ECMWF Report on ERS-2 RA for June 2003

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

By: *Saleh Abdalla*

Date: *7 July 2003*

Overview:

Based on the data received during the whole month, on average, 11496 observations arrived at ECMWF every 6 hours of which 78.65% passed the quality control. The data coverage, which was rather good before the 22nd. of the month, can be seen in Figure 1. There was no data at the time window centred at 06:00 on the 14th. of the month and during the period starting from time window 18:00 on the 22nd. of the month following the failure of the ERS-2 tape recorder (except for a small amount of data which was received for the time window 12:00 on the 24th.). Data reception was significantly reduced at time windows centred at: 12:00 on the 14th., 06:00 on the 15th. and the 16th. of the month (all times are in UTC). Note that we are talking about the raw data which have arrived at ECMWF before they were processed. The quality of the received data is as good as usual.

Backscatter:

ESR-2 $<\sigma_0>$ = 11.13 dB (with two peaks at 10.6 and 11.1 dB)

Wind Speed Comparison with ECMWF wind speeds (bias):

ERS-2 global: -0.104 m/s

ERS-2 northern hemisphere: -0.628 m/s

ERS-2 tropics: -0.238 m/s

ERS-2 southern hemisphere: 0.300 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

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Wind Speed Comparison with buoy wind speeds (bias):

ERS-2 global: -0.929 m/s

ERS-2 northern hemisphere: -0.940 m/s

ERS-2 tropics: -0.979 m/s

Wave Height Comparison with ECMWF wave heights (bias):

ERS-2 global: -0.048 m (lowest waves measured: 0.6m)

ERS-2 northern hemisphere: 0.023 m

ERS-2 tropics: -0.087 m

ERS-2 southern hemisphere: -0.061 m

Wave Height Comparison with buoy wave heights (bias):

ERS-2 global: 0.001 m

ERS-2 northern hemisphere: 0.002 m

ERS-2 tropics: -0.023 m

Remarks:

- The quality of Altimeter data, both wind speed and significant wave height, is as good as it used to be.

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

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- According to ESA (EOHelp message of 4 July 2003), the recording capabilities of ERS-2 are declared permanently unavailable following the failure of the ERS-2 tape recorder on 22 June 2003. The ERS-2 tape recorders were used to record the ERS-2 Low Rate mission globally for a period of 8 years of continuous acquisition. The global coverage is, therefore, discontinued. The ERS-2 Low Rate mission will be continued within the visibility of ESA ground stations over Europe, North Atlantic, the Arctic and western North America. ESA has the intention to extend the coverage of the Real Time Low Rate acquisition over the North Atlantic in the near future.

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 June 2003.

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

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

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

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

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

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

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

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

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Figure 12: Comparison of buoy wind speed observations with ERS-2 Altimeter wind speed data for June 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 June 2003.

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

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

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

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

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

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

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

Figure 22: Comparison of buoy wave height observations with ERS-2 Altimeter wave height data for June 2003 (northern hemisphere).

Saleh Abdalla
European Centre for Medium Range Weather Forecasts
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Figure 23: Comparison of buoy wave height observations with ERS-2 Altimeter wave height data for June 2003 (tropics).

Figure 24: ERS-2 Altimeter wave heights: Timeseries of bias (ERS-2 - model) and scatter index (SI) for June 2003.

Figure 25: ERS-2 Altimeter wave heights: Timeseries of bias (ERS-2 - model) and scatter index (SI) from December 1996 to June 2003

Figure 26: ERS-2 Altimeter wind speeds: Timeseries of bias (ERS-2 - model) and scatter index (SI) from December 1996 to June 2003

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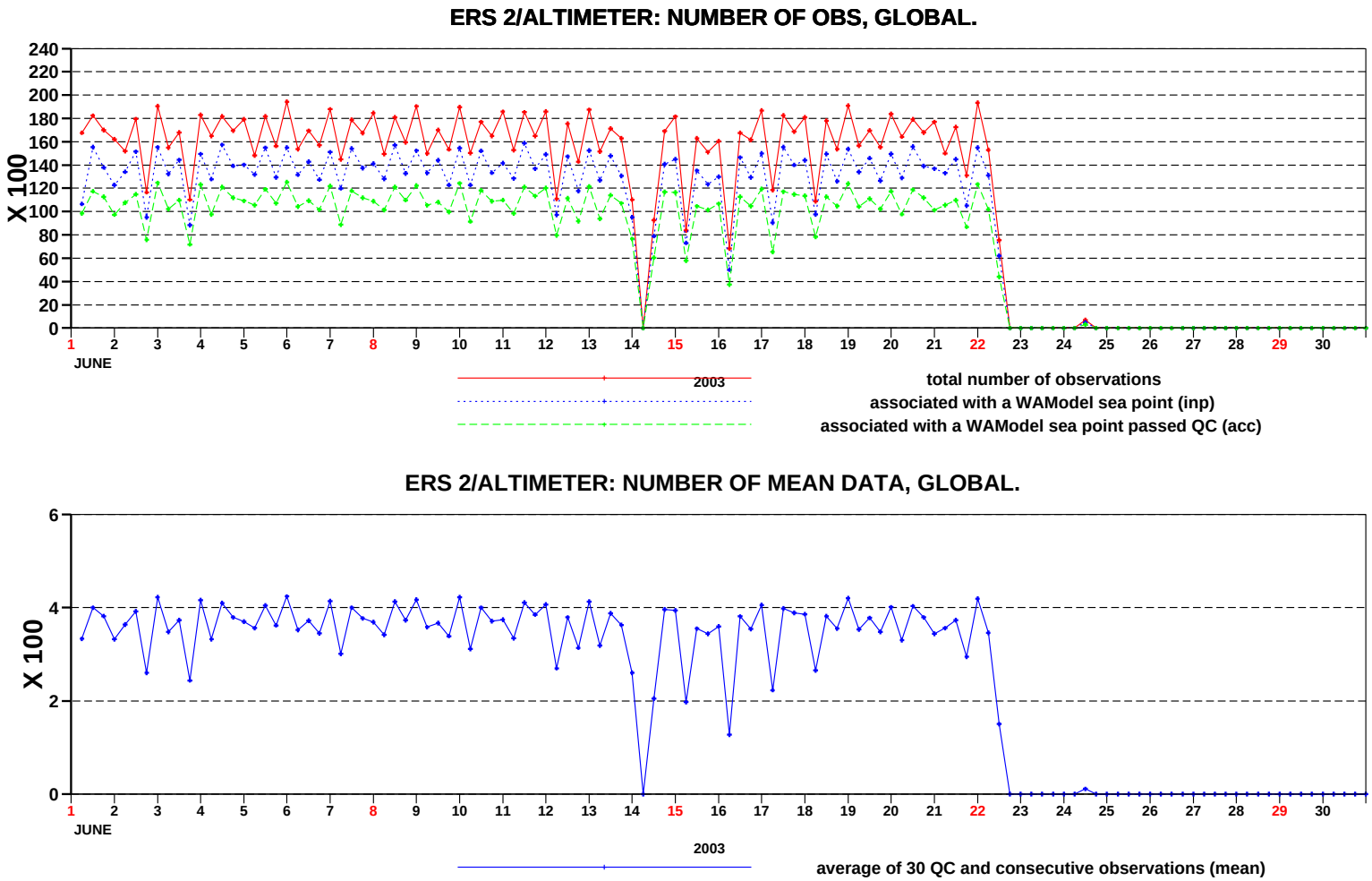


Figure 1: Time series of data reception for ERS-2 Altimeter data for June 2003

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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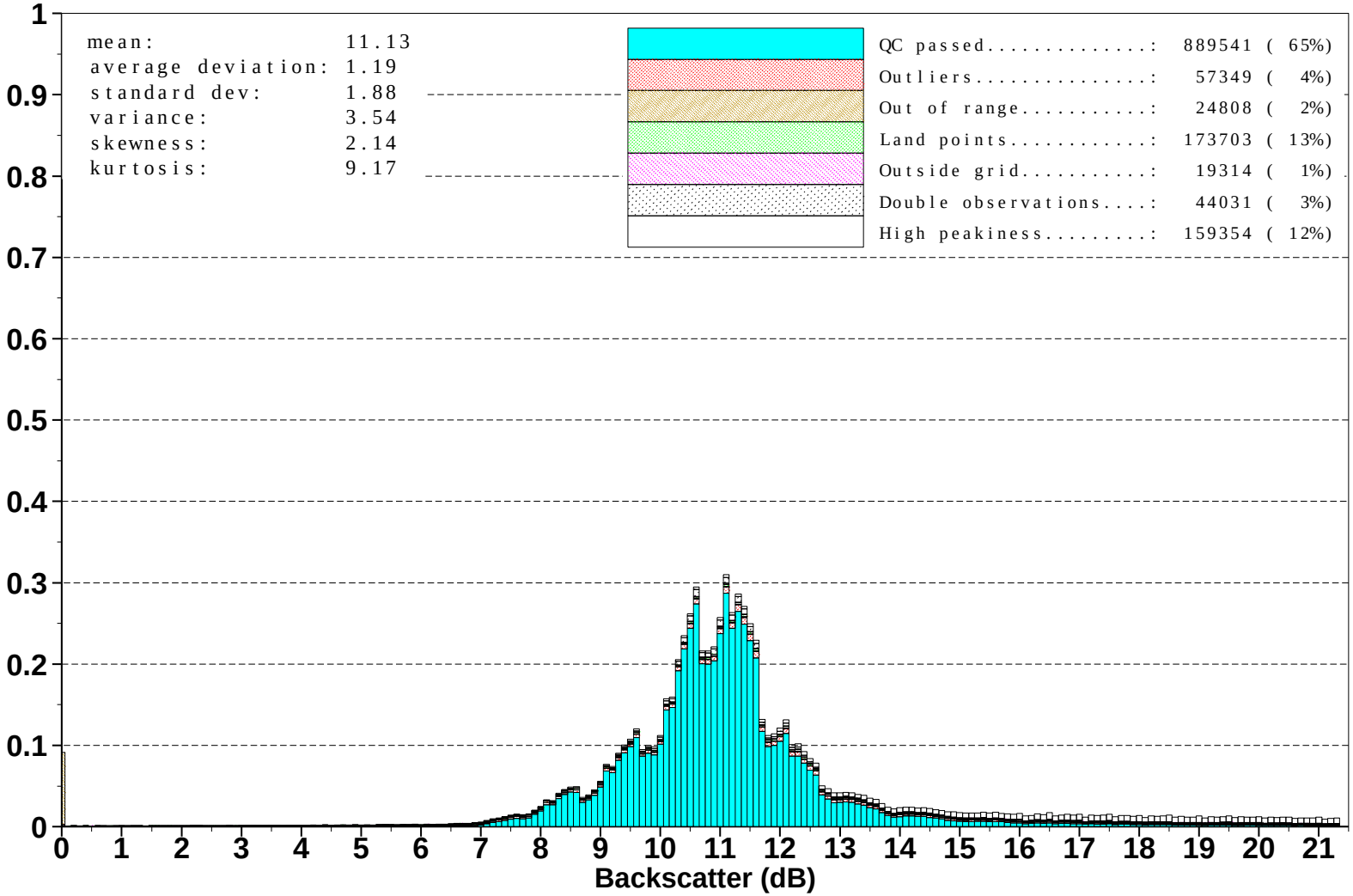


