

■ ECMWF Report on ENVISAT RA-2 for April 2010 ■

Report on ENVISAT Radar Altimeter - 2 (RA-2)

Wind/Wave Product with Height Information (RA2 WWV 2P)

By: *Saleh Abdalla*

Date: *12 May 2010*

Overview:

Based on the data received during this month, on average, 18579 observations arrived at ECMWF every 6-hour window of which an average of 6977 observations were rejected initially because of one of the following reasons: being over land, being outside model domain, being a double observation or flagged for rain contamination. On average 78.38% of the remaining part passed the quality control. As can be seen in Figure 1, there was no data gaps in terms of the 6-hour time windows during the whole month. However, there was some significant reduction in data volume during several 6-hour time windows.

Note that we are talking about the raw data which we downloaded in “BUFR” format before they were processed. Some of the data losses was due to delays in the availability of data files on ESA ftp servers.

Quality of Received Data:

For the period covered, the RA-2 Ku-band wave height data are generally of very good quality. The quality of wind speed observations is as good as usual. The MWR products, after removing the ice contaminated observations, are



■ ECMWF Report on ENVISAT RA-2 for April 2010 ■

generally in good agreement with the model (wet tropo correction is somewhat smaller than the model). The S-band altimeter has been out of order since 18 January 2008.

Backscatter:

- ENVISAT Ku-band $\langle \sigma^0 \rangle = 10.91$ dB (with a main peak at 10.6 dB).
- ENVISAT S-band: *Not available since 18 January 2008.*

Comparison Summary:

Table 1: Comparison of Surface Wind Speeds:

	RA2 - ECMWF		RA2 - Buoy	
	Bias (m/s)	SI (%)	Bias (m/s)	SI (%)
Global	+ 0.34	14.7	-0.21	16.9
Northern Hemisphere	+ 0.25	14.3	-0.17	17.8
Tropics	+ 0.20	15.6	-0.32	12.6
Southern Hemisphere	+ 0.48	14.2	----	----

■
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 ENVISAT RA-2 for April 2010 ■

Table 2: Comparison of Ku-Band Significant Wave Heights:

	RA2 (Ku) - WAM		RA2 (Ku) - Buoy	
	Bias (m)	SI (%)	Bias (m)	SI (%)
Global	-0.01	10.2	-0.04	13.6
Northern Hemisphere	-0.01	11.2	-0.04	13.7
Tropics	-0.04	9.2	-0.06	11.9
Southern Hemisphere	+0.01	9.6	----	----

Table 3: Comparison of S-Band Significant Wave Heights:

	RA2 (S) - WAM		RA2 (S) - Buoy	
	Bias (m)	SI (%)	Bias (m)	SI (%)
Global	----	----	----	----
Northern Hemisphere	----	----	----	----
Tropics	----	----	----	----
Southern Hemisphere	----	----	----	----

■
Saleh Abdalla

■ ECMWF Report on ENVISAT RA-2 for April 2010 ■

Table 4: Comparison of Wet Tropo Correction and Total Column Water Vapour Values:

	MWR WTC - ECMWF WTC		MWR TCWV - ECMWF TCWV	
	Bias (m)	SI (%)	Bias (kg/m ²)	SI (%)
Global	-0.013	10.3	-0.67	8.5
Northern Hemisphere	-0.014	11.2	-1.21	9.5
Tropics	-0.017	7.8	-0.42	6.1
Southern Hemisphere	-0.011	12.5	-0.55	11.2

Remarks:

- The ENVISAT Altimetry Level 1b and Level 2 Near Real Time (NRT) processing chains generating the FDGDR products (NRT IPF version 6.02L04) has gone operational since 7:30 UTC on 2 February 2010 (orbit 41443).
- “Envisat RA-2 (A-Side) S-band transmission power suddenly dropped at 23:23:40 UTC on 17 January 2008”. All S-band parameters are no longer valid since then.
- According to the used land sea mask (which is used for the operational WAM run at ECMWF), about one third of all processed data have been collected over land.

■
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 ENVISAT RA-2 for April 2010 ■

- The rain flag is responsible for the rejection of about **2.19% of the data this month. This is an increase by ~50% compared to the last two months, which are already higher than usual.** This may be due to the implementation of NRT IPF Ver. 6.02L04.
- As a result of the implementation of the IPF version 5.02 processing chain, the wind speed product is now limited to a lower value of 1.18 m/s (Figures 4 and 5). This is an expected result as the algorithm was tailored to fit the model and the buoy wind speeds requiring this type of shift. Further adjustment was not found suitable below this value since there is some doubts about the capability of wind with lower speeds to generate any detectable surface water waves. Irrespective of this, the wind speed histogram of Figure 5 compares well with the model counterpart in Figure 6.
- As can be seen in Table 1 and Figures 7-10, the wind speed data are in good agreement with the ECMWF model. ENVISAT wind speed product is globally about 35 cm/s **higher** than the model for this month. On the other hand, it is almost 21 cm/s **lower** than the buoy measurements for this month. The upper limit of the algorithm of 21.3 m/s has been relaxed since the implementation of IPF 6.02L04 on 2 February 2010.
- The Ku-band significant wave heights are almost **unbiased** when compared to WAM model results (+0.3% in the NH, -0.1% in Tropics and +0.5% in SH) over the whole month. This is visually clear in the scatter plots of Figures 22-25 (Ku-band - WAM comparisons) and can be inferred from the symmetric slope values of same scatter plots. On the other hand, the RA-2 Ku-band wave heights are about 1.4% **lower** than buoy wave heights for this month as can be seen in Figures 30-32 (Ku-band - buoy comparison). **This reduction of bias is due to IPF 6.02L04.**
- Note that all S-band observations are not valid after the 17th. of January 2008. Therefore, all plots related to S-band should be ignored for this month (although there appears a handful of observations passed the quality control during some months).
- While the MWR derived TCWV is in good agreement with the model counterpart (MWR TCWV is slightly dryer than the model especially in the Extra Tropics), the MWR WTC is still consistently smaller (drier) than the model values.

■
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 ENVISAT RA-2 for April 2010 ■

- There used to be a small cloud (few outliers this month) of TCWV scatter plot outliers hanging below the main cloud at model values between 20 and 30 kg/m² as can be seen in Figures 42-45. It occurs almost anywhere. This group of outliers becomes very clear in the rather long-period scatter plots. No specific condition or geographical location could be associated with this behaviour. The additional quality control criteria mentioned above did not help much to eliminate this kind of outliers. This issue is still unresolved. **Although this is usually visible in long-term scatter plots (e.g. a year), there is no indication on this issue being existing this month as it was the case last month as well.**
- It is important to stress that one needs to keep in mind when making the comparison between the results presented here for the ENVISAT RA-2 and the results presented in the ERS-2 altimeter reports that the ERS-2 plots and statistics are done for super-observations composed of 30 individual observation, while the plots and statistics here are for super-observations with 11 individual observations. Therefore, it is natural for the RA-2 plots and statistics to show a bit more variability.
- 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 CY36R1 (since the 26th of January 2010).

List of Figures:

Figure 1: Time series of data reception for ENVISAT Altimeter data for April 2010.

Figure 2: Distribution of the ENVISAT Altimeter Ku-band backscatter after QC for April 2010.

Figure 3: Distribution of the ENVISAT Altimeter S-band backscatter after QC for April 2010.

Figure 4: Distribution of the ENVISAT Altimeter wind speeds after QC for April 2010.

■
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 ENVISAT RA-2 for April 2010 ■

- Figure 5: Distribution of the ENVISAT Altimeter wind speeds after along track averaging for April 2010.
- Figure 6: Global distribution of ECMWF ocean surface wind speeds for April 2010.
- Figure 7: Comparison between ENVISAT Altimeter and ECMWF surface wind speeds for April 2010 (Global).
- Figure 8: Comparison between ENVISAT Altimeter and ECMWF surface wind speeds for April 2010 (Northern Hemisphere).
- Figure 9: Comparison between ENVISAT Altimeter and ECMWF surface wind speeds for April 2010 (Tropics).
- Figure 10: Comparison between ENVISAT Altimeter and ECMWF surface wind speeds for April 2010 (Southern Hemisphere).
- Figure 11: Comparison between ENVISAT Altimeter and buoy surface wind speeds for April 2010 (Global).
- Figure 12: Comparison between ENVISAT Altimeter and buoy surface wind speeds for April 2010 (Northern Hemisphere).
- Figure 13: Comparison between ENVISAT Altimeter and buoy surface wind speeds for April 2010 (Tropics).
- Figure 14: ENVISAT Altimeter wind speeds: Timeseries of daily bias (RA2 - model) and scatter index for April 2010.
- Figure 15: Distribution of the ENVISAT Altimeter Ku-band wave heights after QC for April 2010.
- Figure 16: Distribution of the ENVISAT Altimeter S-band wave heights after QC for April 2010.
- Figure 17: Distribution of the ENVISAT Altimeter Ku-band wave heights after along track averaging for April 2010.
- Figure 18: Distribution of the ENVISAT Altimeter S-band wave heights after along track averaging for April 2010.
- Figure 19: Distribution of the ERS-2 Altimeter wave heights after along track averaging for April 2010.
- Figure 19b: Distribution of WAM first guess (4V) wave heights collocated with ENVISAT for April 2010.
- Figure 20: Global distribution of WAM first guess wave heights for April 2010.
- Figure 21: Global distribution of WAM analysis (ERS-2 RA Assimilation) wave heights for April 2010.
- Figure 22: Comparison between ENVISAT Altimeter Ku-band and WAM significant wave heights for April 2010 (Global).
- Figure 23: Comparison between ENVISAT Altimeter Ku-band and WAM sig. wave heights for April 2010 (Northern Hemisphere).
- Figure 24: Comparison between ENVISAT Altimeter Ku-band and WAM significant wave heights for April 2010 (Tropics).
- Figure 25: Comparison between ENVISAT Altimeter Ku-band and WAM sig. wave heights for April 2010 (Southern Hemisphere).
- Figure 26: Comparison between ENVISAT Altimeter S-band and WAM significant wave heights for April 2010 (Global).
- Figure 27: Comparison between ENVISAT Altimeter S-band and WAM sig. wave heights for April 2010 (Northern Hemisphere).

■
Saleh Abdalla

■ ECMWF Report on ENVISAT RA-2 for April 2010 ■

- Figure 28: Comparison between ENVISAT Altimeter S-band and WAM significant wave heights for April 2010 (Tropics).
- Figure 29: Comparison between ENVISAT Altimeter S-band and WAM sig. wave heights for April 2010 (Southern Hemisphere).
- Figure 30: Comparison between ENVISAT Altimeter Ku-band and buoy significant wave heights for April 2010 (Global).
- Figure 31: Comparison between ENVISAT Altimeter Ku-band and buoy sig. wave heights for April 2010 (Northern Hemisphere).
- Figure 32: Comparison between ENVISAT Altimeter Ku-band and buoy significant wave heights for April 2010 (Tropics).
- Figure 33: Comparison between ENVISAT Altimeter S-band and buoy significant wave heights for April 2010 (Global).
- Figure 34: Comparison between ENVISAT Altimeter S-band and buoy sig. wave heights for April 2010 (Northern Hemisphere).
- Figure 35: Comparison between ENVISAT Altimeter S-band and buoy significant wave heights for April 2010 (Tropics).
- Figure 36: ENVISAT Altimeter Ku-band wave heights: Timeseries of daily bias (RA2 - model) and scatter index for April 2010.
- Figure 37: ENVISAT Altimeter S-band wave heights: Timeseries of daily bias (RA2 - model) and scatter index for April 2010.
- Figure 38: Comparison between ENVISAT MWR and ECMWF wet tropospheric correction for April 2010 (Global).
- Figure 39: Comparison between ENVISAT MWR and ECMWF wet tropospheric correction for April 2010 (Northern Hemisphere).
- Figure 40: Comparison between ENVISAT MWR and ECMWF wet tropospheric correction for April 2010 (Tropics).
- Figure 41: Comparison between ENVISAT MWR and ECMWF wet tropospheric correction for April 2010 (Southern Hemisphere).
- Figure 42: Comparison between ENVISAT MWR and ECMWF total column water vapour for April 2010 (Global).
- Figure 43: Comparison between ENVISAT MWR and ECMWF total column water vapour for April 2010 (Northern Hemisphere).
- Figure 44: Comparison between ENVISAT MWR and ECMWF total column water vapour for April 2010 (Tropics).
- Figure 45: Comparison between ENVISAT MWR and ECMWF total column water vapour for April 2010 (Southern Hemisphere).
- Figure 46: ENVISAT MWR wet tropospheric correction: Timeseries of daily bias (MWR-model) and scatter index for April 2010.
- Figure 47: ENVISAT MWR total column water vapour: Timeseries of daily bias (MWR-model) and scatter index for April 2010.
- Figure 48: Timeseries of daily global ratio between mean Ku-Band to mean S-Band significant wave heights since the 13th. of May 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
Telex 984 7908 ECMWF G, Telefax (0118) 986 9450, e-mail abdalla@ecmwf.int

■ ECMWF Report on ENVISAT RA-2 for April 2010 ■



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 ENVISAT RA-2 for April 2010 ■

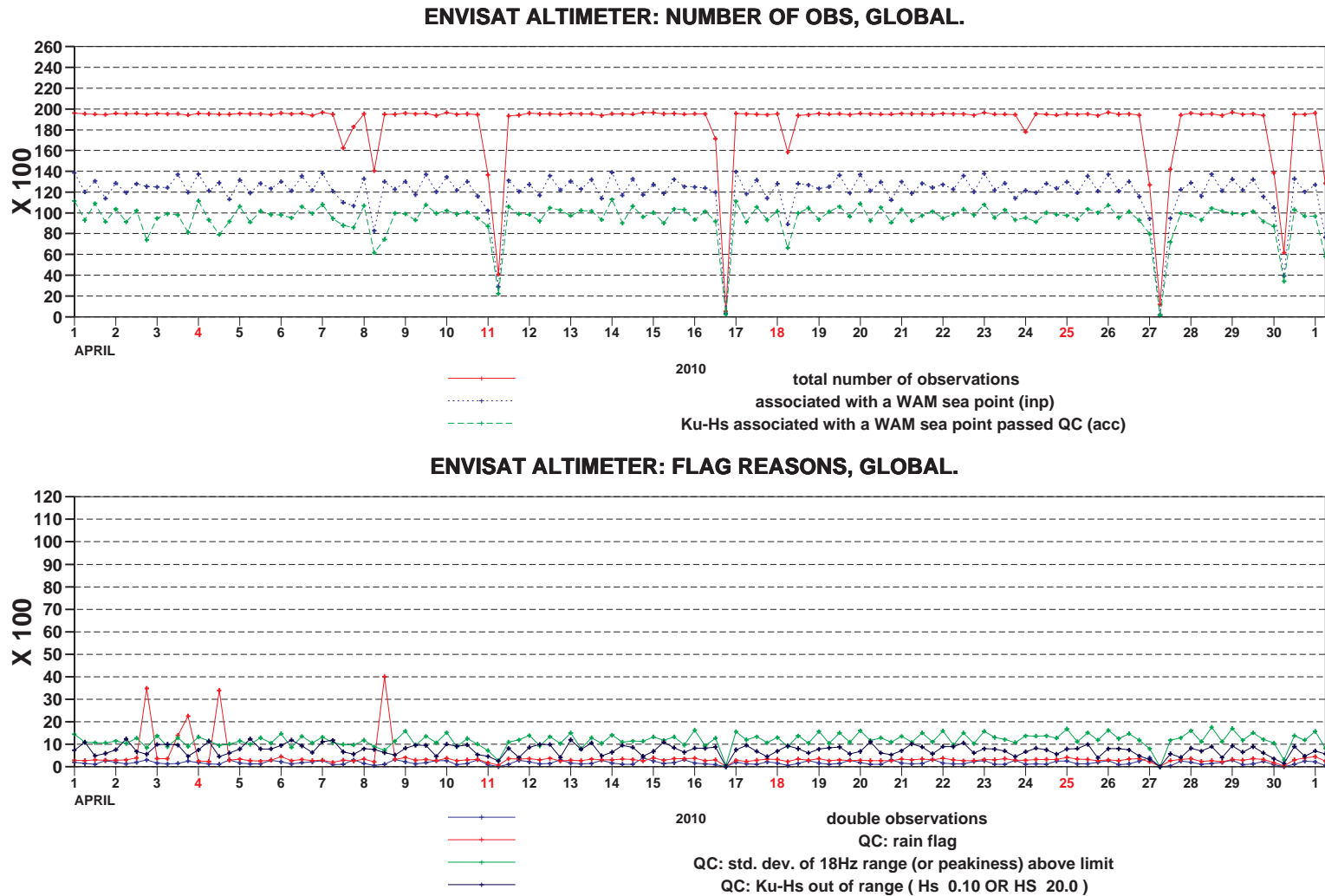


Figure 1: Time series of data reception for ENVISAT Altimeter data for April 2010

