ECMWF Report on ERS-2 RA for March 2003

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

By: *Saleh Abdalla*

Date: *7 April 2003*

Overview:

Based on the data received during the full month, on average, 15495 observations arrived at ECMWF every 6 hours of which 82.2% passed the quality control. The data coverage, which was rather good, can be seen in Figure 1. Data were missed during time-windows centred at 18:00 on the 2nd., and at 00:00 and 12:00 on the 20th. of the month. Data reception was significantly reduced during time-windows centred at 00:00 on the 13th., the 14th. and the 17th., at 06:00 on the 18th., at 18:00 on the 19th., at 06:00 on the 20th. and on the 23rd. (all times are in UTC). Note that we are talking about the raw data which have arrived at ECMWF before they were processed. Apart from the impact of the DES Sun-Blinding phenomenon, which was active during the first three weeks of the month, the quality of the received data is as good as usual.

Backscatter:

ESR-2 $<\sigma_0>$ = 11.08 dB (with two peaks at 10.6 and 11.1 dB)

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

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Wind Speed Comparison with ECMWF wind speeds (bias):

ERS-2 global: 0.037 m/s

ERS-2 northern hemisphere: 0.040 m/s

ERS-2 tropics: -0.242 m/s

ERS-2 southern hemisphere: 0.217 m/s

Wind Speed Comparison with buoy wind speeds (bias):

ERS-2 global: -0.550 m/s

ERS-2 northern hemisphere: -0.506 m/s

ERS-2 tropics: -0.797 m/s

Wave Height Comparison with ECMWF wave heights (bias):

ERS-2 global: -0.055 m (lowest waves measured: 0.6m)

ERS-2 northern hemisphere: 0.018 m

ERS-2 tropics: -0.081 m

ERS-2 southern hemisphere: -0.074 m

Wave Height Comparison with buoy wave heights (bias):

ERS-2 global: -0.13 m

ERS-2 northern hemisphere: -0.13 m

ERS-2 tropics: -0.23 m

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

Remarks:

- This month there are quite a number of outliers (RA values higher than model) in the scatter plot for the wind speed in the Southern Hemisphere (Figure 9). Most of the outliers can be attributed to the DES sun-blinding phenomenon due to high solar activity. The solar activity was high during most of the of the month, especially the first three weeks.
- Apart from that, the quality of Altimeter data is as good as they used to be.

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.

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Figure captions:

Figure 1: Time series of data reception for ERS-2 Altimeter data for March 2003.

Figure 2: Distribution of the ERS-2 Altimeter Backscatter after QC for March 2003.

Figure 3: Distribution of the ERS-2 Altimeter wind speeds after QC for March 2003.

Figure 4: Distribution of the ERS-2 Altimeter wind speeds after along track averaging for March 2003.

Figure 5: Global distribution of ECMWF ocean surface wind speeds for March 2003.

Figure 6: Comparison of ECMWF wind speed results with ERS-2 Altimeter wind speed data for March 2003 (global).

Figure 7: Comparison of ECMWF wind speed results with ERS-2 Altimeter wind speed data for March 2003 (northern hemisphere)

Figure 8: Comparison of ECMWF wind speed results with ERS-2 Altimeter wind speed data for March 2003 (tropics)

Figure 9: Comparison of ECMWF wind speed results with ERS-2 Altimeter wind speed data for March 2003 (southern hemisphere)

Figure 10: Comparison of buoy wind speed observations with ERS-2 Altimeter wind speed data for March 2003 (global).

Figure 11: Comparison of buoy wind speed observations with ERS-2 Altimeter wind speed data for March 2003 (northern hemisphere).

Figure 12: Comparison of buoy wind speed observations with ERS-2 Altimeter wind speed data for March 2003 (tropics).

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 March 2003.

Figure 15: Distribution of the ERS-2 Altimeter wave heights after along track averaging for March 2003.

Figure 16: Global distribution of ECMWF wave heights for March 2003.

Figure 17: Comparison of ECMWF wave height results with ERS-2 Altimeter wave height data for March 2003 (global).

Figure 18: Comparison of ECMWF wave height results with ERS-2 Altimeter wave height data for March 2003 (northern hemisphere)

Figure 19: Comparison of ECMWF wave height results with ERS-2 Altimeter wave height data for March 2003 (tropics)

Figure 20: Comparison of ECMWF wave height results with ERS-2 Altimeter wave height data for March 2003 (southern hemisphere)

Figure 21: Comparison of buoy wave height observations with ERS-2 Altimeter wave height data for March 2003 (global).

Saleh Abdalla
European Centre for Medium Range Weather Forecasts
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Figure 22: Comparison of buoy wave height observations with ERS-2 Altimeter wave height data for March 2003 (northern hemisphere).
Figure 23: Comparison of buoy wave height observations with ERS-2 Altimeter wave height data for March 2003 (tropics).
Figure 24: ERS-2 Altimeter wave heights: Timeseries of bias (ERS-2 - model) and scatter index (SI) for March 2003.
Figure 25: ERS-2 Altimeter wave heights: Timeseries of bias (ERS-2 - model) and scatter index (SI) from December 1996 to March 2003
Figure 26: ERS-2 Altimeter wind speeds: Timeseries of bias (ERS-2 - model) and scatter index (SI) from December 1996 to March 2003

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
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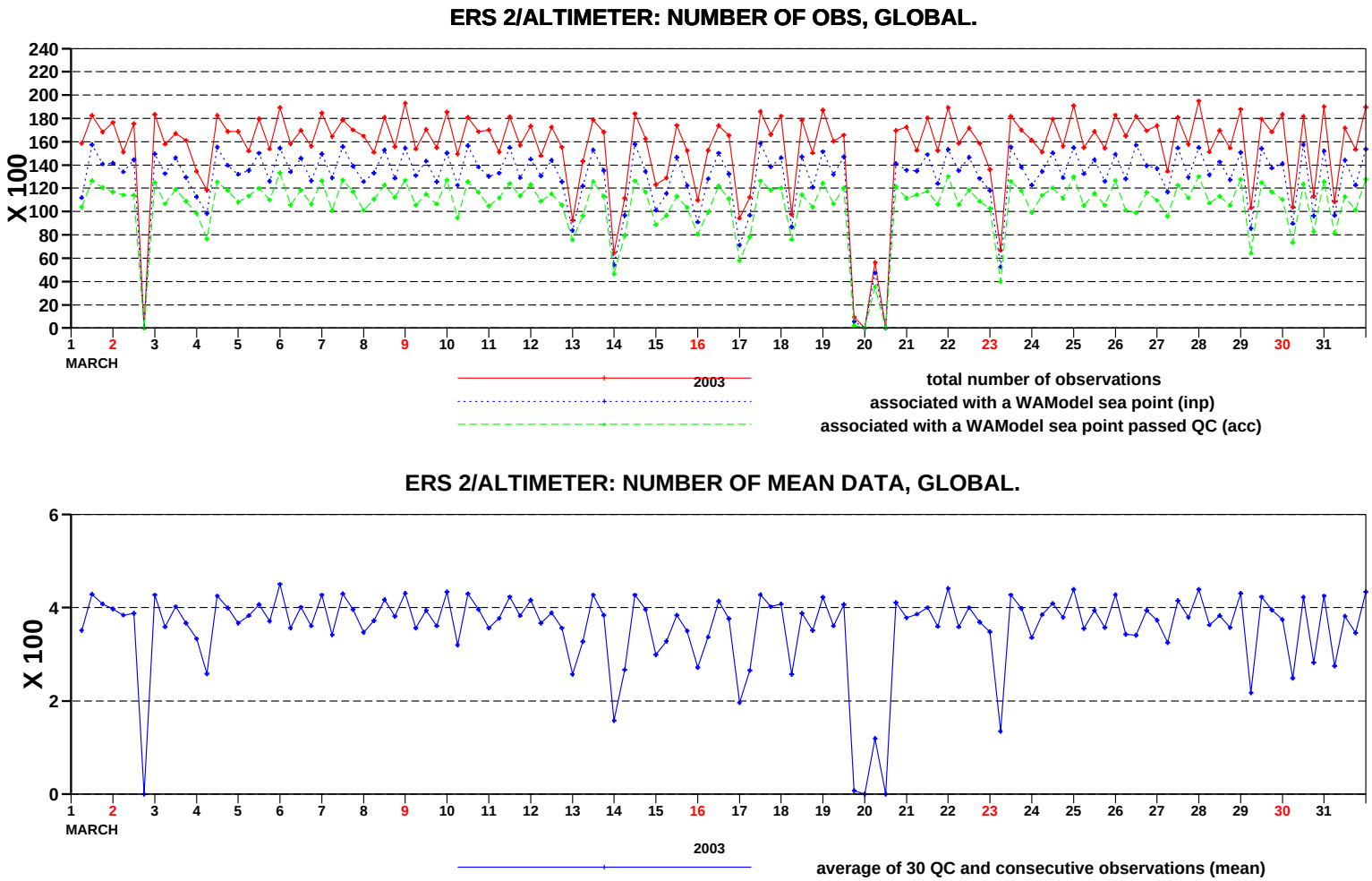


Figure 1: Time series of data reception for ERS-2 Altimeter data for March 2003

Saleh Abdalla
European Centre for Medium Range Weather Forecasts
Shinfield Park, Reading, Berkshire RG2 9AX, England
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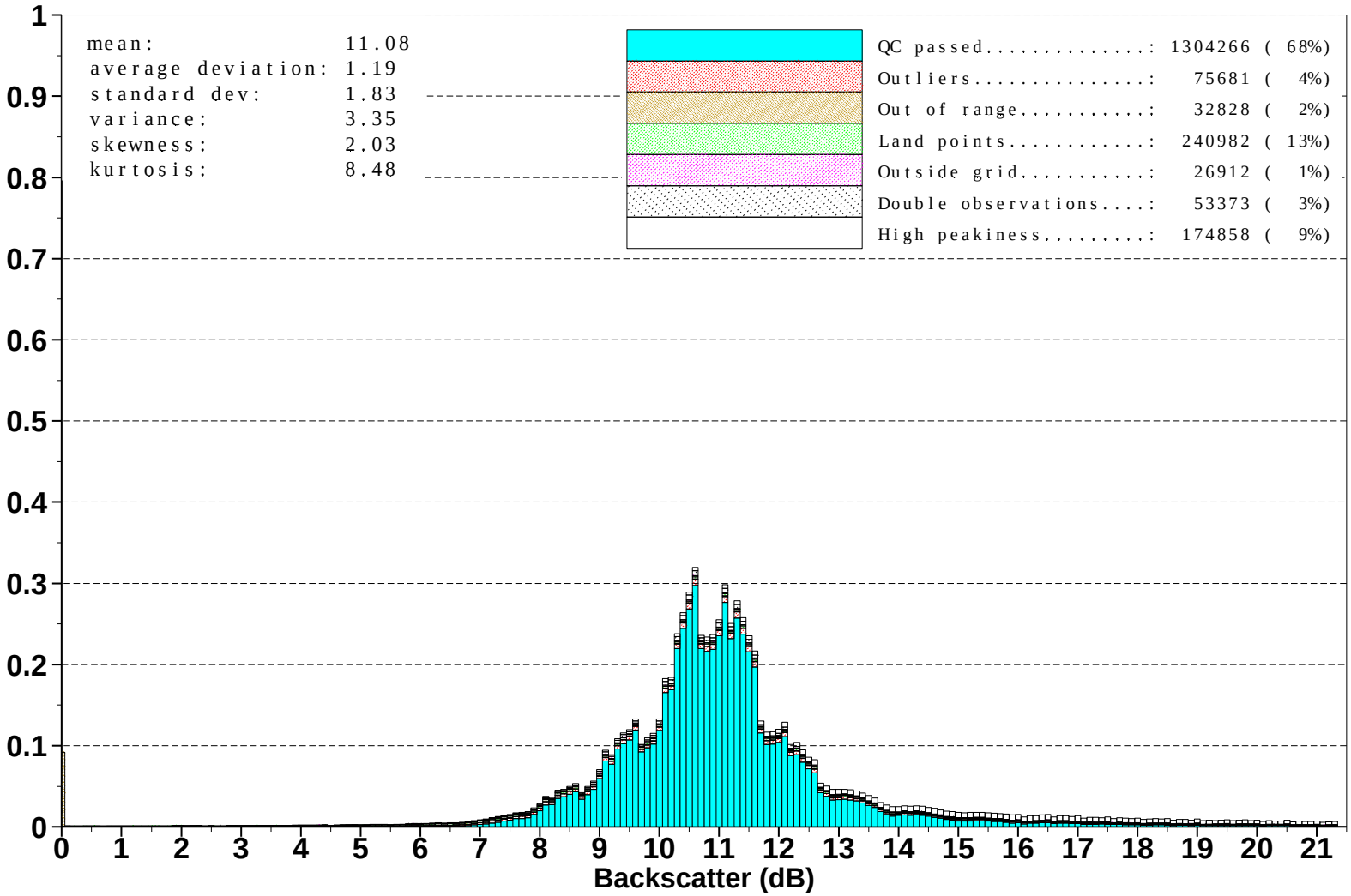


