ECMWF Report on ERS-2 RA for June 2010

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

By: *Saleh Abdalla*

Date: *15 July 2010*

Overview:

Based on the data received at ECMWF during the whole month, on average, 3803 observations arrived at ECMWF every 6 hours of which 67.6% passed the quality control. As can be seen in Figure 1, there was no data gaps, in terms of 6-hour time windows, during the whole month.

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

Backscatter:

ESR-2 $<\sigma_0>$ = 11.65 dB (with a main peak at 11.1 dB).

Wind Speed Comparison with ECMWF wind speeds (bias):

ERS-2 global: -0.425 m/s

ERS-2 northern hemisphere: -0.777 m/s

ERS-2 tropics: -0.004 m/s

ERS-2 southern hemisphere: +0.909 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: -0.944 m/s

ERS-2 northern hemisphere: -1.046 m/s

ERS-2 tropics (Hawaii): *missing*

Wave Height Comparison with ECMWF wave heights (bias):

ERS-2 global: +0.047 m (lowest waves measured: 0.6m)

ERS-2 northern hemisphere: +0.083 m

ERS-2 tropics: +0.063 m

ERS-2 southern hemisphere: -0.294 m

Wave Height Comparison with buoy wave heights (bias):

ERS-2 global: +0.075 m

ERS-2 northern hemisphere: +0.069 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
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Telephone: U.K. (0118) 949 9703, International (+44 118) 949 9703
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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. Coverage extended to include eastern coast of China and around Korea and Japan since 25 June 2005, the Southern Ocean since 4 July 2005, the north eastern parts of the Indian Ocean since 19 October 2006 and around South Africa since 23 May 2008 (no data was received recently from this station). Current coverage can be seen in Figure 27.
- Assimilation of ERS-2 RA wave heights into ECMWF wave model was stopped on 21st. of October 2003 and replaced by ENVISAT RA-2 Ku-band wave heights. Both instruments can not be assimilated at the same time as both satellites follow the same track with relatively short time separation (both can be assimilated safely if they were not so close).
- ENVISAT RA-2 Ku-band significant wave height and ASAR Wave Mode Level 1b data as well as Jason-1 (blacklisted since the 1st of April 2010) and Jason-2 altimeter significant wave height data are assimilated in the ECMWF wave model.
- The ECMWF model changed to CY36R2 on the 22nd of June 2010. This change is technical and involves: GRIB API, ensemble data assimilation (EDA), and surface pressure processing. The current operational IFS cycle is CY36R2 (since the 22nd of June 2010).

Comparison Method:

The Altimeter wave height and wind speed data, as received by ECMWF from ESA through GTS, are the so-called fast delivery products. At ECMWF these data are subject to a quality control method, the details of which are described by Janssen et al. (1989) and Bauer et al. (1992). Consequently, superobservations are formed by averaging 30 consecutive

Saleh Abdalla
European Centre for Medium Range Weather Forecasts
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data in order to match the spatial scales of the operational WAM model. Therefore, the collocation statistics are based on the comparison between these superobservations and operational wavemodel products.

In addition, since also wave observations from buoys are received through the GTS, the Altimeter products are also compared against buoy observations. Again, in order to have matching scales, the buoy observations are averaged over a six hour time window. Apart from this, also a height correction is applied to the wind speed observations, since not all buoys observe the winds at the standard height of 10 m. A default observation height of 5 m is assumed, and when available the actual observation height is used. In order to interpolate from the observation height to the standard height a logarithmic wind profile with a roughness length as given by the Charnock relation is assumed, where the Charnock parameter is given the constant value of 0.018.

Figure captions:

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

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

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

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

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

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

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

Figure 8: Comparison of ECMWF wind speed results with ERS-2 Altimeter wind speed data for June 2010 (tropics)

Figure 9: Comparison of ECMWF wind speed results with ERS-2 Altimeter wind speed data for June 2010 (southern hemisphere)

Figure 10: Comparison of buoy wind speed observations with ERS-2 Altimeter wind speed data for June 2010 (global).

Figure 11: Comparison of buoy wind speed observations with ERS-2 Altimeter wind speed data for June 2010 (northern hemisphere).

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Figure 12: Comparison of buoy wind speed observations with ERS-2 Altimeter wind speed data for June 2010 (hawaii).
Figure 13: ERS-2 Altimeter wind speeds: Timeseries of bias (ERS-2 - model) and scatter index (SI).
Figure 14: Distribution of the ERS-2 Altimeter wave heights after QC for June 2010.
Figure 15: Distribution of the ERS-2 Altimeter wave heights after along track averaging for June 2010.
Figure 16: Global distribution of ECMWF wave heights for June 2010.
Figure 17: Comparison of ECMWF wave height results with ERS-2 Altimeter wave height data for June 2010 (global).
Figure 18: Comparison of ECMWF wave height results with ERS-2 Altimeter wave height data for June 2010 (northern hemisphere)
Figure 19: Comparison of ECMWF wave height results with ERS-2 Altimeter wave height data for June 2010 (tropics)
Figure 20: Comparison of ECMWF wave height results with ERS-2 Altimeter wave height data for June 2010 (southern hemisphere)
Figure 21: Comparison of buoy wave height observations with ERS-2 Altimeter wave height data for June 2010 (global).
Figure 22: Comparison of buoy wave height observations with ERS-2 Altimeter wave height data for June 2010 (northern hemisphere).
Figure 23: Comparison of buoy wave height observations with ERS-2 Altimeter wave height data for June 2010 (hawaii).
Figure 24: ERS-2 Altimeter wave heights: Timeseries of bias (ERS-2 - model) and scatter index (SI) for June 2010.
Figure 25: ERS-2 Altimeter wave heights: Timeseries of bias (ERS-2 - model) and scatter index (SI) from December 1996 to June 2010.
Figure 26: ERS-2 Altimeter wind speeds: Timeseries of bias (ERS-2 - model) and scatter index (SI) from December 1996 to June 2010.
Figure 27: Significant wave height: Monthly mean difference of ERS-2 altimeter data minus wave model results for June 2010.

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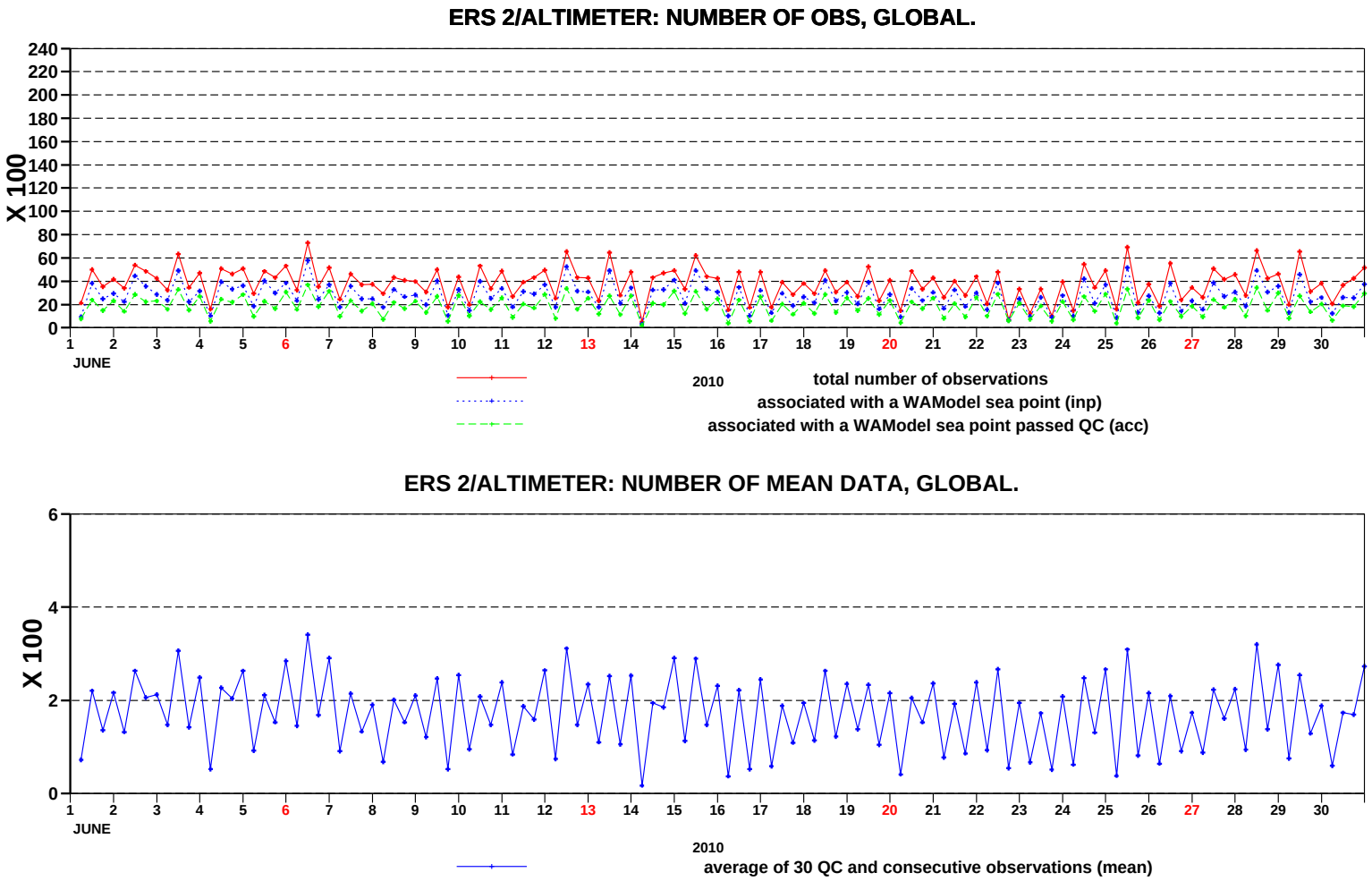


Figure 1:Time series of data reception for ERS-2 Altimeter data for June 2010

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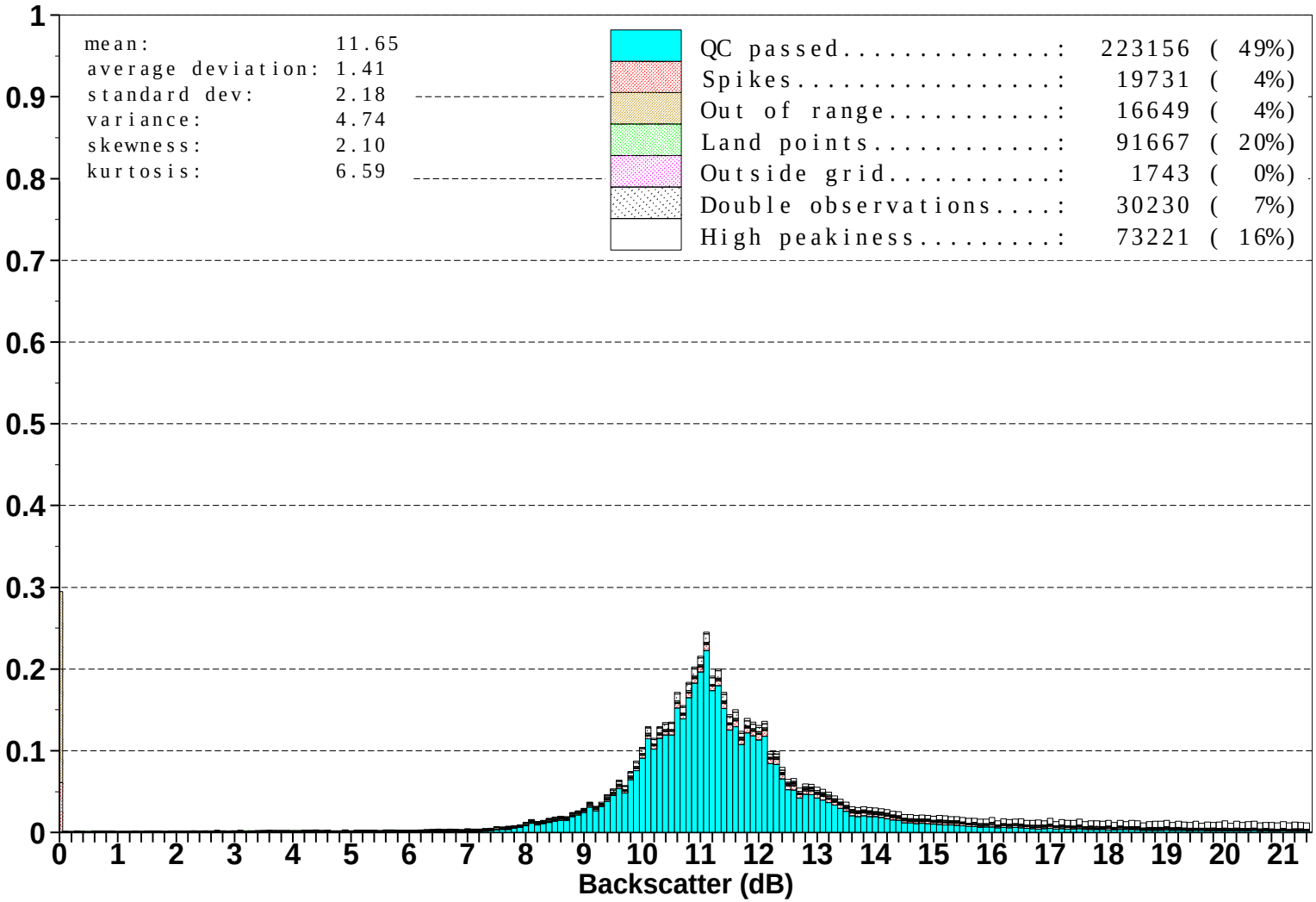