ECMWF Report on ENVISAT RA-2 for April 2010

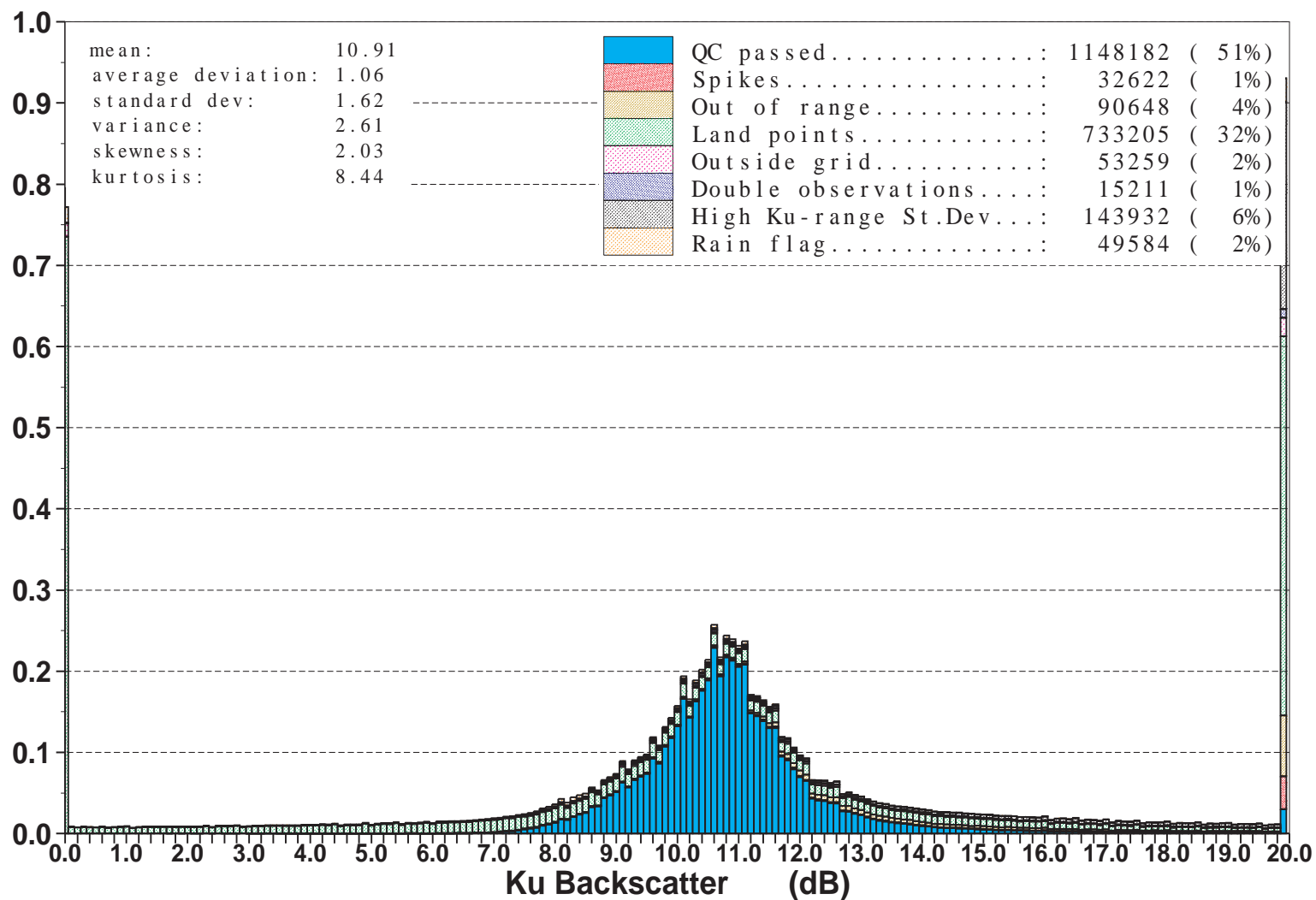


Figure 2: Distribution of the ENVISAT Altimeter Ku Backscatter after QC for April 2010

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 ENVISAT RA-2 for April 2010 ■

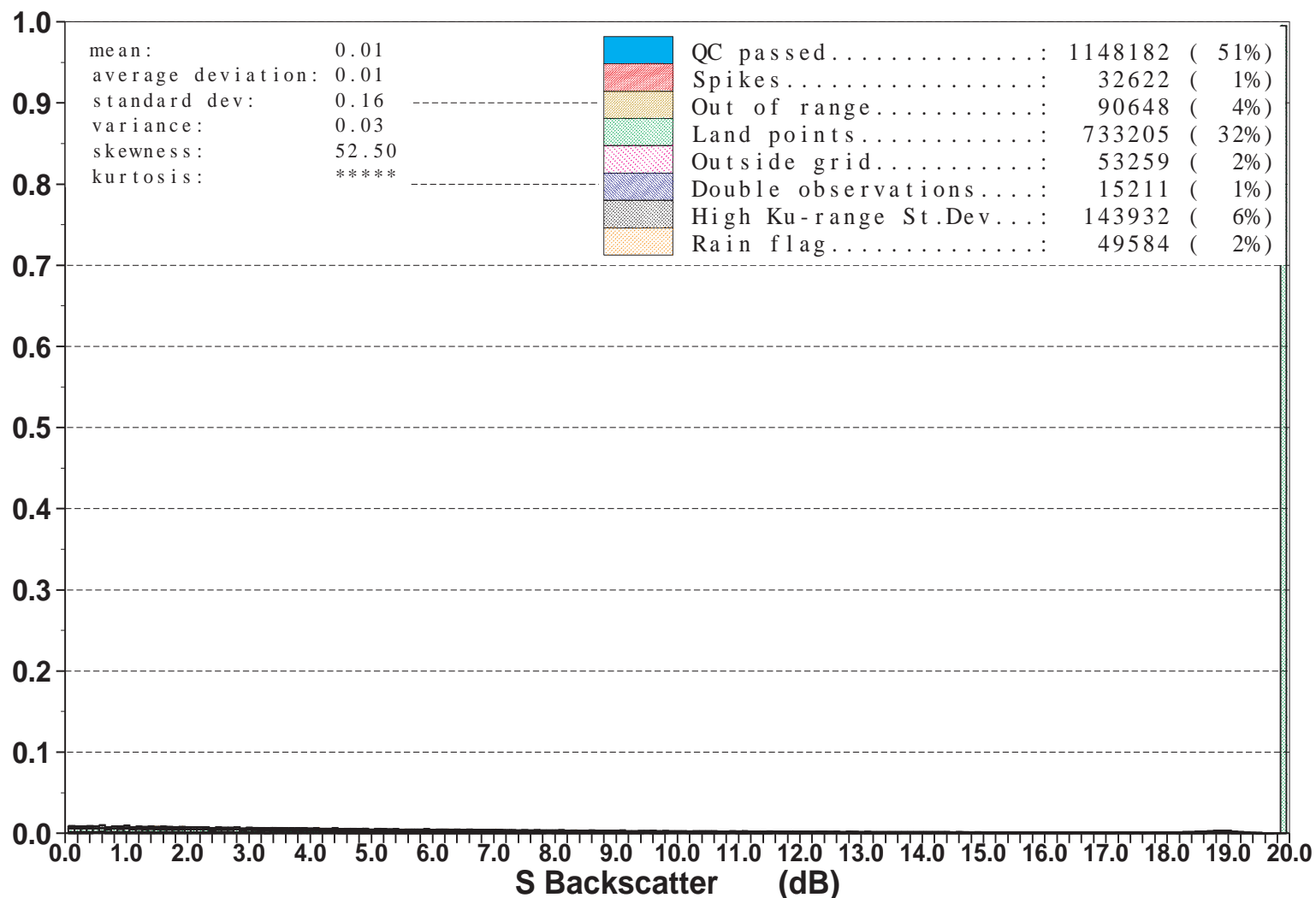


Figure 3: Distribution of the ENVISAT Altimeter S Backscatter after QC for April 2010

■
Saleh Abdalla

■ ECMWF Report on ENVISAT RA-2 for April 2010 ■

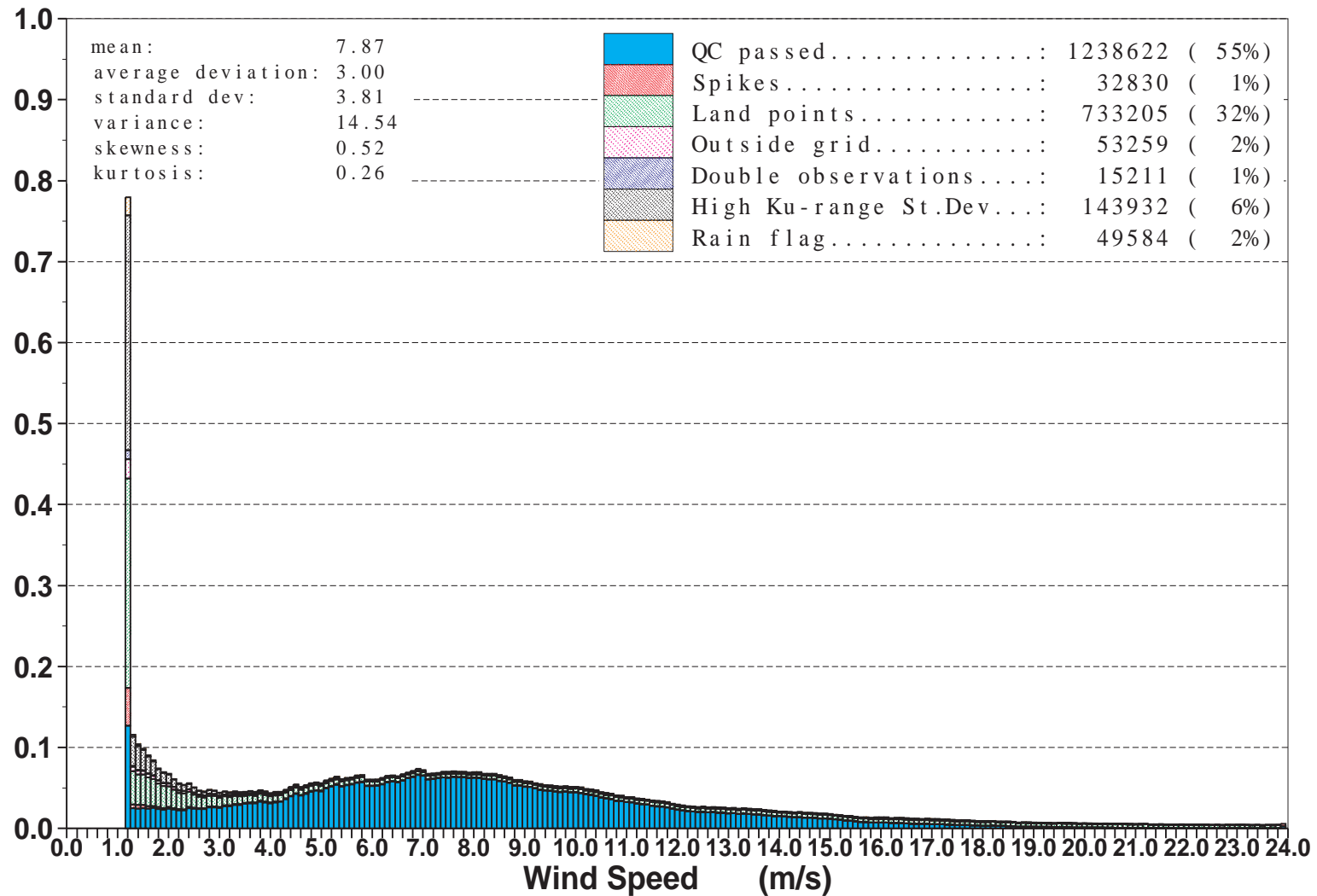


Figure 4: Distribution of the ENVISAT Altimeter Wind Speed after QC for April 2010

■
Saleh Abdalla

■ ECMWF Report on ENVISAT RA-2 for April 2010 ■

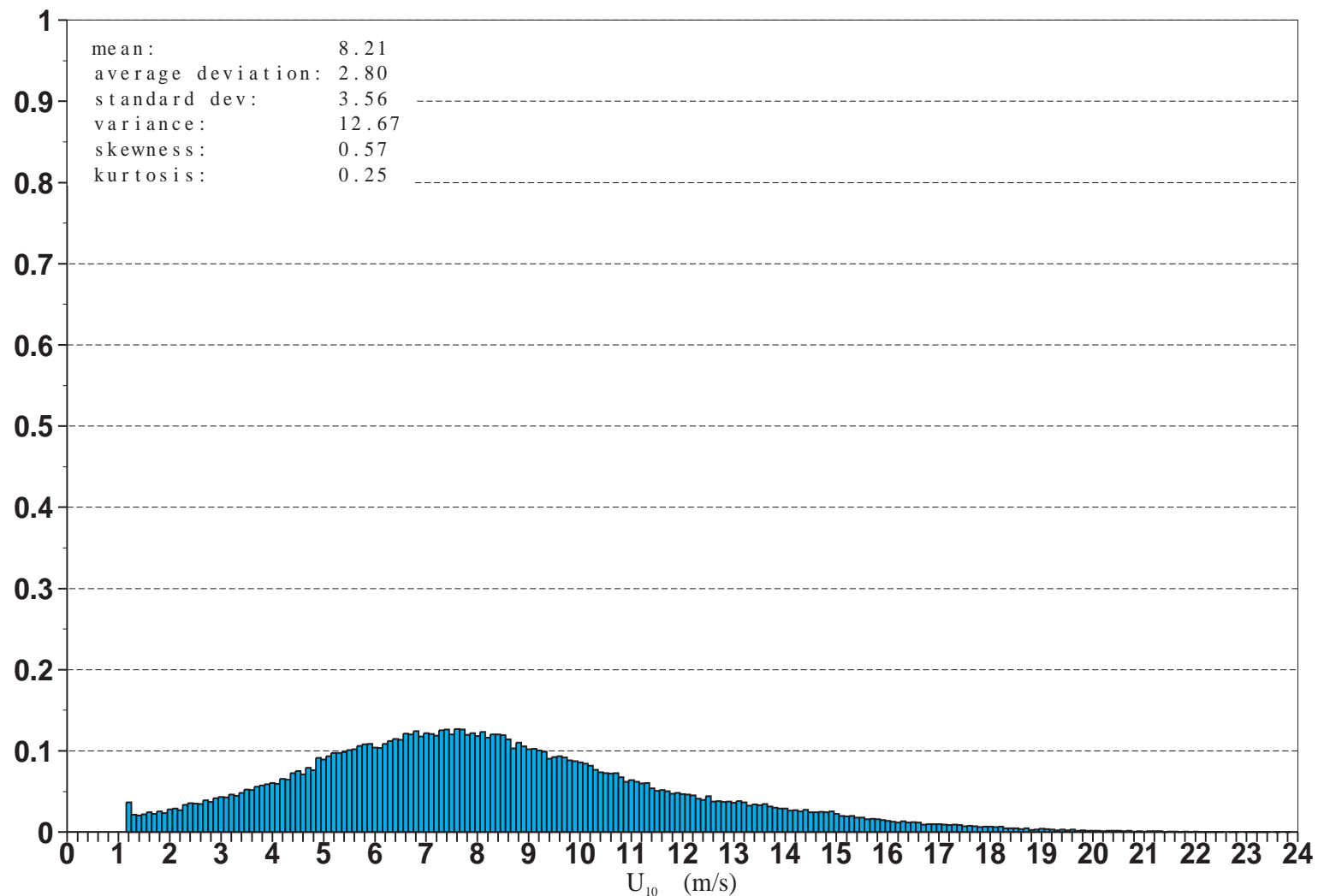


Figure 5: Distribution of ENVISAT Altimeter Wind Speeds after Along-Track Averaging for April 2010

■
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 ENVISAT RA-2 for April 2010 ■

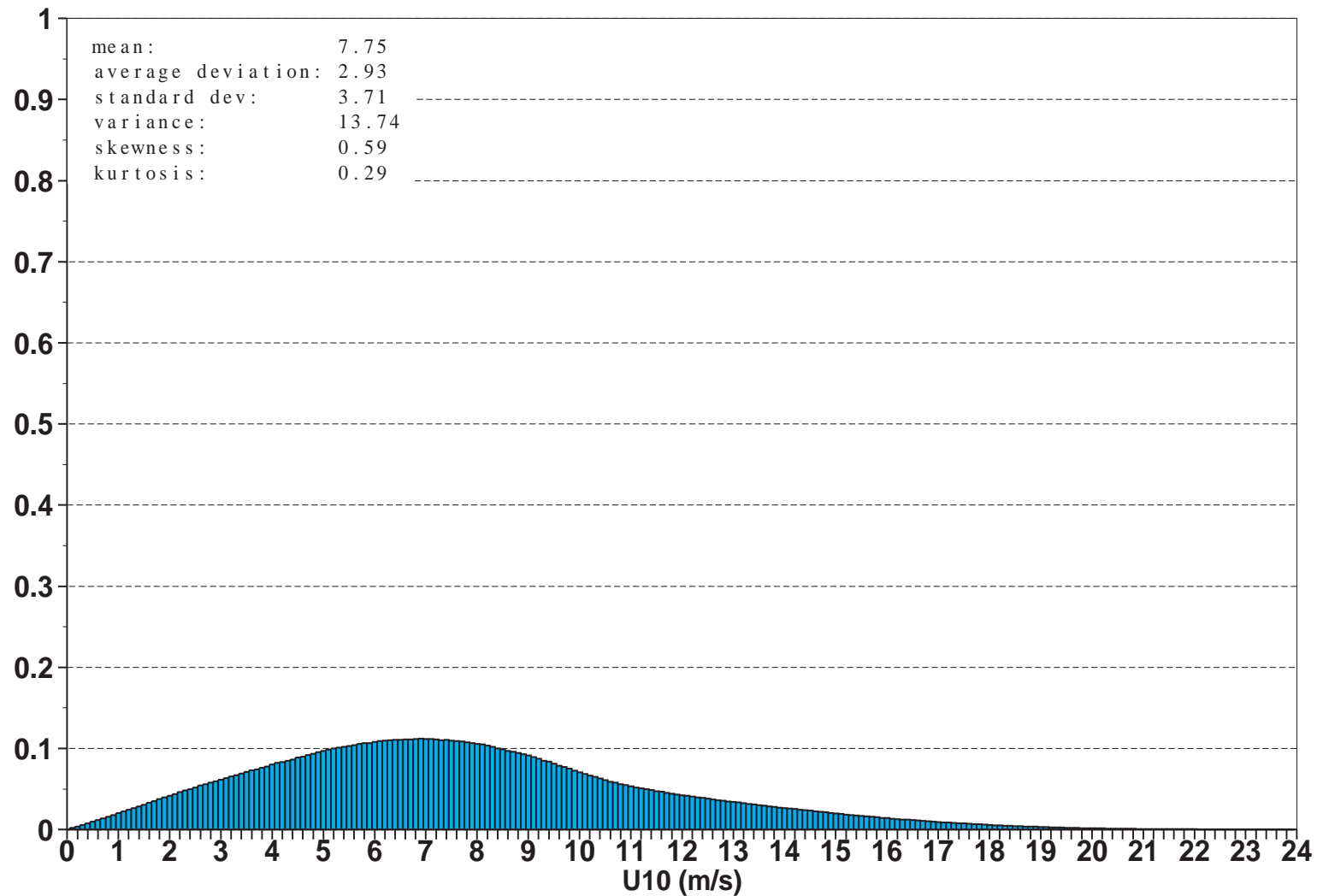


Figure 6: Global distribution of ECMWF Analysis ocean surface wind speeds for April 2010