Figure 2: Distribution of the ERS-2 Altimeter backscatter after QC for March 2003

Saleh Abdalla
European Centre for Medium Range Weather Forecasts
Shinfield Park, Reading, Berkshire RG2 9AX, England
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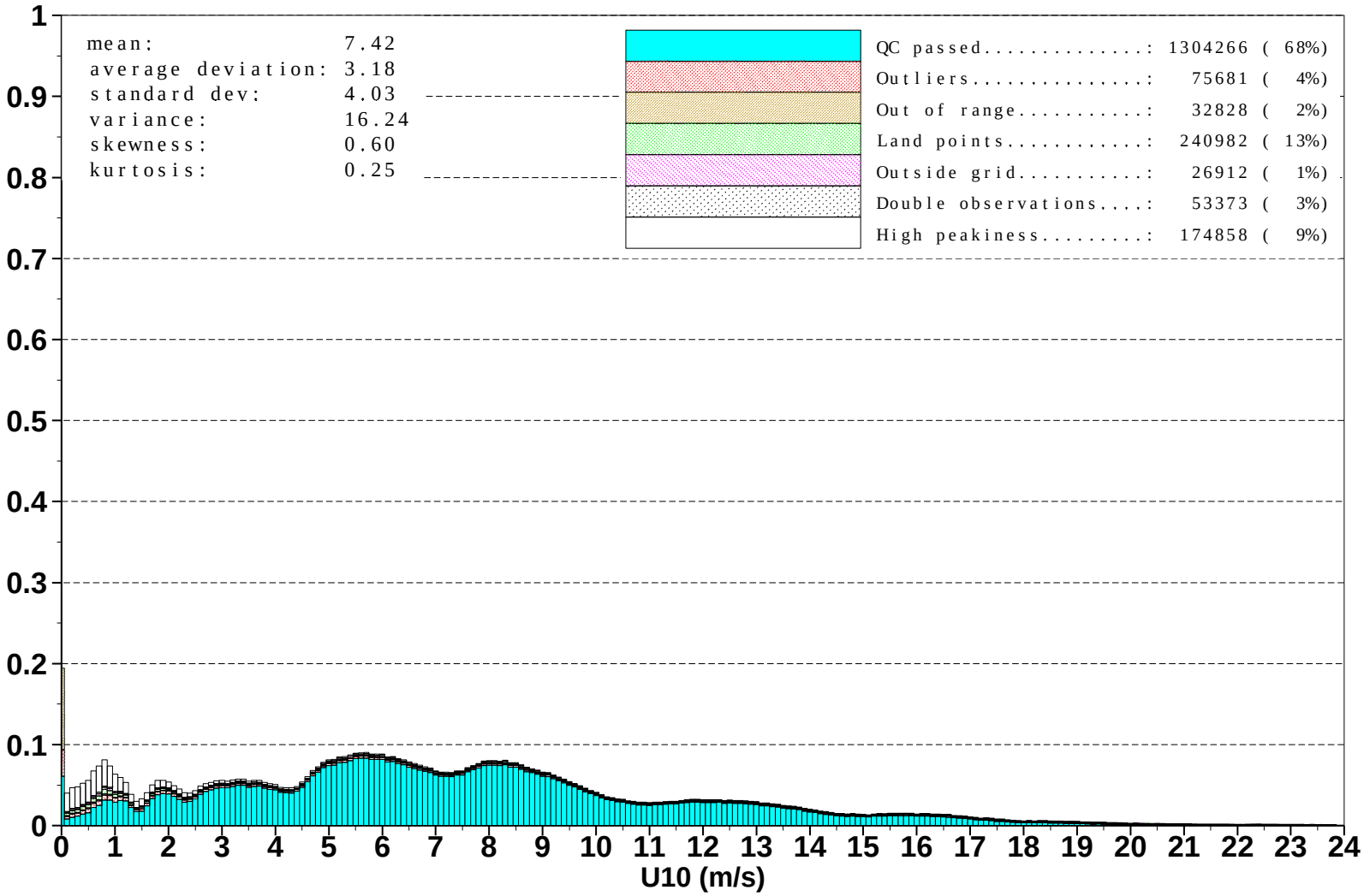


Figure 3: Distribution of the ERS-2 Altimeter wind speeds after QC for March 2003

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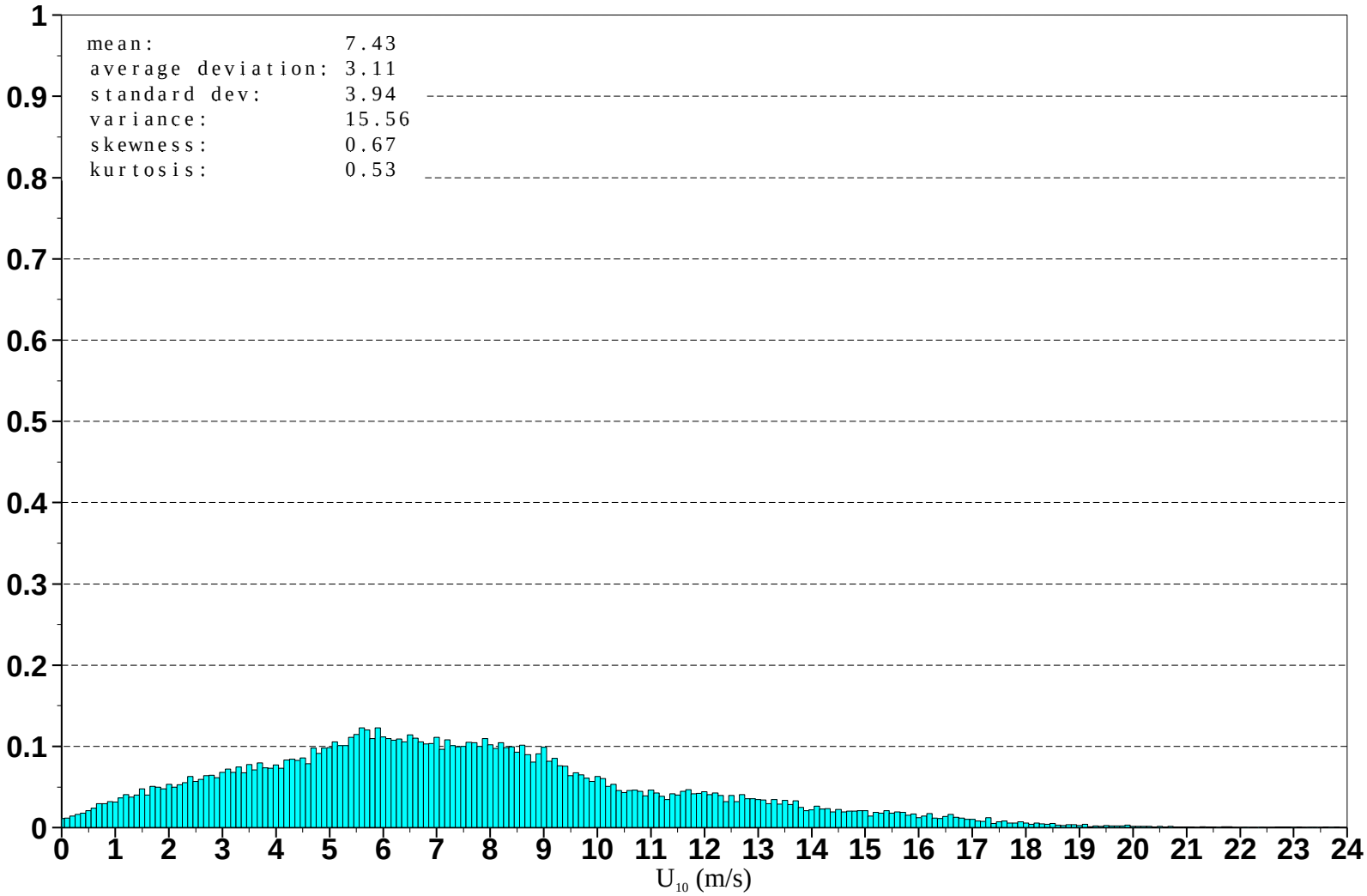


Figure 4: Distribution of ERS-2 Altimeter wind speeds after along track averaging for March 2003

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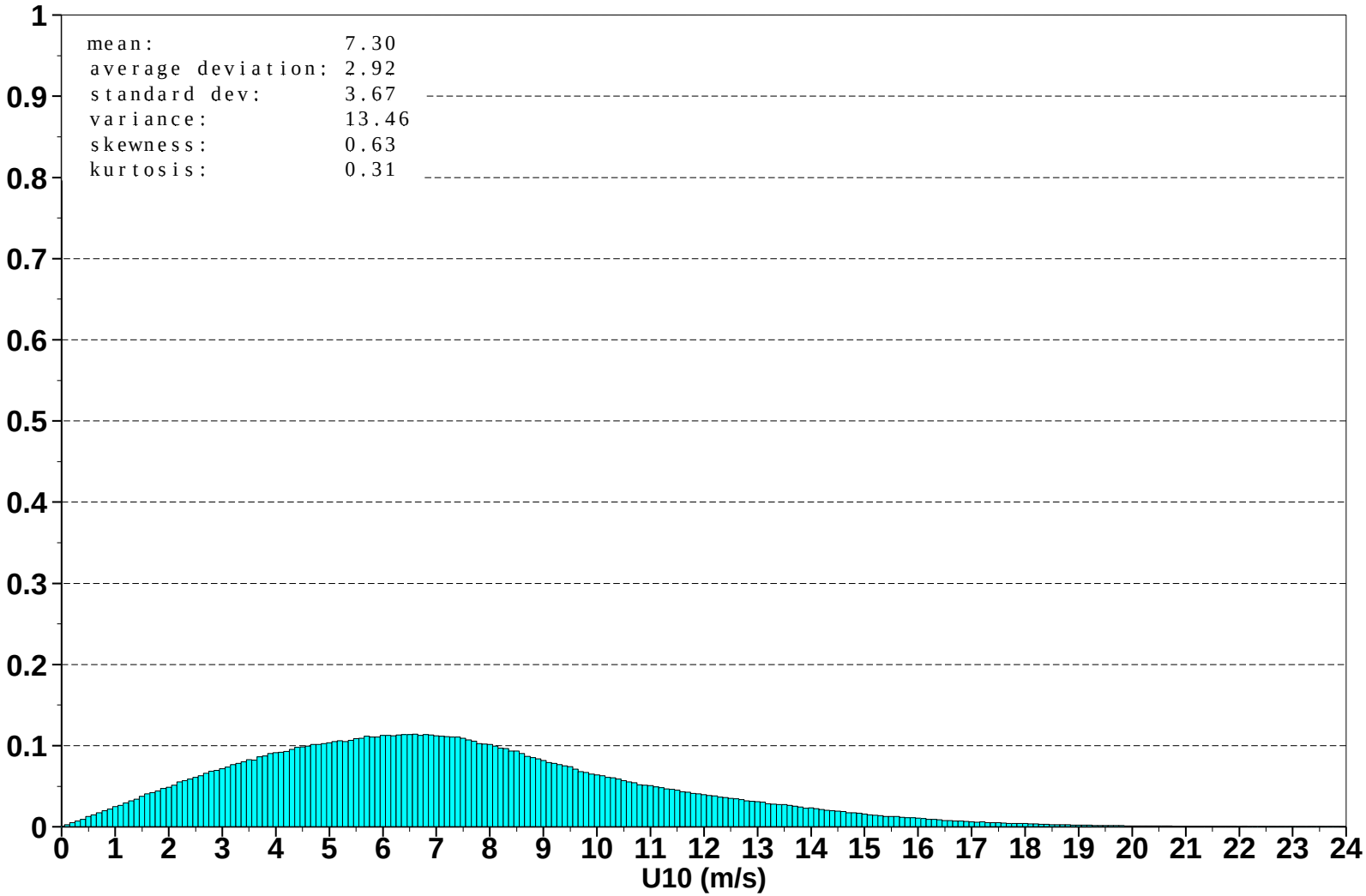
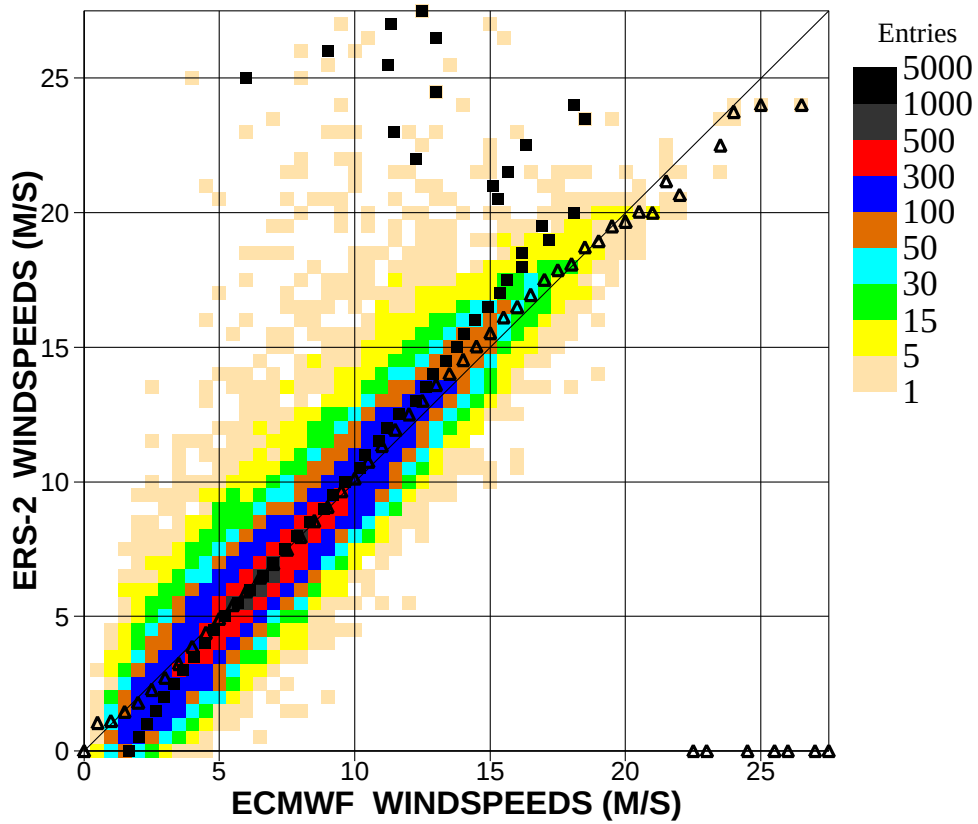