Figure 2: Distribution of the ERS-2 Altimeter backscatter after QC for June 2010

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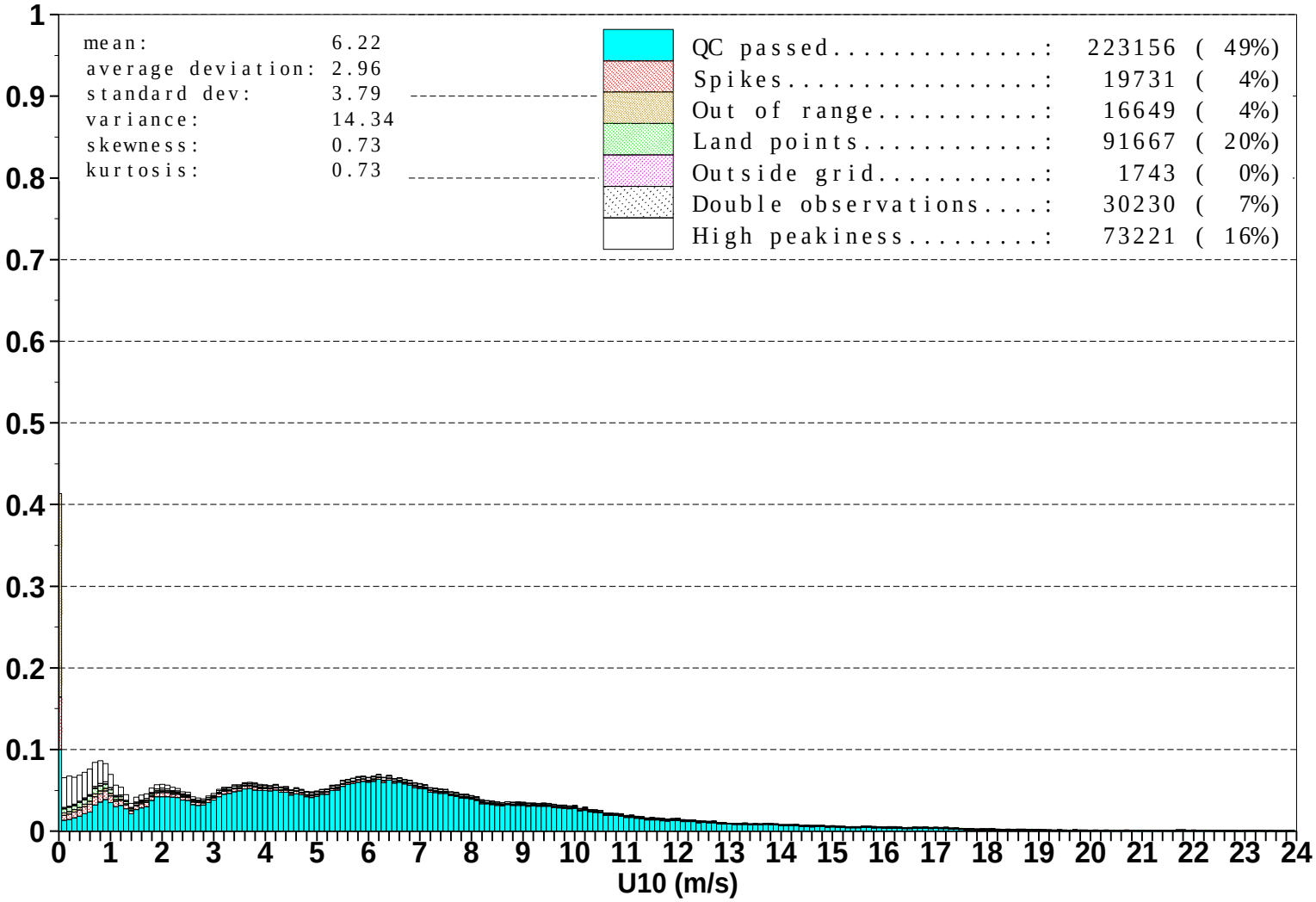


Figure 3: Distribution of the ERS-2 Altimeter wind speeds after QC for June 2010

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European Centre for Medium Range Weather Forecasts
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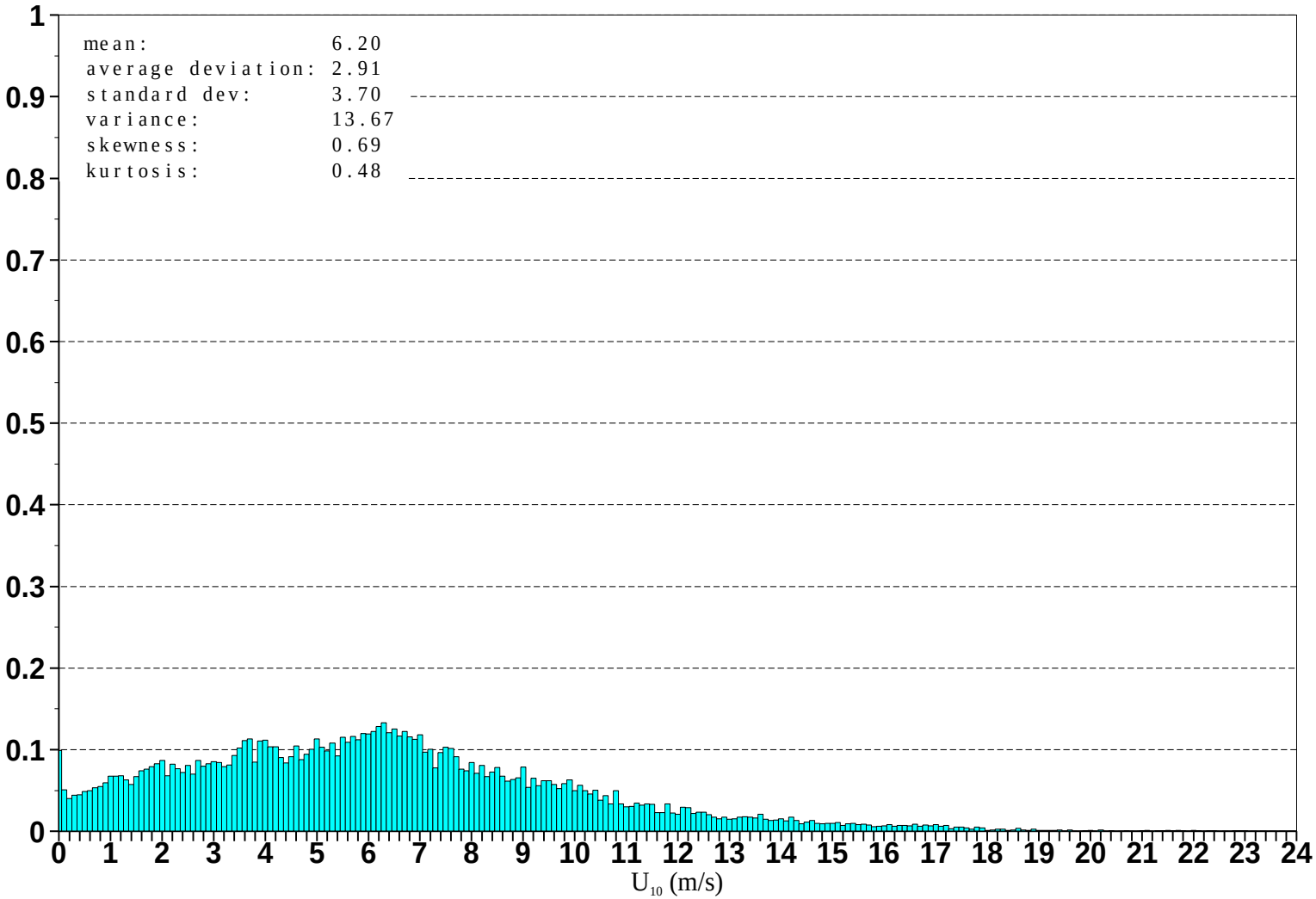


Figure 4: Distribution of ERS-2 Altimeter wind speeds after along track averaging for June 2010

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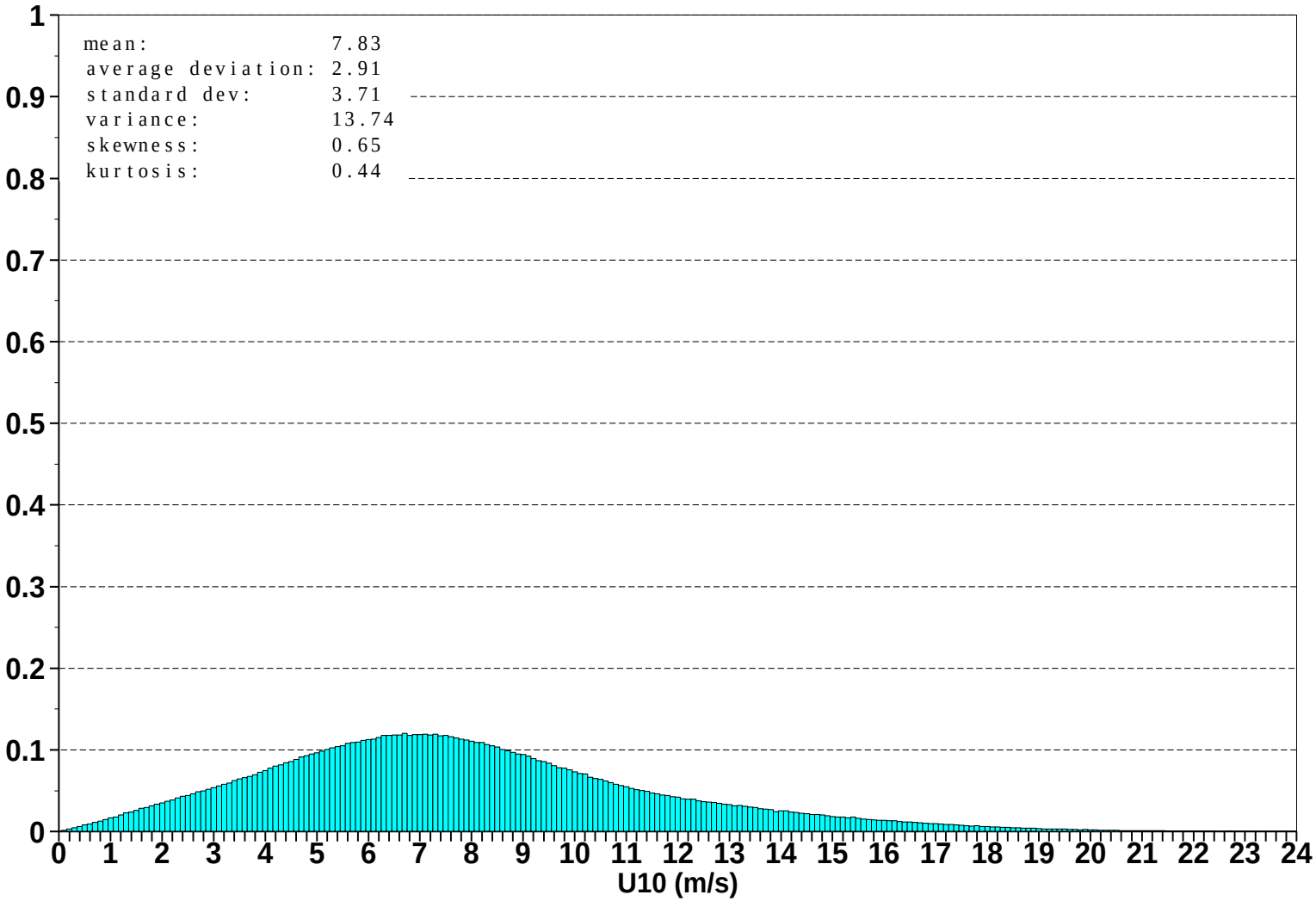
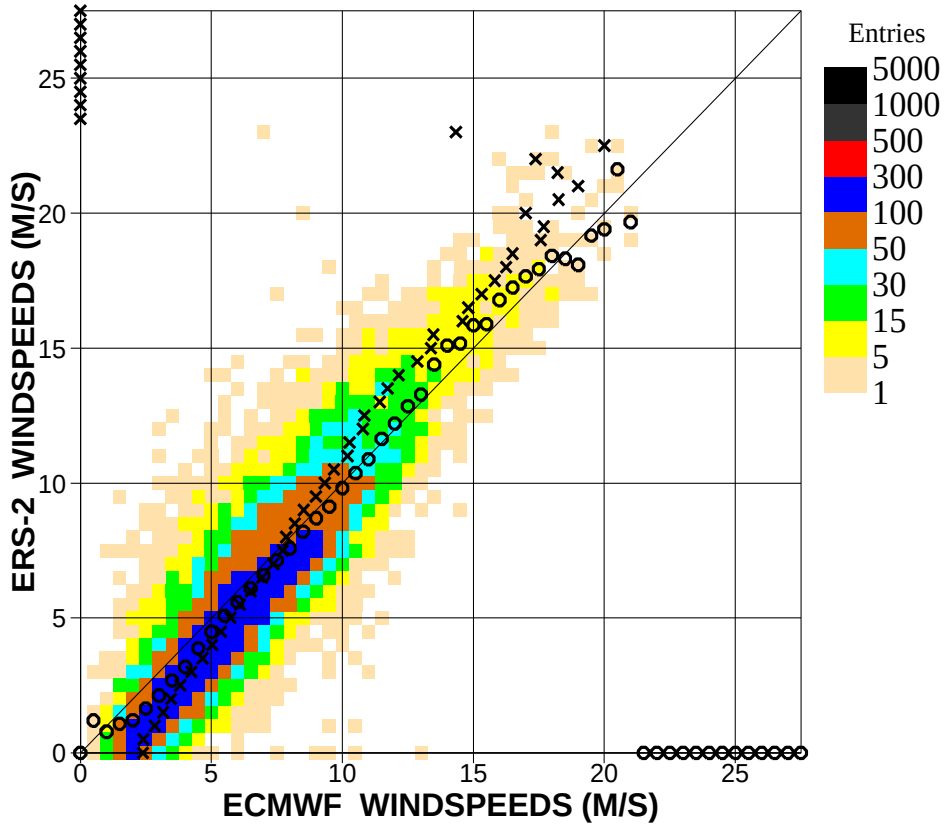