■
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 ENVISAT RA-2 for April 2010 ■

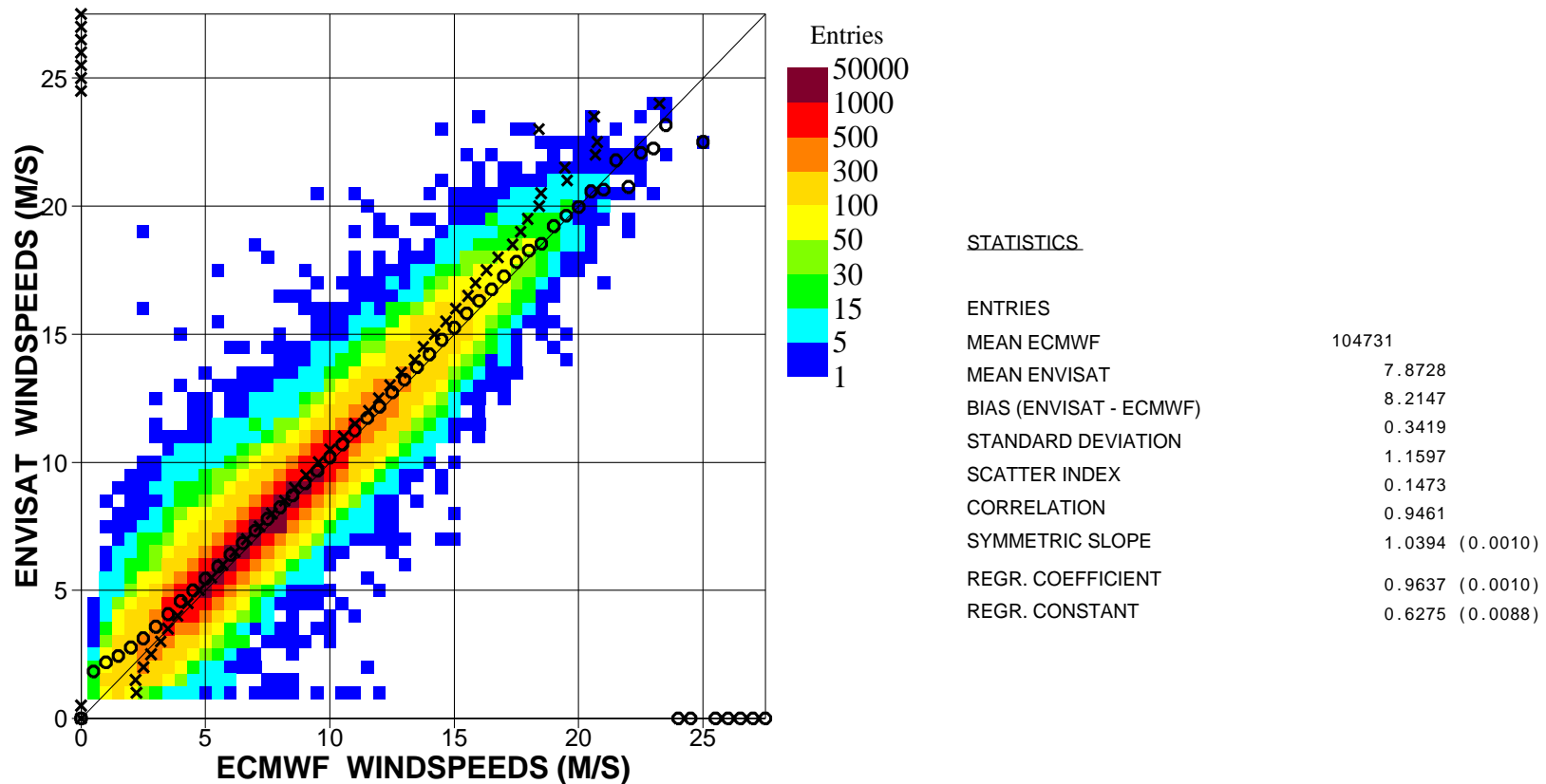


Figure 7. Comparison between ENVISAT Altimeter and ECMWF wind speeds for April 2010 (Global)

■
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

■ ECMWF Report on ENVISAT RA-2 for April 2010 ■

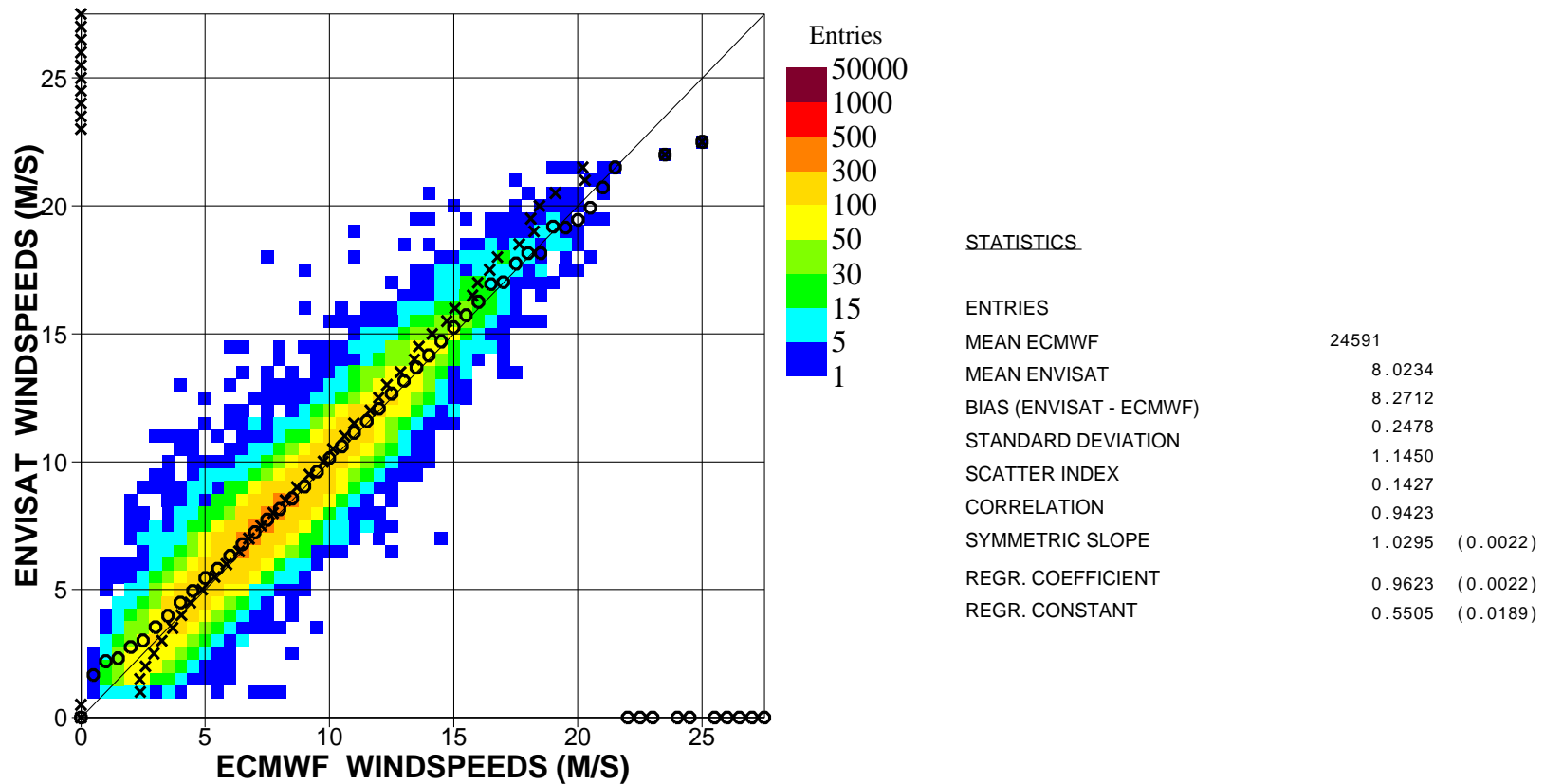


Figure 8. Comparison between ENVISAT Altimeter and ECMWF wind speeds for April 2010 (N.Hem.)

■
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

■ ECMWF Report on ENVISAT RA-2 for April 2010 ■

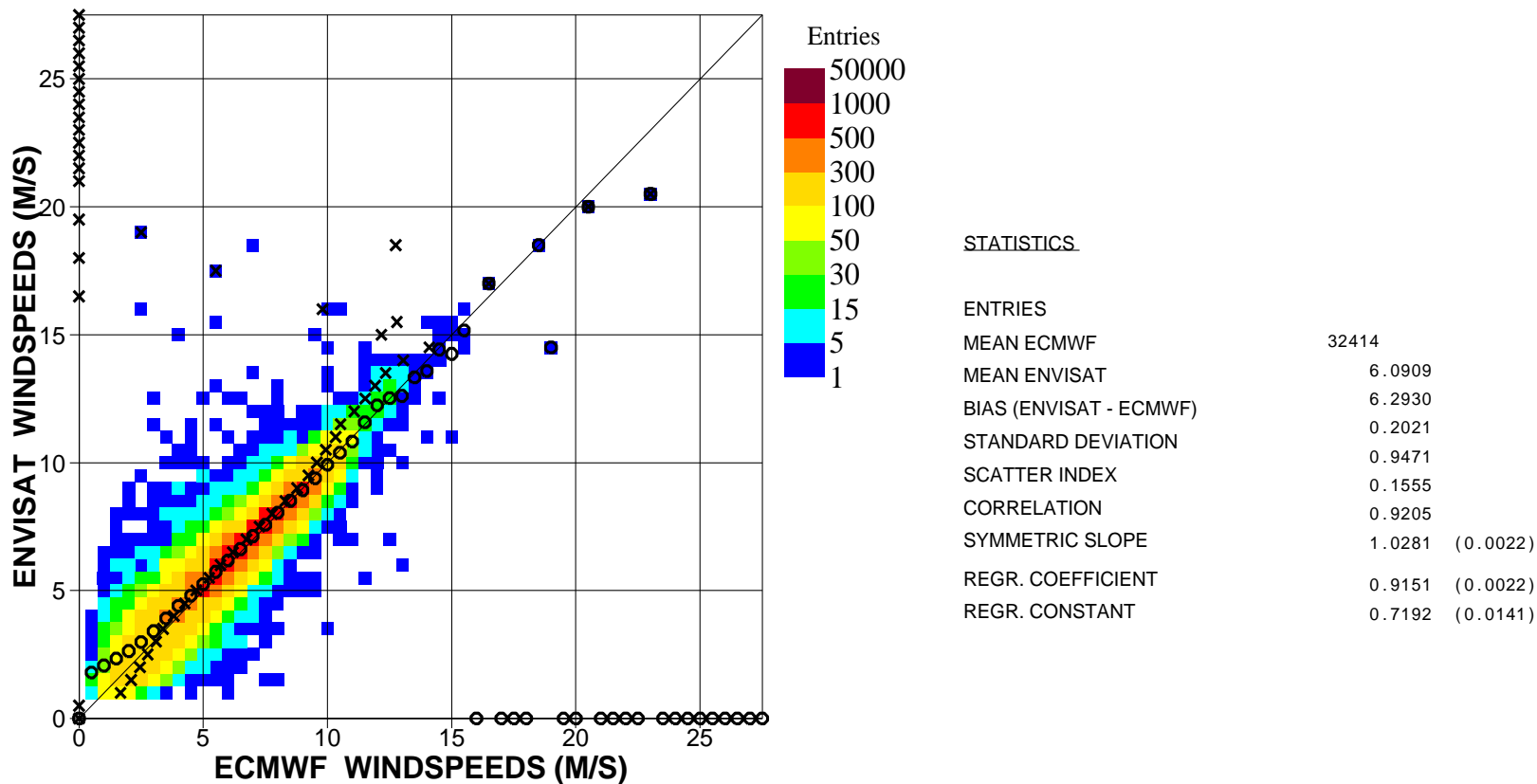


Figure 9. Comparison between ENVISAT Altimeter and ECMWF wind speeds for April 2010 (Tropics)

■
Saleh Abdalla

■ ECMWF Report on ENVISAT RA-2 for April 2010 ■

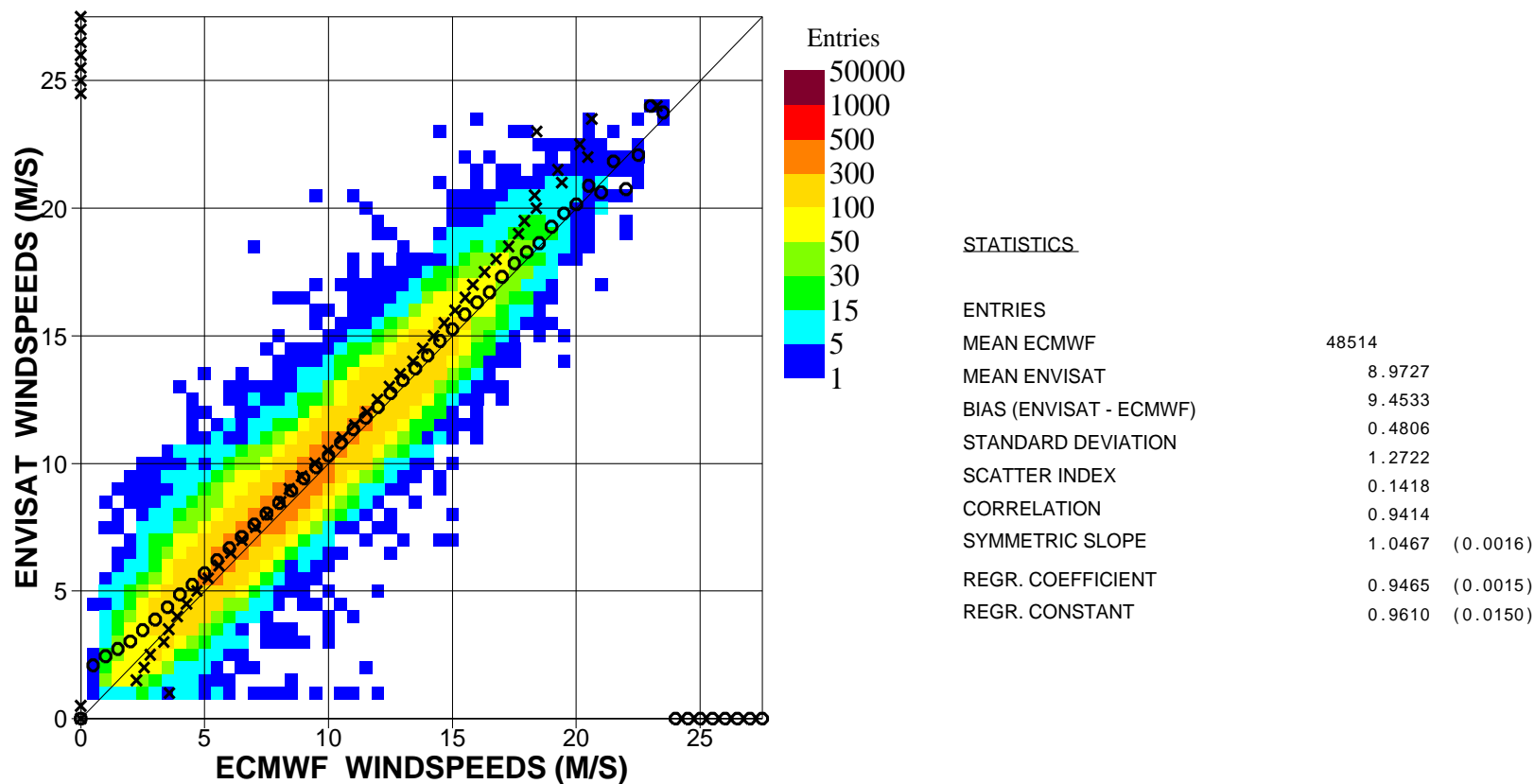


Figure 10. Comparison between ENVISAT Altimeter and ECMWF wind speeds for April 2010 (S.Hem.)