Figure 5: Global distribution of ECMWF ocean surface wind speeds for March 2003

Saleh Abdalla
European Centre for Medium Range Weather Forecasts
Shinfield Park, Reading, Berkshire RG2 9AX, England
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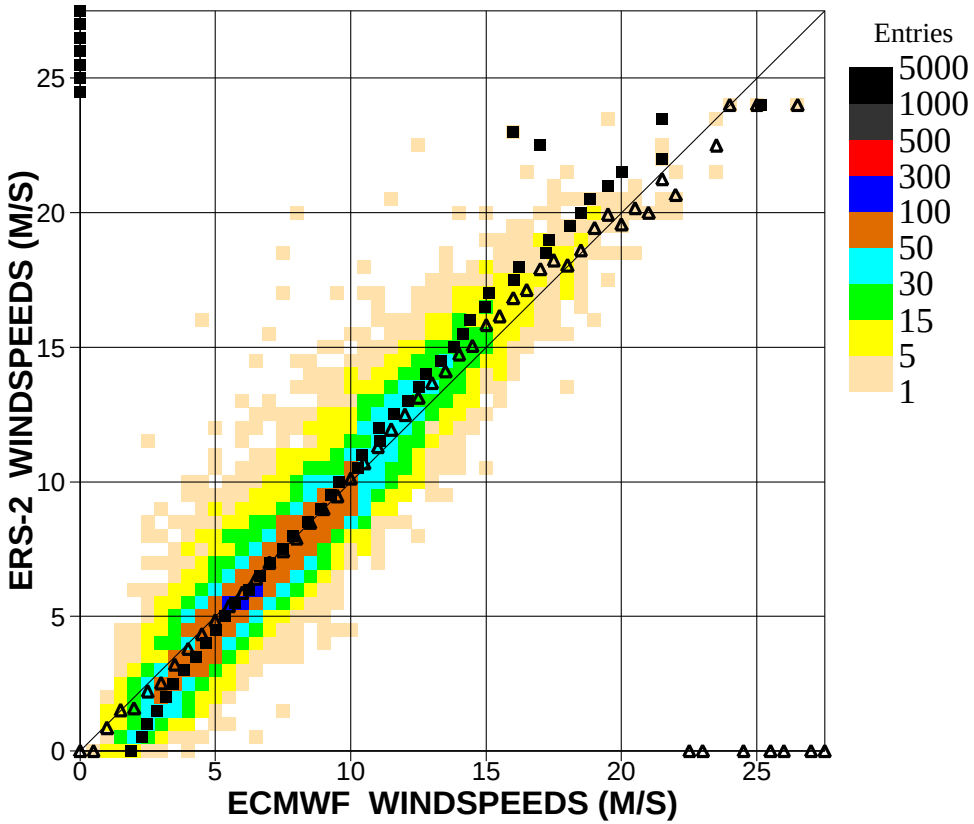
STATISTICS

ENTRIES	44035
MEAN ECMWF	7.3898
MEAN ERS-2	7.4270
BIAS (ERS-2 - ECMWF)	0.0372
STANDARD DEVIATION	1.4447
SCATTER INDEX	0.1955
CORRELATION	0.9320
SYMMETRIC SLOPE	1.0303 (0.0020)
REGR. COEFFICIENT	1.0605 (0.0020)
REGR. CONSTANT	-0.4101 (0.0160)

Figure 6. Comparison of ECMWF wind speed results with ERS2 Altimeter wind speed data for March 2003 (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
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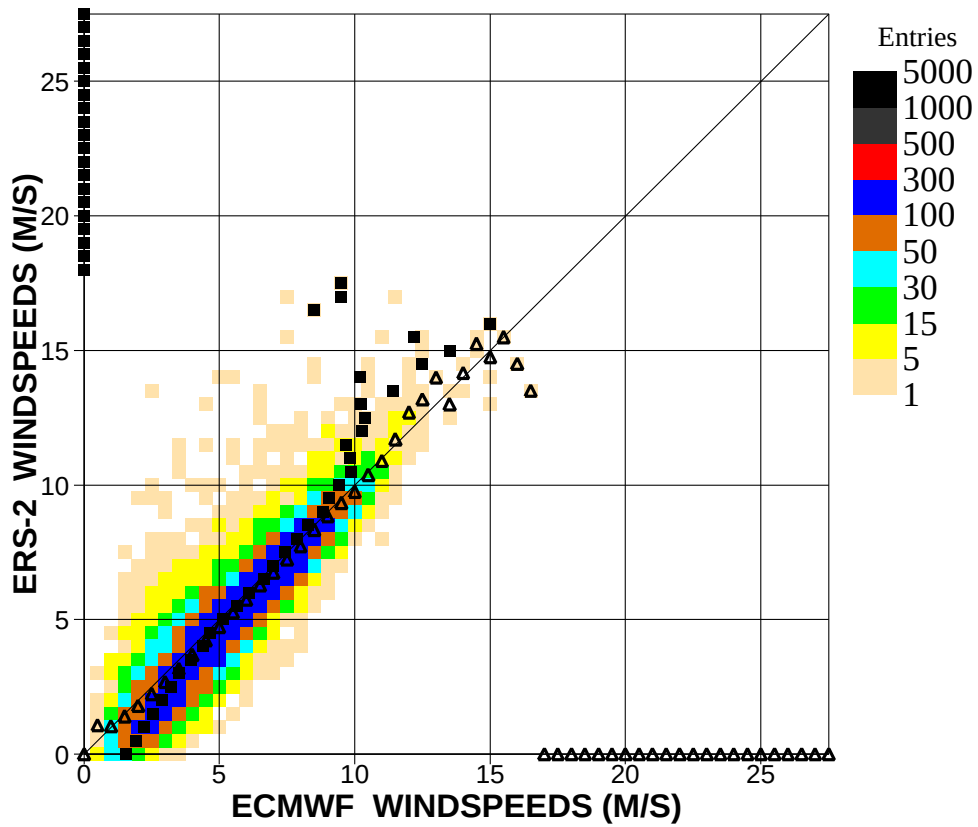
STATISTICS

ENTRIES	10064	
MEAN ECMWF	8.0009	
MEAN ERS-2	8.0408	
BIAS (ERS-2 - ECMWF)	0.0399	
STANDARD DEVIATION	1.4062	
SCATTER INDEX	0.1758	
CORRELATION	0.9430	
SYMMETRIC SLOPE	1.0293	(0.0038)
REGR. COEFFICIENT	1.0748	(0.0038)
REGR. CONSTANT	-0.5586	(0.0332)

Figure 7. Comparison of ECMWF wind speed results with ERS2 Altimeter wind speed data for March 2003 (n.hem.)

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European Centre for Medium Range Weather Forecasts
Shinfield Park, Reading, Berkshire RG2 9AX, England
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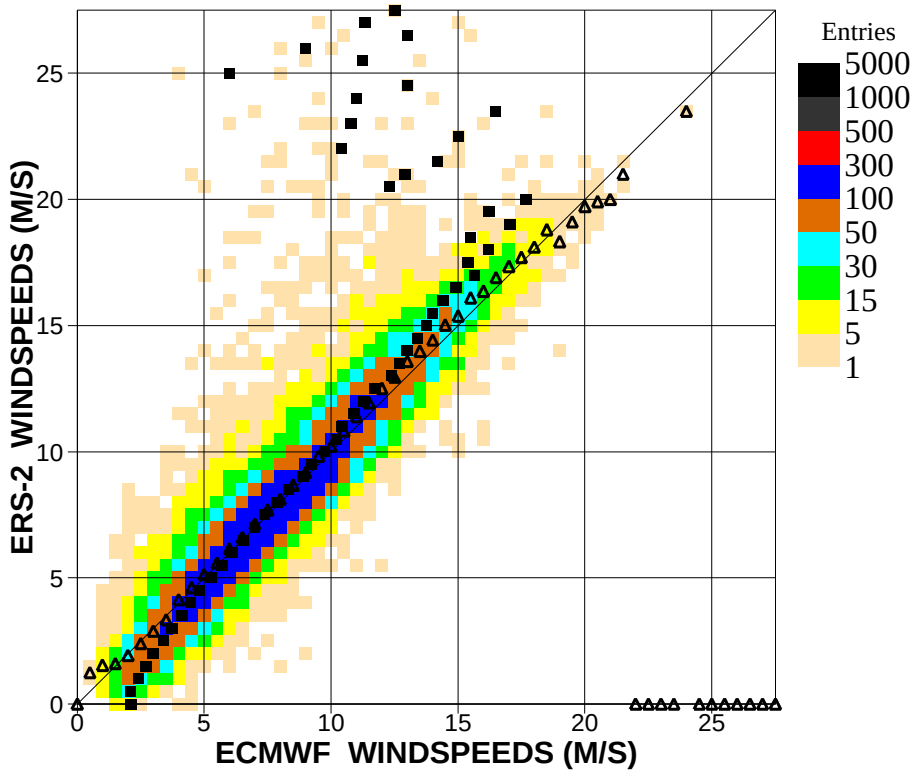