Figure 2: Distribution of the ERS-2 Altimeter backscatter after QC for June 2003

Saleh Abdalla
European Centre for Medium Range Weather Forecasts
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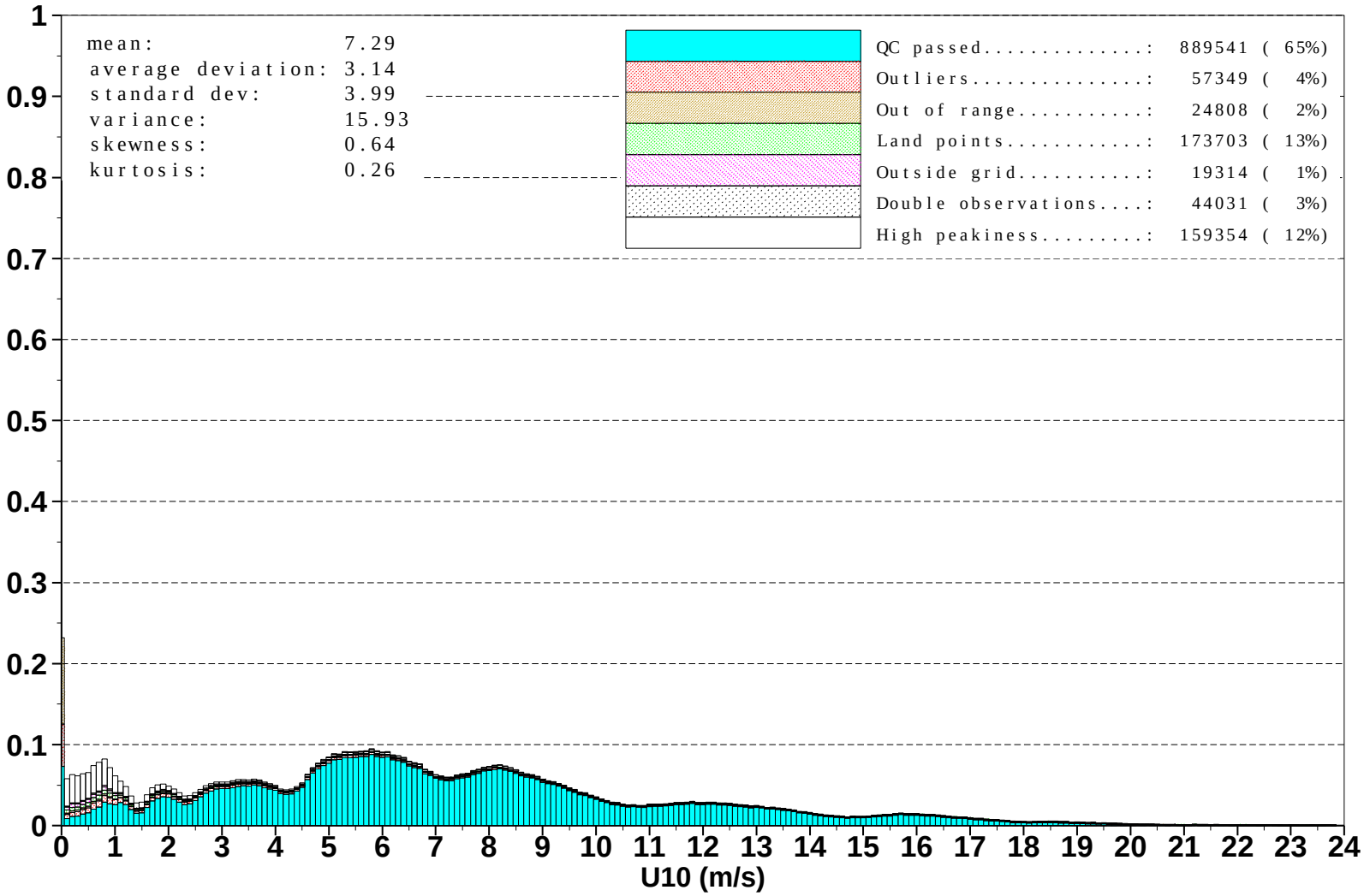


Figure 3: Distribution of the ERS-2 Altimeter wind speeds after QC for June 2003

Saleh Abdalla
European Centre for Medium Range Weather Forecasts
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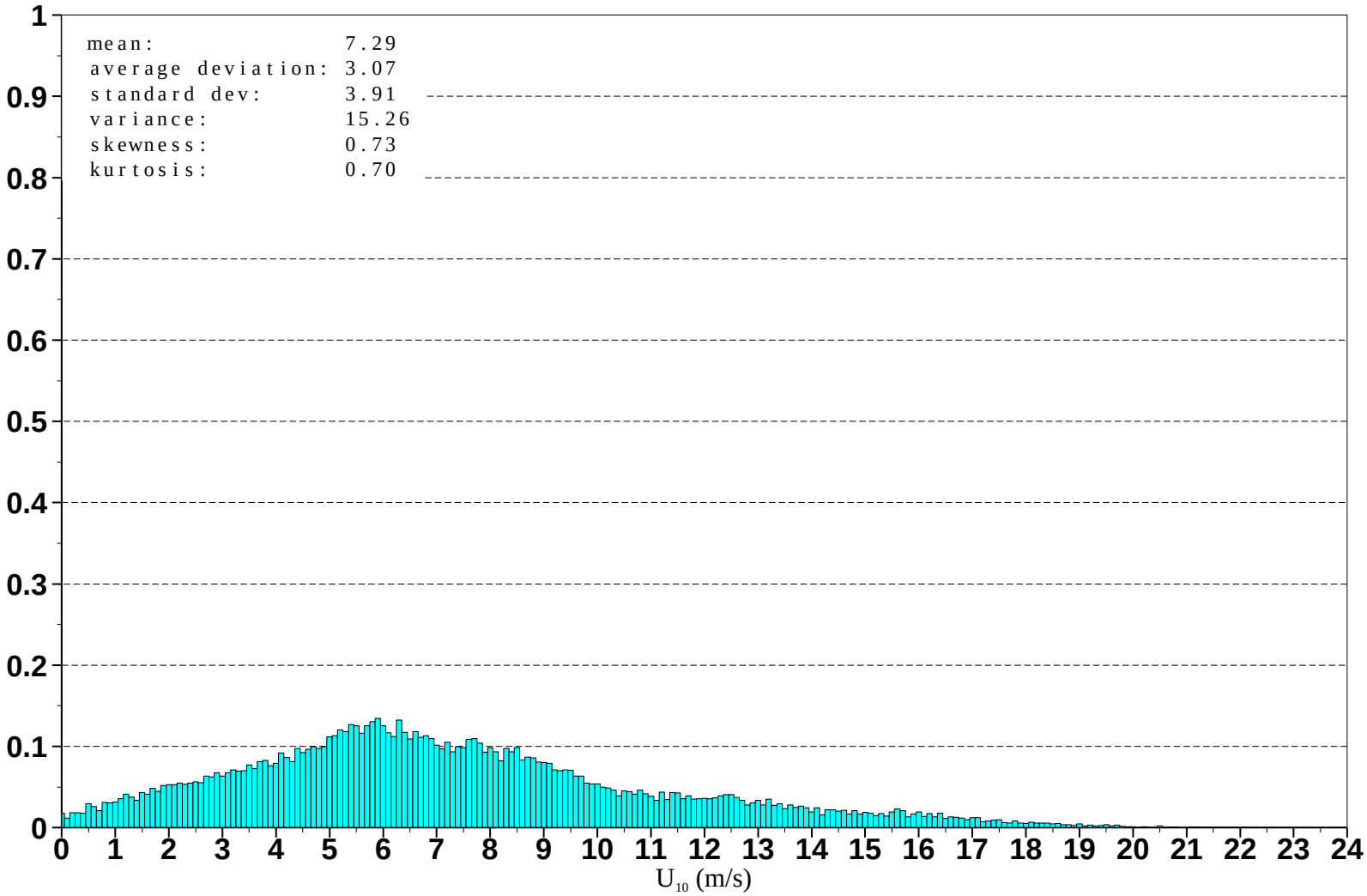


Figure 4: Distribution of ERS-2 Altimeter wind speeds after along track averaging for June 2003

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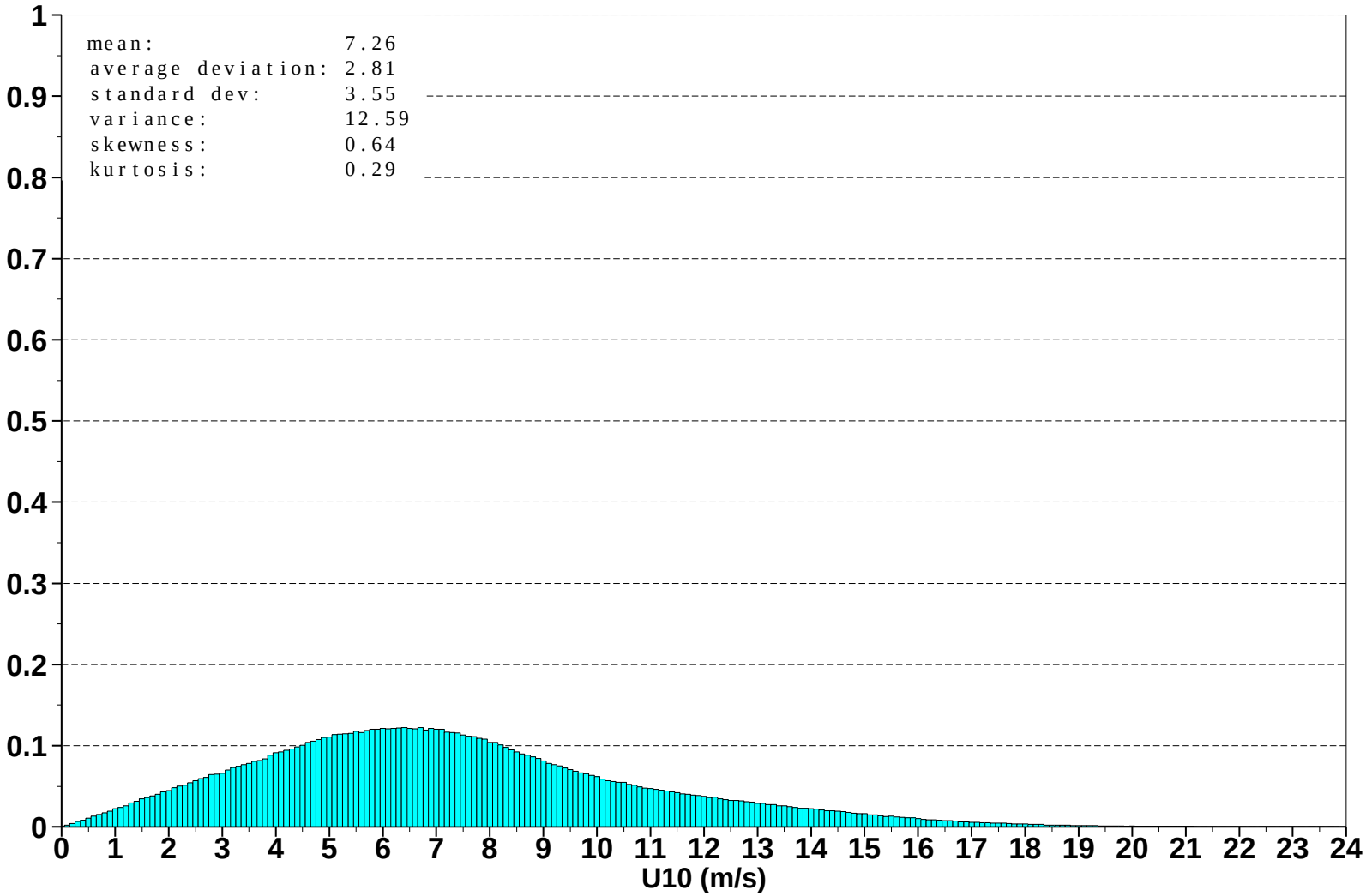
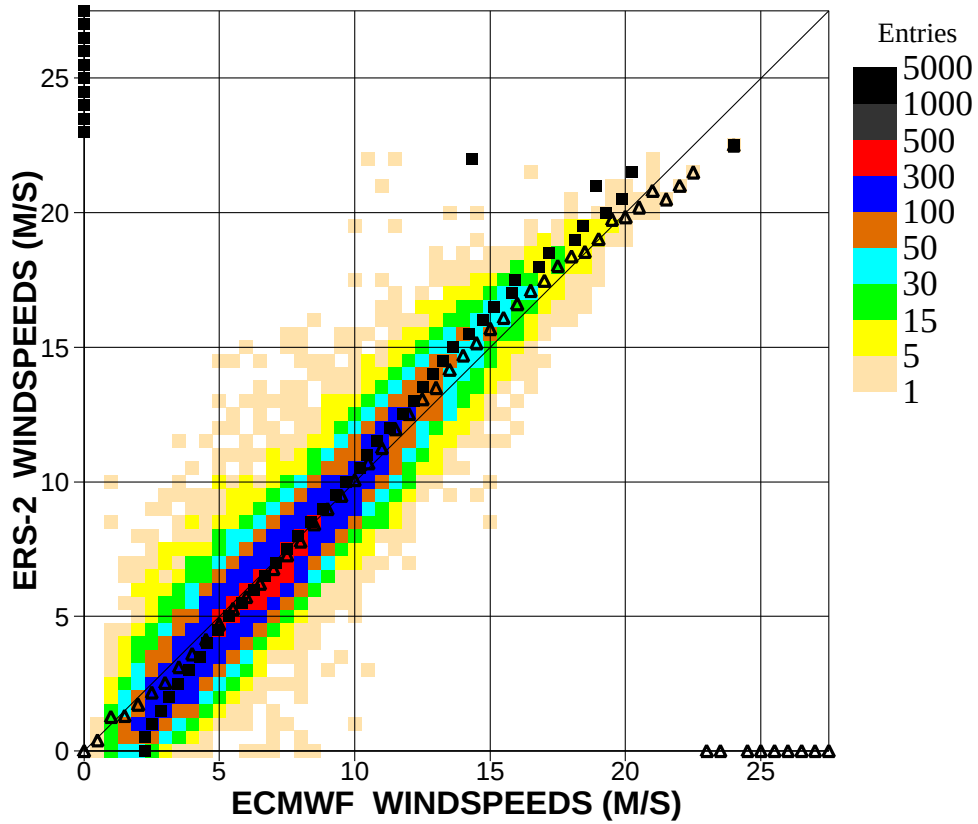