■
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

■ ECMWF Report on ENVISAT RA-2 for April 2010 ■

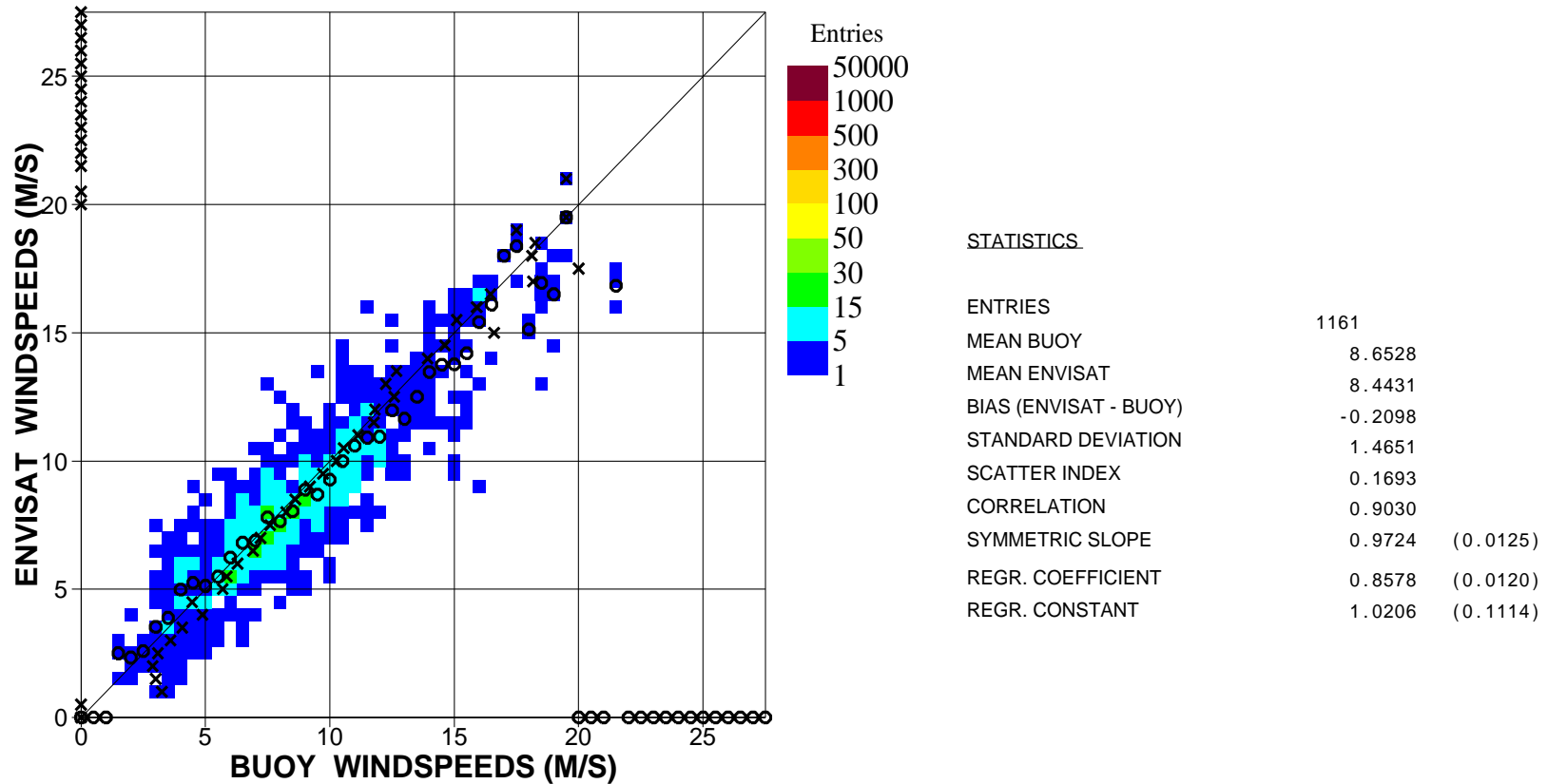


Figure 11. Comparison between ENVISAT Altimeter and buoy wind speeds for April 2010 (Global)

■
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

■ ECMWF Report on ENVISAT RA-2 for April 2010 ■

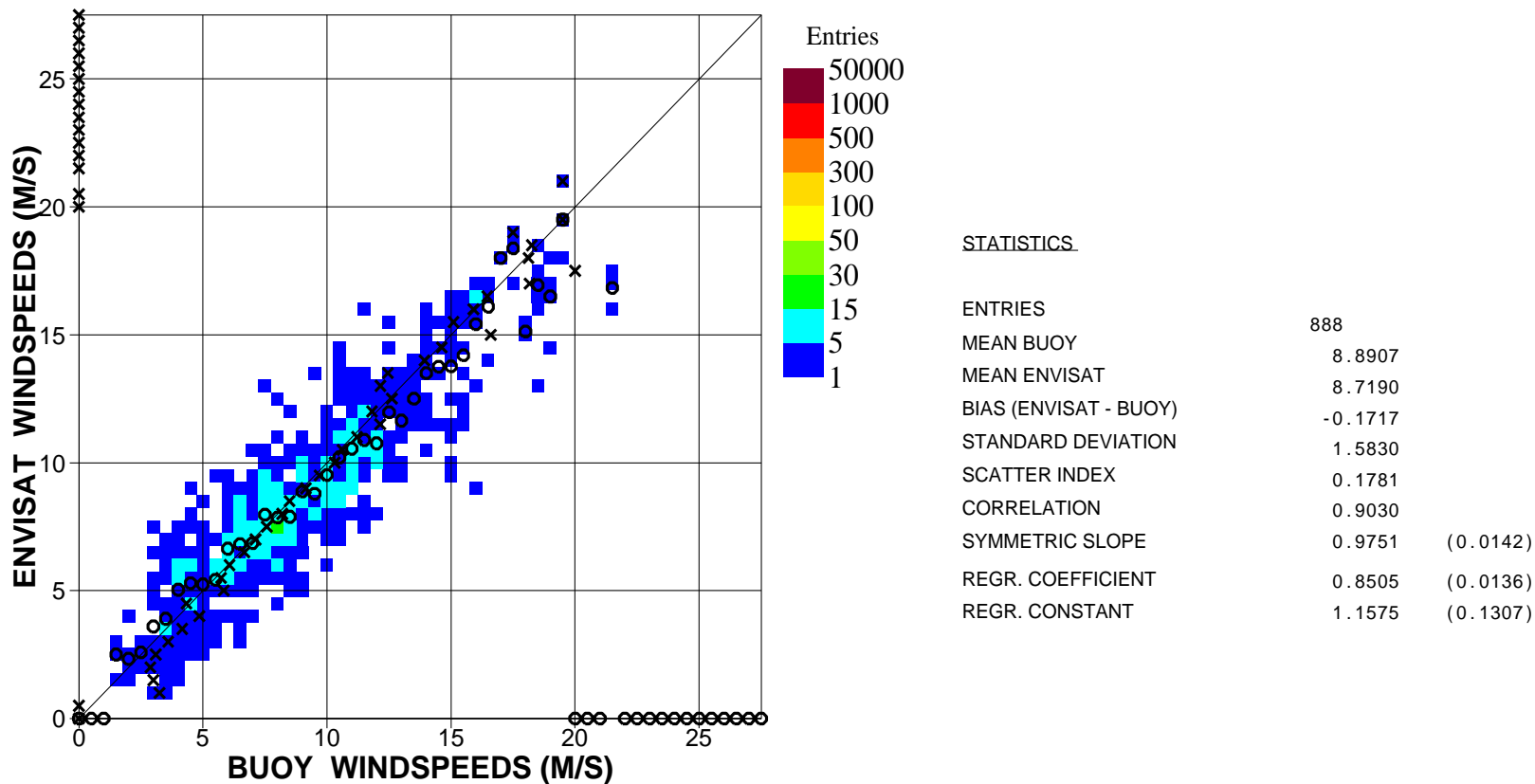


Figure 12. Comparison between ENVISAT Altimeter and buoy wind speeds for April 2010 (N.Hem.)

■
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

■ ECMWF Report on ENVISAT RA-2 for April 2010 ■

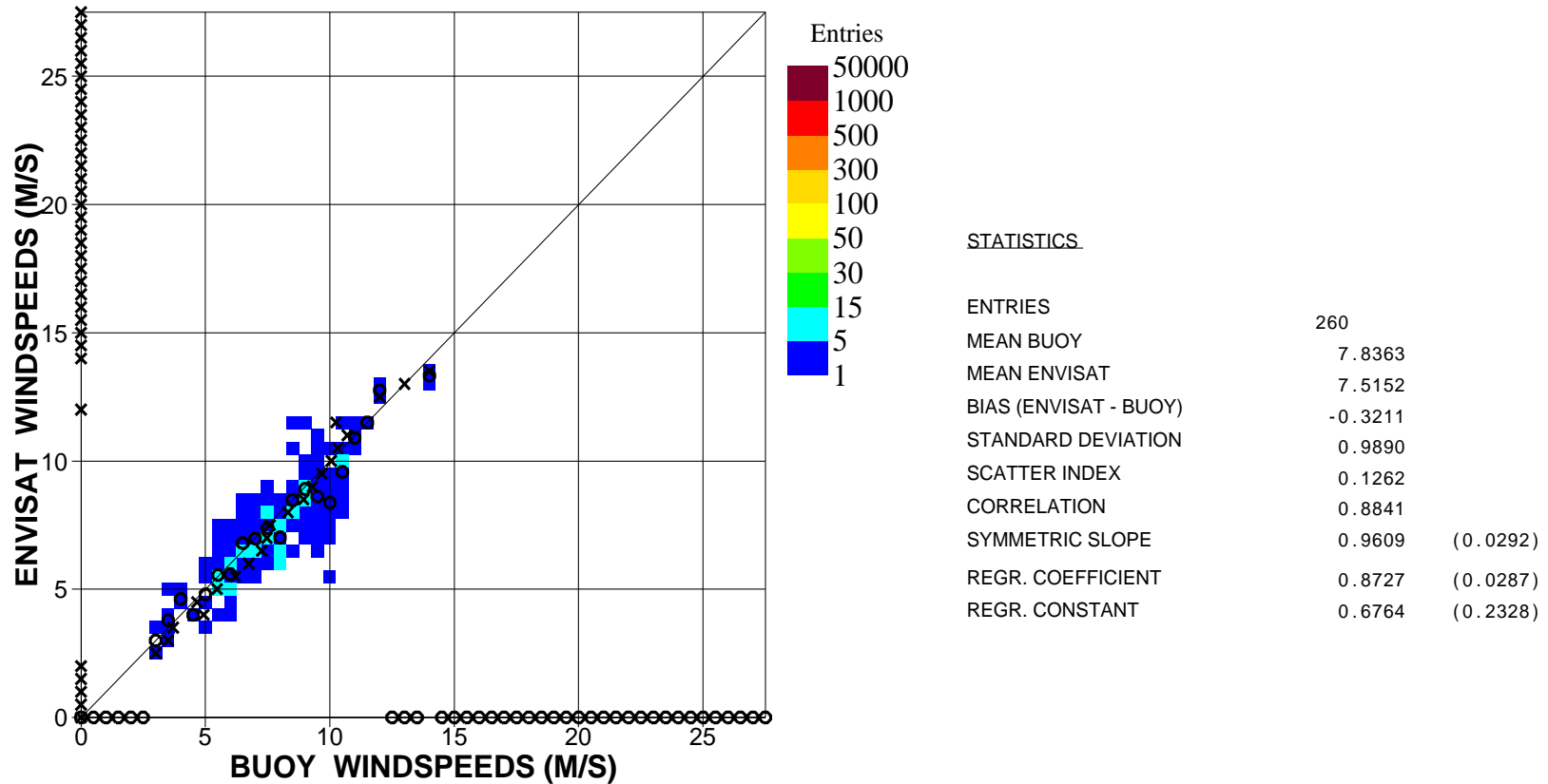


Figure 13. Comparison between ENVISAT Altimeter and buoy wind speeds for April 2010 (Tropics)

■
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

ECMWF Report on ENVISAT RA-2 for April 2010

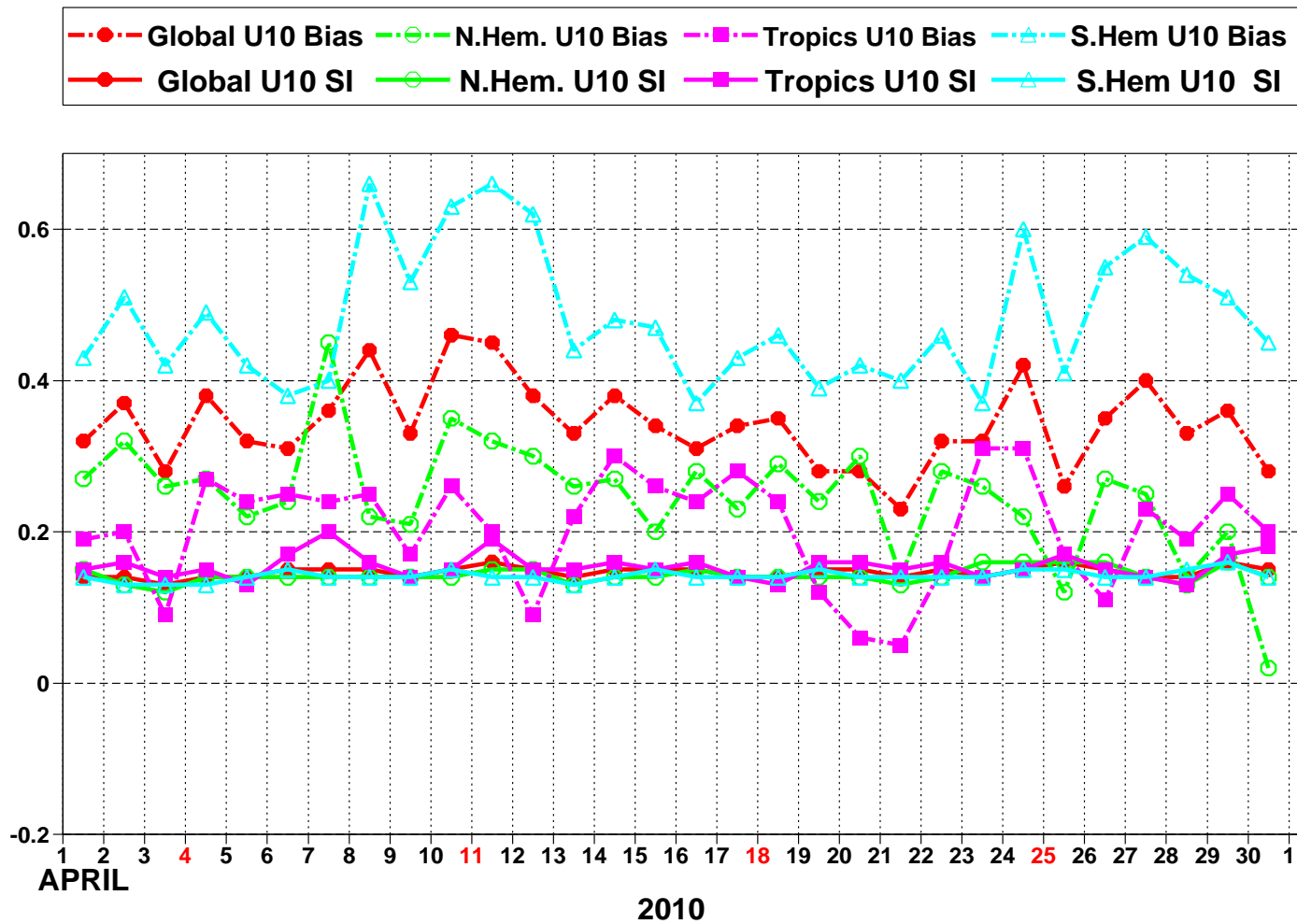


Figure 14: ENVISAT Altimeter wind speeds: Timeseries of bias (ENVISAT - ECMWF) and scatter index (SI)