Figure 5: Global distribution of ECMWF ocean surface wind speeds for June 2010

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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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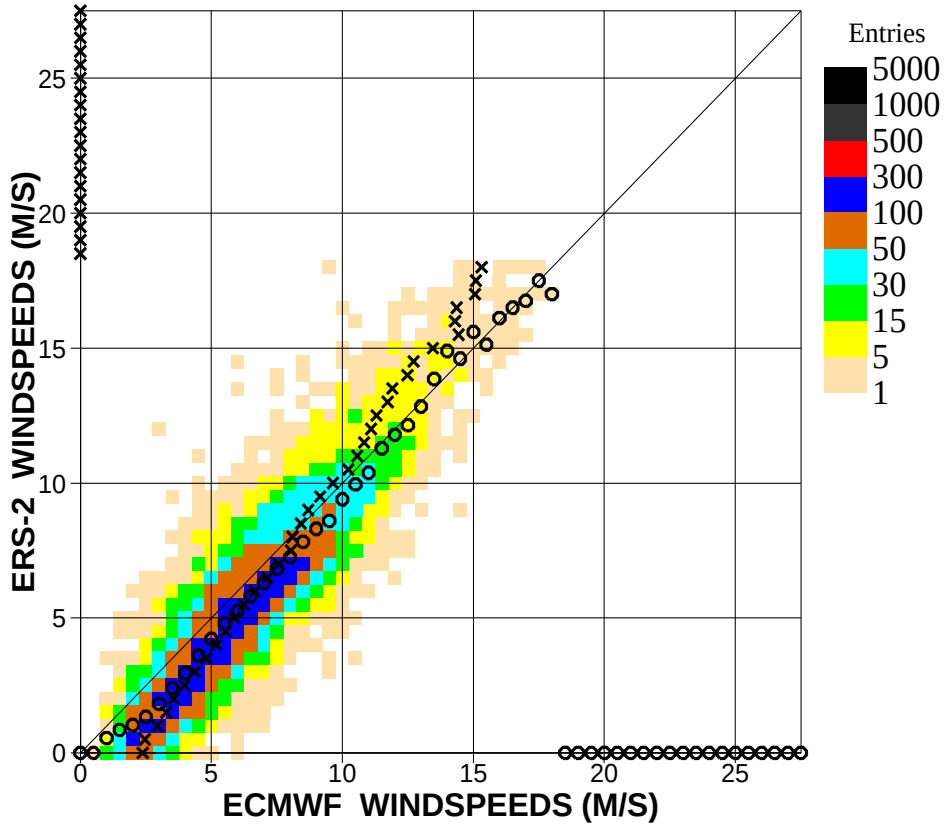
STATISTICS

ENTRIES	20101	
MEAN ECMWF	6.6299	
MEAN ERS-2	6.2053	
BIAS (ERS-2 - ECMWF)	-0.4246	
STANDARD DEVIATION	1.6456	
SCATTER INDEX	0.2482	
CORRELATION	0.8990	
SYMMETRIC SLOPE	0.9908	(0.0039)
REGR. COEFFICIENT	1.0962	(0.0038)
REGR. CONSTANT	-1.0627	(0.0275)

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

Saleh Abdalla
European Centre for Medium Range Weather Forecasts
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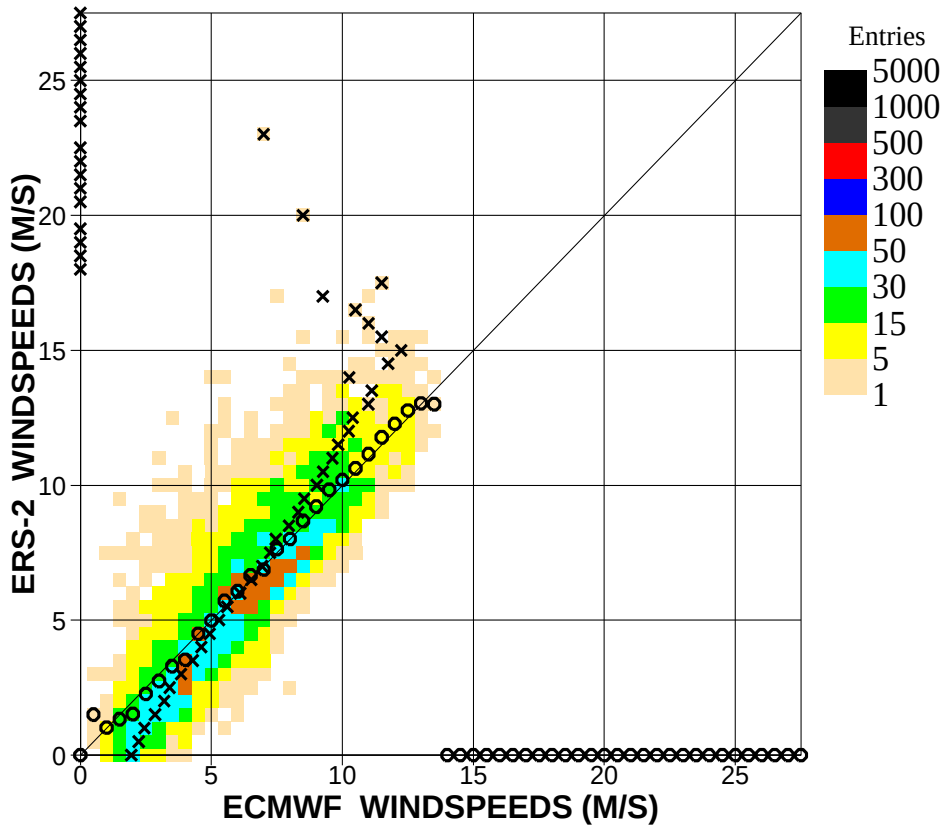


STATISTICS

ENTRIES	12968	
MEAN ECMWF	6.3183	
MEAN ERS-2	5.5414	
BIAS (ERS-2 - ECMWF)	-0.7769	
STANDARD DEVIATION	1.4376	
SCATTER INDEX	0.2275	
CORRELATION	0.8973	
SYMMETRIC SLOPE	0.9333	(0.0049)
REGR. COEFFICIENT	1.0728	(0.0046)
REGR. CONSTANT	-1.2370	(0.0318)

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

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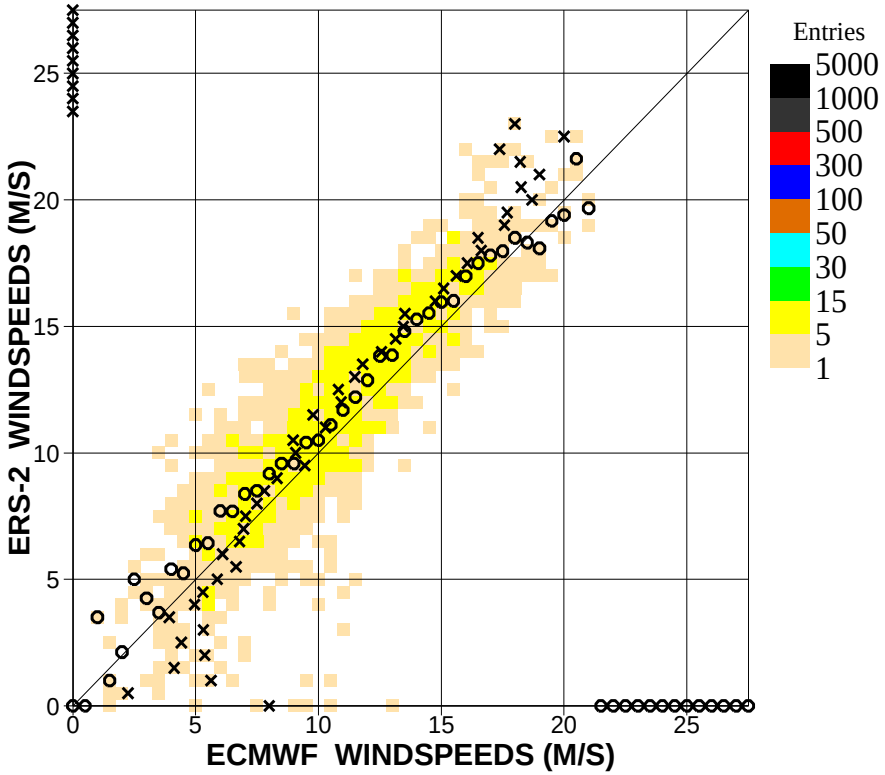
STATISTICS

ENTRIES	5600	
MEAN ECMWF	6.1758	
MEAN ERS-2	6.1713	
BIAS (ERS-2 - ECMWF)	-0.0044	
STANDARD DEVIATION	1.6658	
SCATTER INDEX	0.2697	
CORRELATION	0.8628	
SYMMETRIC SLOPE	1.0392	(0.0084)
REGR. COEFFICIENT	1.0630	(0.0083)
REGR. CONSTANT	-0.3934	(0.0560)