Figure 5: Global distribution of ECMWF ocean surface wind speeds for June 2003

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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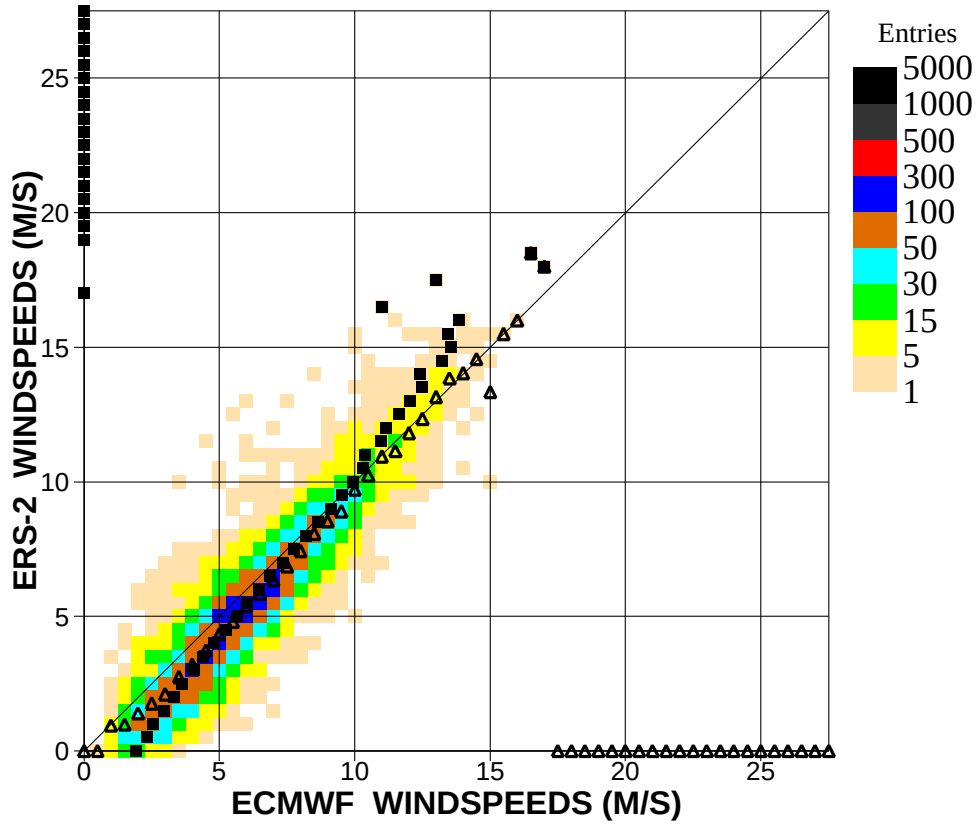
STATISTICS

ENTRIES	29990
MEAN ECMWF	7.3981
MEAN ERS-2	7.2941
BIAS (ERS-2 - ECMWF)	-0.1040
STANDARD DEVIATION	1.3394
SCATTER INDEX	0.1810
CORRELATION	0.9421
SYMMETRIC SLOPE	1.0162 (0.0023)
REGR. COEFFICIENT	1.0822 (0.0022)
REGR. CONSTANT	-0.7118 (0.0181)

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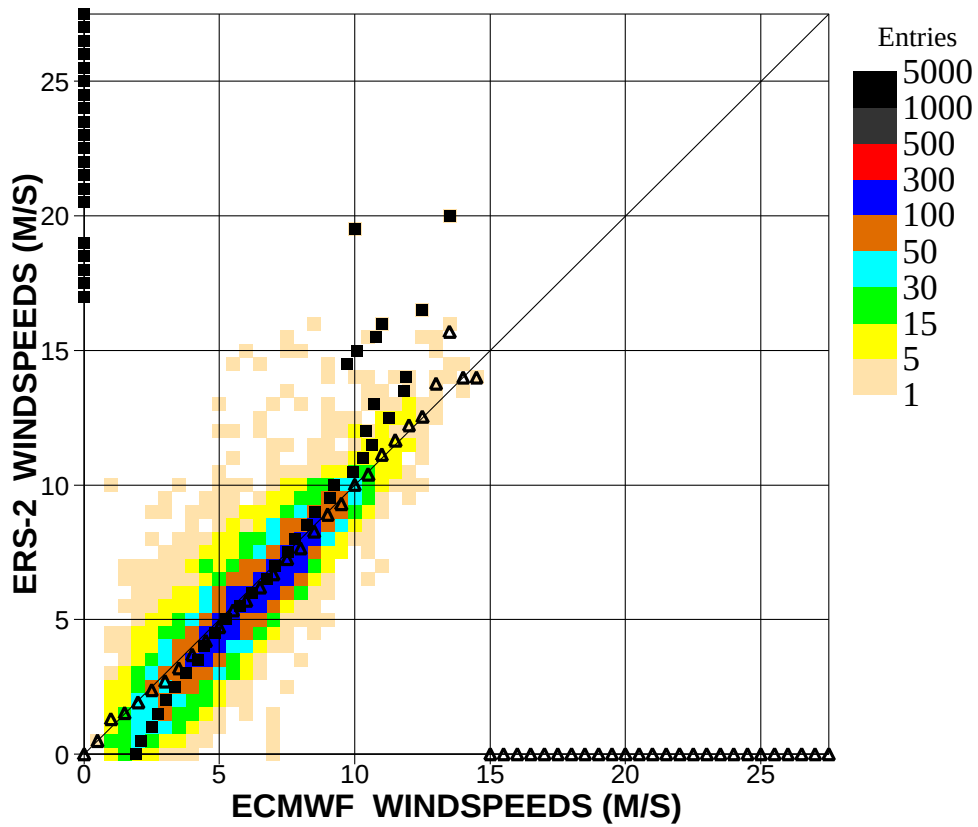
STATISTICS

ENTRIES	7595	
MEAN ECMWF	5.9998	
MEAN ERS-2	5.3715	
BIAS (ERS-2 - ECMWF)	-0.6283	
STANDARD DEVIATION	1.1373	
SCATTER INDEX	0.1896	
CORRELATION	0.9232	
SYMMETRIC SLOPE	0.9378	(0.0053)
REGR. COEFFICIENT	1.0537	(0.0050)
REGR. CONSTANT	-0.9503	(0.0329)

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

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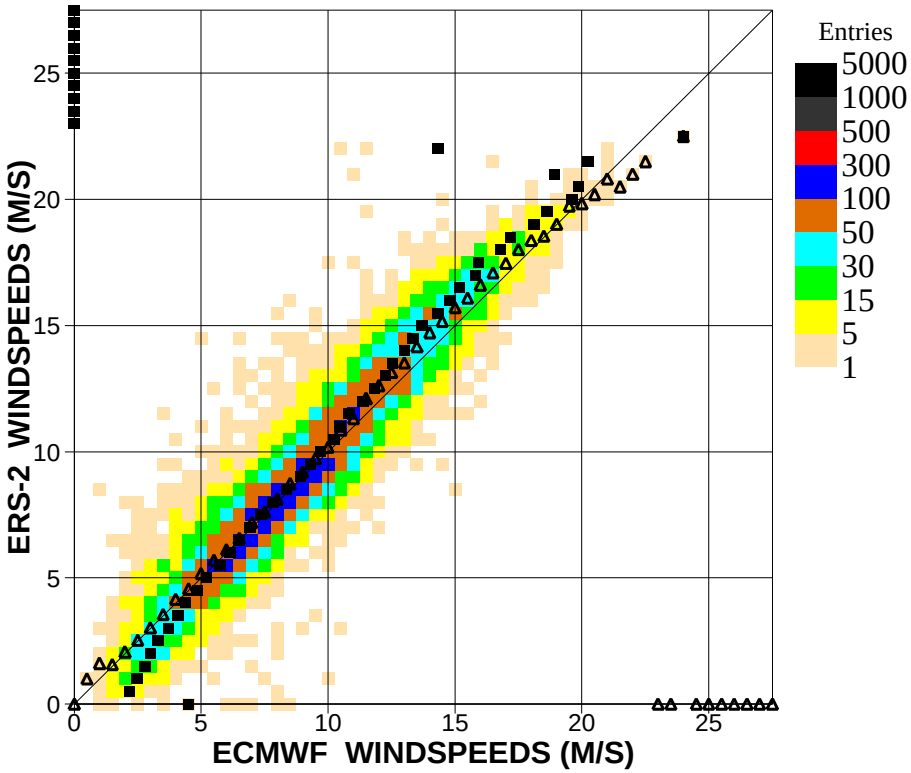
STATISTICS

ENTRIES	9630	
MEAN ECMWF	6.0469	
MEAN ERS-2	5.8087	
BIAS (ERS-2 - ECMWF)	-0.2382	
STANDARD DEVIATION	1.1456	
SCATTER INDEX	0.1895	
CORRELATION	0.8903	
SYMMETRIC SLOPE	0.9832	(0.0053)
REGR. COEFFICIENT	1.0137	(0.0053)
REGR. CONSTANT	-0.3212	(0.0340)