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

■ ECMWF Report on ENVISAT RA-2 for April 2010 ■

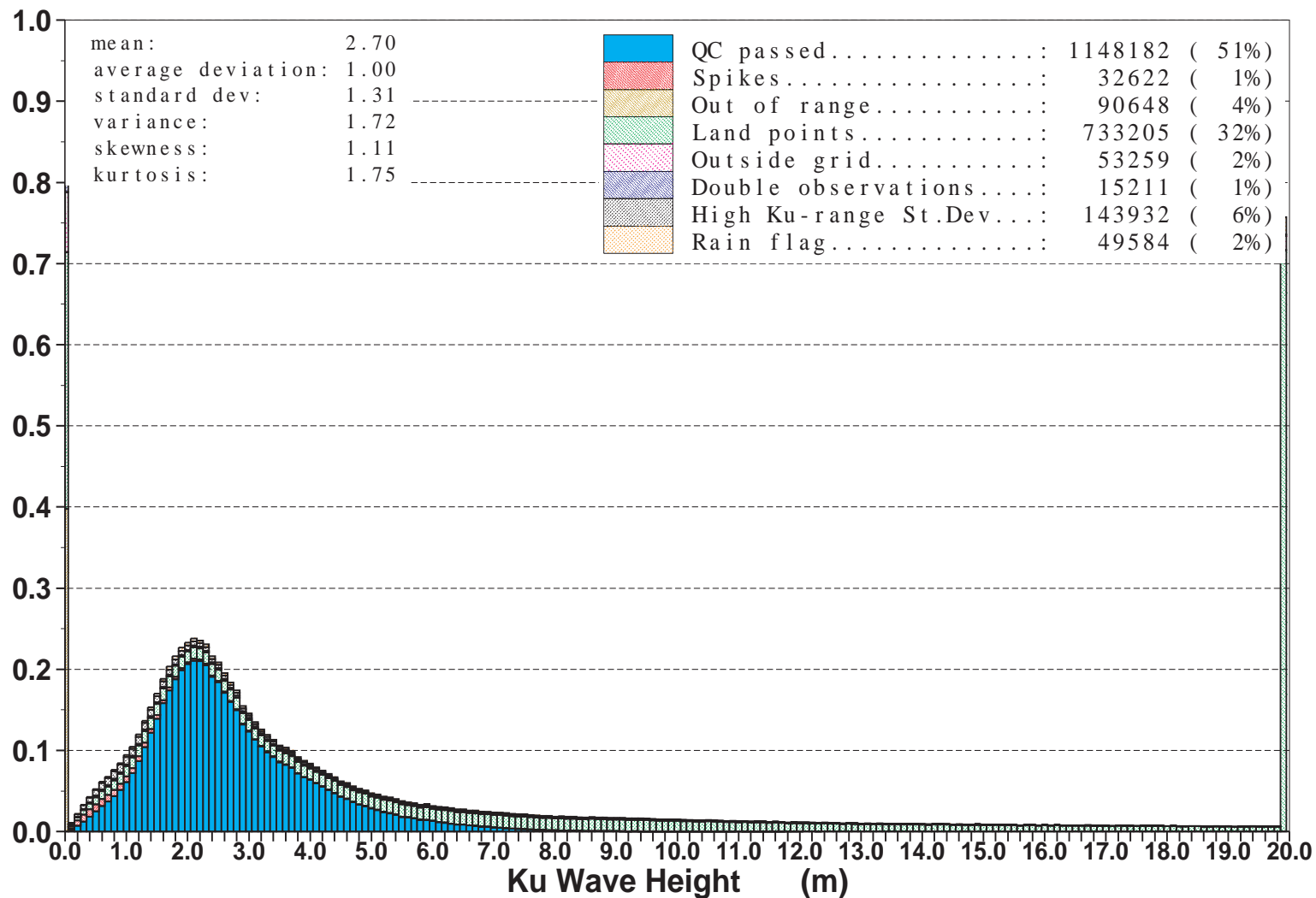


Figure 15: Distribution of the ENVISAT Altimeter Ku Wave Height after QC for April 2010

■
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 ENVISAT RA-2 for April 2010 ■

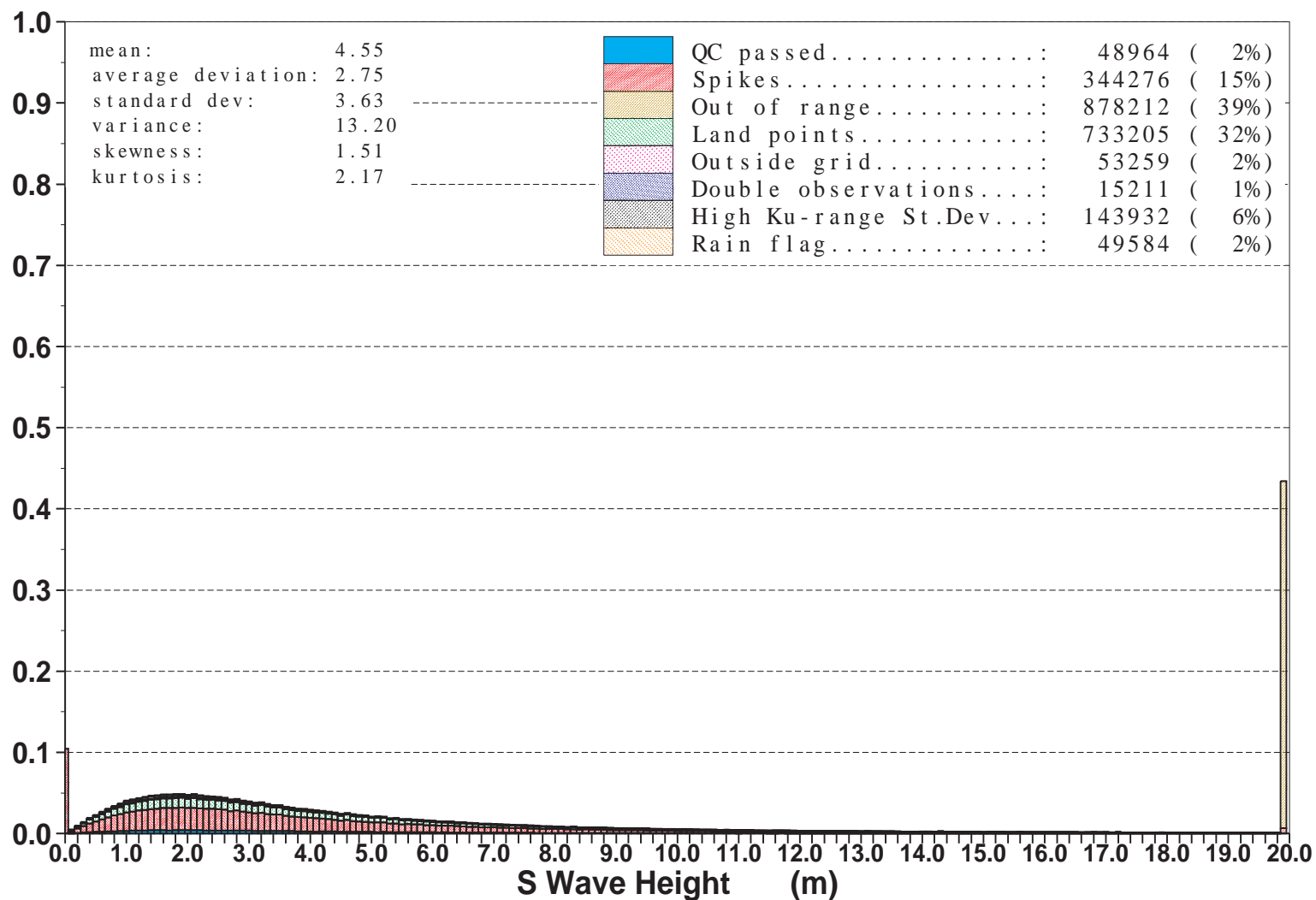


Figure 16: Distribution of the ENVISAT Altimeter S Wave Height after QC for April 2010

■
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 ENVISAT RA-2 for April 2010 ■

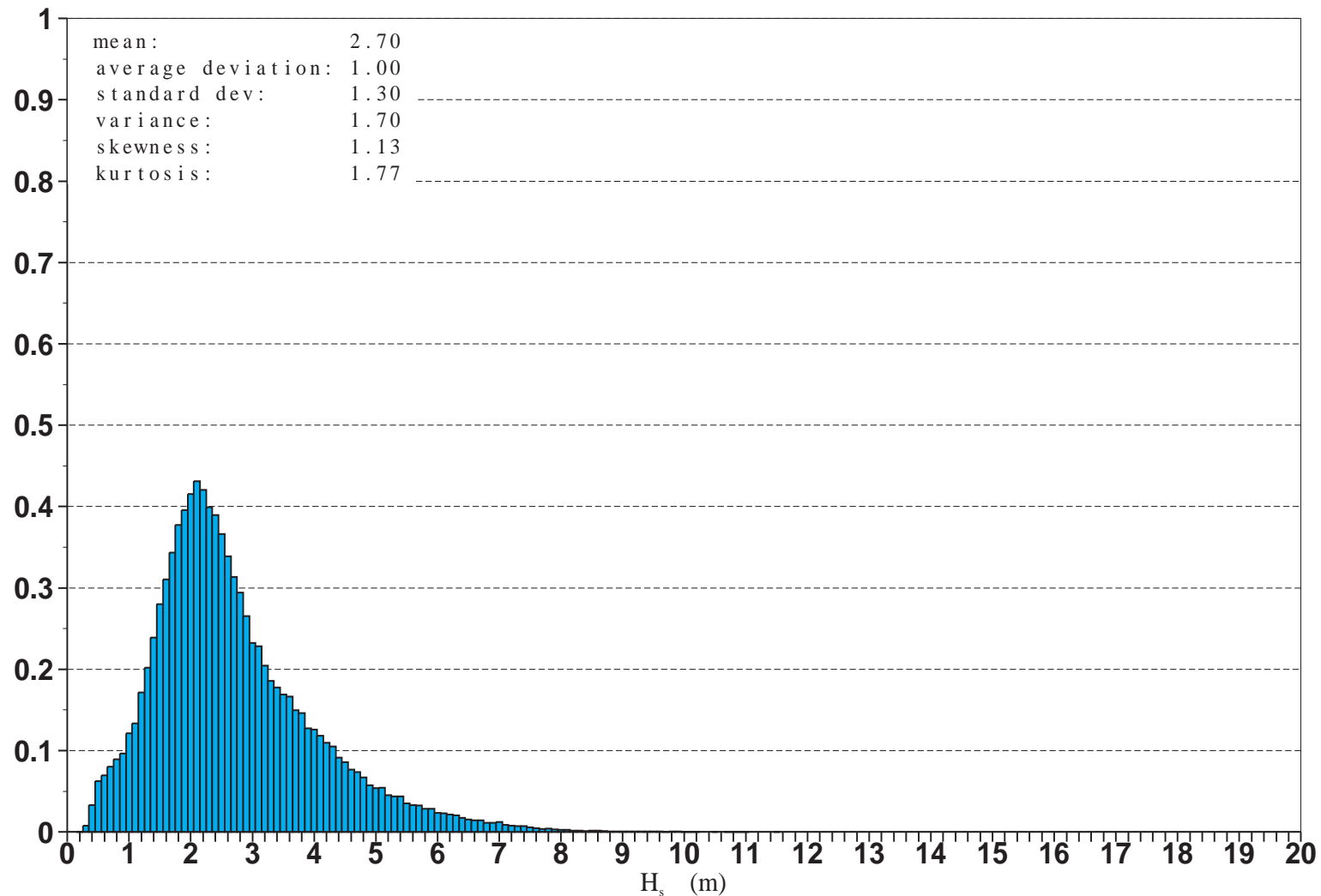


Figure 17: Distribution of ENVISAT Altimeter Ku-Band Wave Heights after Along-Track Averaging for April 2010

■
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 ENVISAT RA-2 for April 2010 ■

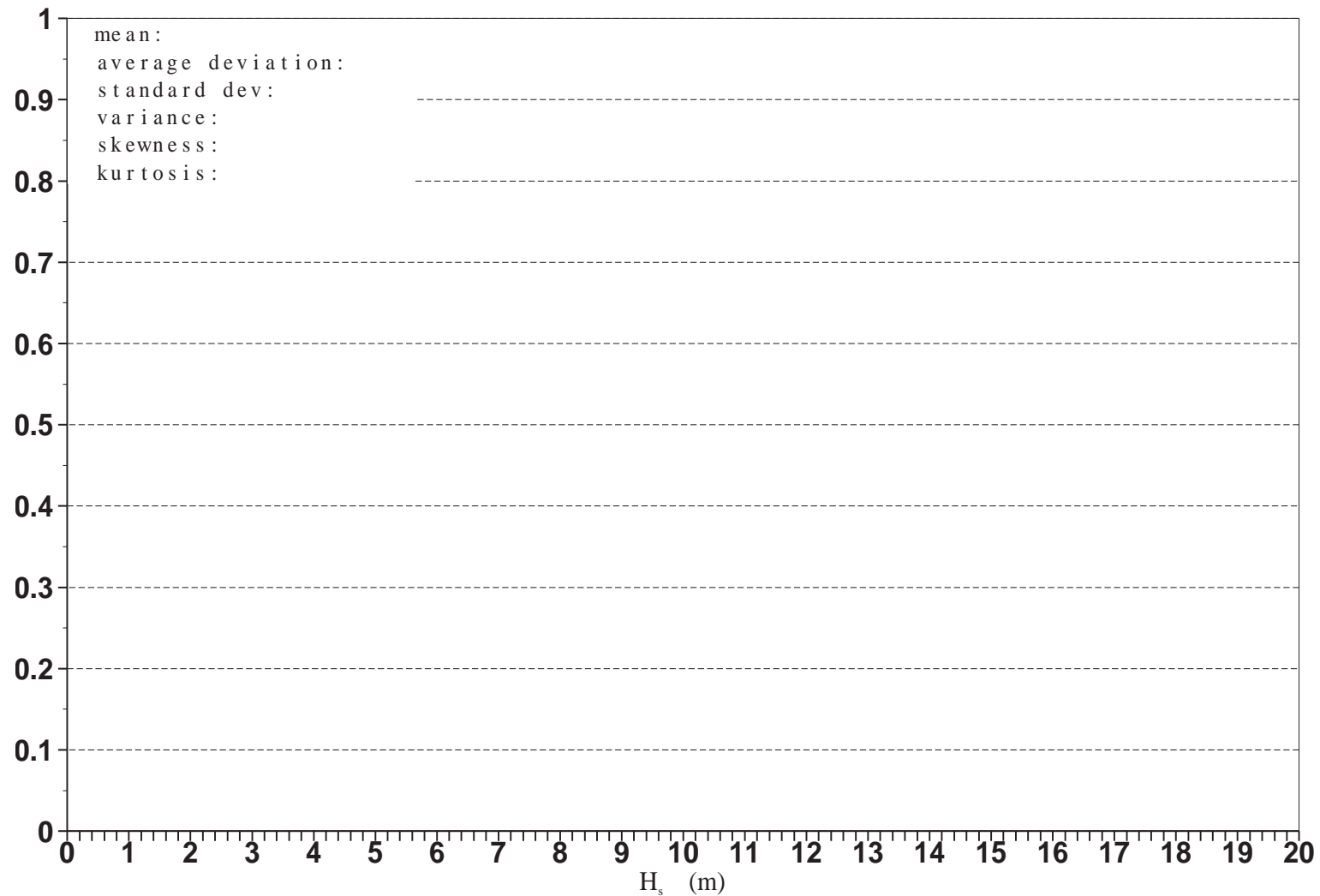
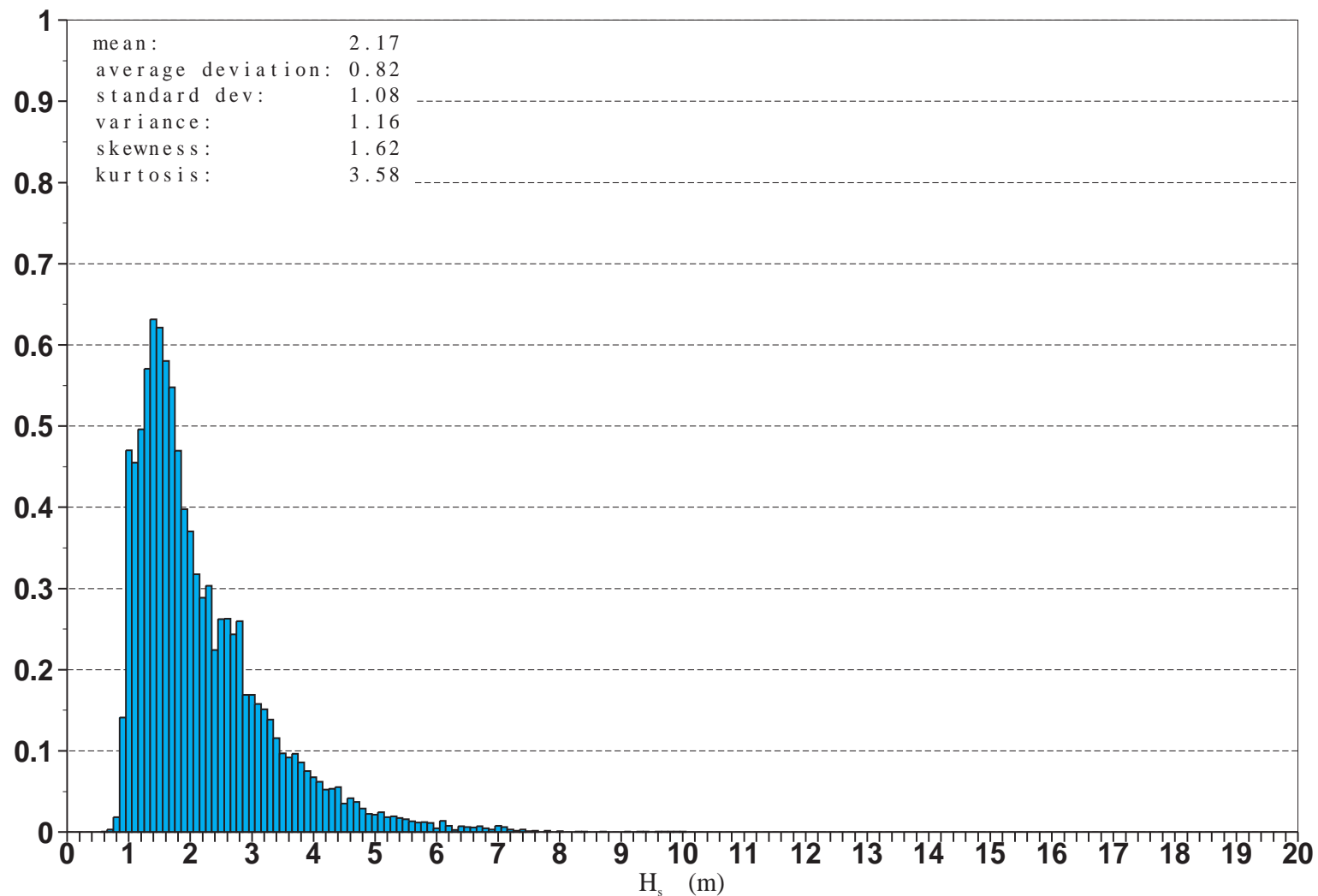