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

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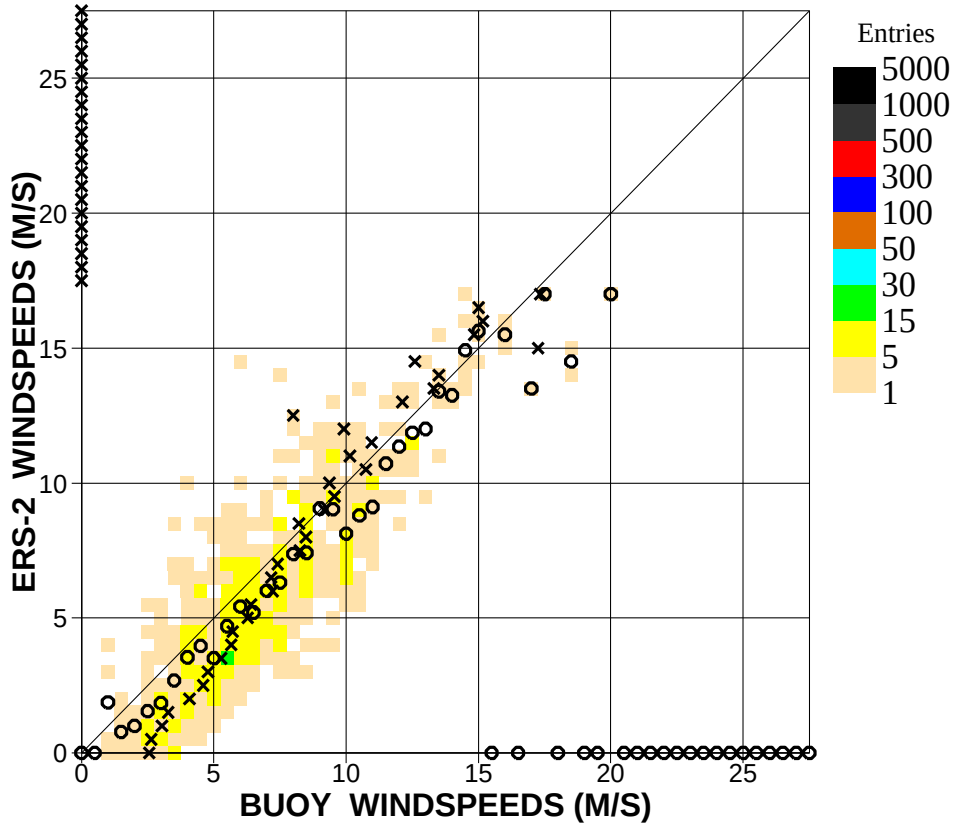


STATISTICS

ENTRIES	1672	
MEAN ECMWF	10.6257	
MEAN ERS-2	11.5348	
BIAS (ERS-2 - ECMWF)	0.9091	
STANDARD DEVIATION	2.0278	
SCATTER INDEX	0.1908	
CORRELATION	0.8688	
SYMMETRIC SLOPE	1.0886	(0.0138)
REGR. COEFFICIENT	0.9675	(0.0135)
REGR. CONSTANT	1.2548	(0.1517)

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

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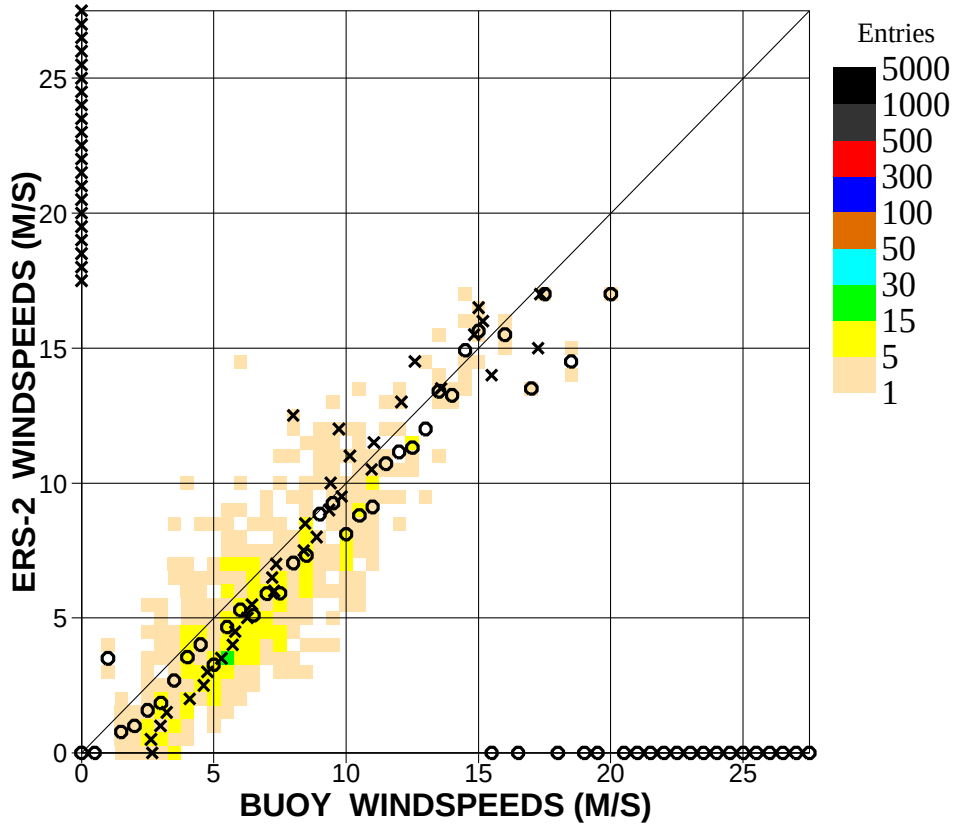


STATISTICS

ENTRIES	935	
MEAN BUOY	6.8424	
MEAN ERS-2	5.8988	
BIAS (ERS-2 - BUOY)	-0.9435	
STANDARD DEVIATION	1.7745	
SCATTER INDEX	0.2593	
CORRELATION	0.8460	
SYMMETRIC SLOPE	0.9106	(0.0204)
REGR. COEFFICIENT	0.9668	(0.0199)
REGR. CONSTANT	-0.7163	(0.1483)

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

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



STATISTICS

ENTRIES	824	
MEAN BUOY	6.8156	
MEAN ERS-2	5.7695	
BIAS (ERS-2 - BUOY)	-1.0460	
STANDARD DEVIATION	1.7525	
SCATTER INDEX	0.2571	
CORRELATION	0.8522	
SYMMETRIC SLOPE	0.8966	(0.0210)
REGR. COEFFICIENT	0.9578	(0.0205)
REGR. CONSTANT	-0.7587	(0.1525)

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

Saleh Abdalla
European Centre for Medium Range Weather Forecasts
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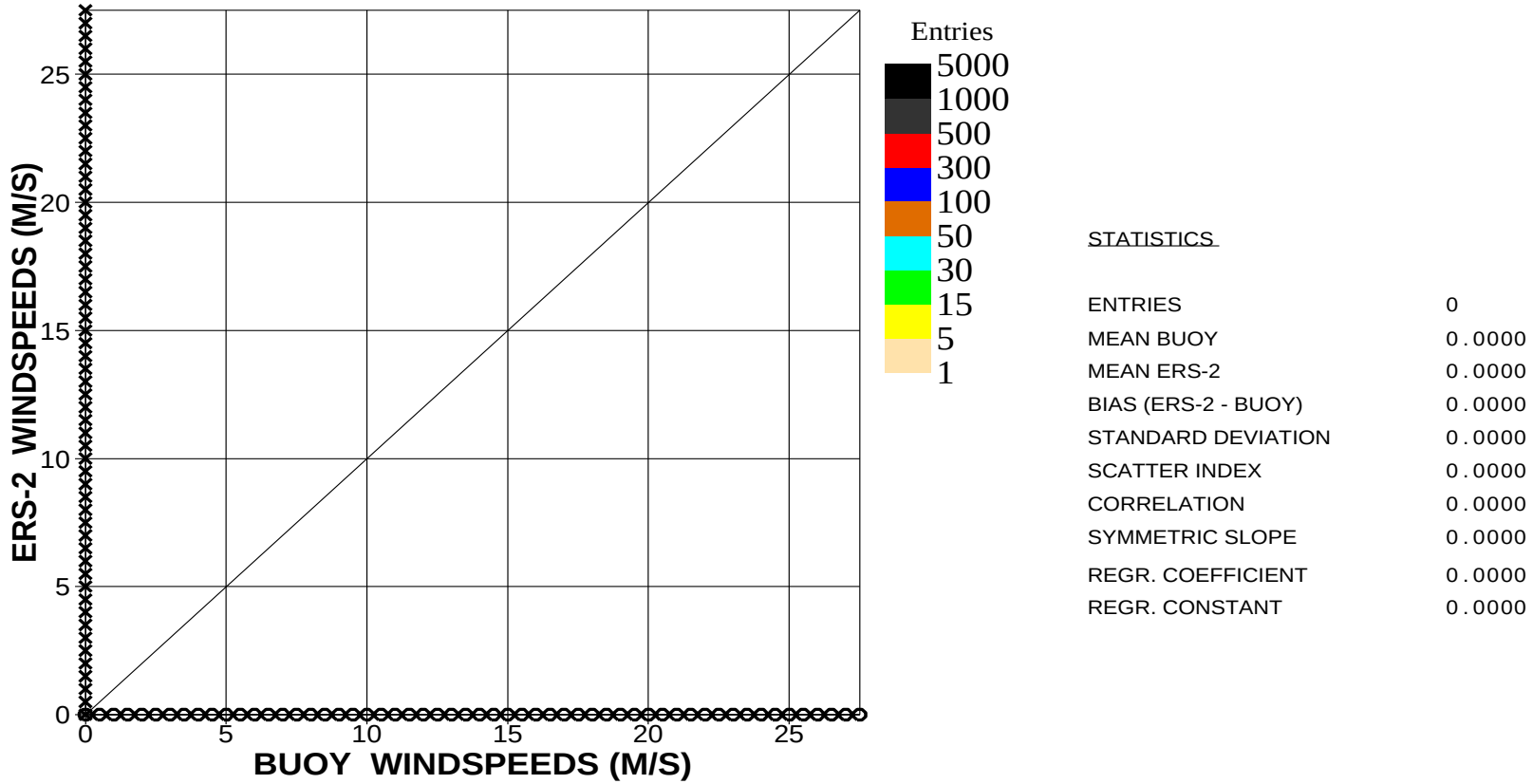


Figure 12. Comparison of buoy wind speed observations with ERS2 Altimeter wind speed data for June 2010 (hawaii)

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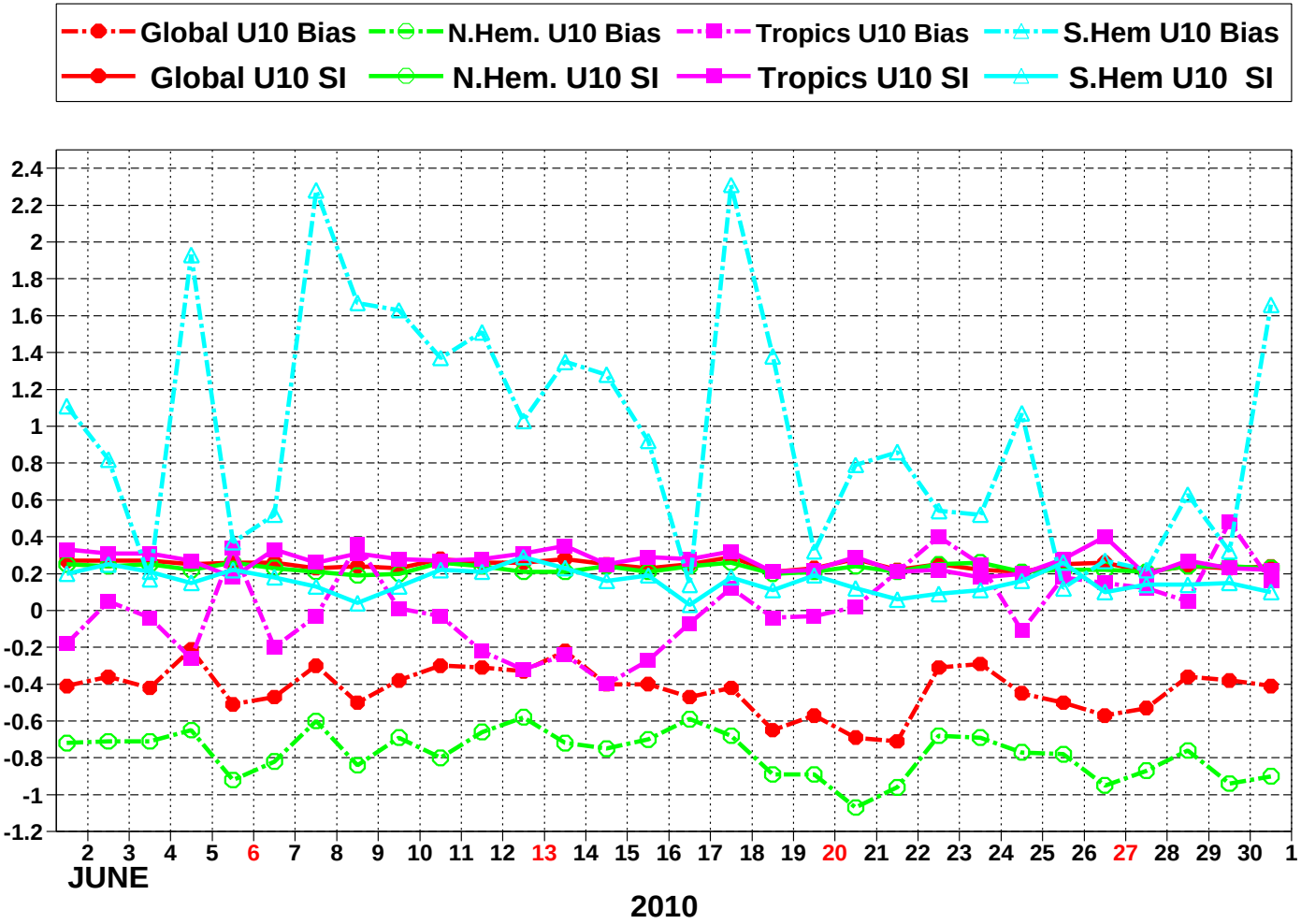