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

Saleh Abdalla
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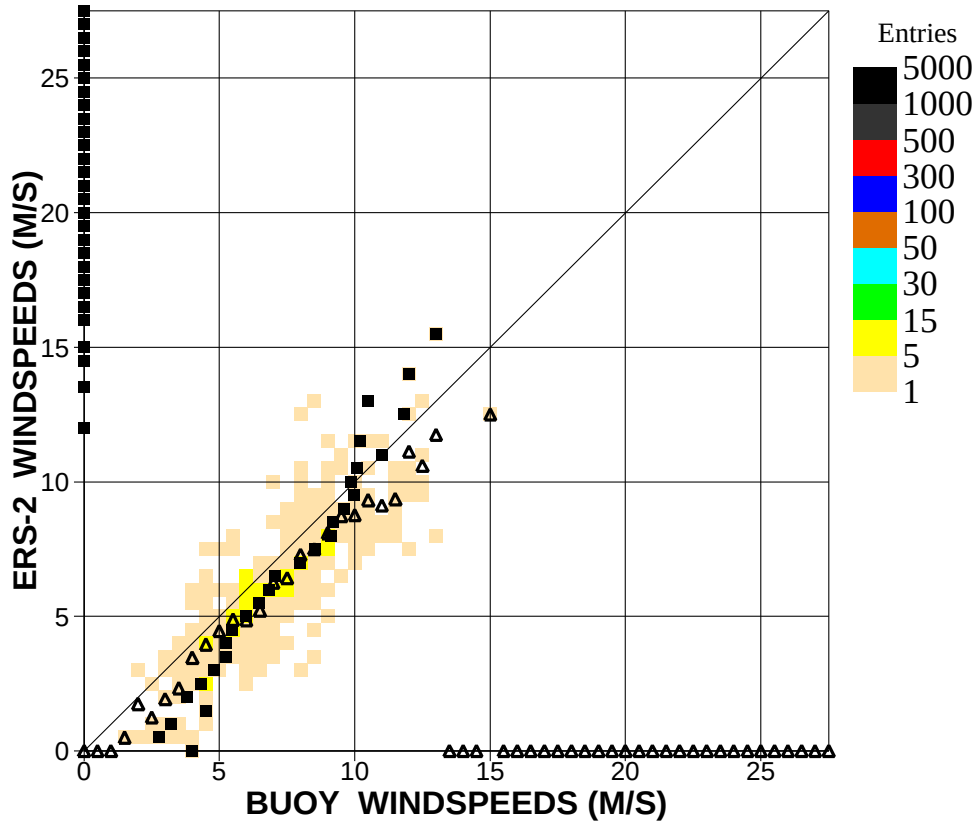


STATISTICS

ENTRIES	12979
MEAN ECMWF	9.2004
MEAN ERS-2	9.5001
BIAS (ERS-2 - ECMWF)	0.2998
STANDARD DEVIATION	1.4467
SCATTER INDEX	0.1572
CORRELATION	0.9373
SYMMETRIC SLOPE	1.0448 (0.0034)
REGR. COEFFICIENT	1.0481 (0.0034)
REGR. CONSTANT	-0.1432 (0.0339)

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

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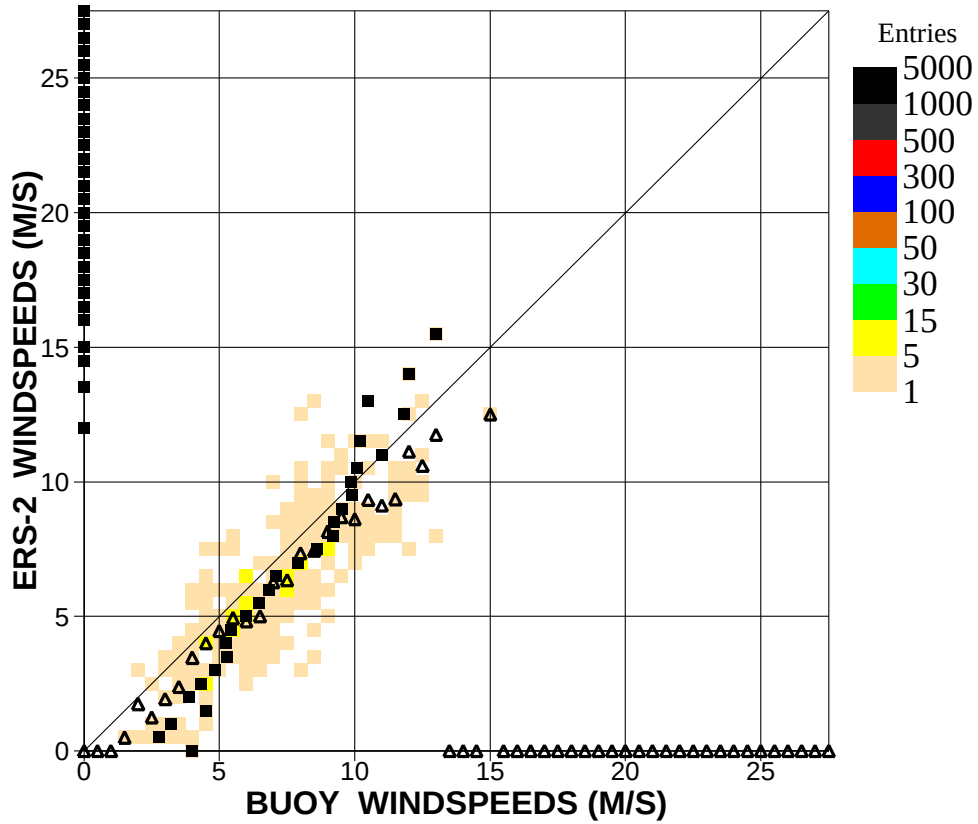


STATISTICS

ENTRIES	361	
MEAN BUOY	7.1214	
MEAN ERS-2	6.1920	
BIAS (ERS-2 - BUOY)	-0.9294	
STANDARD DEVIATION	1.4413	
SCATTER INDEX	0.2024	
CORRELATION	0.8429	
SYMMETRIC SLOPE	0.8968	(0.0319)
REGR. COEFFICIENT	0.9351	(0.0315)
REGR. CONSTANT	-0.4670	(0.2367)

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

Saleh Abdalla
European Centre for Medium Range Weather Forecasts
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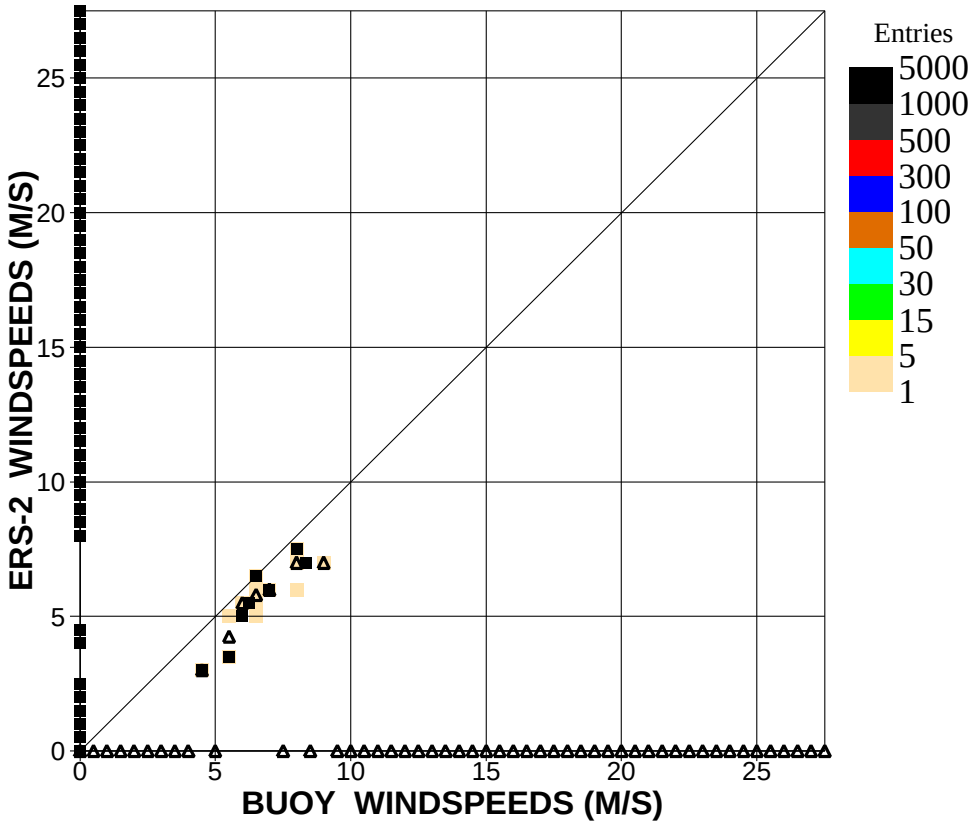


STATISTICS

ENTRIES	325	
MEAN BUOY	7.0664	
MEAN ERS-2	6.1265	
BIAS (ERS-2 - BUOY)	-0.9400	
STANDARD DEVIATION	1.5062	
SCATTER INDEX	0.2132	
CORRELATION	0.8361	
SYMMETRIC SLOPE	0.8961	(0.0342)
REGR. COEFFICIENT	0.9268	(0.0338)
REGR. CONSTANT	-0.4227	(0.2531)

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

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

ENTRIES	16	
MEAN BUOY	6.8477	
MEAN ERS-2	5.8688	
BIAS (ERS-2 - BUOY)	-0.9789	
STANDARD DEVIATION	0.6123	
SCATTER INDEX	0.0894	
CORRELATION	0.8867	
SYMMETRIC SLOPE	0.8650	(0.1415)
REGR. COEFFICIENT	0.9847	(0.1372)
REGR. CONSTANT	-0.8745	(0.9528)

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

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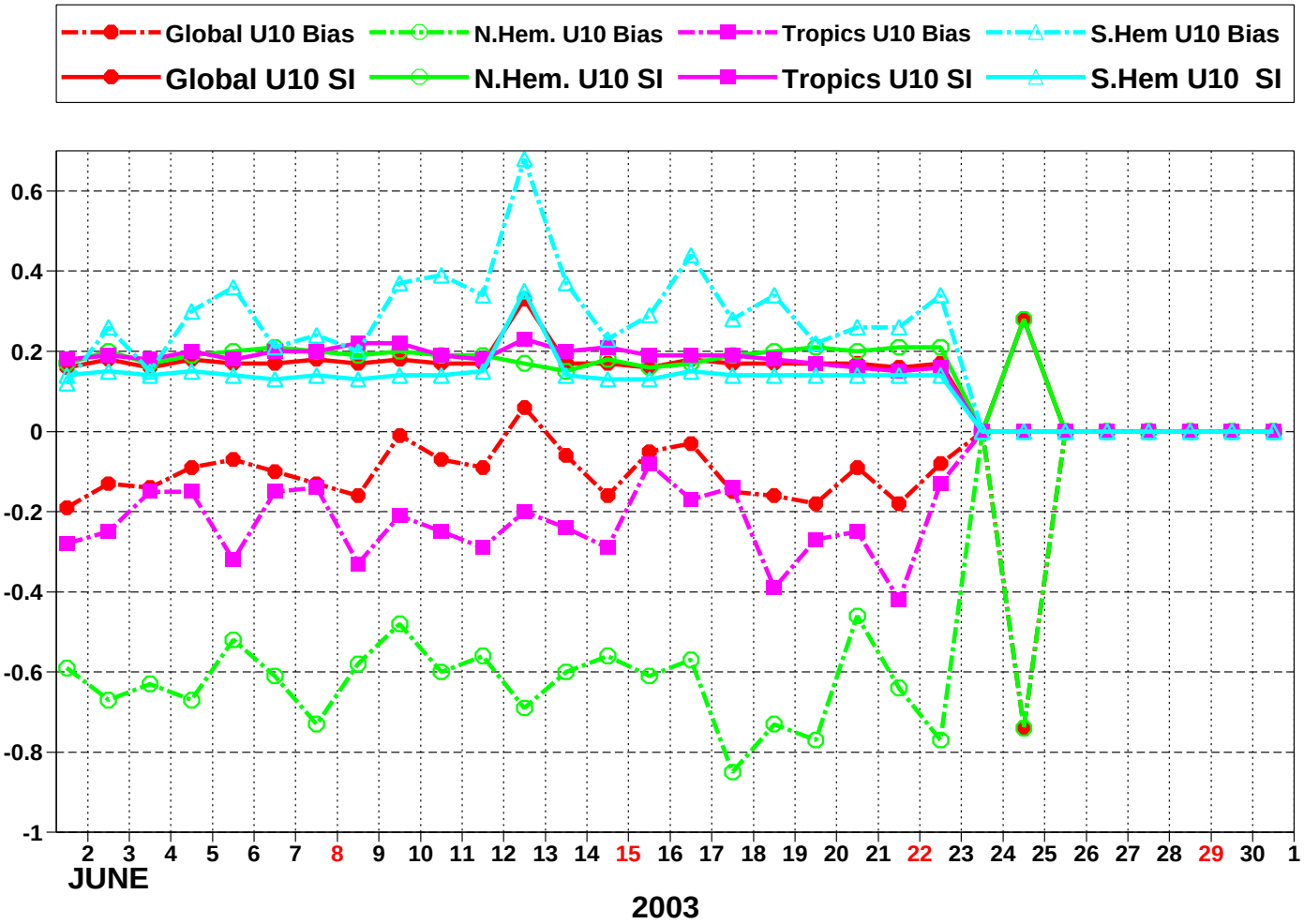