Figure 18: Distribution of ENVISAT Altimeter S-Band Wave Heights after Along-Track Averaging for April 2010

■
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

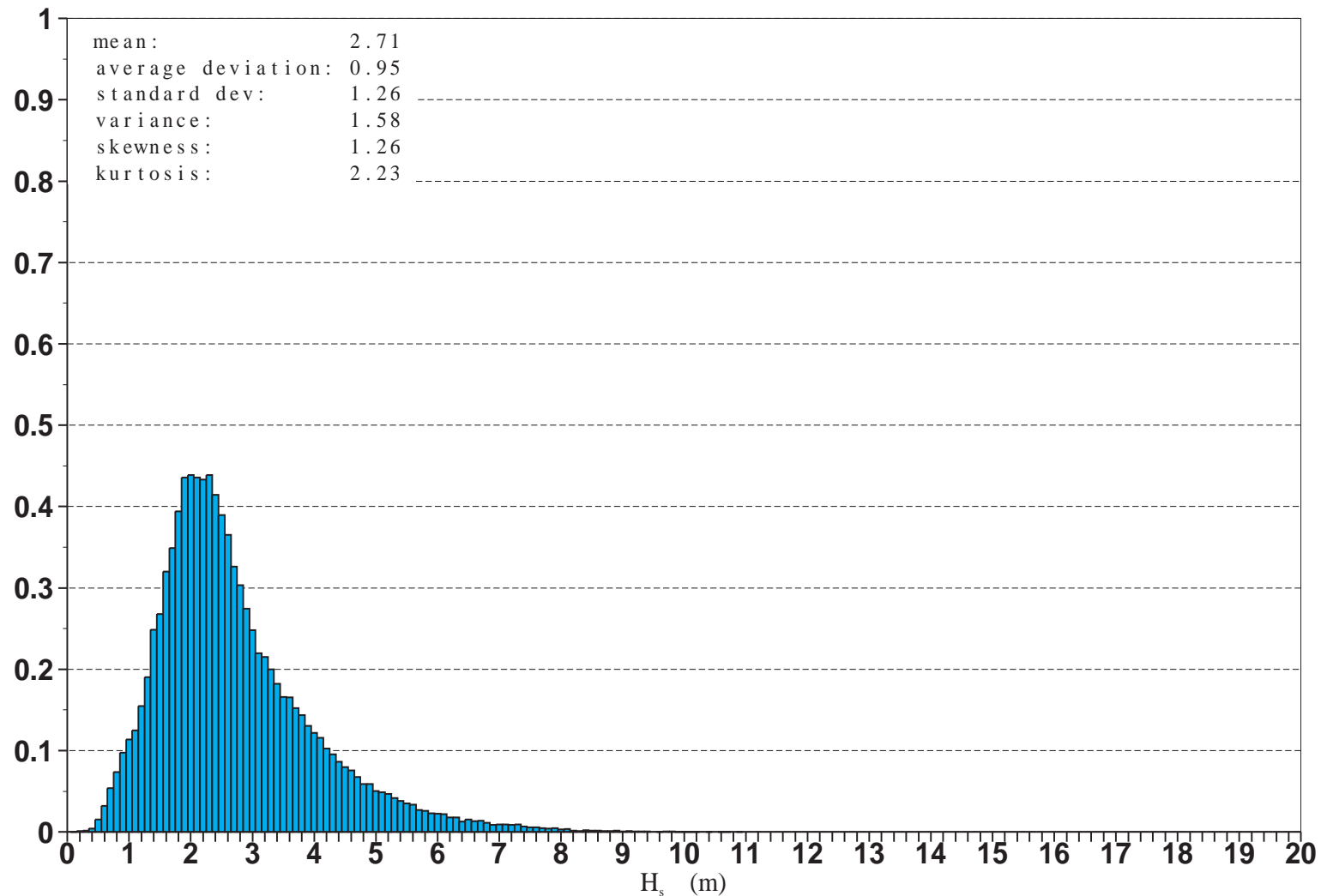
■ ECMWF Report on ENVISAT RA-2 for April 2010 ■



■
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 ENVISAT RA-2 for April 2010 ■



■
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 ENVISAT RA-2 for April 2010 ■

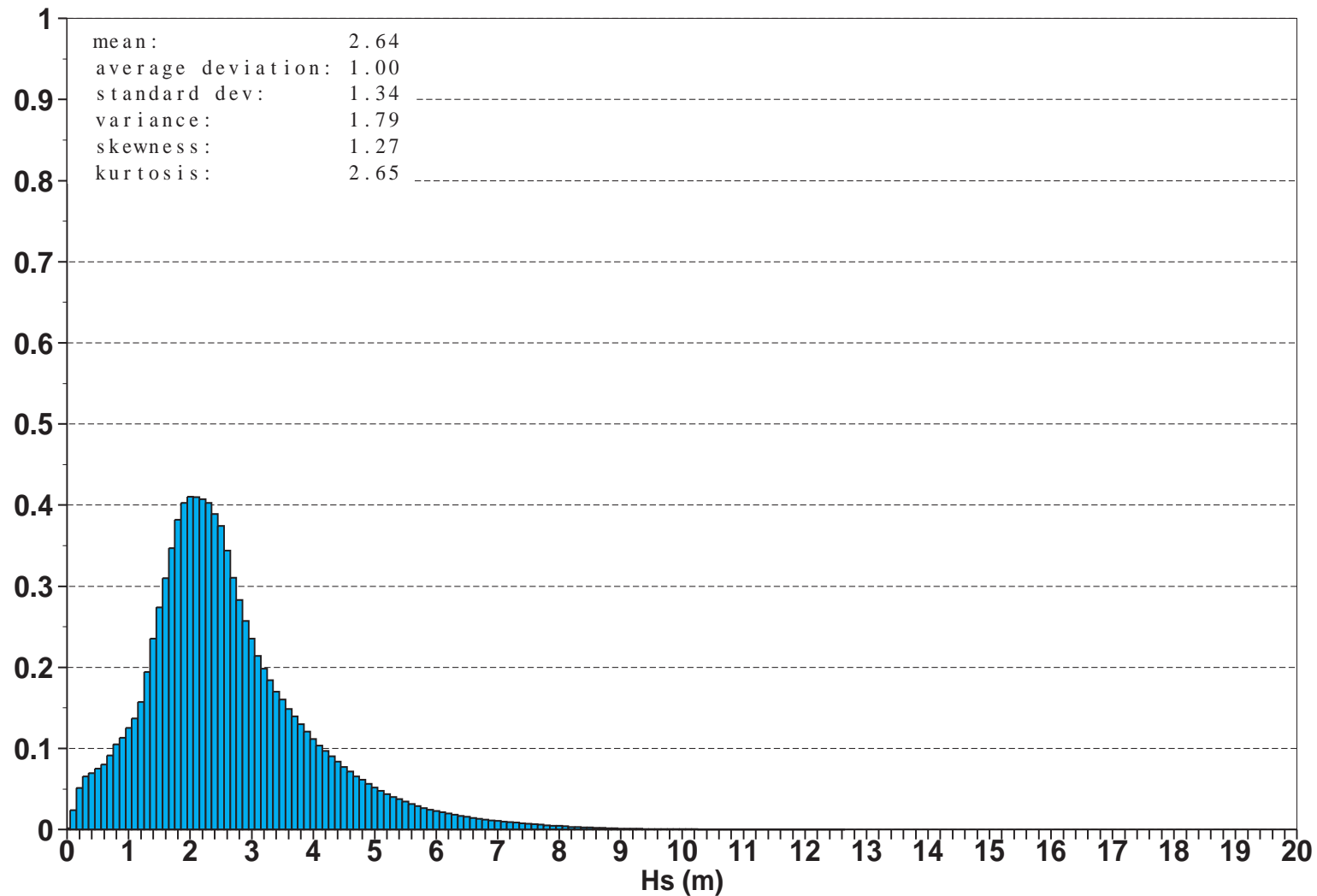


Figure 20: Global distribution of ECMWF First-Guess wave heights for April 2010

■
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 ENVISAT RA-2 for April 2010 ■

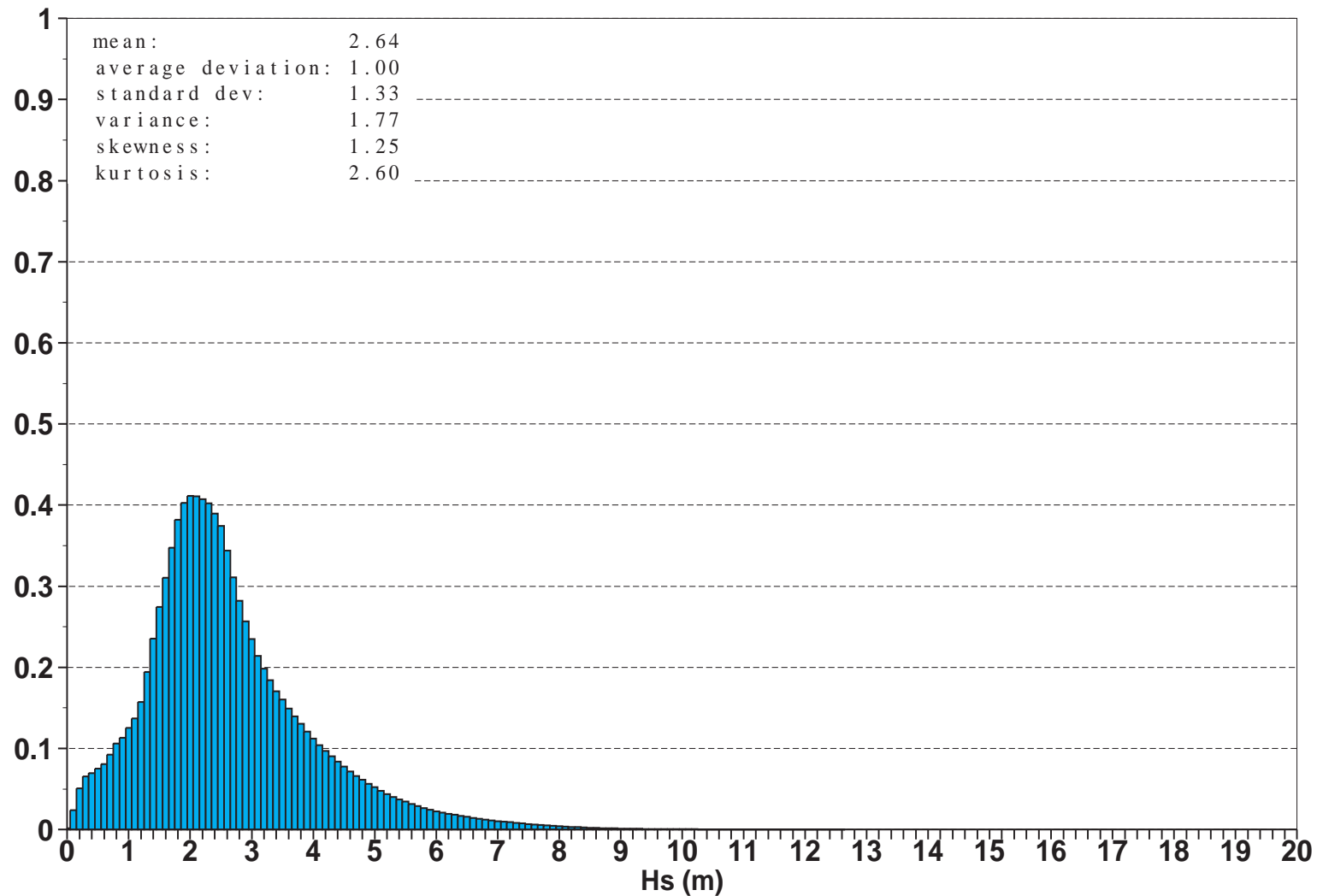


Figure 21: Global distribution of ECMWF Analysis wave heights for April 2010

■
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 ENVISAT RA-2 for April 2010 ■

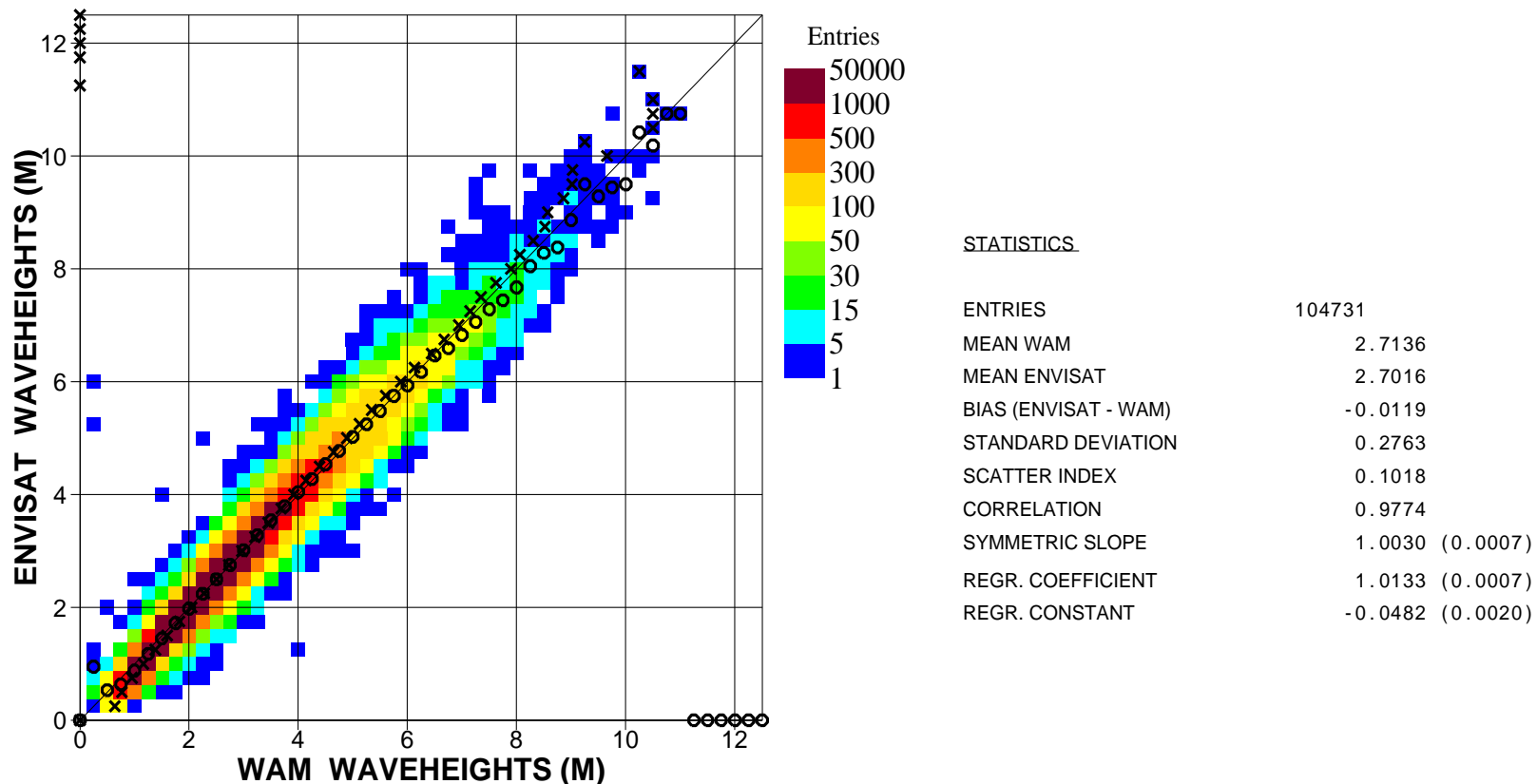


Figure 22. Comparison between ENVISAT Altimeter Ku-Band and WAM (first guess) significant wave heights for April 2010 (Global)