Figure 13: ERS-2 Altimeter wind speeds: Timeseries of bias (ERS-2 - model) and scatter index (SI)

Saleh Abdalla
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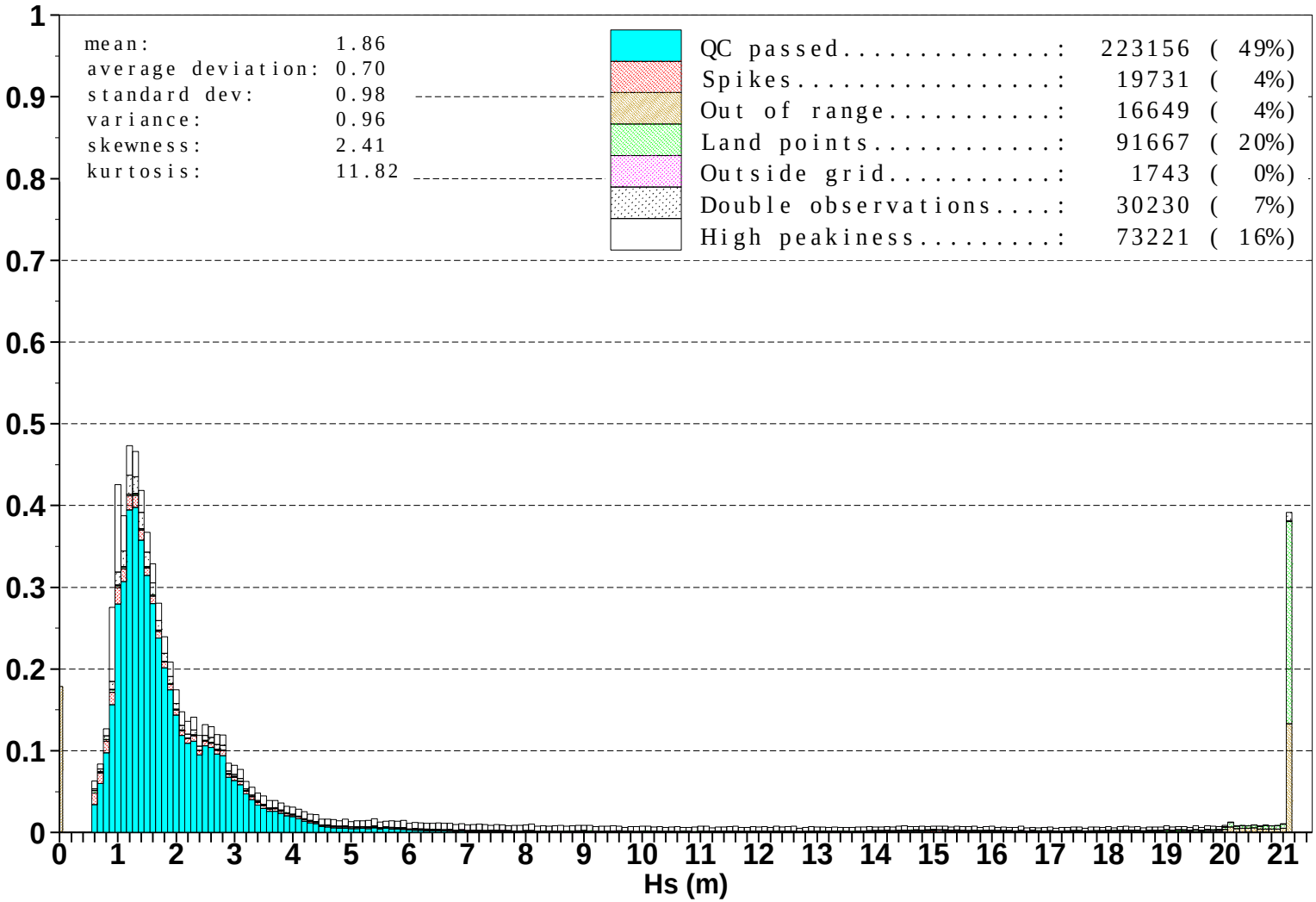


Figure 14: Distribution of the ERS-2 Altimeter wave heights after QC for June 2010

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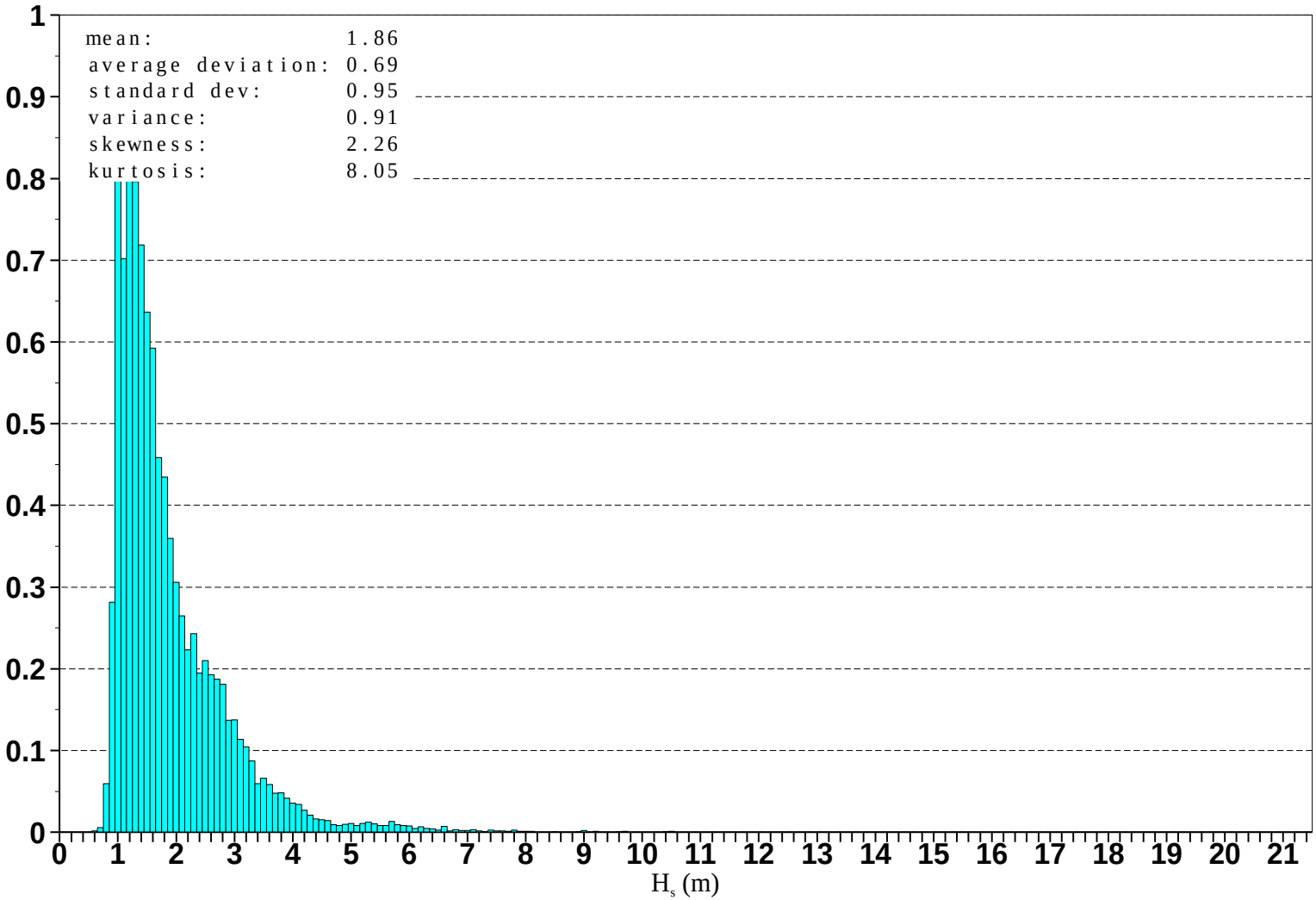


Figure 15: Distribution of ERS-2 Altimeter wave heights after along track averaging for June 2010

Saleh Abdalla
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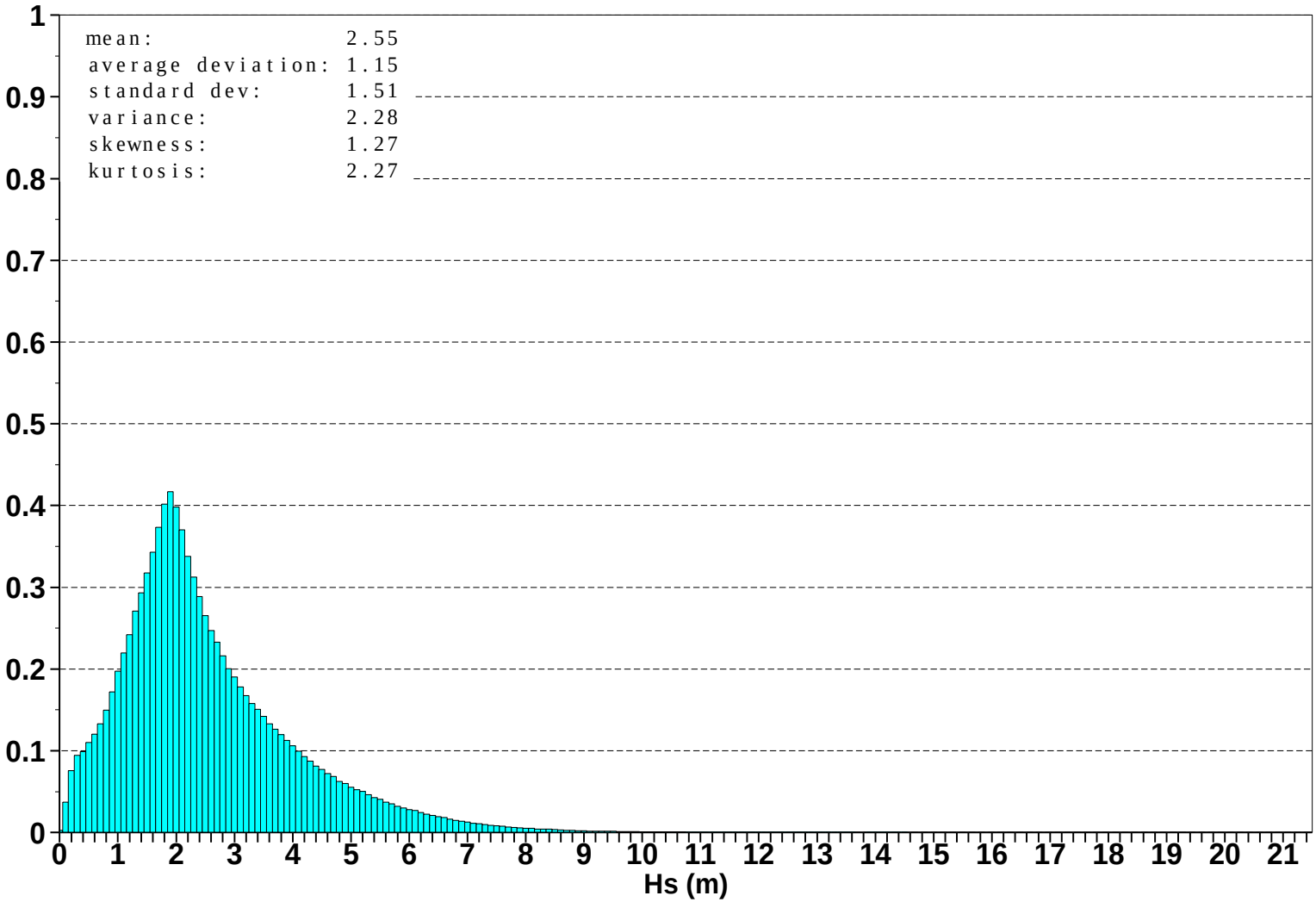
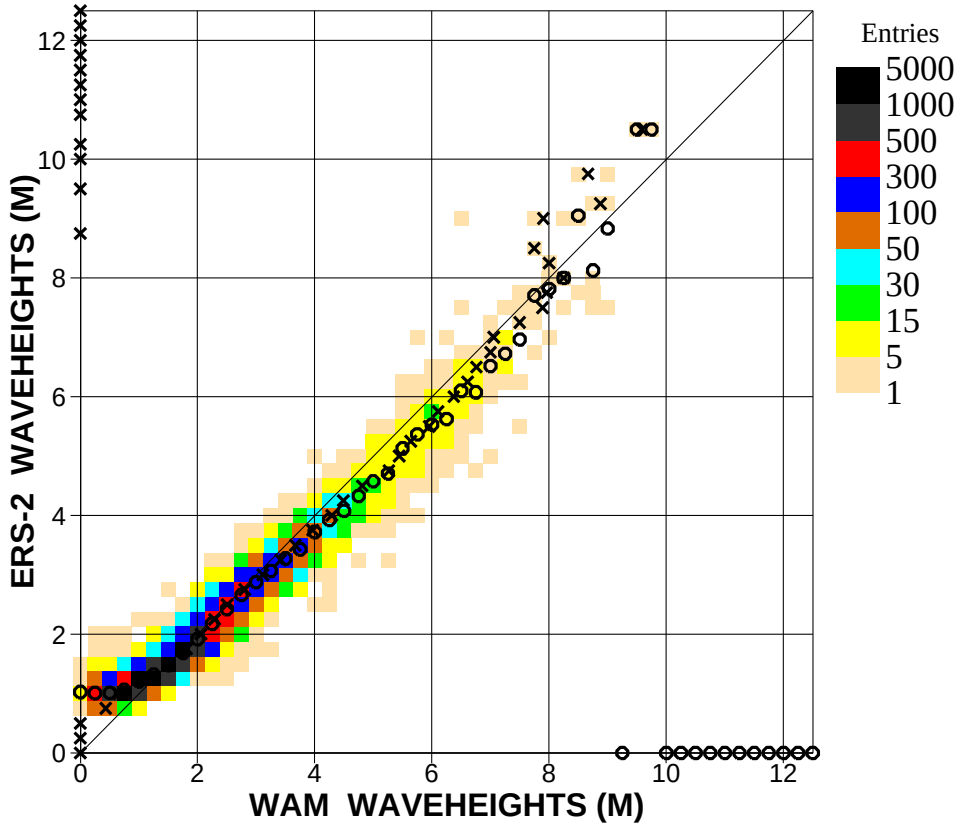