Figure 13: ERS-2 Altimeter wind speeds: Timeseries of bias (ERS-2 - model) and scatter index (SI)

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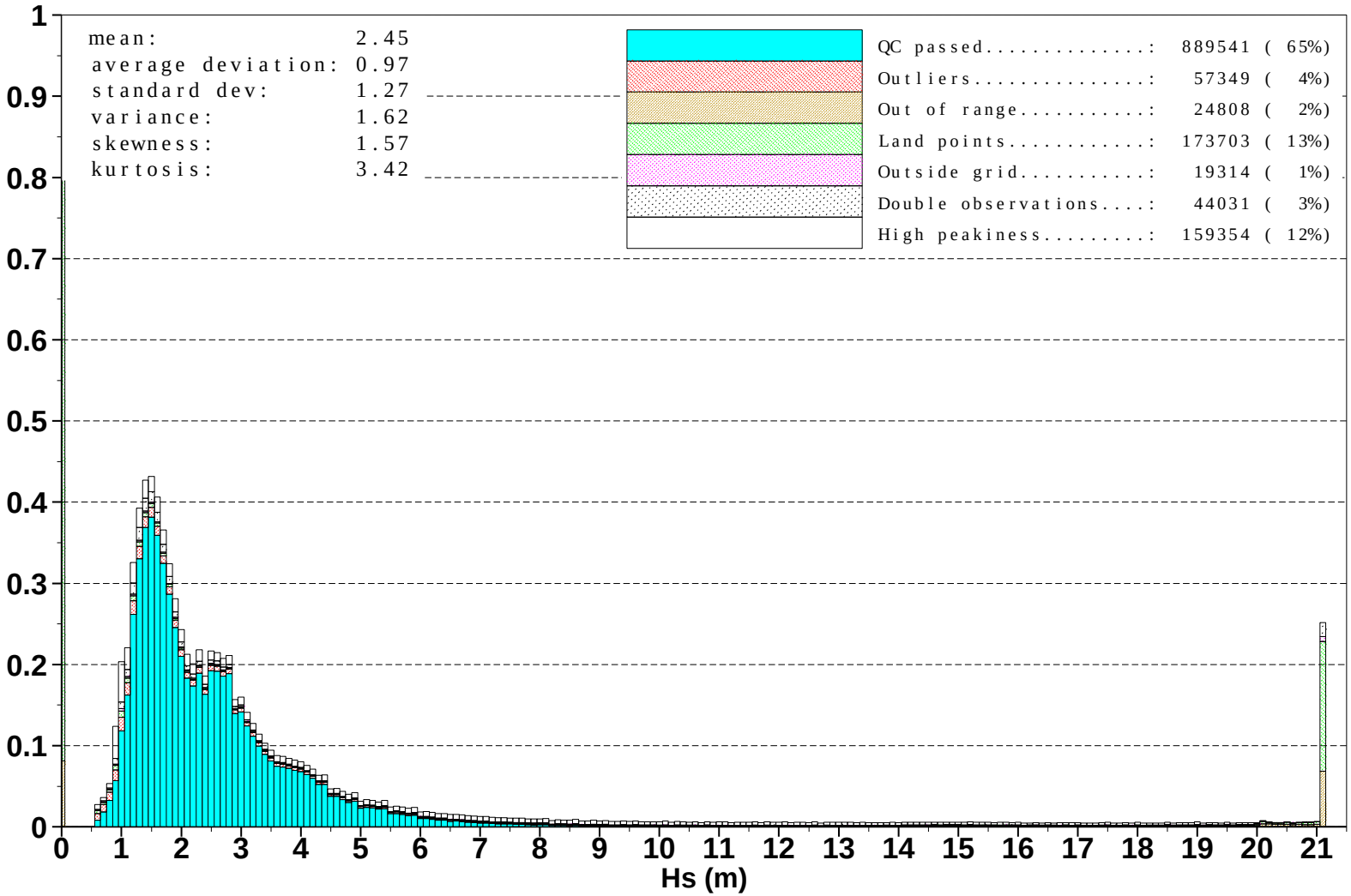


Figure 14: Distribution of the ERS-2 Altimeter wave heights after QC for June 2003

Saleh Abdalla
European Centre for Medium Range Weather Forecasts
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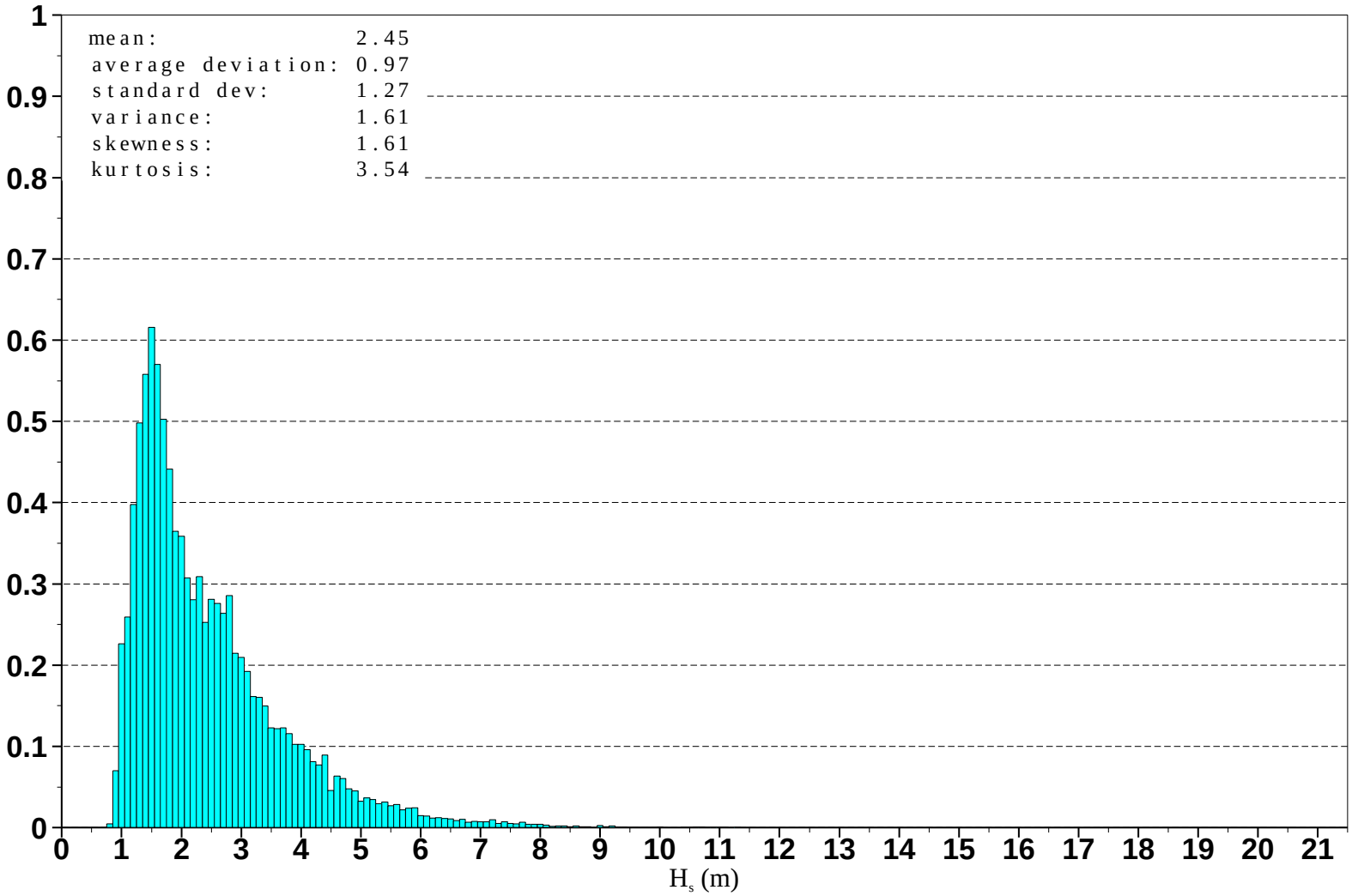


Figure 15: Distribution of ERS-2 Altimeter wave heights after along track averaging for June 2003