STATISTICS

ENTRIES	13659	
MEAN ECMWF	5.5134	
MEAN ERS-2	5.2711	
BIAS (ERS-2 - ECMWF)	-0.2423	
STANDARD DEVIATION	1.1031	
SCATTER INDEX	0.2001	
CORRELATION	0.9054	
SYMMETRIC SLOPE	0.9820	(0.0041)
REGR. COEFFICIENT	1.0111	(0.0041)
REGR. CONSTANT	-0.3036	(0.0243)

Figure 8. Comparison of ECMWF wind speed results with ERS2 Altimeter wind speed data for March 2003 (tropics)

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European Centre for Medium Range Weather Forecasts
Shinfield Park, Reading, Berkshire RG2 9AX, England
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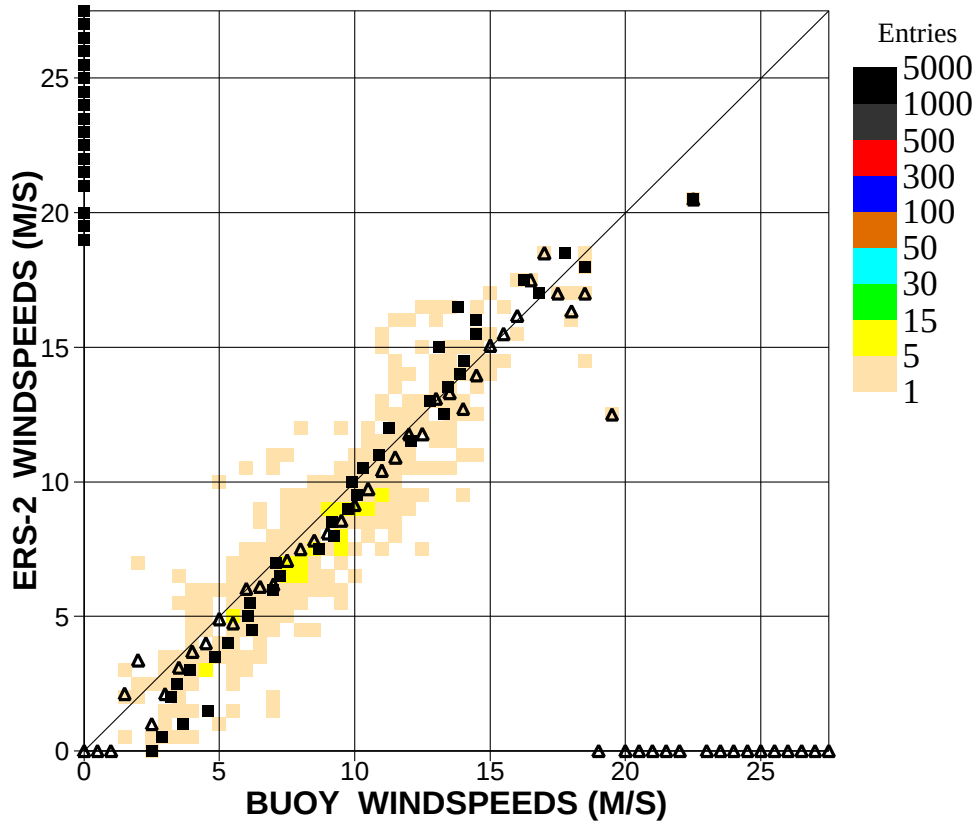
STATISTICS

ENTRIES	20642
MEAN ECMWF	8.3145
MEAN ERS-2	8.5313
BIAS (ERS-2 - ECMWF)	0.2169
STANDARD DEVIATION	1.6183
SCATTER INDEX	0.1946
CORRELATION	0.9153
SYMMETRIC SLOPE	1.0439 (0.0032)
REGR. COEFFICIENT	1.0423 (0.0032)
REGR. CONSTANT	-0.1348 (0.0288)

Figure 9. Comparison of ECMWF wind speed results with ERS2 Altimeter wind speed data for March 2003 (s.hem.)

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Shinfield Park, Reading, Berkshire RG2 9AX, England
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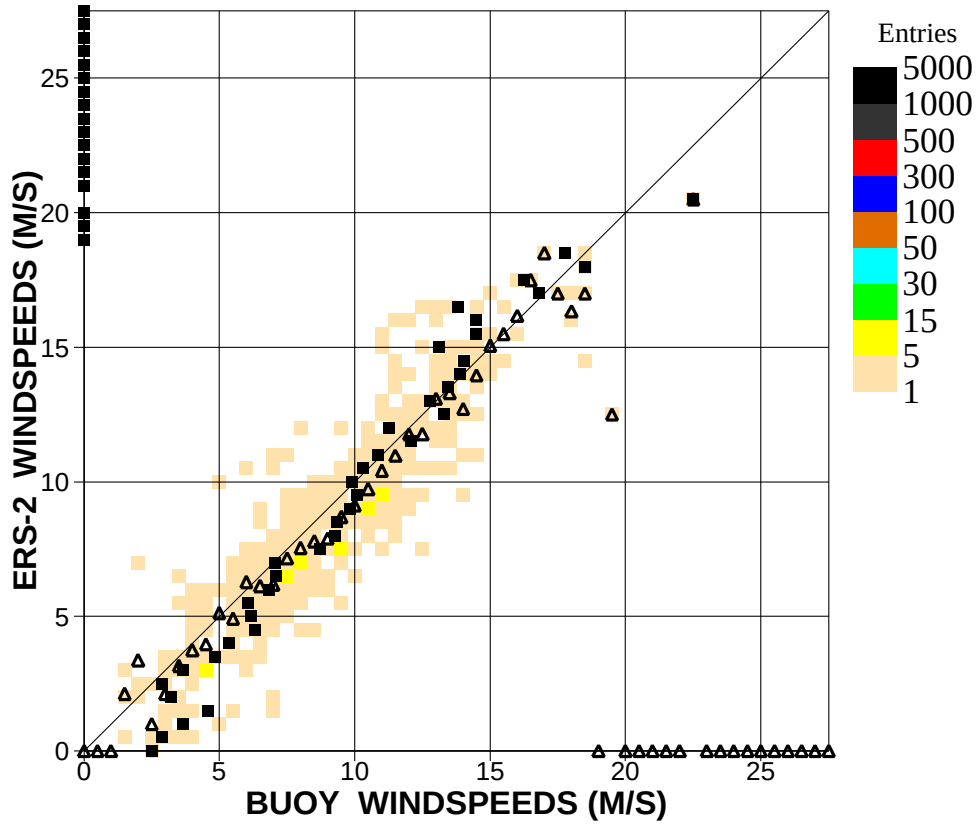


STATISTICS

ENTRIES	479	
MEAN BUOY	8.9854	
MEAN ERS-2	8.4359	
BIAS (ERS-2 - BUOY)	-0.5495	
STANDARD DEVIATION	1.6548	
SCATTER INDEX	0.1842	
CORRELATION	0.9027	
SYMMETRIC SLOPE	0.9594	(0.0215)
REGR. COEFFICIENT	0.9767	(0.0213)
REGR. CONSTANT	-0.3406	(0.2059)

Figure 10. Comparison of buoy wind speed observations with ERS2 Altimeter wind speed data for March 2003 (global)

Saleh Abdalla
European Centre for Medium Range Weather Forecasts
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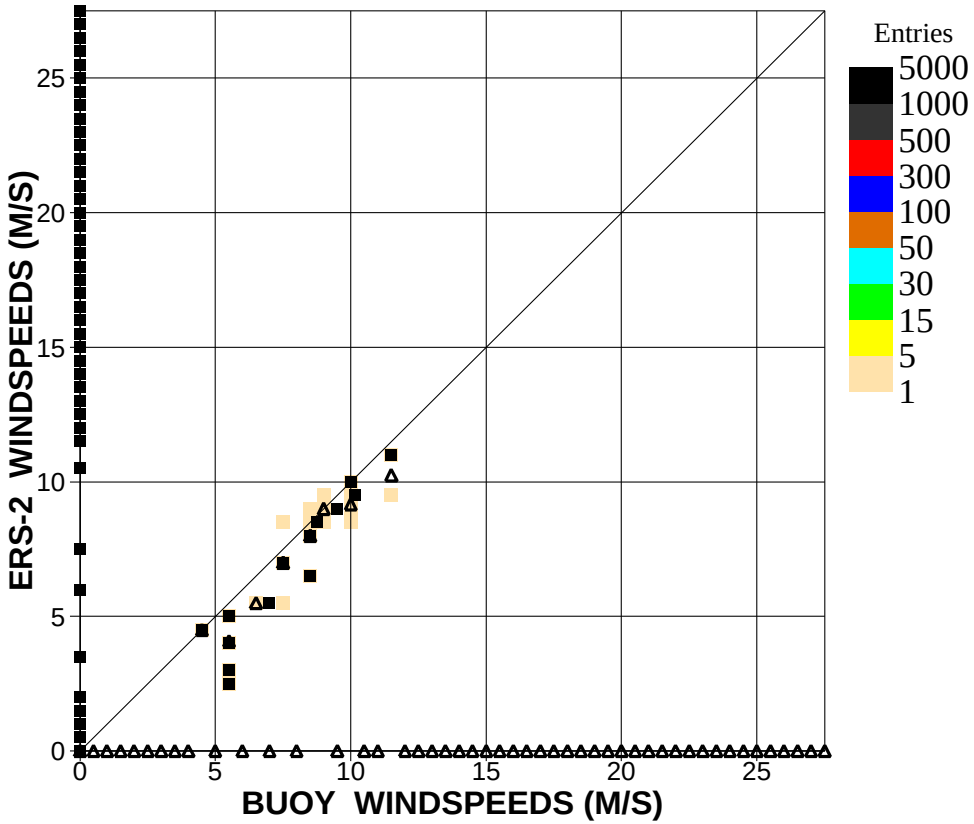


STATISTICS

ENTRIES	432	
MEAN BUOY	9.1176	
MEAN ERS-2	8.6118	
BIAS (ERS-2 - BUOY)	-0.5057	
STANDARD DEVIATION	1.7131	
SCATTER INDEX	0.1879	
CORRELATION	0.9011	
SYMMETRIC SLOPE	0.9640	(0.0226)
REGR. COEFFICIENT	0.9706	(0.0225)
REGR. CONSTANT	-0.2379	(0.2213)

Figure 11. Comparison of buoy wind speed observations with ERS2 Altimeter wind speed data for March 2003 (n.hem.)

Saleh Abdalla
European Centre for Medium Range Weather Forecasts
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STATISTICS

ENTRIES	26	
MEAN BUOY	8.1089	
MEAN ERS-2	7.3115	
BIAS (ERS-2 - BUOY)	-0.7973	
STANDARD DEVIATION	0.9050	
SCATTER INDEX	0.1116	
CORRELATION	0.9237	
SYMMETRIC SLOPE	0.9169	(0.0931)
REGR. COEFFICIENT	1.0455	(0.0885)
REGR. CONSTANT	-1.1659	(0.7399)

Figure 12. Comparison of buoy wind speed observations with ERS2 Altimeter wind speed data for March 2003 (hawaii)