Figure 16: Global distribution of ECMWF wave heights for June 2010

Saleh Abdalla
European Centre for Medium Range Weather Forecasts
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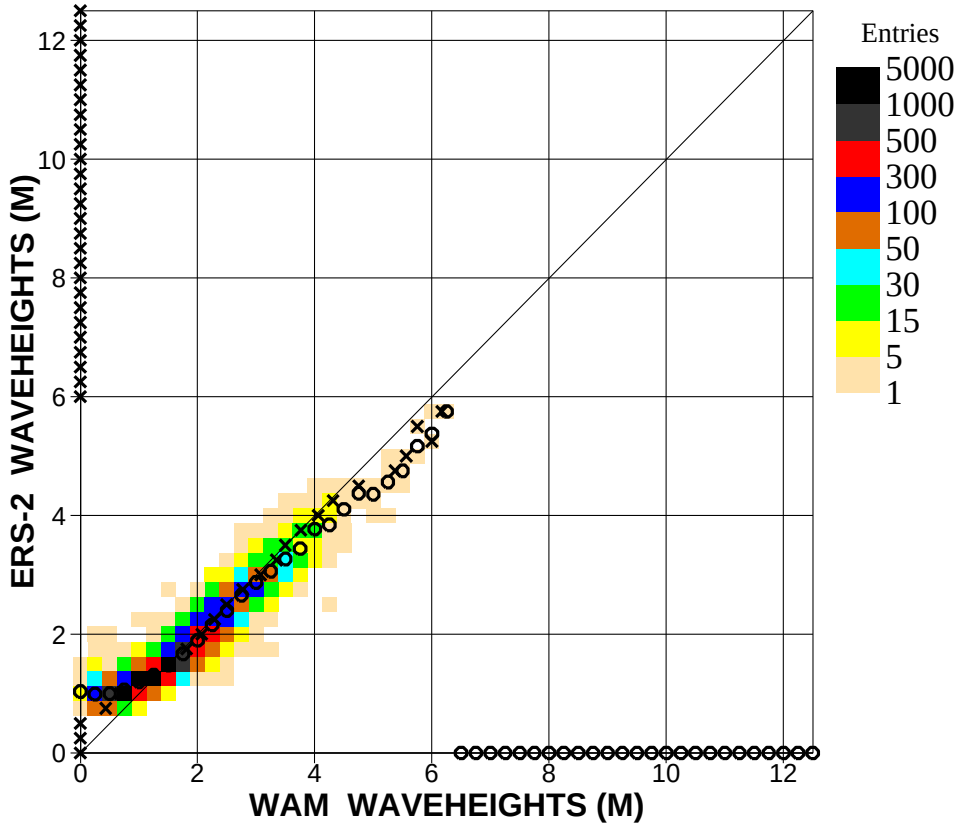


STATISTICS

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MEAN WAM	1.8151	
MEAN ERS-2	1.8617	
BIAS (ERS-2 - WAM)	0.0466	
STANDARD DEVIATION	0.3034	
SCATTER INDEX	0.1672	
CORRELATION	0.9707	
SYMMETRIC SLOPE	0.9797	(0.0019)
REGR. COEFFICIENT	0.8236	(0.0014)
REGR. CONSTANT	0.3668	(0.0031)

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

Saleh Abdalla
European Centre for Medium Range Weather Forecasts
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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

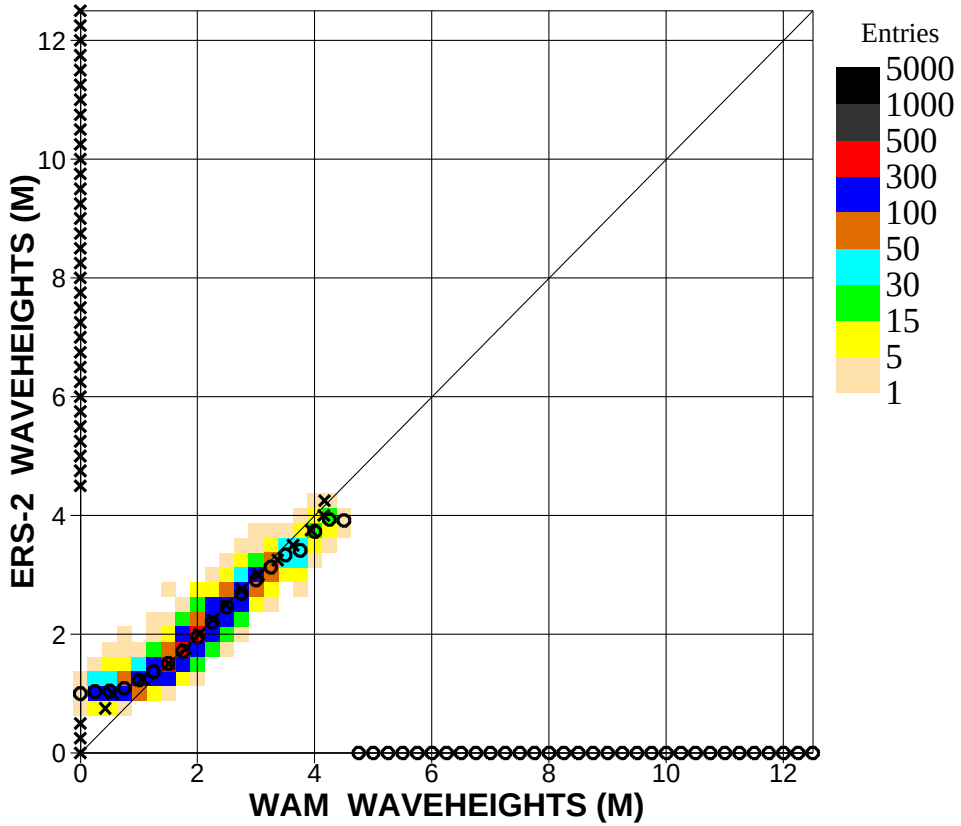


STATISTICS

ENTRIES	12968	
MEAN WAM	1.4981	
MEAN ERS-2	1.5812	
BIAS (ERS-2 - WAM)	0.0831	
STANDARD DEVIATION	0.2717	
SCATTER INDEX	0.1814	
CORRELATION	0.9459	
SYMMETRIC SLOPE	1.0080	(0.0033)
REGR. COEFFICIENT	0.7550	(0.0023)
REGR. CONSTANT	0.4501	(0.0038)

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

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

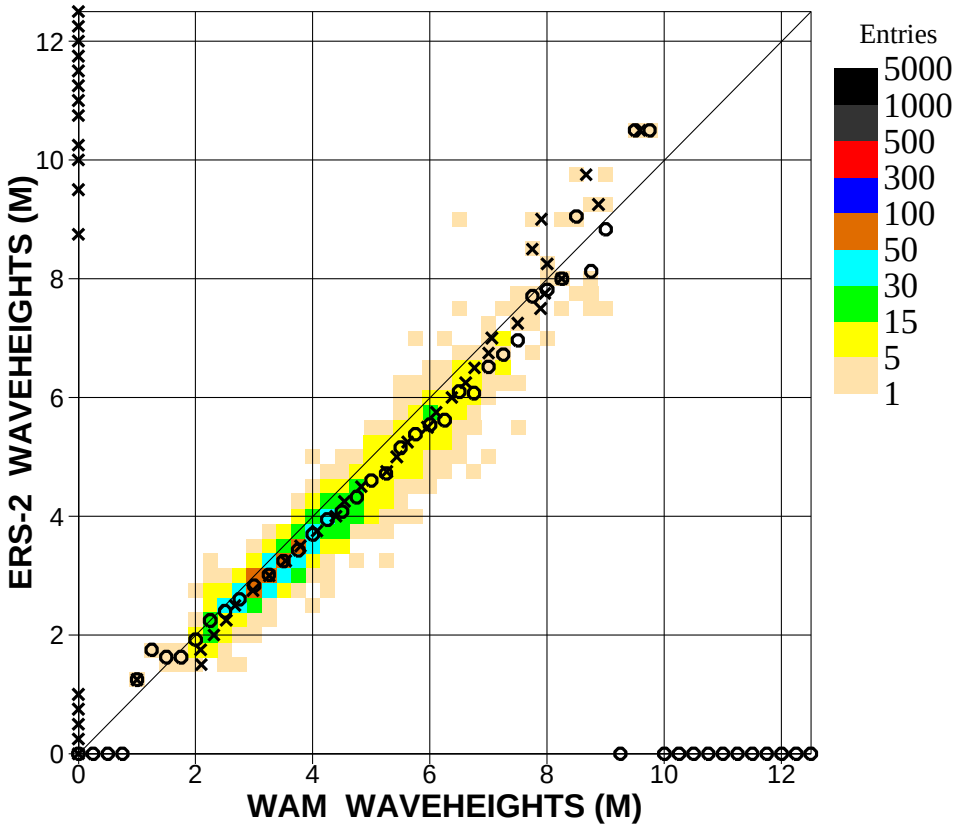


STATISTICS

ENTRIES	5600	
MEAN WAM	1.8497	
MEAN ERS-2	1.9122	
BIAS (ERS-2 - WAM)	0.0625	
STANDARD DEVIATION	0.2849	
SCATTER INDEX	0.1540	
CORRELATION	0.9561	
SYMMETRIC SLOPE	0.9968	(0.0045)
REGR. COEFFICIENT	0.7717	(0.0032)
REGR. CONSTANT	0.4848	(0.0065)