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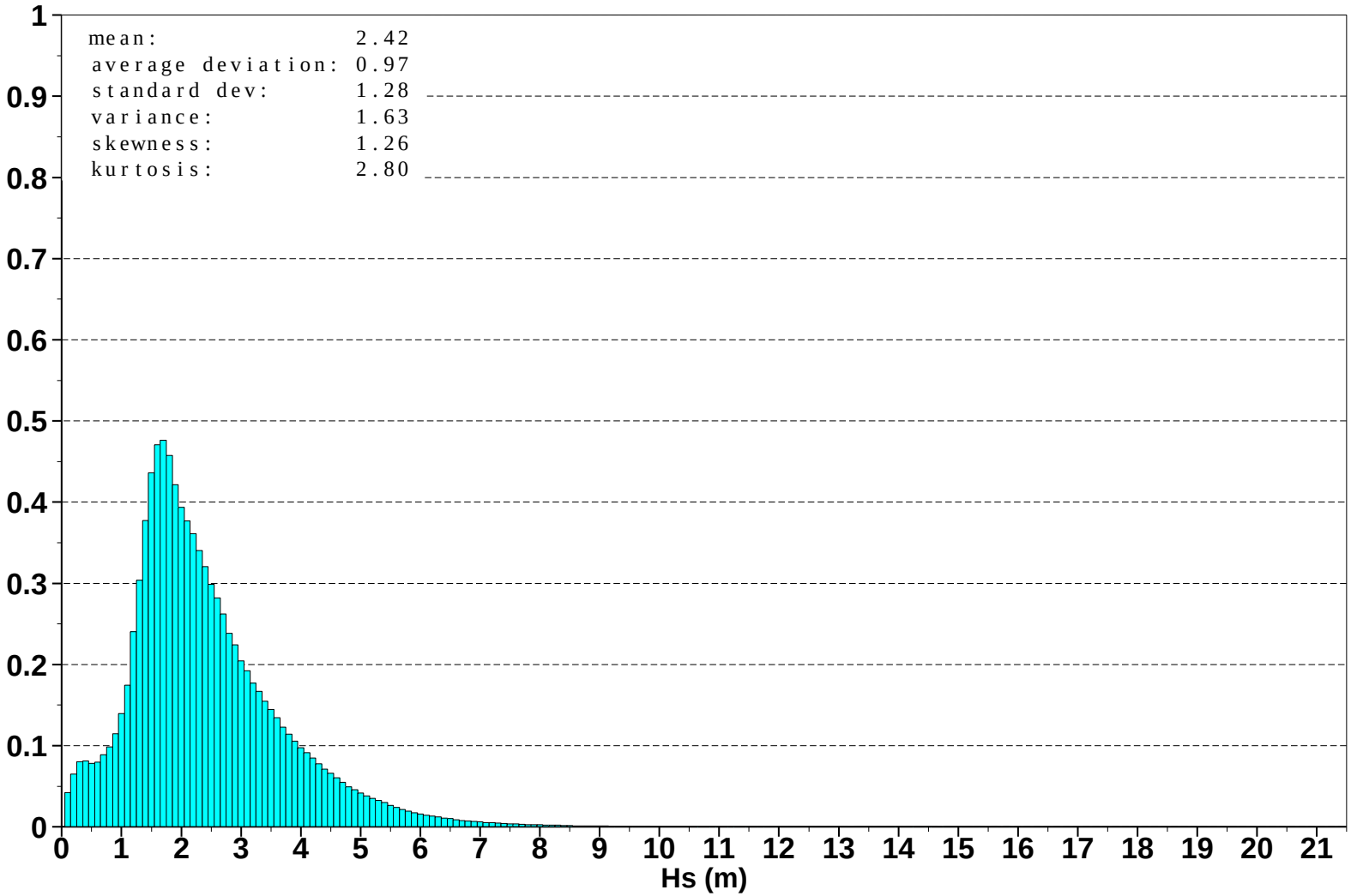
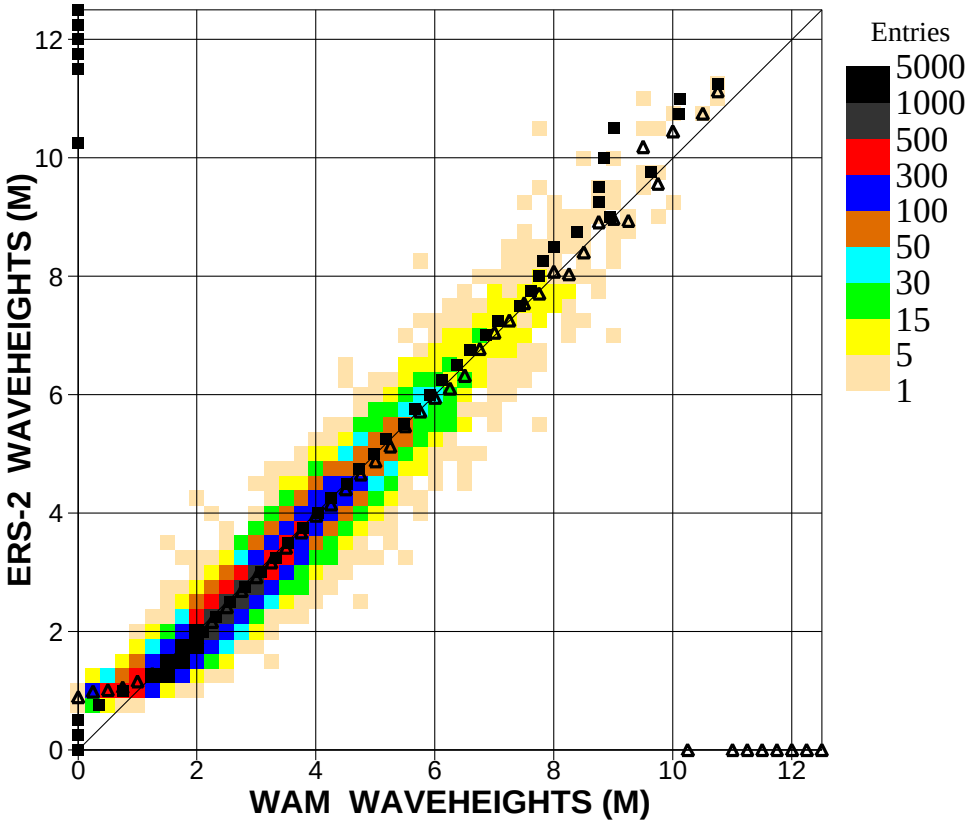


Figure 16: Global distribution of ECMWF wave heights for June 2003

Saleh Abdalla
European Centre for Medium Range Weather Forecasts
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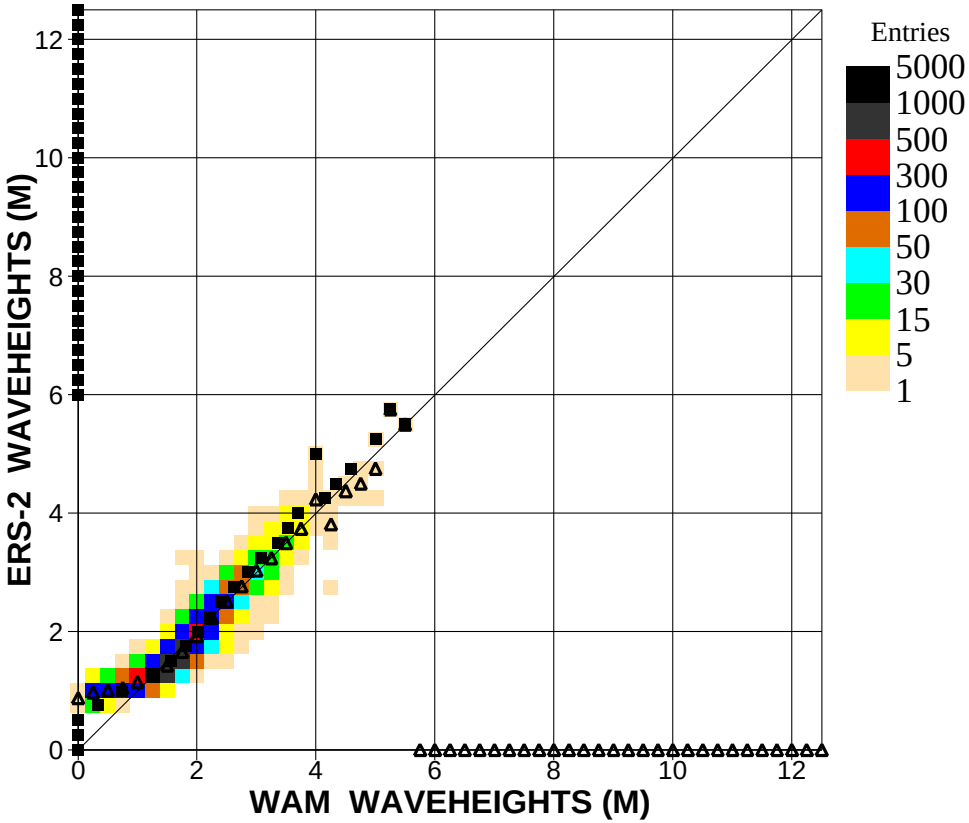


STATISTICS

ENTRIES	29990	
MEAN WAM	2.5021	
MEAN ERS-2	2.4536	
BIAS (ERS-2 - WAM)	-0.0484	
STANDARD DEVIATION	0.2761	
SCATTER INDEX	0.1103	
CORRELATION	0.9764	
SYMMETRIC SLOPE	0.9835	(0.0012)
REGR. COEFFICIENT	0.9708	(0.0012)
REGR. CONSTANT	0.0247	(0.0035)

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

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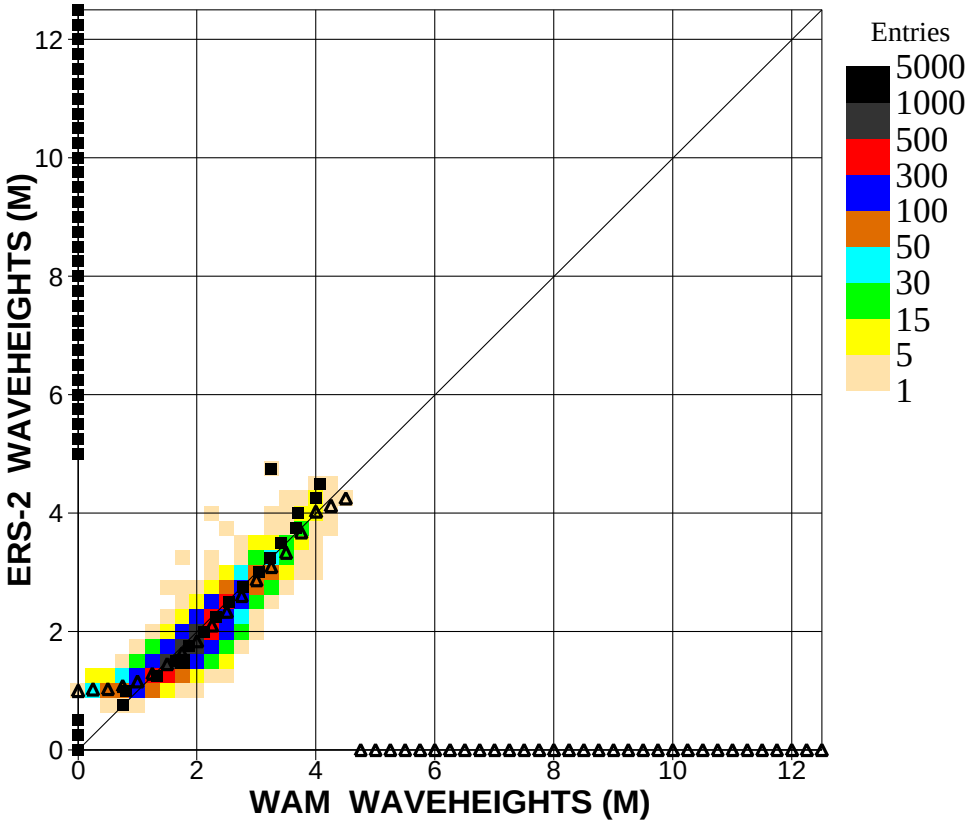


STATISTICS

ENTRIES	7595	
MEAN WAM	1.6016	
MEAN ERS-2	1.6244	
BIAS (ERS-2 - WAM)	0.0227	
STANDARD DEVIATION	0.2383	
SCATTER INDEX	0.1488	
CORRELATION	0.9267	
SYMMETRIC SLOPE	1.0019	(0.0043)
REGR. COEFFICIENT	0.8524	(0.0040)
REGR. CONSTANT	0.2591	(0.0068)