Saleh Abdalla
European Centre for Medium Range Weather Forecasts
Shinfield Park, Reading, Berkshire RG2 9AX, England
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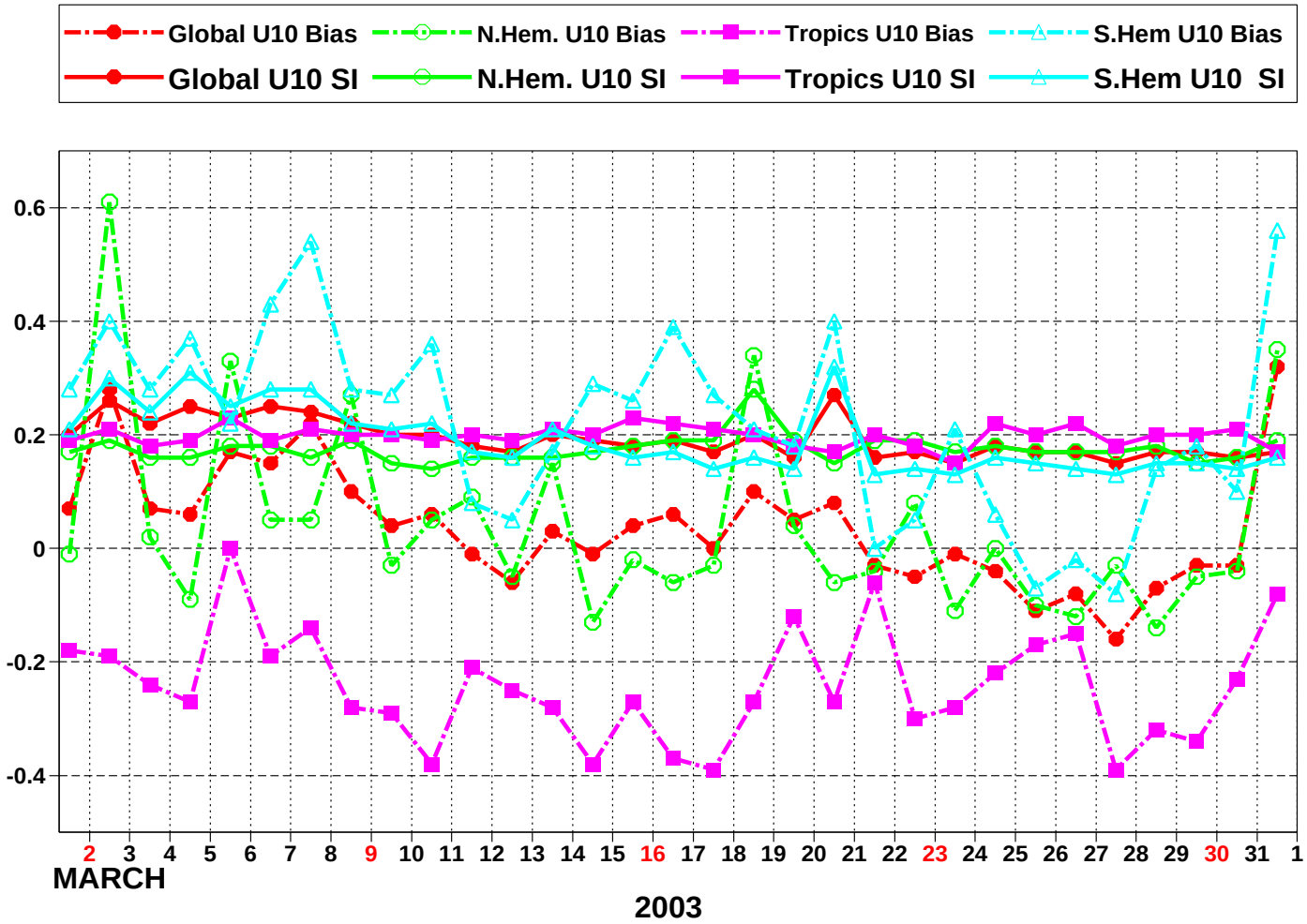


Figure 13: ERS-2 Altimeter wind speeds: Timeseries of bias (ERS-2 - model) and scatter index (SI)

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European Centre for Medium Range Weather Forecasts
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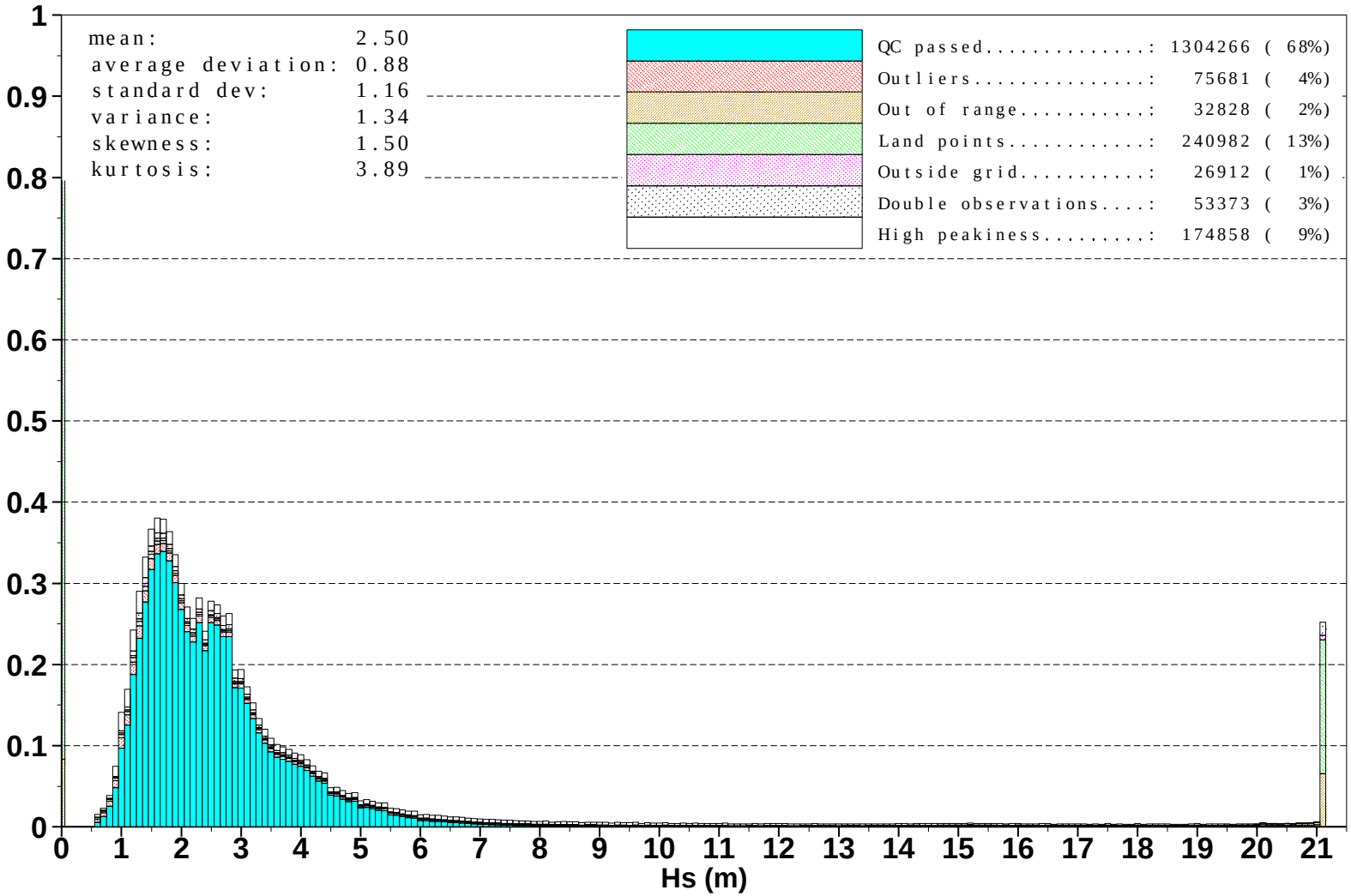


Figure 14: Distribution of the ERS-2 Altimeter wave heights after QC for March 2003

Saleh Abdalla
European Centre for Medium Range Weather Forecasts
Shinfield Park, Reading, Berkshire RG2 9AX, England
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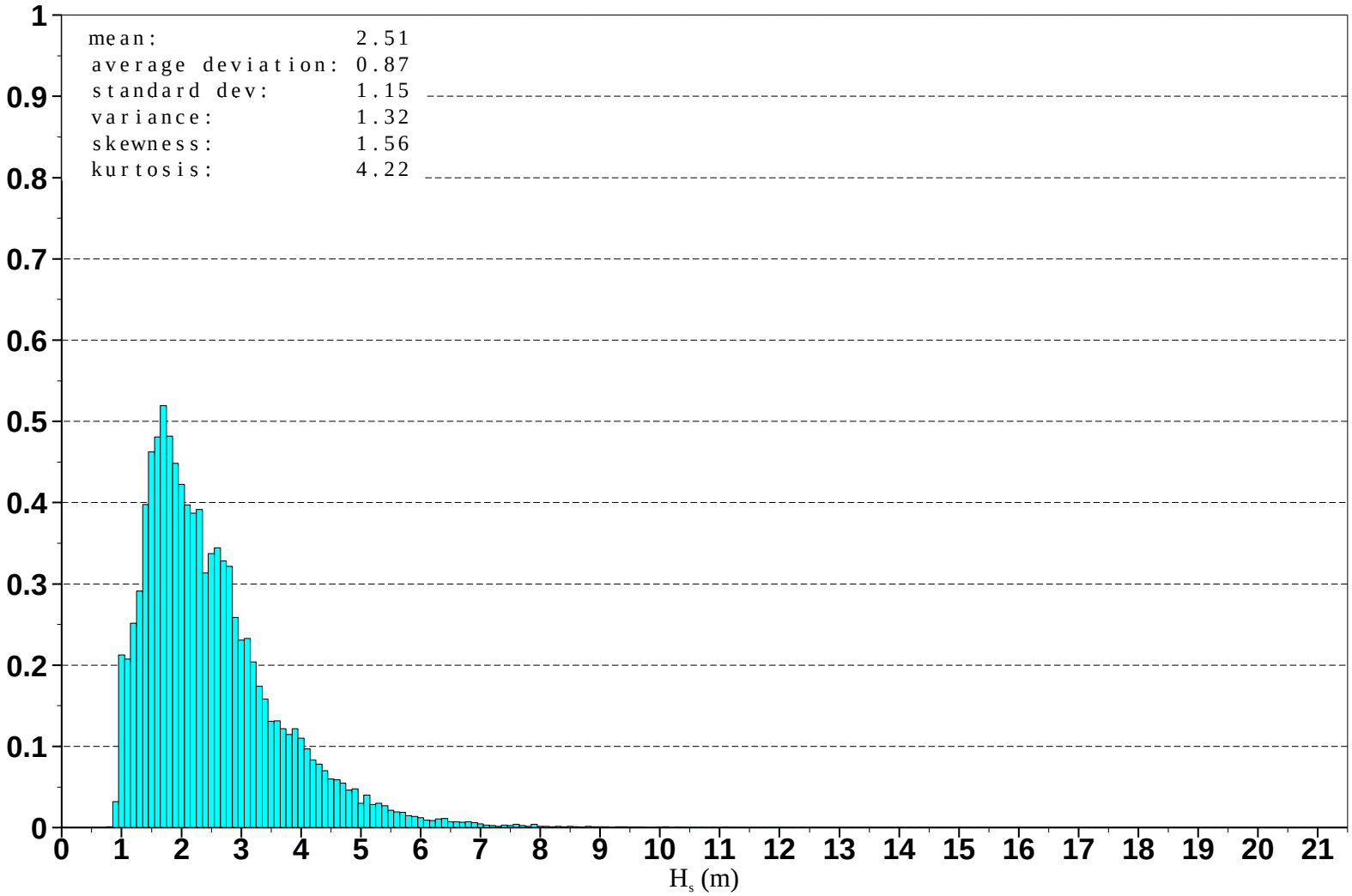


Figure 15: Distribution of ERS-2 Altimeter wave heights after along track averaging for March 2003