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

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

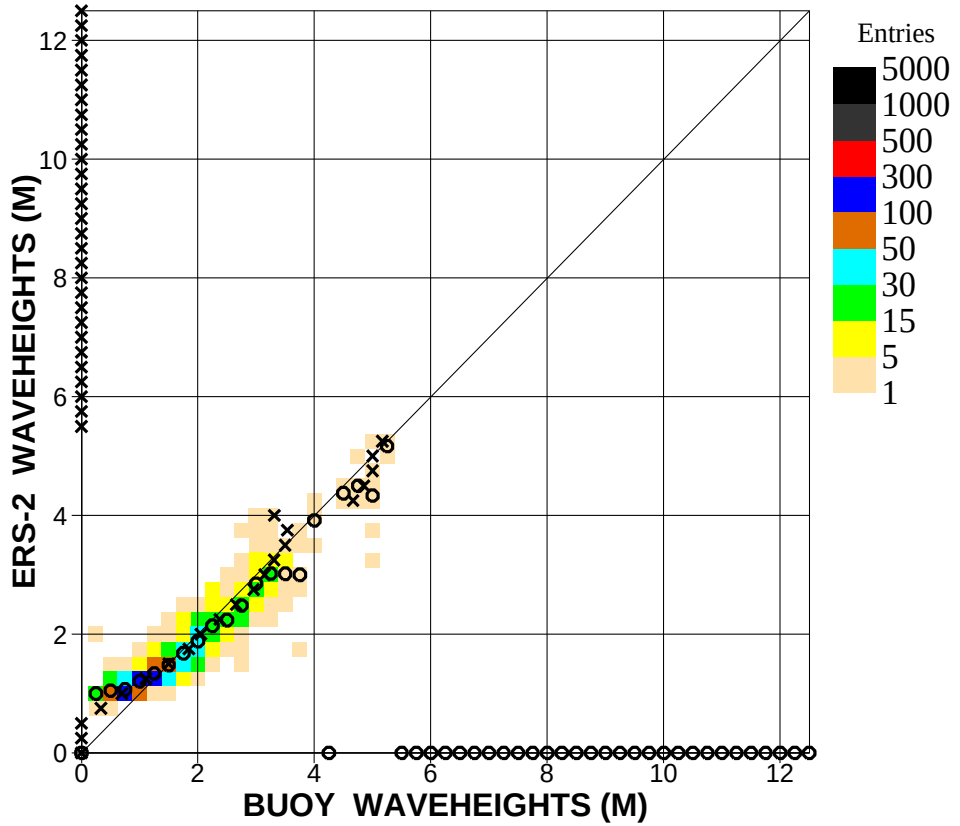


STATISTICS

ENTRIES	1672	
MEAN WAM	4.1657	
MEAN ERS-2	3.8721	
BIAS (ERS-2 - WAM)	-0.2937	
STANDARD DEVIATION	0.3754	
SCATTER INDEX	0.0901	
CORRELATION	0.9633	
SYMMETRIC SLOPE	0.9336	(0.0064)
REGR. COEFFICIENT	0.9334	(0.0064)
REGR. CONSTANT	-0.0162	(0.0280)

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

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

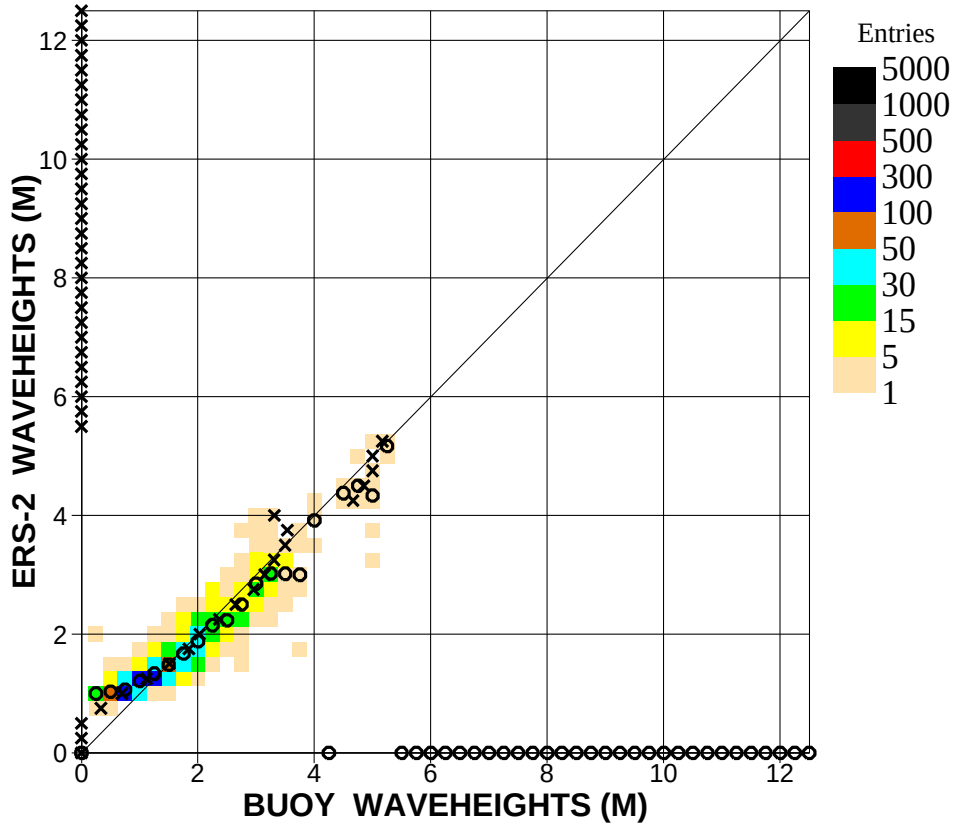


STATISTICS

ENTRIES	1440	
MEAN BUOY	1.5586	
MEAN ERS-2	1.6333	
BIAS (ERS-2 - BUOY)	0.0747	
STANDARD DEVIATION	0.3273	
SCATTER INDEX	0.2100	
CORRELATION	0.9382	
SYMMETRIC SLOPE	0.9929	(0.0101)
REGR. COEFFICIENT	0.7416	(0.0072)
REGR. CONSTANT	0.4774	(0.0129)

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

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



STATISTICS

ENTRIES	1312	
MEAN BUOY	1.5910	
MEAN ERS-2	1.6602	
BIAS (ERS-2 - BUOY)	0.0692	
STANDARD DEVIATION	0.3314	
SCATTER INDEX	0.2083	
CORRELATION	0.9386	
SYMMETRIC SLOPE	0.9904	(0.0105)
REGR. COEFFICIENT	0.7474	(0.0076)
REGR. CONSTANT	0.4712	(0.0138)

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

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

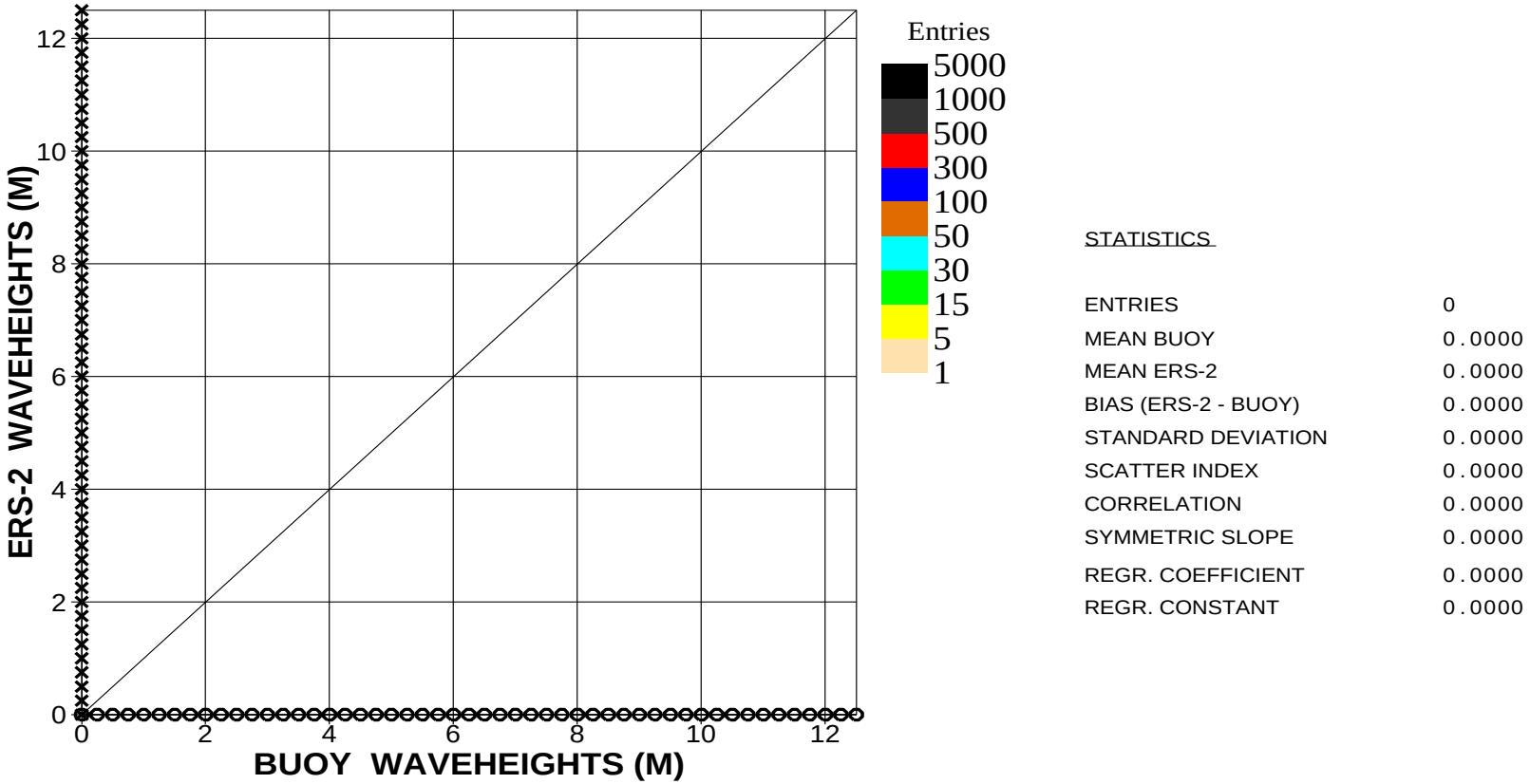


Figure 23. Comparison of buoy wave height observations with ERS2 Altimeter wave height data for June 2010 (hawaii)

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

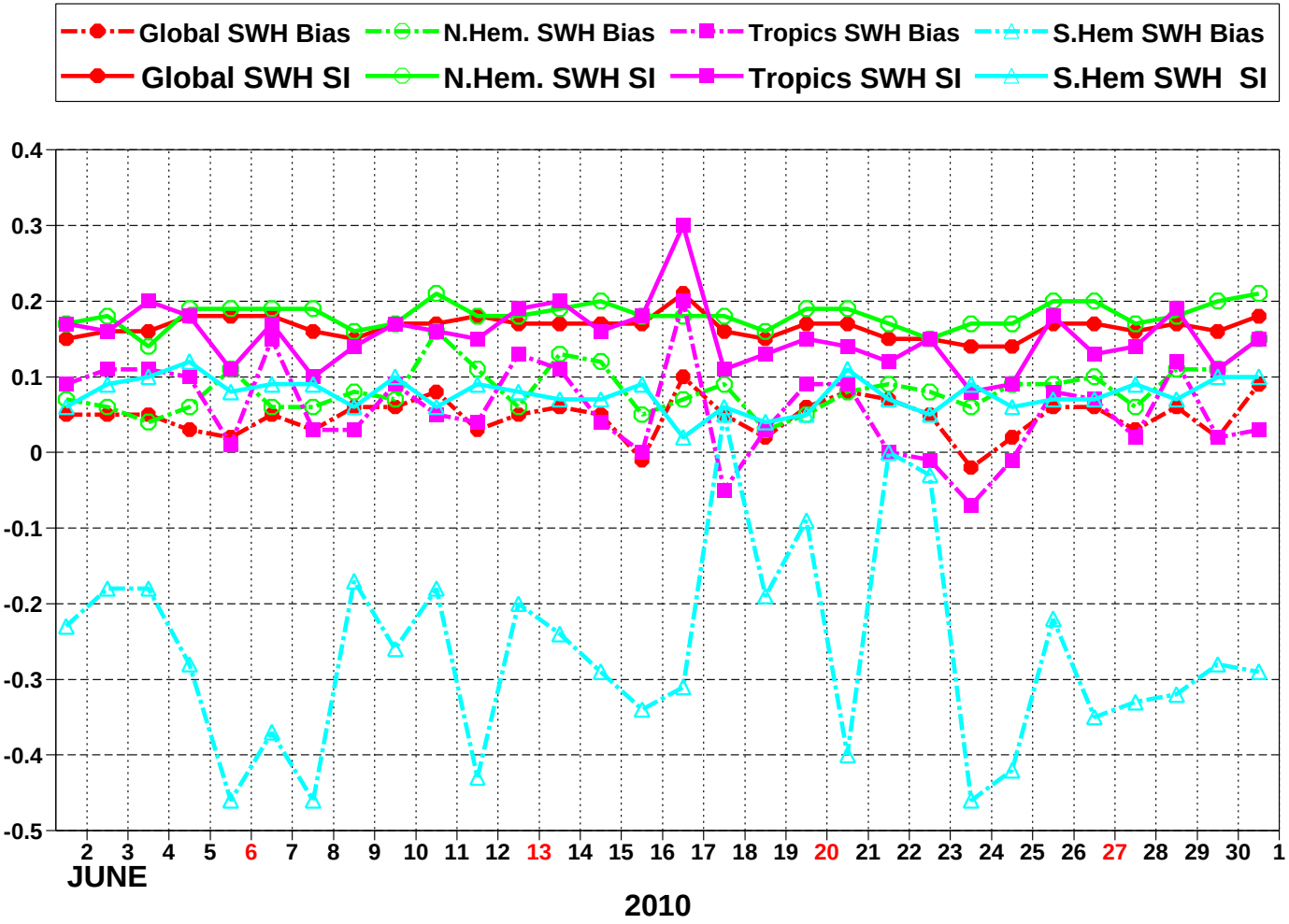


Figure 24: ERS-2 Altimeter wave heights: Timeseries of bias (ERS-2 - model) and scatter index (SI)