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



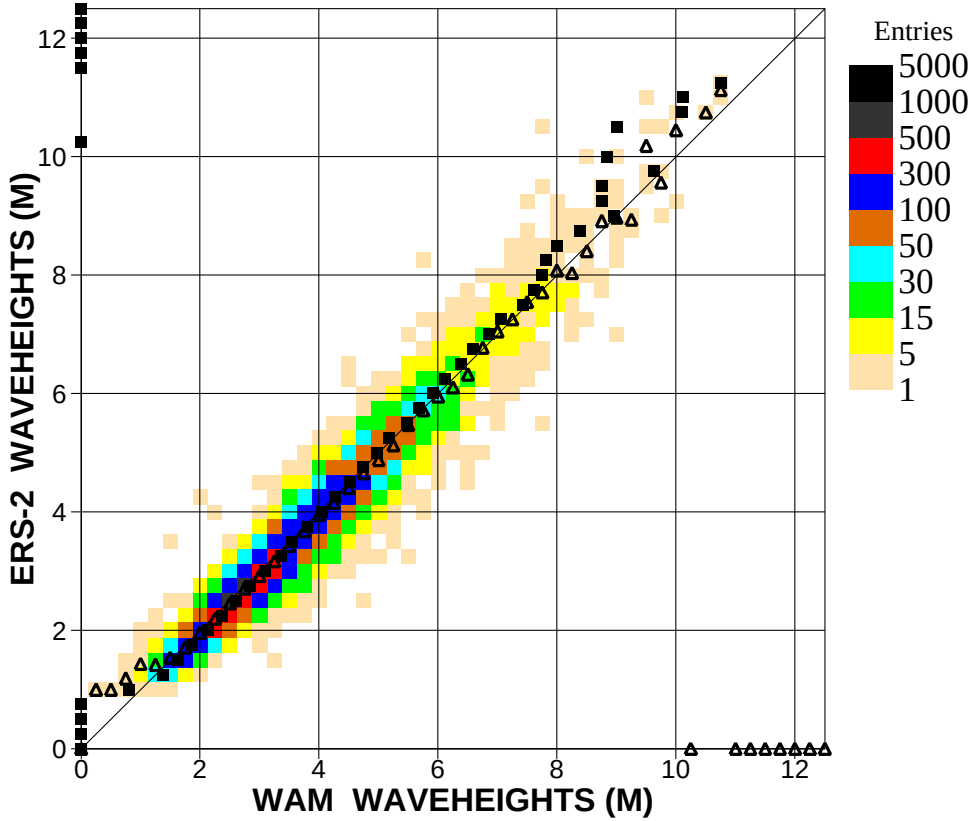
STATISTICS

ENTRIES	9630	
MEAN WAM	1.9134	
MEAN ERS-2	1.8265	
BIAS (ERS-2 - WAM)	-0.0869	
STANDARD DEVIATION	0.2201	
SCATTER INDEX	0.1151	
CORRELATION	0.9209	
SYMMETRIC SLOPE	0.9528	(0.0038)
REGR. COEFFICIENT	0.8588	(0.0037)
REGR. CONSTANT	0.1834	(0.0074)

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

ECMWF Report on ERS-2 RA for June 2003

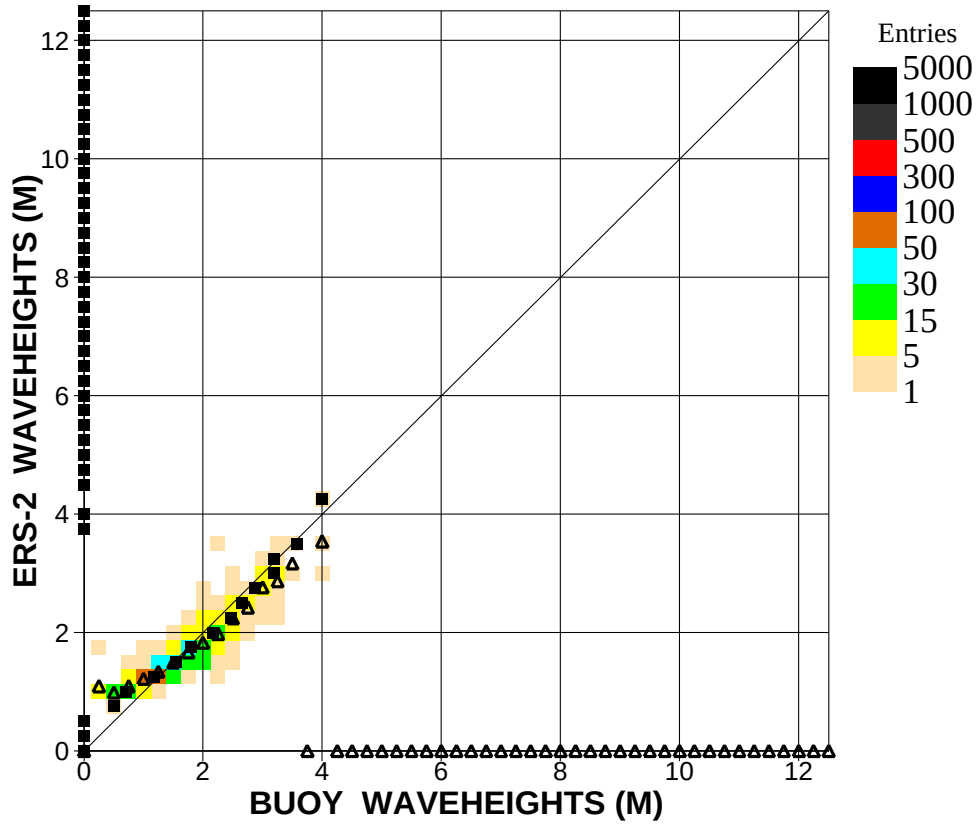


STATISTICS

ENTRIES	12979	
MEAN WAM	3.4583	
MEAN ERS-2	3.3969	
BIAS (ERS-2 - WAM)	-0.0614	
STANDARD DEVIATION	0.3217	
SCATTER INDEX	0.0930	
CORRELATION	0.9696	
SYMMETRIC SLOPE	0.9876	(0.0022)
REGR. COEFFICIENT	0.9944	(0.0022)
REGR. CONSTANT	-0.0422	(0.0081)

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

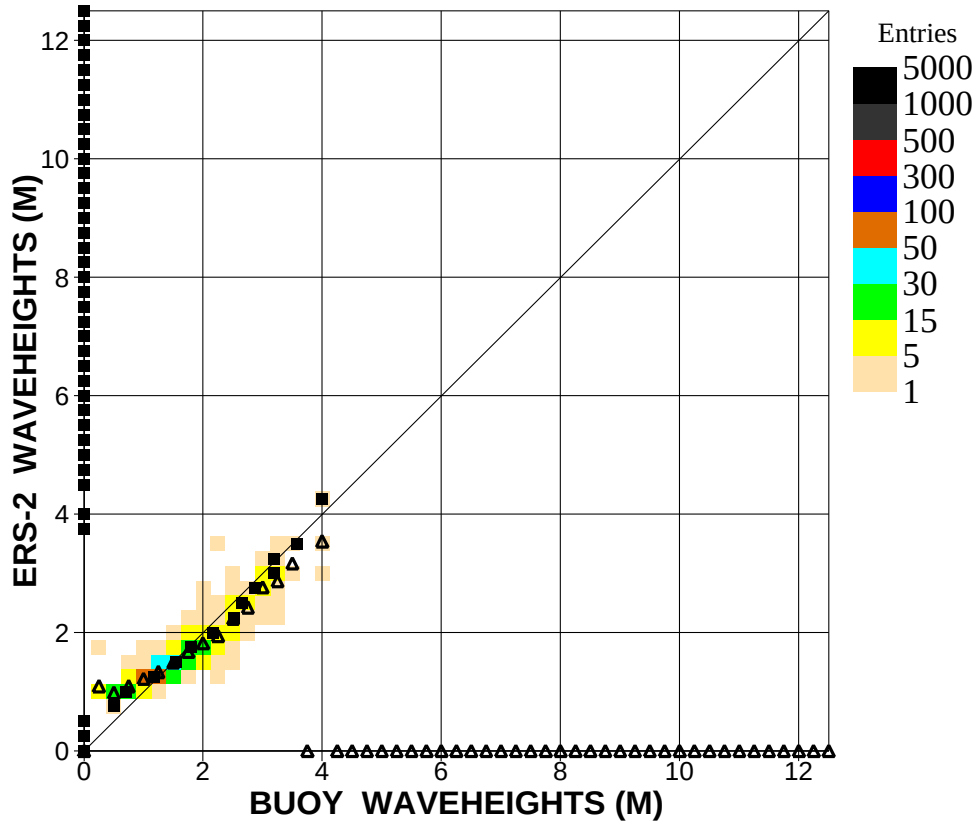


STATISTICS

ENTRIES	560	
MEAN BUOY	1.6480	
MEAN ERS-2	1.6491	
BIAS (ERS-2 - BUOY)	0.0011	
STANDARD DEVIATION	0.3143	
SCATTER INDEX	0.1907	
CORRELATION	0.9174	
SYMMETRIC SLOPE	0.9650	(0.0174)
REGR. COEFFICIENT	0.6976	(0.0128)
REGR. CONSTANT	0.4995	(0.0231)

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

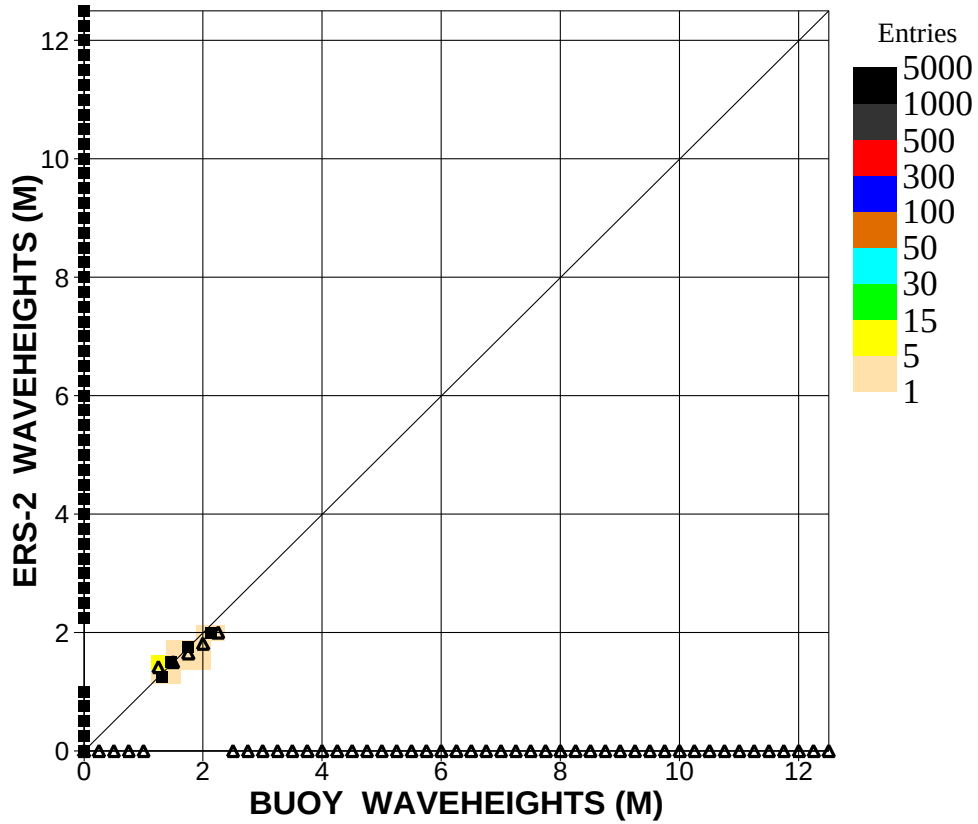


STATISTICS

ENTRIES	514	
MEAN BUOY	1.6440	
MEAN ERS-2	1.6459	
BIAS (ERS-2 - BUOY)	0.0019	
STANDARD DEVIATION	0.3234	
SCATTER INDEX	0.1967	
CORRELATION	0.9167	
SYMMETRIC SLOPE	0.9637	(0.0182)
REGR. COEFFICIENT	0.6970	(0.0134)
REGR. CONSTANT	0.4999	(0.0243)

Figure 22. Comparison of buoy wave height observations with ERS2 Altimeter wave height data for June 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	26	
MEAN BUOY	1.6093	
MEAN ERS-2	1.5865	
BIAS (ERS-2 - BUOY)	-0.0228	
STANDARD DEVIATION	0.1486	
SCATTER INDEX	0.0923	
CORRELATION	0.8929	
SYMMETRIC SLOPE	0.9781	(0.0949)
REGR. COEFFICIENT	0.6512	(0.0670)
REGR. CONSTANT	0.5385	(0.1098)

Figure 23. Comparison of buoy wave height observations with ERS2 Altimeter wave height data for June 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