■
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

■ ECMWF Report on ENVISAT RA-2 for April 2010 ■

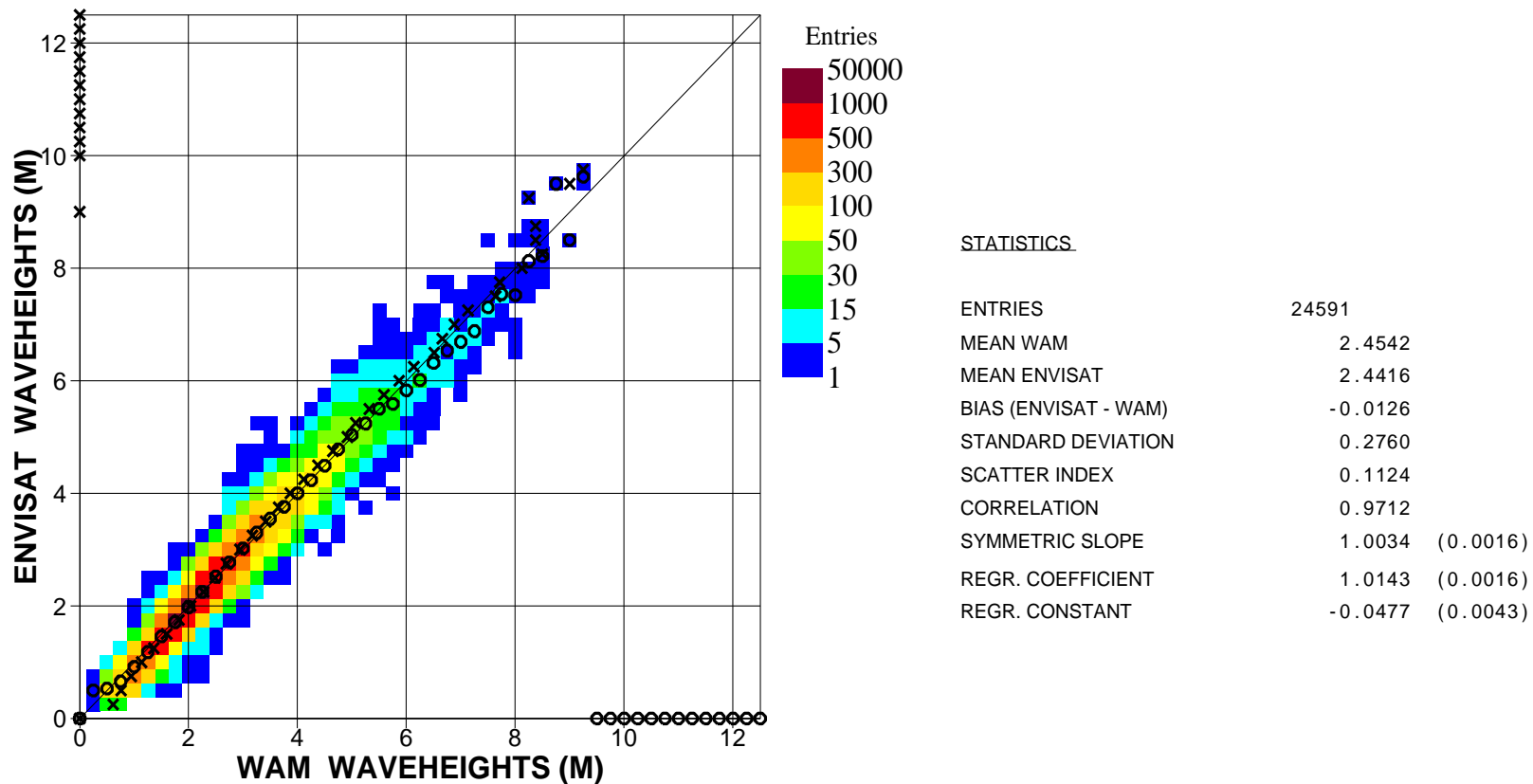


Figure 23. Comparison between ENVISAT Altimeter Ku-Band and WAM (first guess) significant wave heights for April 2010 (N.Hem.)

■
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

■ ECMWF Report on ENVISAT RA-2 for April 2010 ■

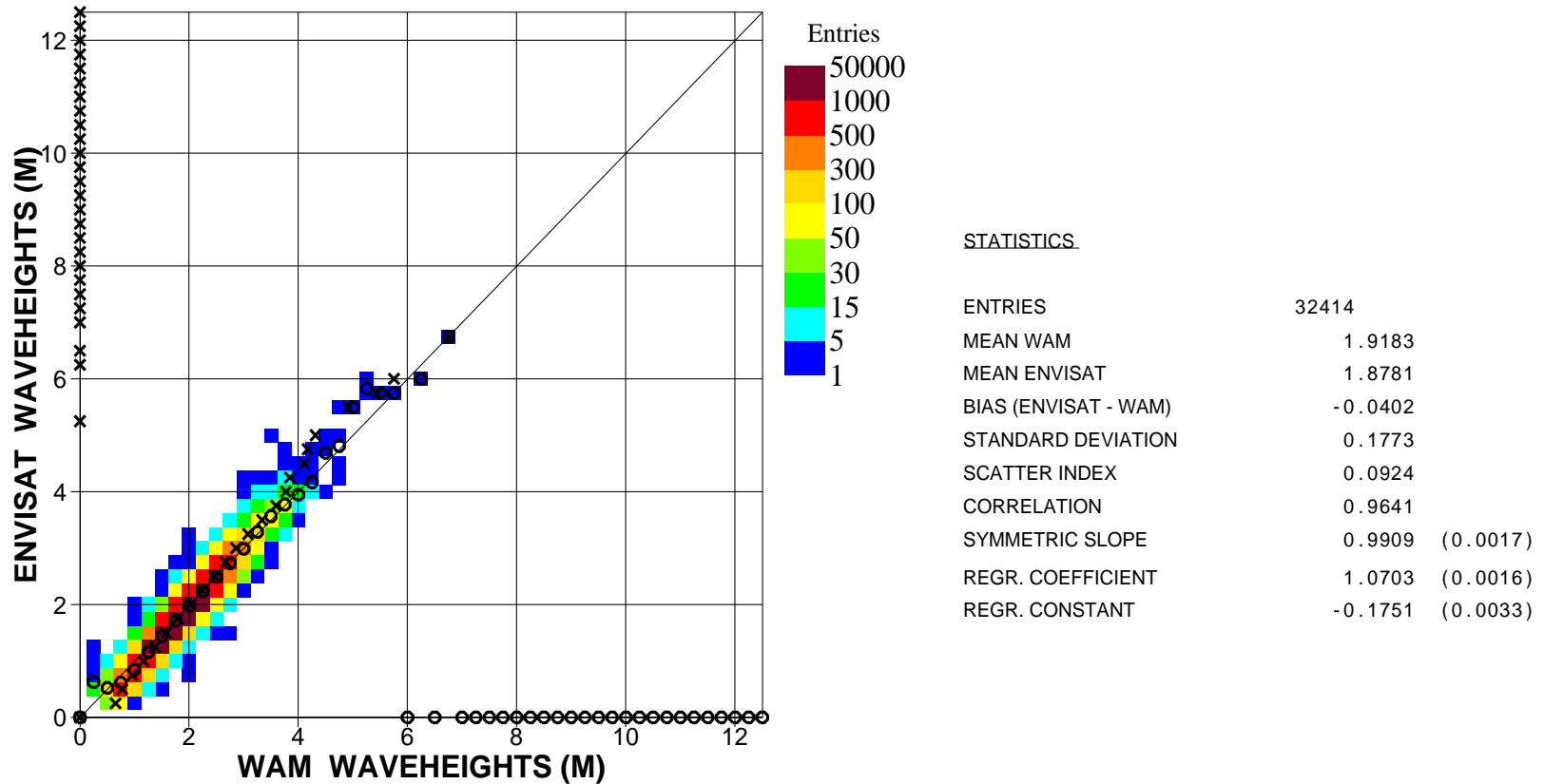


Figure 24. Comparison between ENVISAT Altimeter Ku-Band and WAM (first guess) significant wave heights for April 2010 (Tropics)

■
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

■ ECMWF Report on ENVISAT RA-2 for April 2010 ■

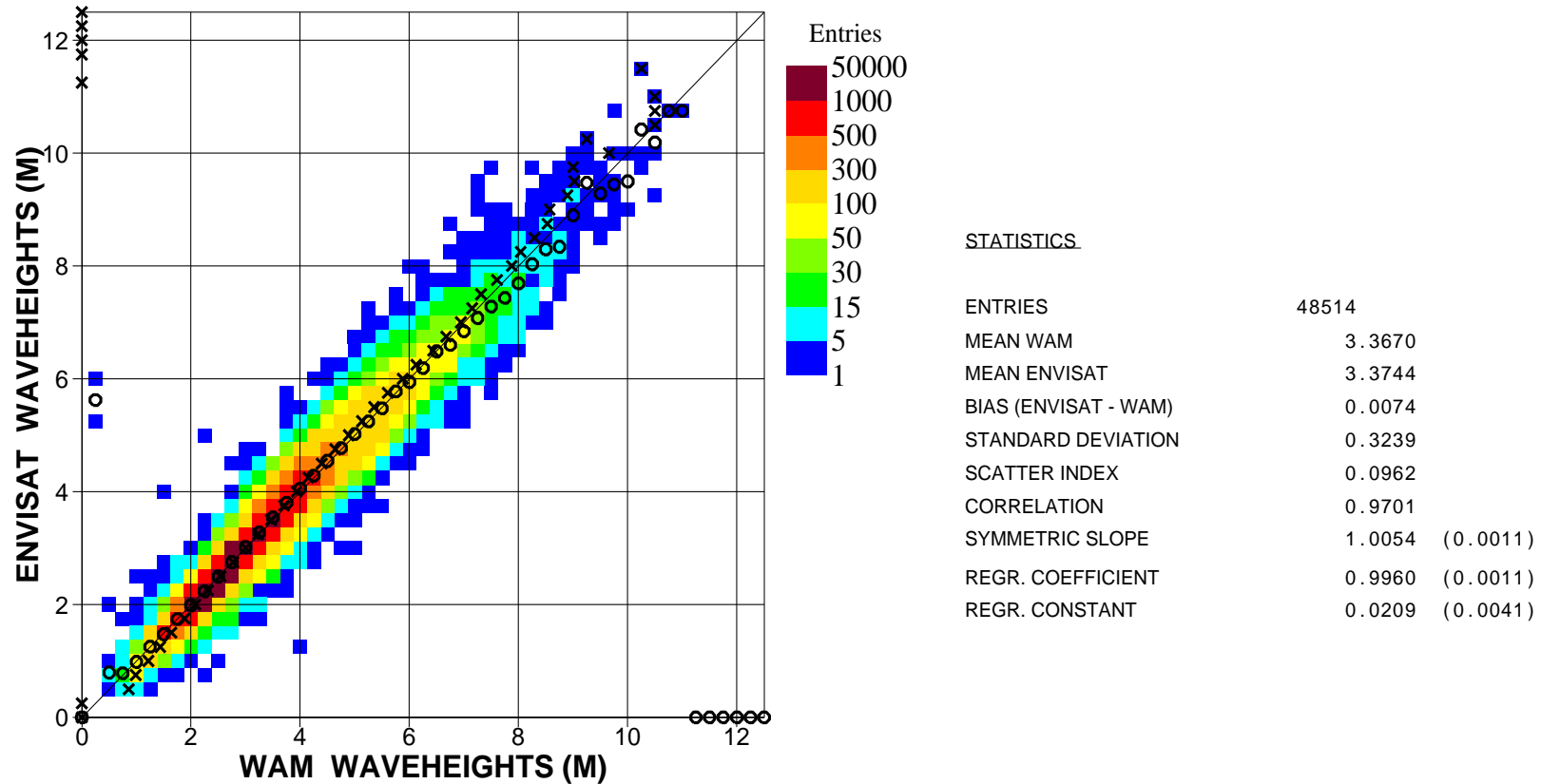


Figure 25. Comparison between ENVISAT Altimeter Ku-Band and WAM (first guess) significant wave heights for April 2010 (S.Hem.)

■
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

■ ECMWF Report on ENVISAT RA-2 for April 2010 ■

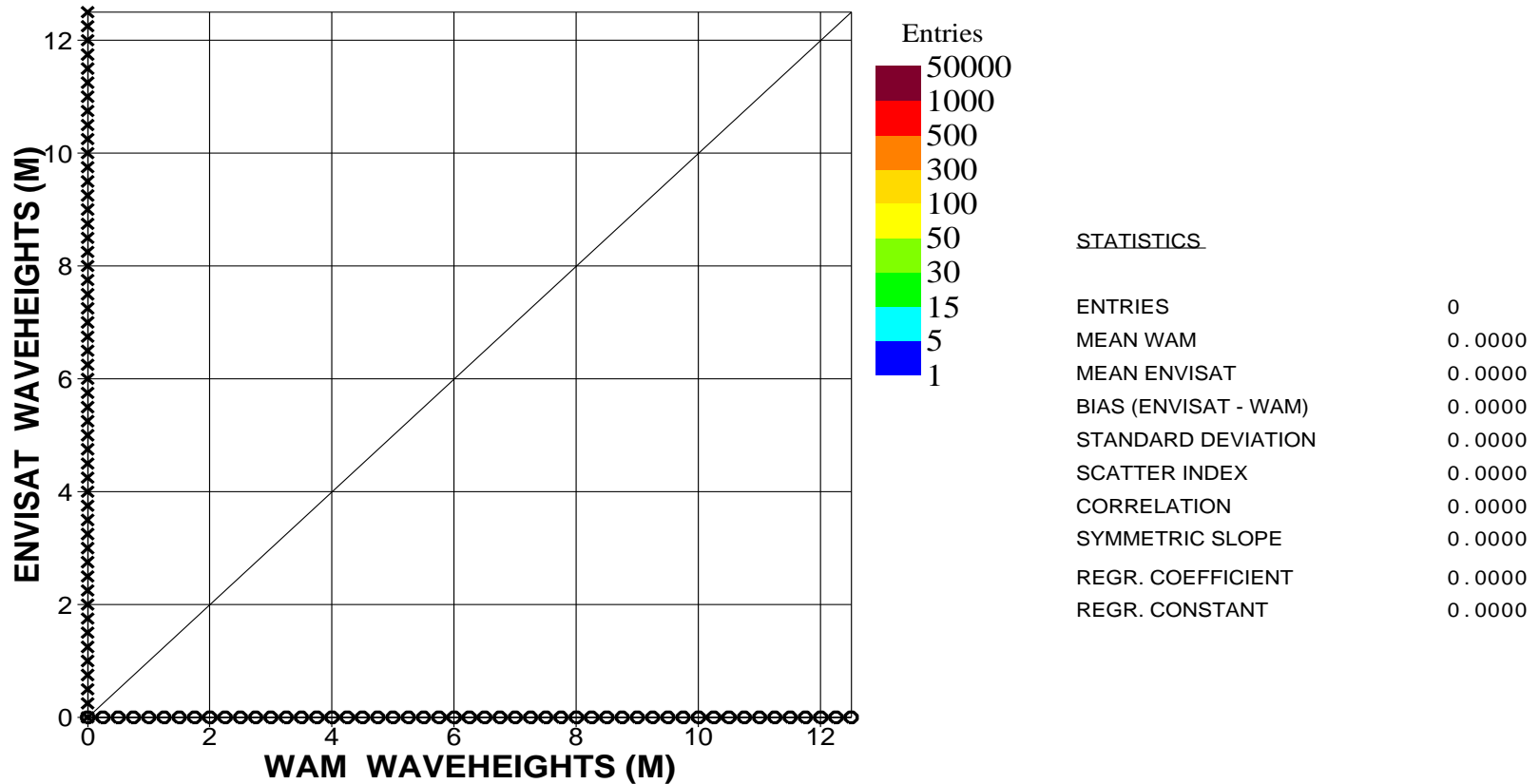


Figure 26. Comparison between ENVISAT Altimeter S-Band and WAM (first guess) significant wave heights for April 2010 (Global)

■
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

■ ECMWF Report on ENVISAT RA-2 for April 2010 ■

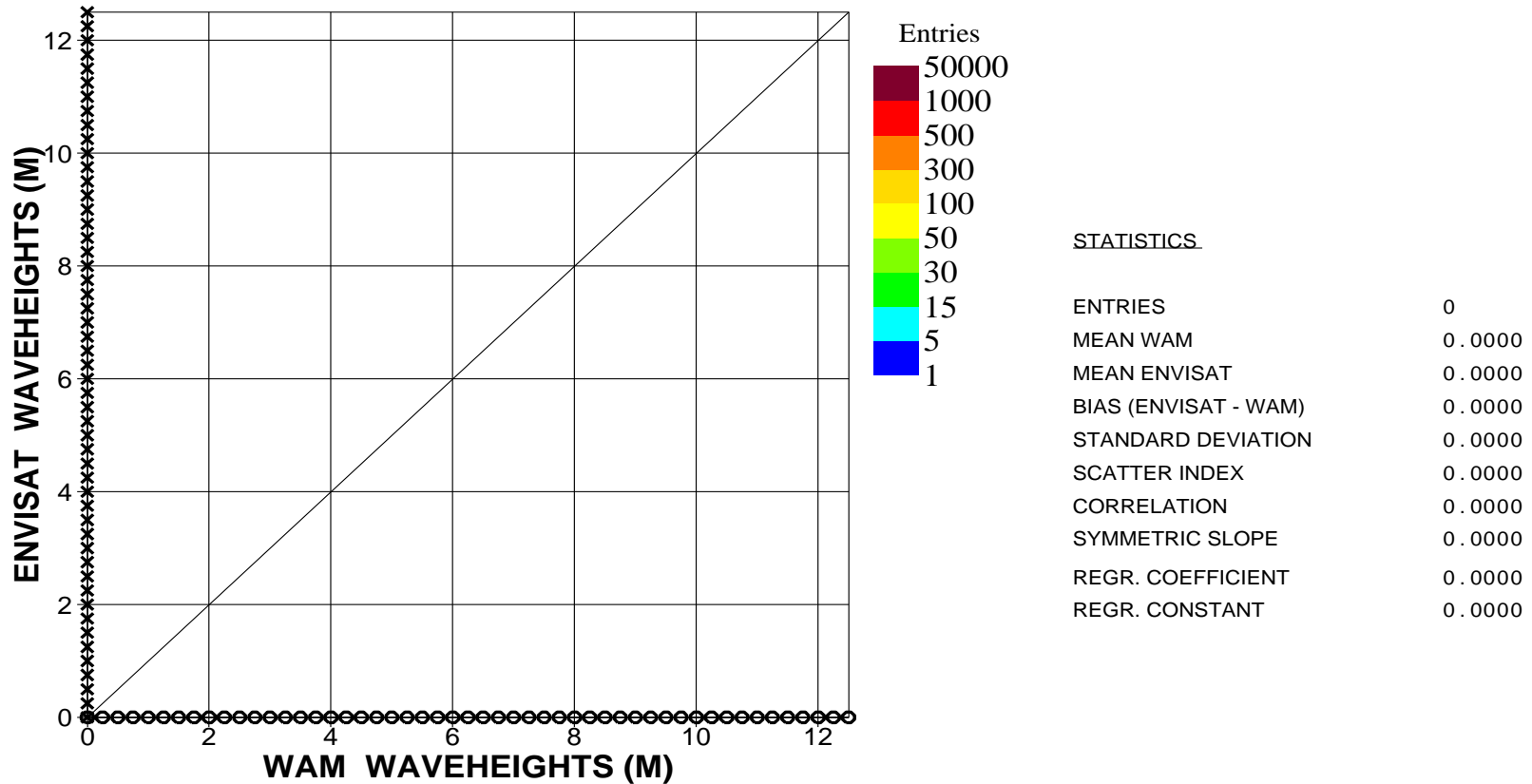


Figure 27. Comparison between ENVISAT Altimeter S-Band and WAM (first guess) significant wave heights for April 2010 (N.Hem.)