Saleh Abdalla
European Centre for Medium Range Weather Forecasts
Shinfield Park, Reading, Berkshire RG2 9AX, England
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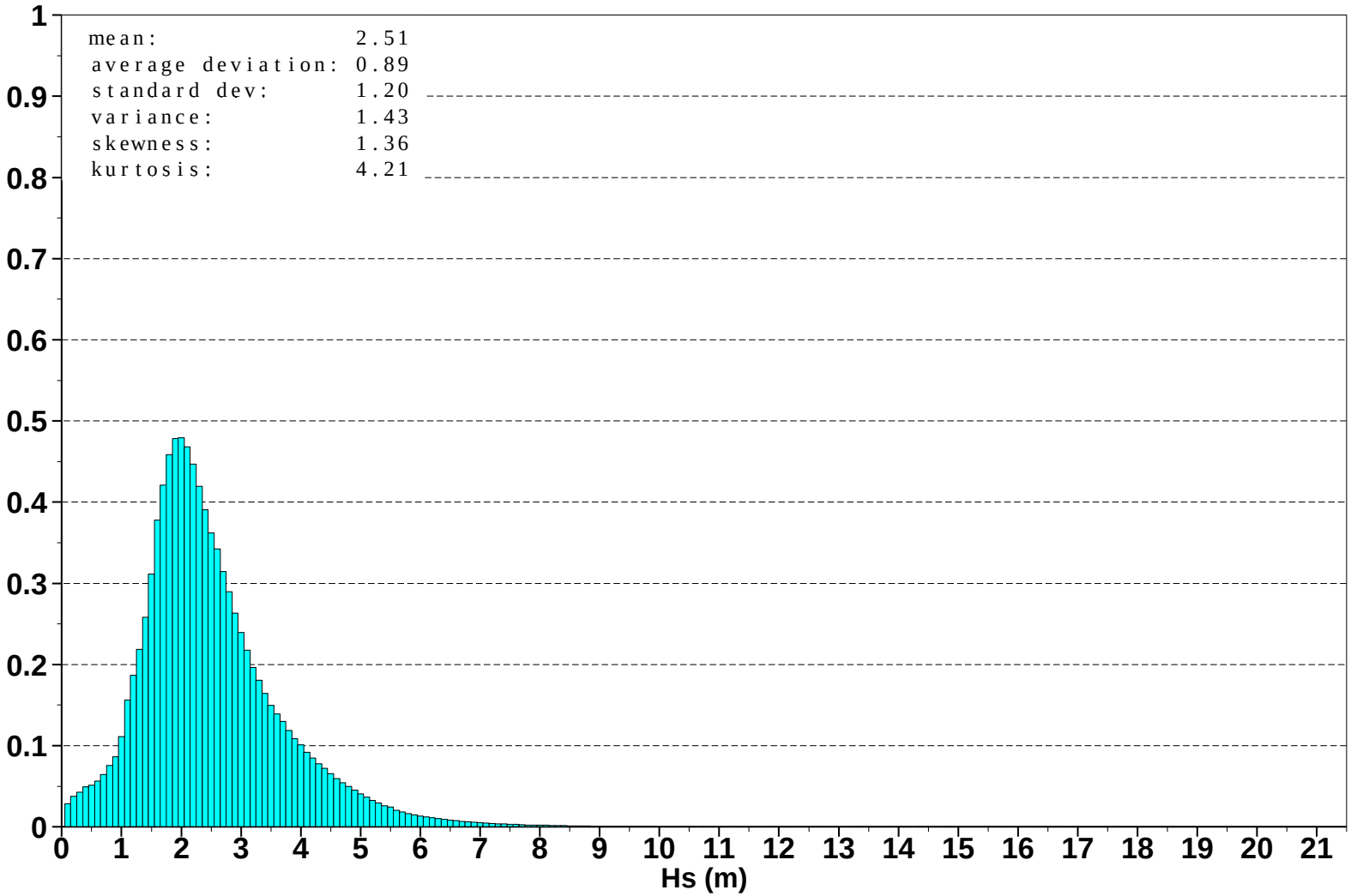
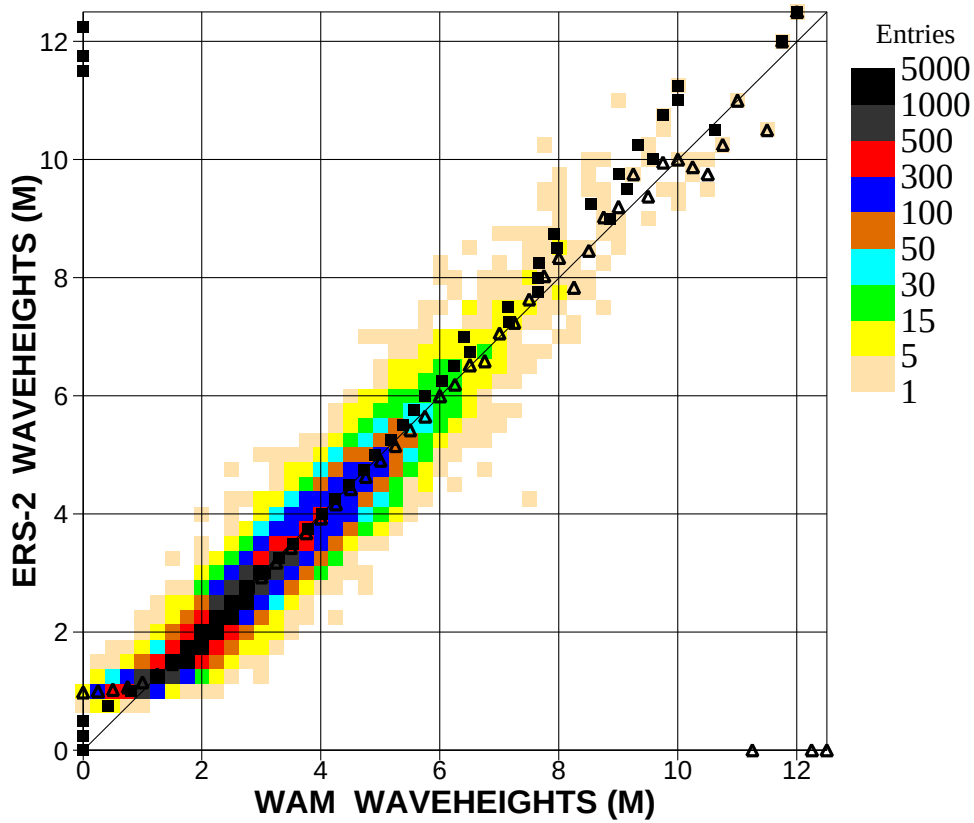


Figure 16: Global distribution of ECMWF wave heights for March 2003

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
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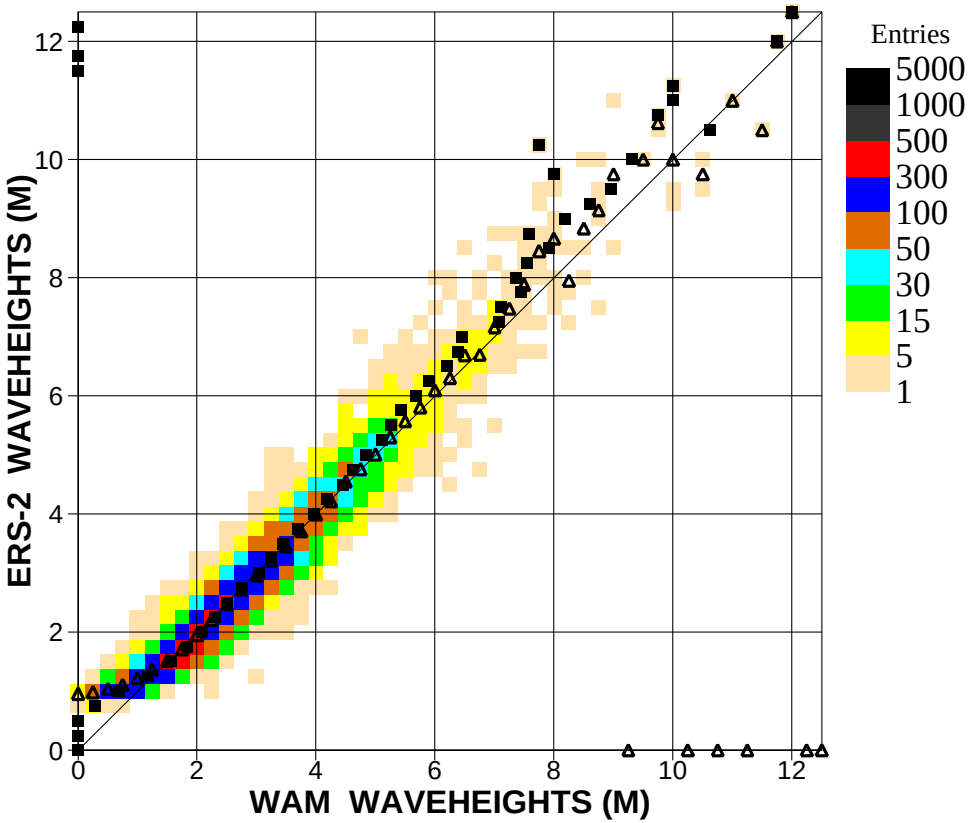


STATISTICS

ENTRIES	44035	
MEAN WAM	2.5609	
MEAN ERS-2	2.5058	
BIAS (ERS-2 - WAM)	-0.0551	
STANDARD DEVIATION	0.2872	
SCATTER INDEX	0.1121	
CORRELATION	0.9686	
SYMMETRIC SLOPE	0.9831	(0.0012)
REGR. COEFFICIENT	0.9745	(0.0012)
REGR. CONSTANT	0.0101	(0.0033)

Figure 17. Comparison of ECMWF wave height results with ERS2 Altimeter wave height data for March 2003 (global)

Saleh Abdalla
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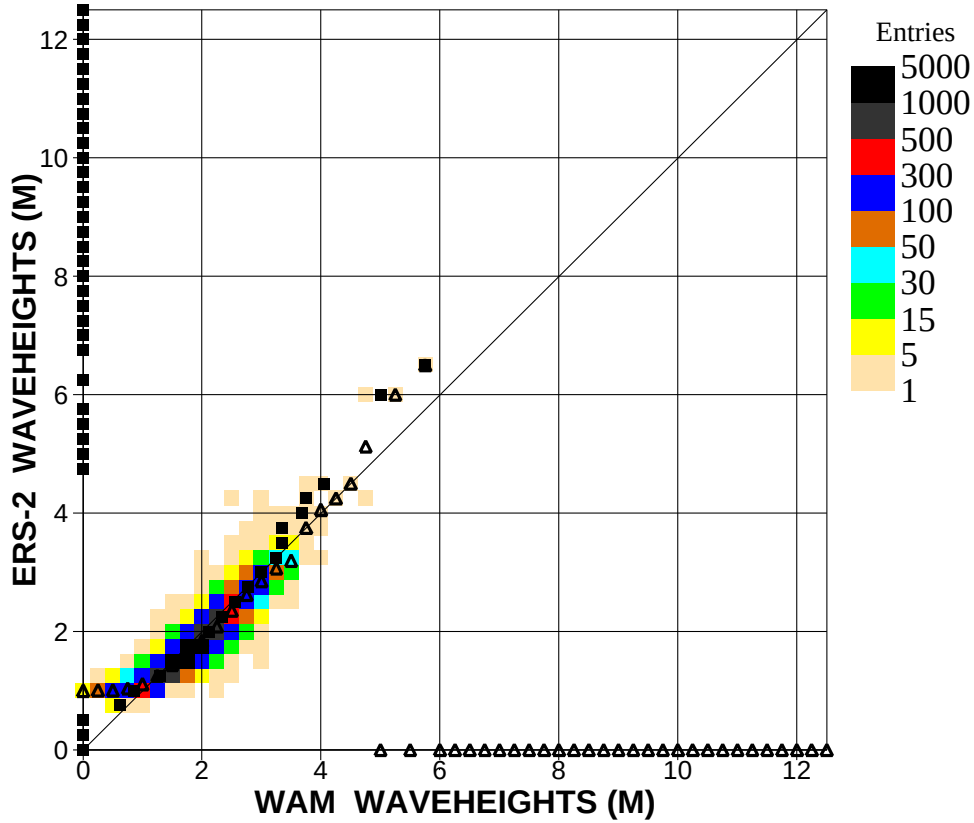


STATISTICS

ENTRIES	10064	
MEAN WAM	2.6671	
MEAN ERS-2	2.6855	
BIAS (ERS-2 - WAM)	0.0183	
STANDARD DEVIATION	0.3361	
SCATTER INDEX	0.1260	
CORRELATION	0.9681	
SYMMETRIC SLOPE	1.0078	(0.0025)
REGR. COEFFICIENT	0.9793	(0.0025)
REGR. CONSTANT	0.0735	(0.0075)

Figure 18. Comparison of ECMWF wave height results with ERS2 Altimeter wave height data for March 2003 (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

