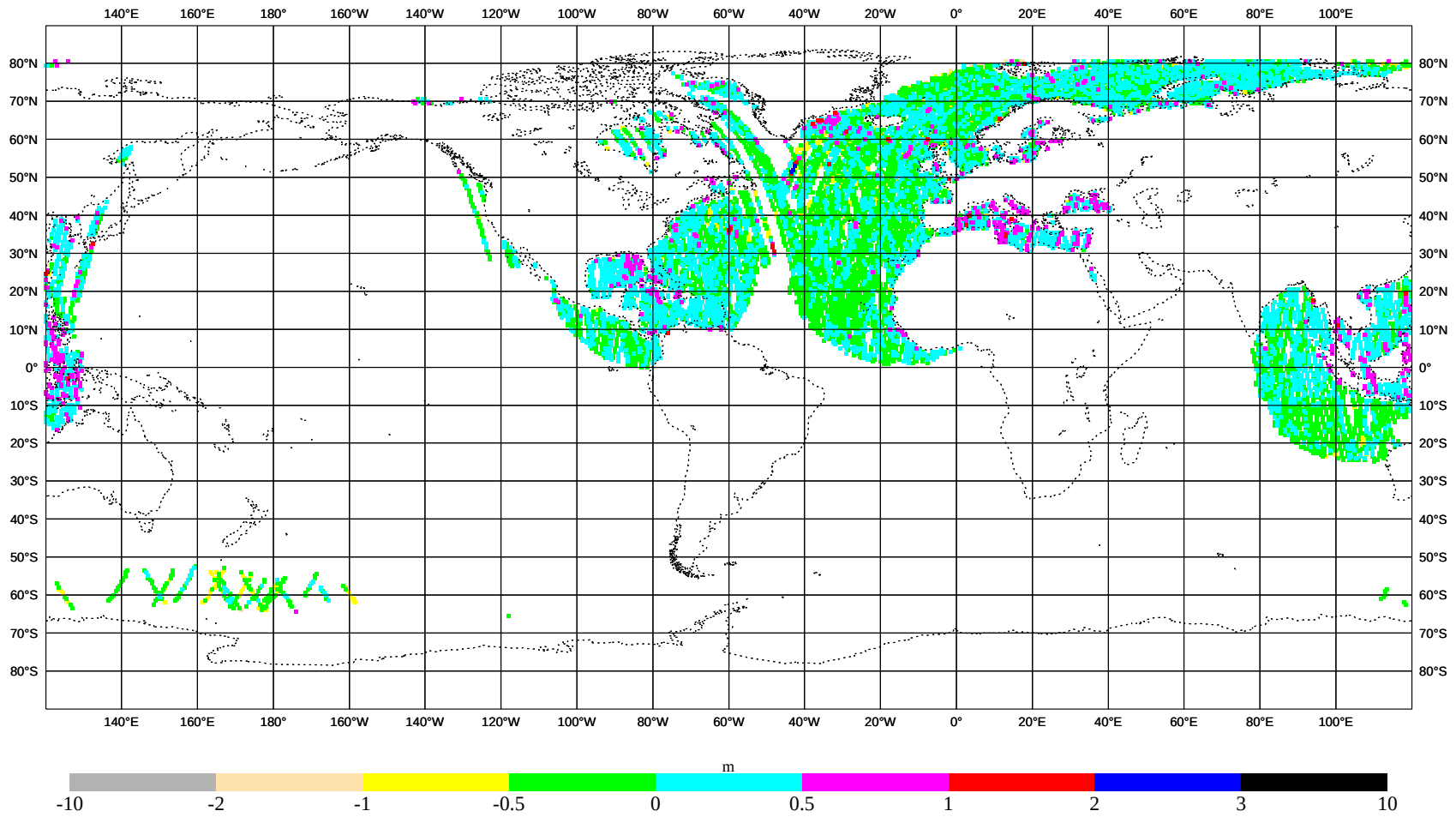


Figure 27: Significant wave height: Monthly mean difference of ERS-2 altimeter data minus wave model results for October 2009.

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