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

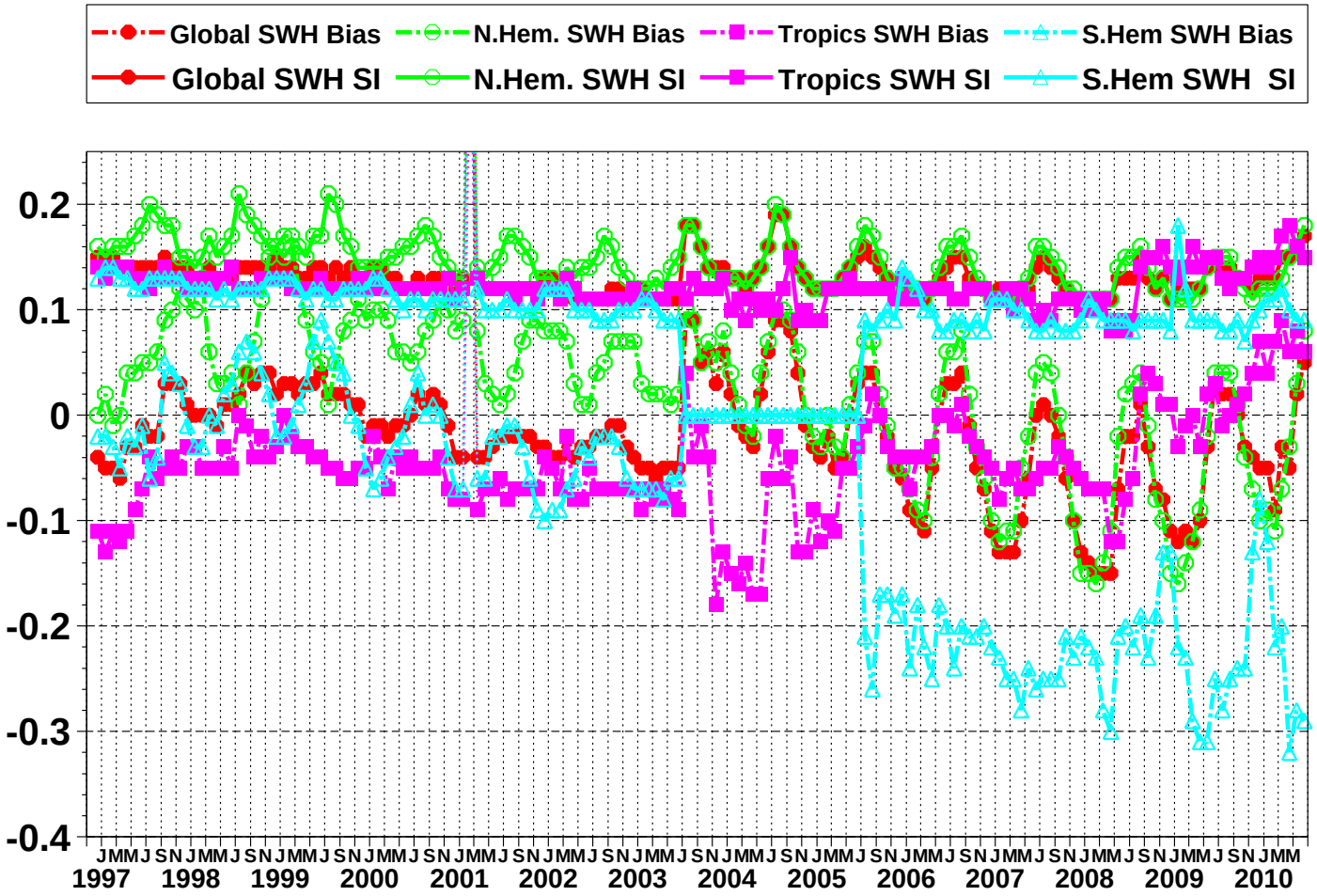


Figure 25: ERS-2 Altimeter wave heights: Timeseries of bias (ERS-2 - model) and scatter index (SI)

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

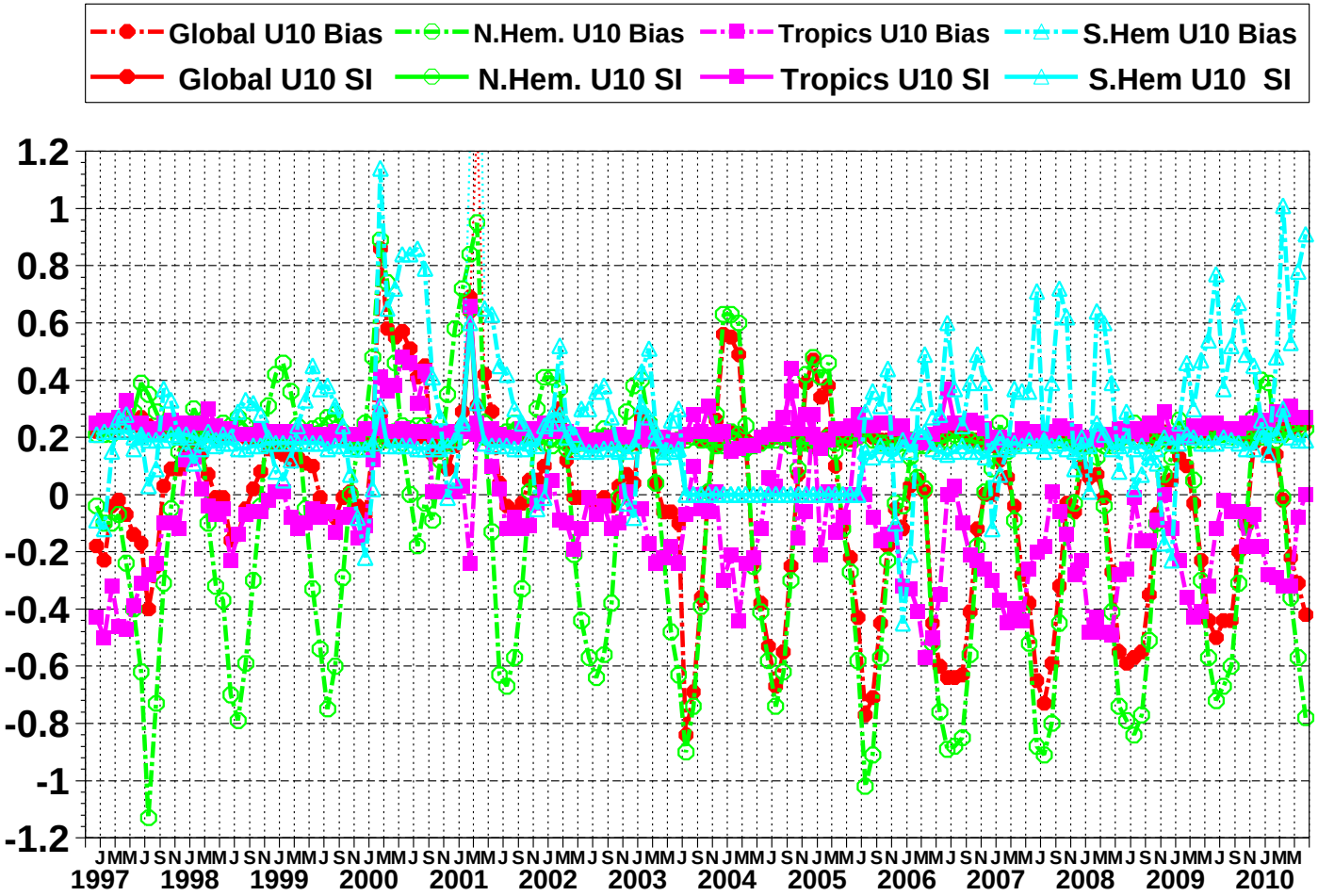


Figure 26: ERS-2 Altimeter wind speeds: Timeseries of bias (ERS-2 - model) and scatter index (SI)

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
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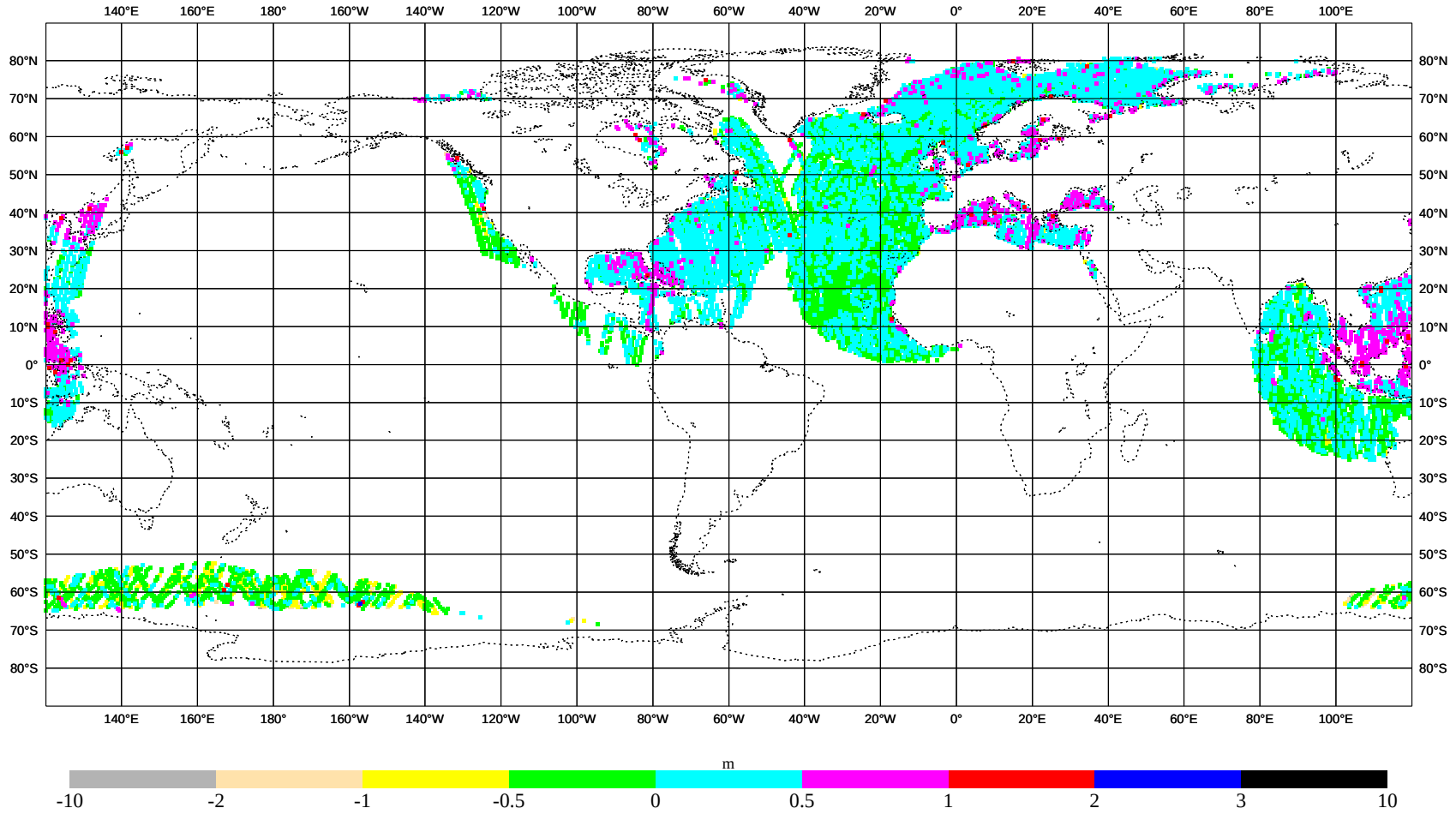


Figure 27: Significant wave height: Monthly mean difference of ERS-2 altimeter data minus wave model results for June 2010.

Saleh Abdalla
European Centre for Medium Range Weather Forecasts
Shinfield Park, Reading, Berkshire RG2 9AX, England
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Telex 984 7908 ECMWF G, Telefax (0118) 986 9450, e-mail: abdalla@ecmwf.int