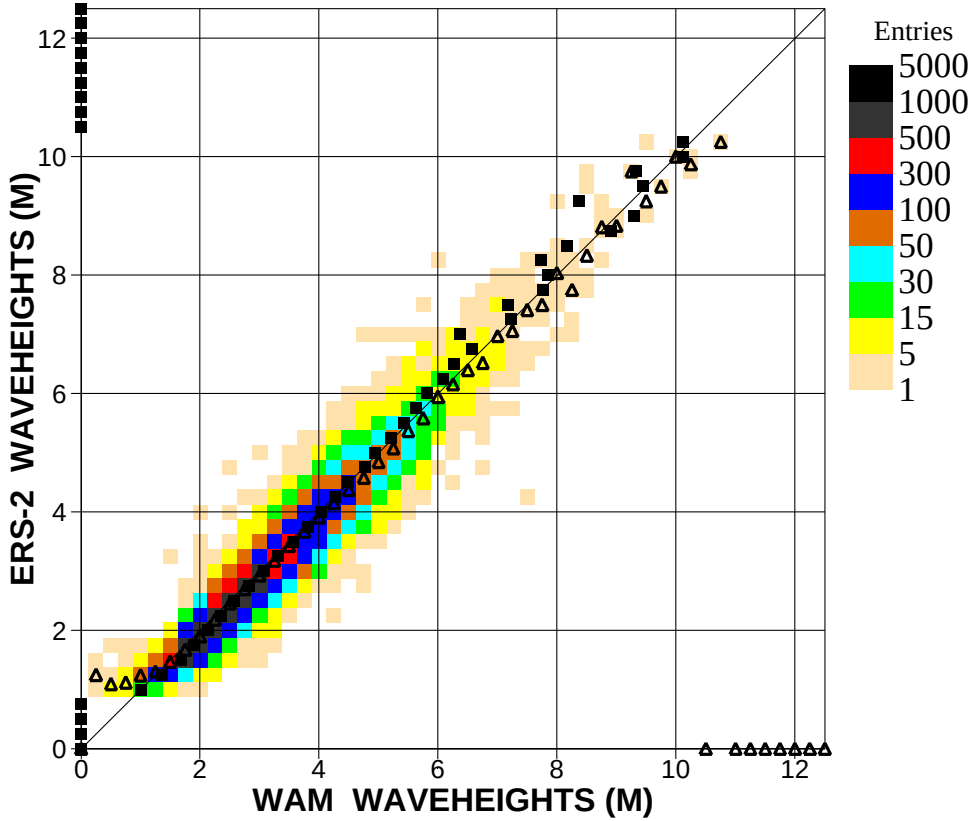


STATISTICS

ENTRIES	13659	
MEAN WAM	1.8524	
MEAN ERS-2	1.7715	
BIAS (ERS-2 - WAM)	-0.0809	
STANDARD DEVIATION	0.2128	
SCATTER INDEX	0.1149	
CORRELATION	0.9312	
SYMMETRIC SLOPE	0.9510	(0.0030)
REGR. COEFFICIENT	0.8335	(0.0028)
REGR. CONSTANT	0.2275	(0.0054)

Figure 19. Comparison of ECMWF wave height results with ERS2 Altimeter wave height data for March 2003 (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

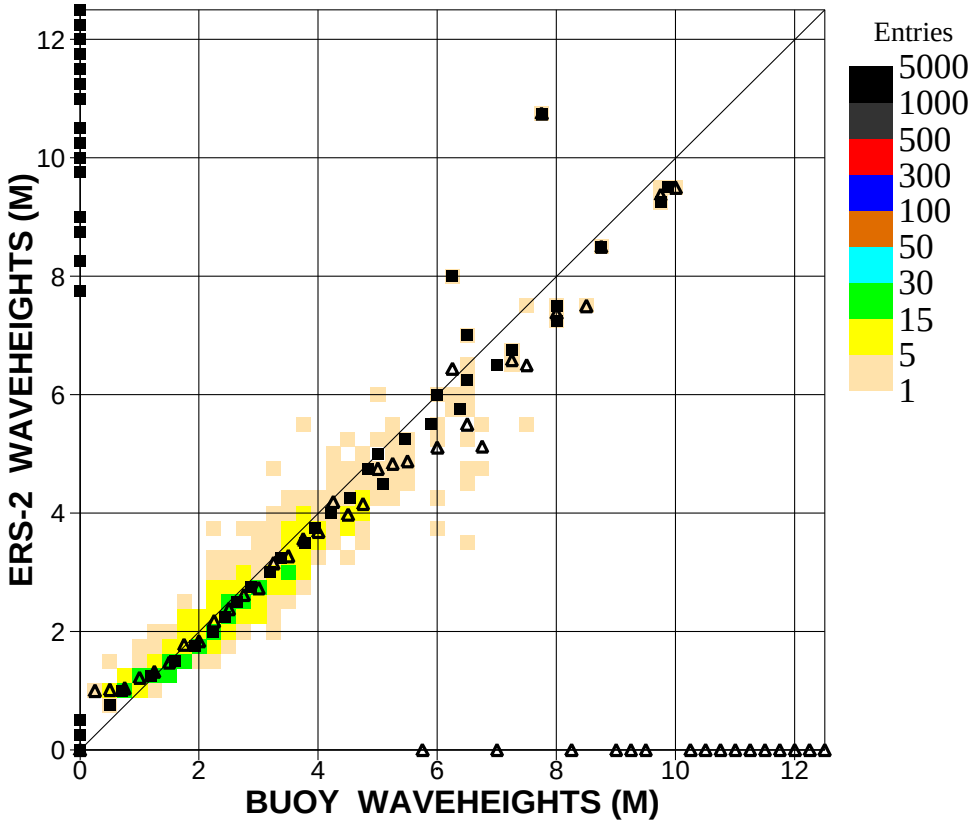


STATISTICS

ENTRIES	20642
MEAN WAM	2.9693
MEAN ERS-2	2.8951
BIAS (ERS-2 - WAM)	-0.0742
STANDARD DEVIATION	0.2969
SCATTER INDEX	0.1000
CORRELATION	0.9645
SYMMETRIC SLOPE	0.9801 (0.0019)
REGR. COEFFICIENT	0.9802 (0.0019)
REGR. CONSTANT	-0.0154 (0.0059)

Figure 20. Comparison of ECMWF wave height results with ERS2 Altimeter wave height data for March 2003 (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



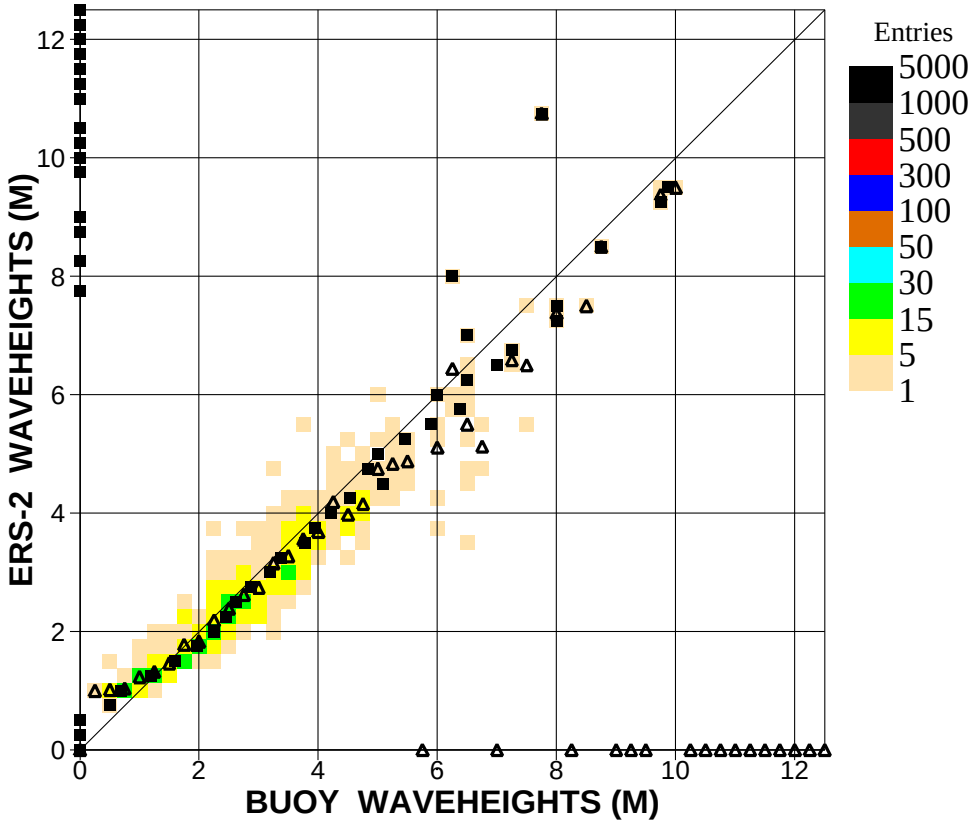
STATISTICS

ENTRIES	740	
MEAN BUOY	2.8159	
MEAN ERS-2	2.6906	
BIAS (ERS-2 - BUOY)	-0.1253	
STANDARD DEVIATION	0.4652	
SCATTER INDEX	0.1652	
CORRELATION	0.9526	
SYMMETRIC SLOPE	0.9454	(0.0106)
REGR. COEFFICIENT	0.8664	(0.0102)
REGR. CONSTANT	0.2510	(0.0326)

Figure 21. Comparison of buoy wave height observations with ERS2 Altimeter wave height data for March 2003 (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

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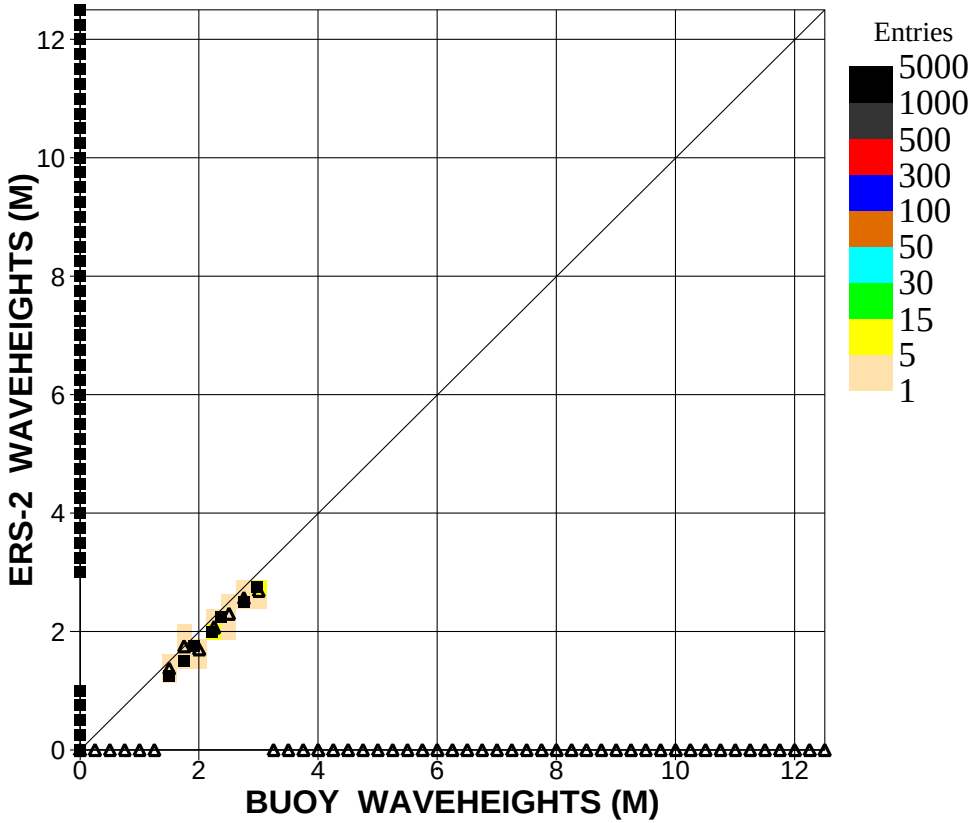


STATISTICS

ENTRIES	681	
MEAN BUOY	2.8831	
MEAN ERS-2	2.7555	
BIAS (ERS-2 - BUOY)	-0.1276	
STANDARD DEVIATION	0.4807	
SCATTER INDEX	0.1667	
CORRELATION	0.9515	
SYMMETRIC SLOPE	0.9457	(0.0112)
REGR. COEFFICIENT	0.8659	(0.0107)
REGR. CONSTANT	0.2590	(0.0352)