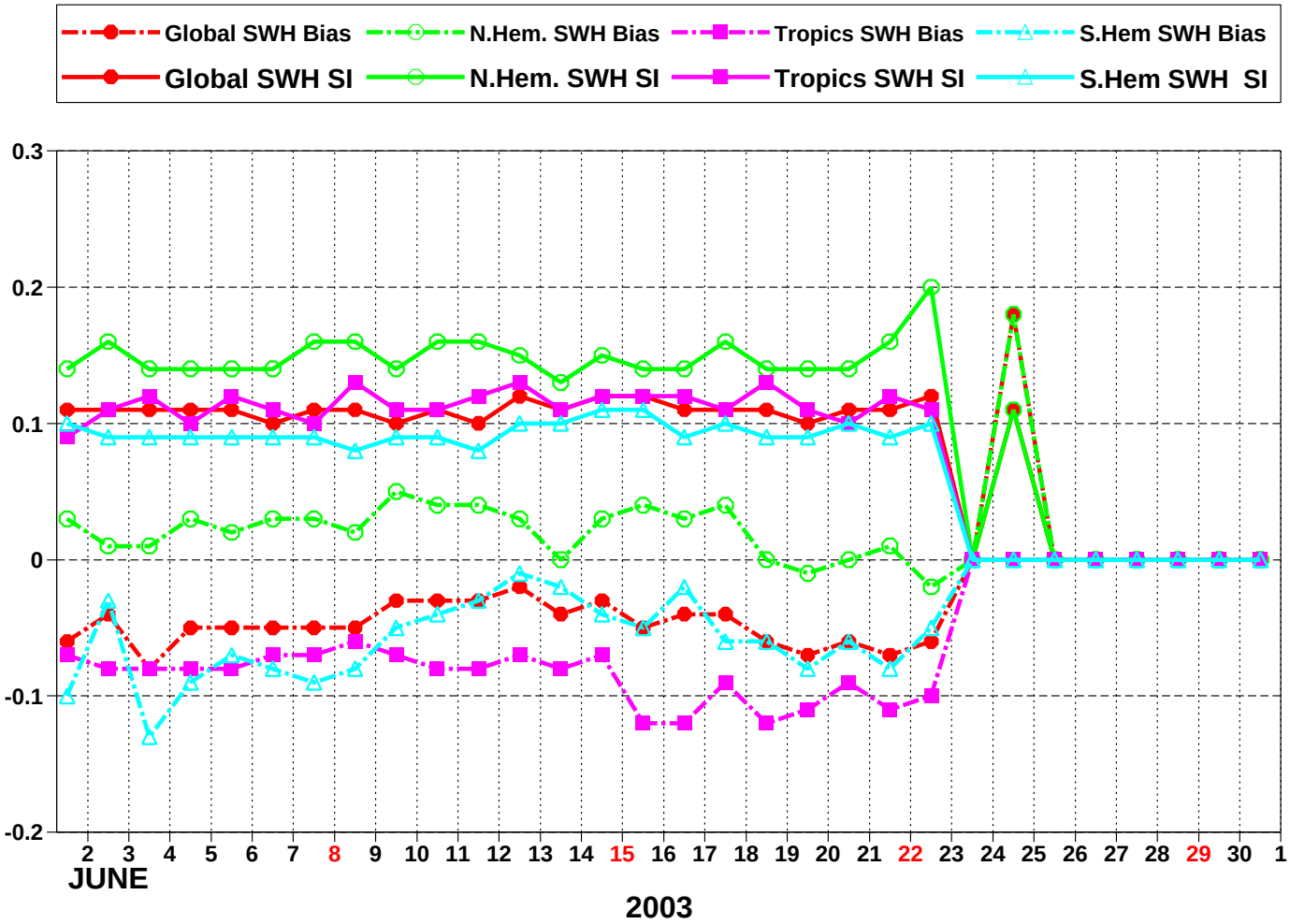


Figure 24: ERS-2 Altimeter wave heights: Timeseries of bias (ERS-2 - model) and scatter index (SI)

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

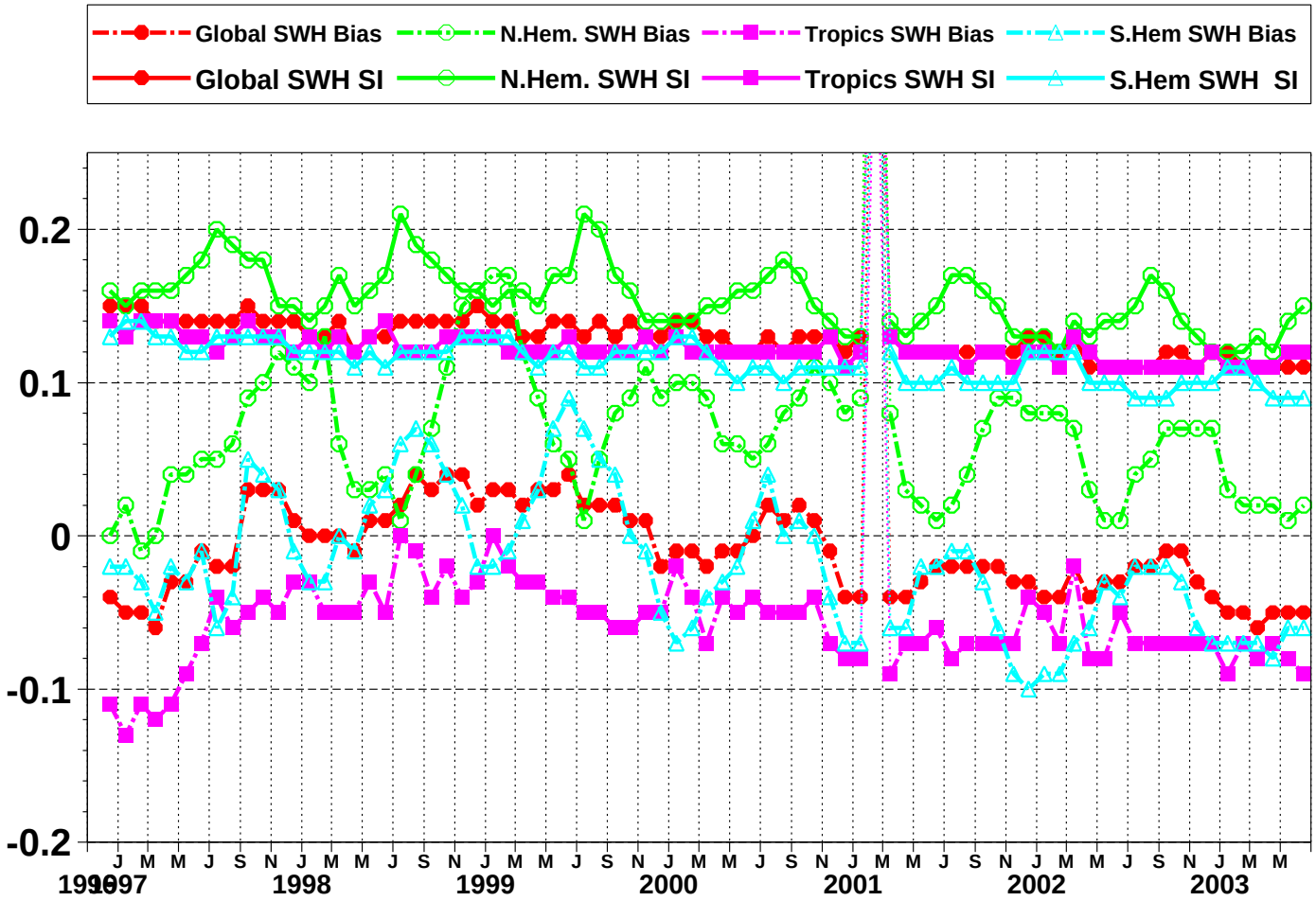


Figure 25: ERS-2 Altimeter wave heights: Timeseries of bias (ERS-2 - model) and scatter index (SI)

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

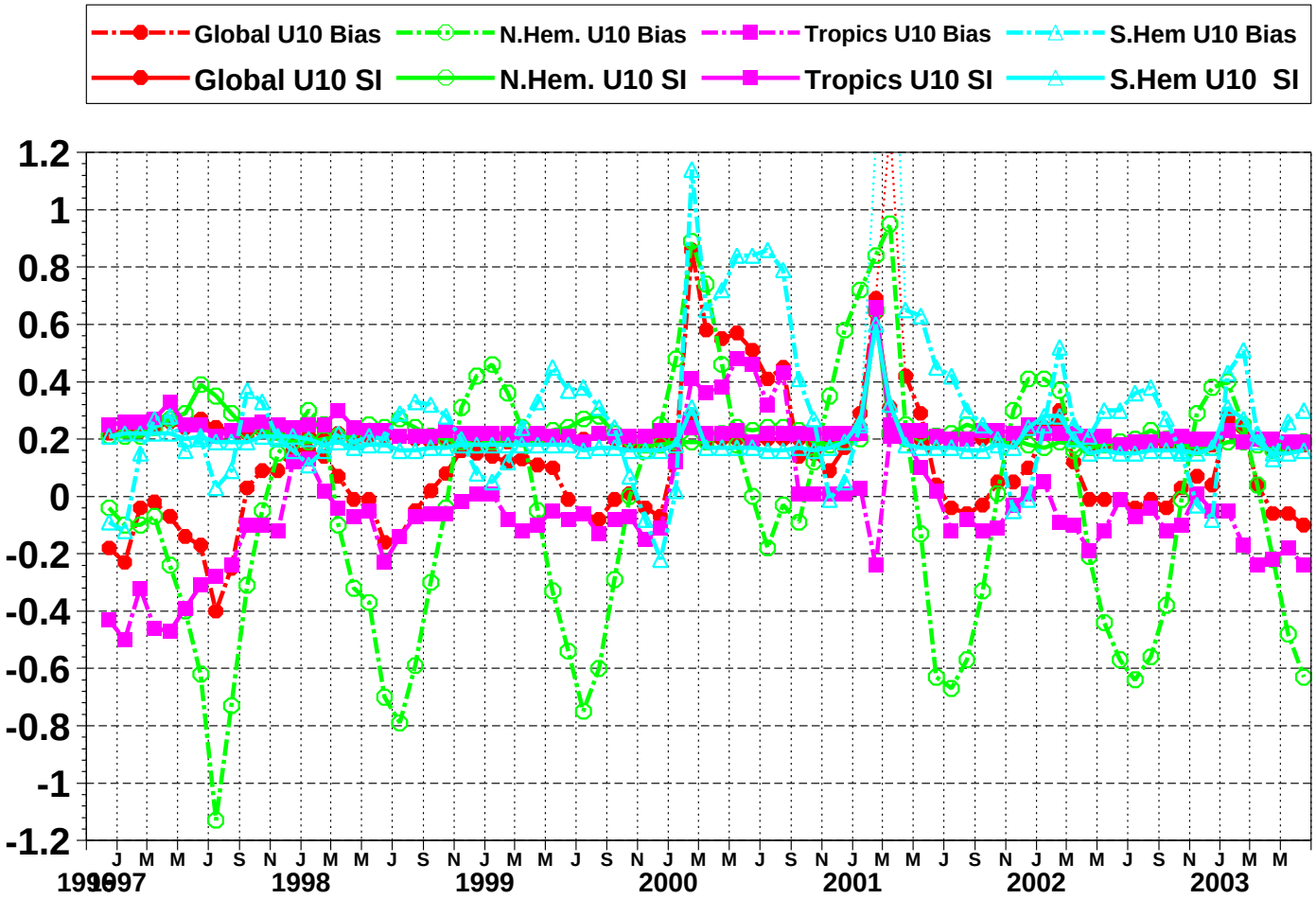


Figure 26: ERS-2 Altimeter wind speeds: Timeseries of bias (ERS-2 - model) and scatter index (SI)

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