Figure 22. Comparison of buoy wave height observations with ERS2 Altimeter wave height data for March 2003 (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	35	
MEAN BUOY	2.3981	
MEAN ERS-2	2.1683	
BIAS (ERS-2 - BUOY)	-0.2298	
STANDARD DEVIATION	0.1384	
SCATTER INDEX	0.0577	
CORRELATION	0.9583	
SYMMETRIC SLOPE	0.9034	(0.0450)
REGR. COEFFICIENT	0.8441	(0.0438)
REGR. CONSTANT	0.1440	(0.1070)

Figure 23. Comparison of buoy wave height observations with ERS2 Altimeter wave height data for March 2003 (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

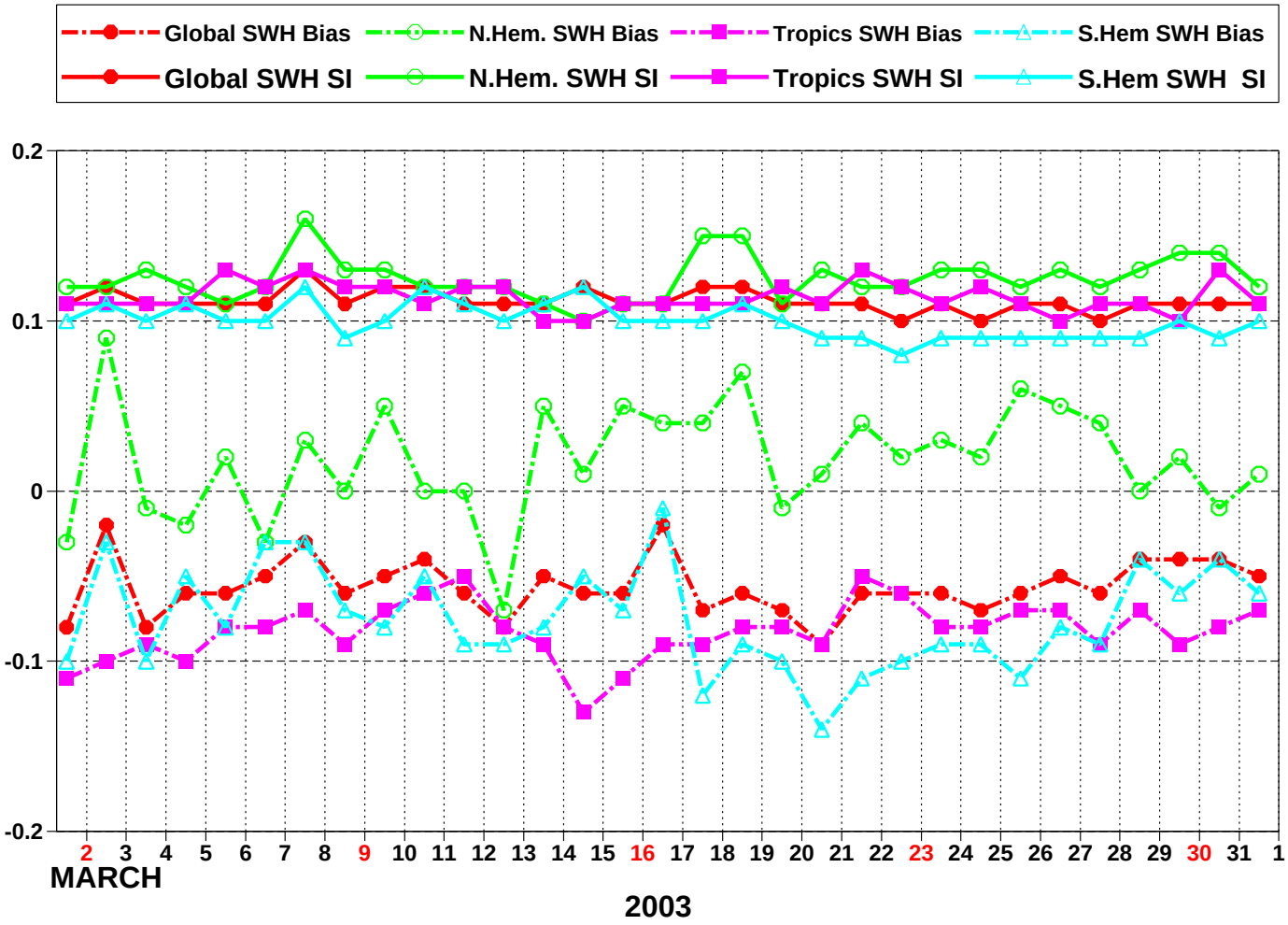


Figure 24: ERS-2 Altimeter wave heights: Timeseries of bias (ERS-2 - model) and scatter index (SI)

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

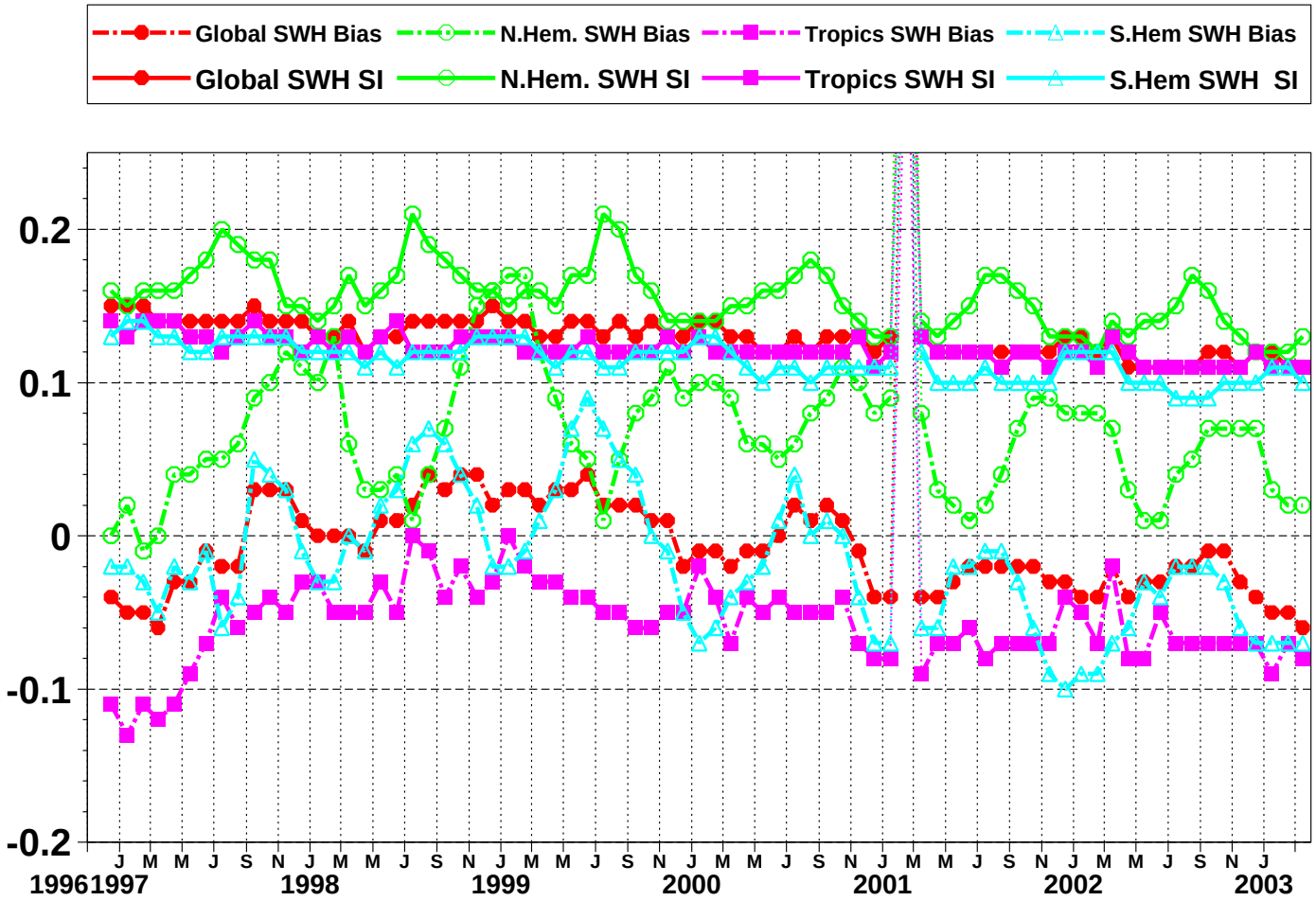


Figure 25: ERS-2 Altimeter wave heights: Timeseries of bias (ERS-2 - model) and scatter index (SI)

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

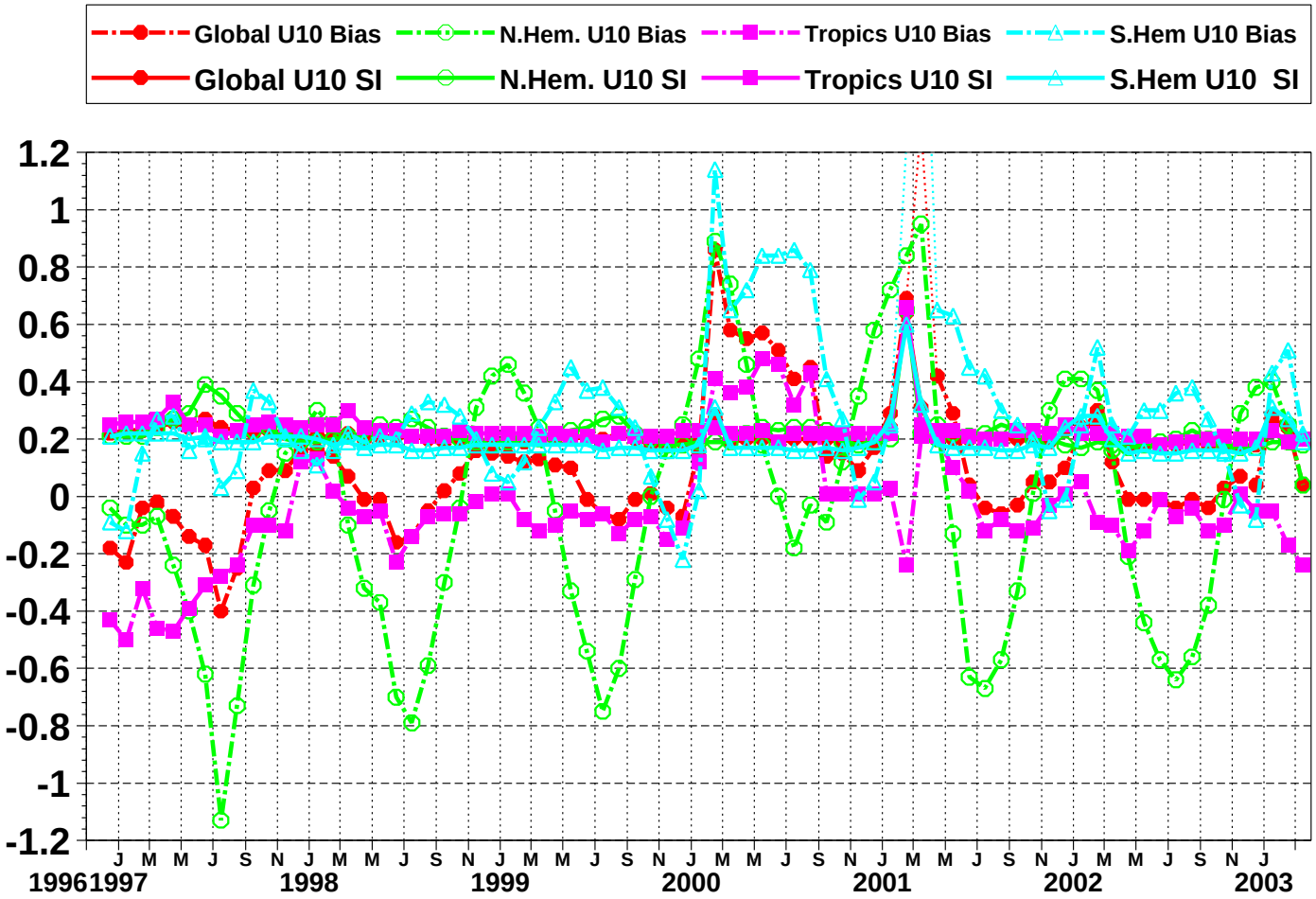


Figure 26: ERS-2 Altimeter wind speeds: Timeseries of bias (ERS-2 - model) and scatter index (SI)

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