■
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

■ ECMWF Report on ENVISAT RA-2 for April 2010 ■

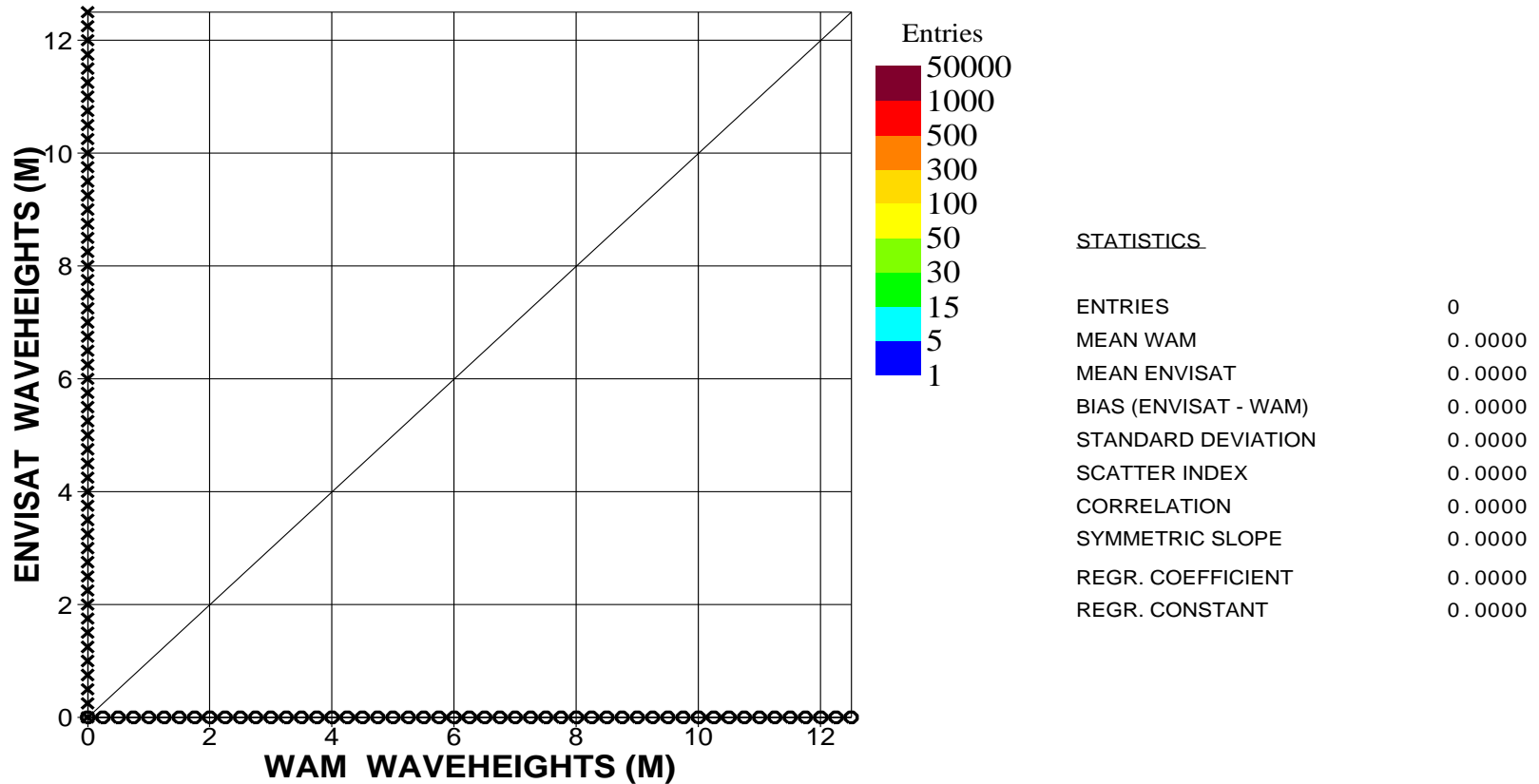


Figure 28. Comparison between ENVISAT Altimeter S-Band and WAM (first guess) significant wave heights for April 2010 (Tropics)

■
Saleh Abdalla

■ ECMWF Report on ENVISAT RA-2 for April 2010 ■

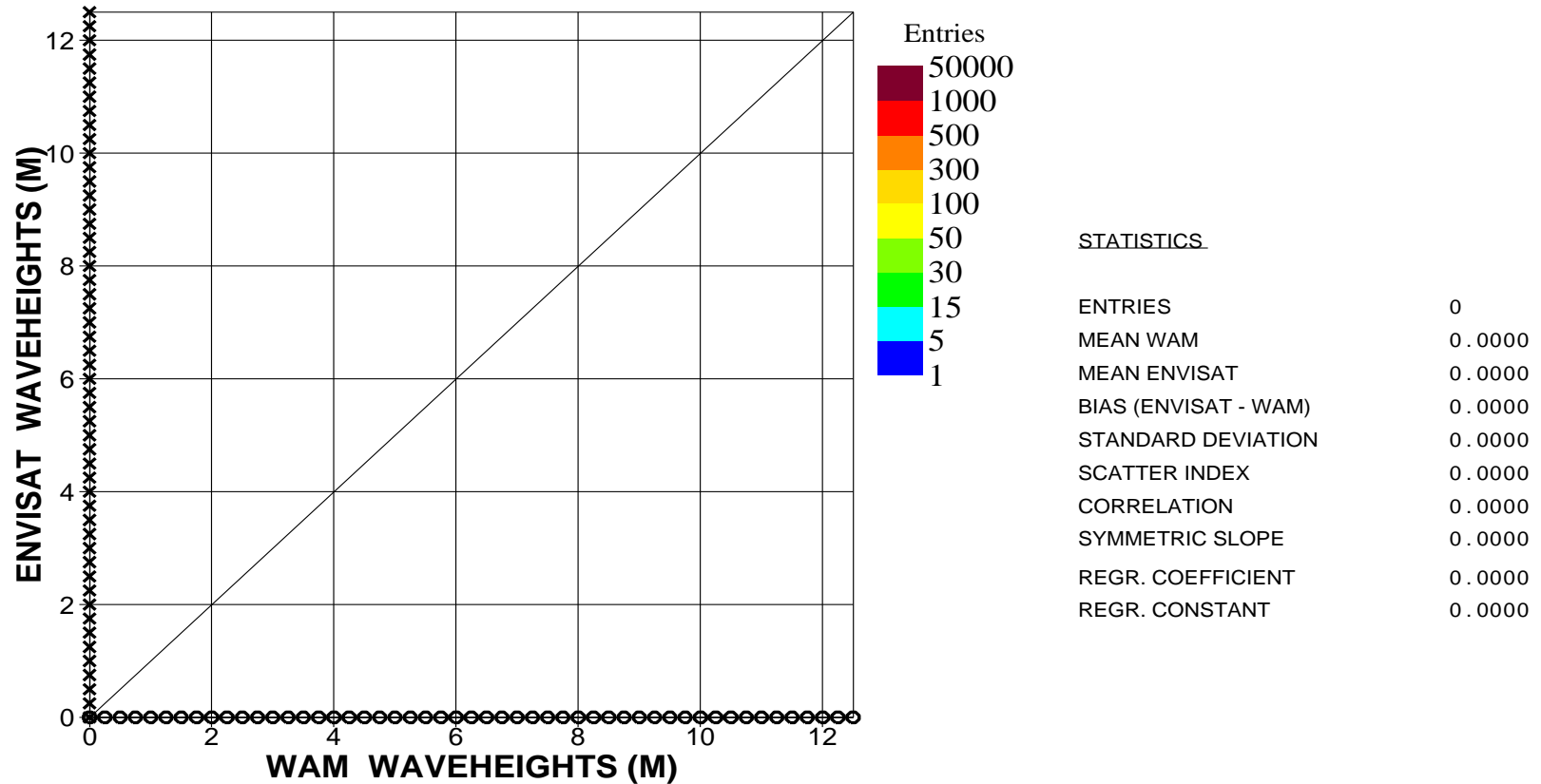


Figure 29. Comparison between ENVISAT Altimeter S-Band and WAM (first guess) significant wave heights for April 2010 (S.Hem.)

■
Saleh Abdalla

■ ECMWF Report on ENVISAT RA-2 for April 2010 ■

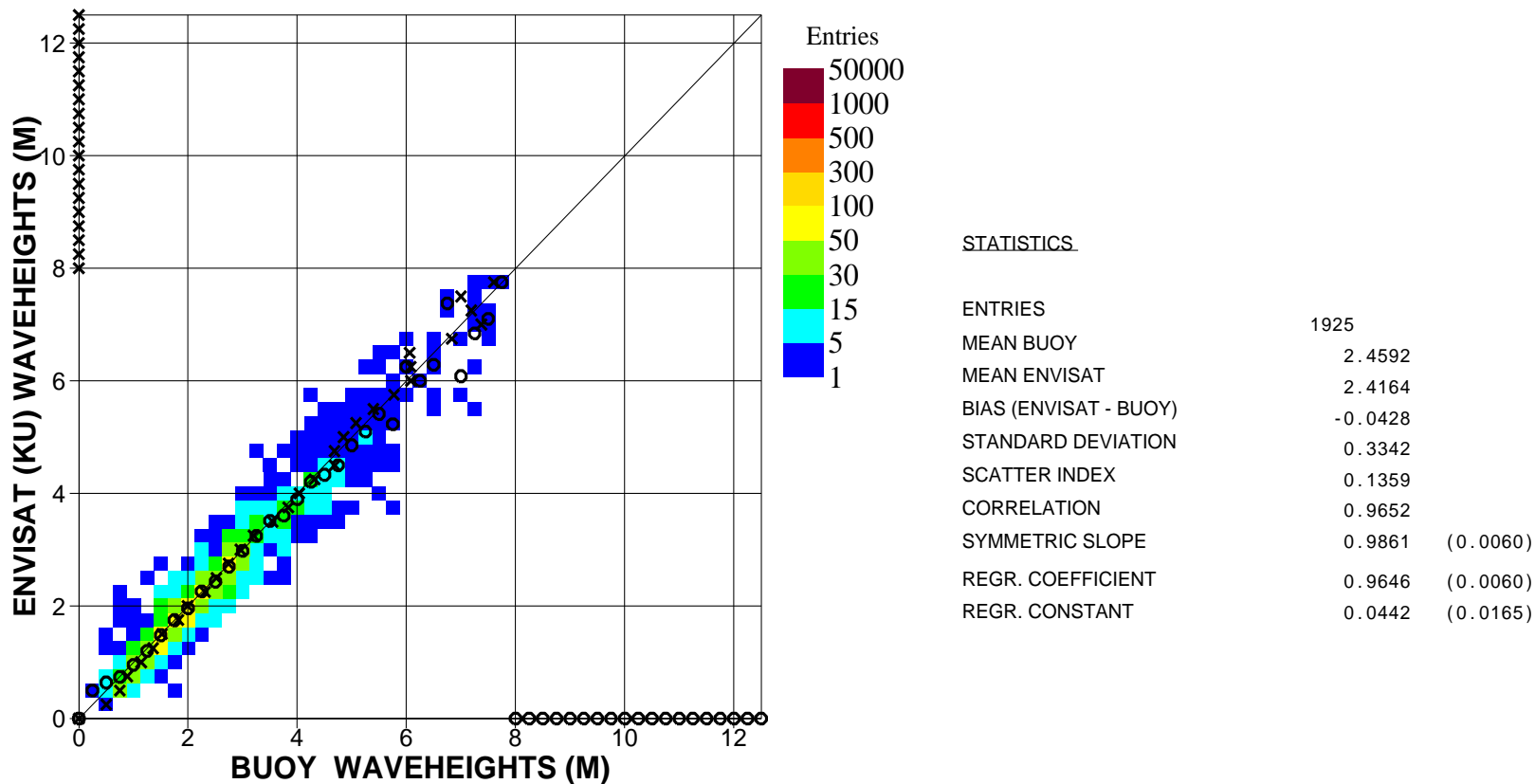


Figure 30. Comparison between ENVISAT Altimeter Ku-Band and buoy significant wave heights for April 2010 (Global)

■
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

■ ECMWF Report on ENVISAT RA-2 for April 2010 ■

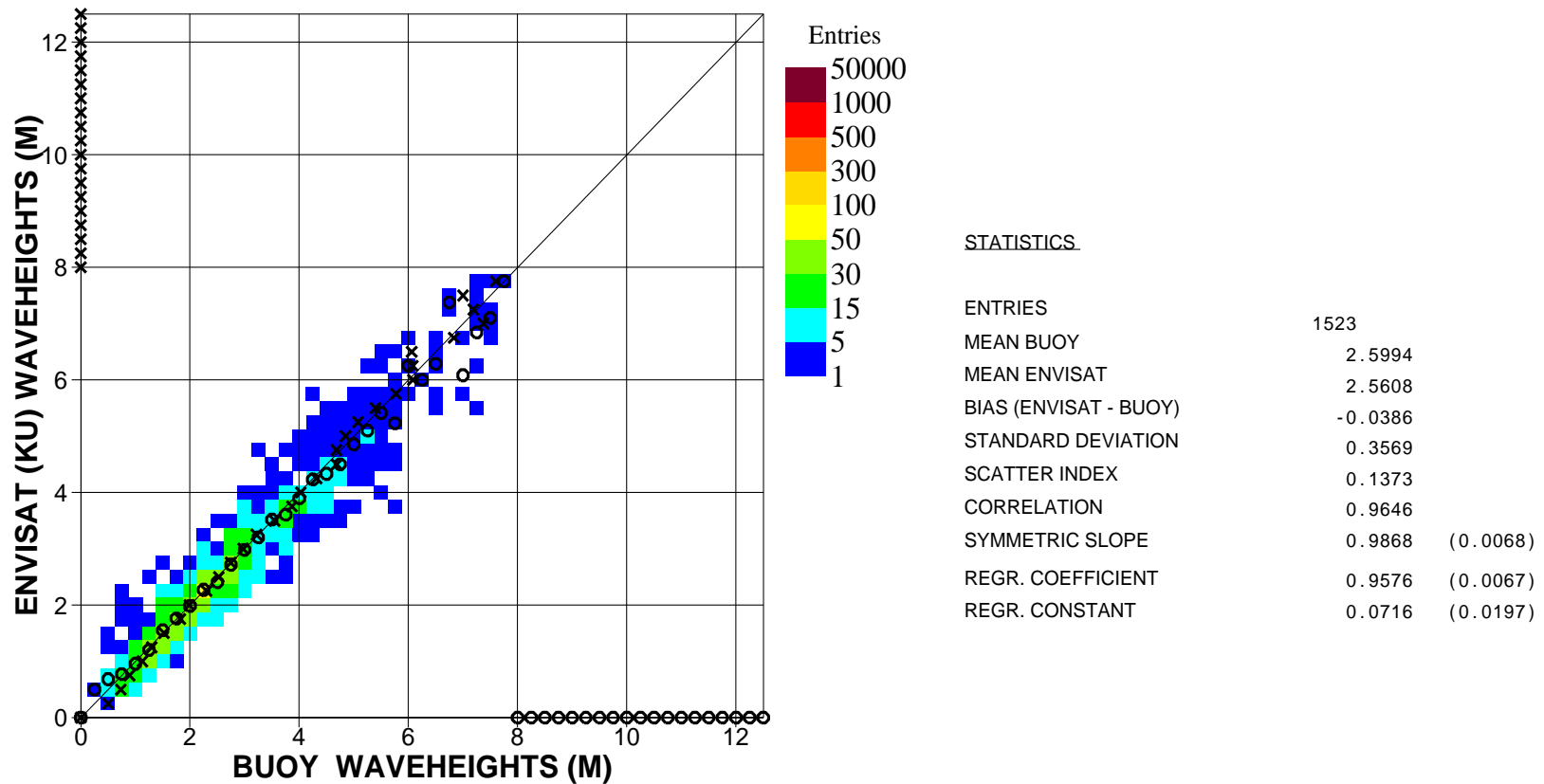


Figure 31. Comparison between ENVISAT Altimeter Ku-Band and buoy significant wave heights for April 2010 (N.Hem.)

■
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

■ ECMWF Report on ENVISAT RA-2 for April 2010 ■

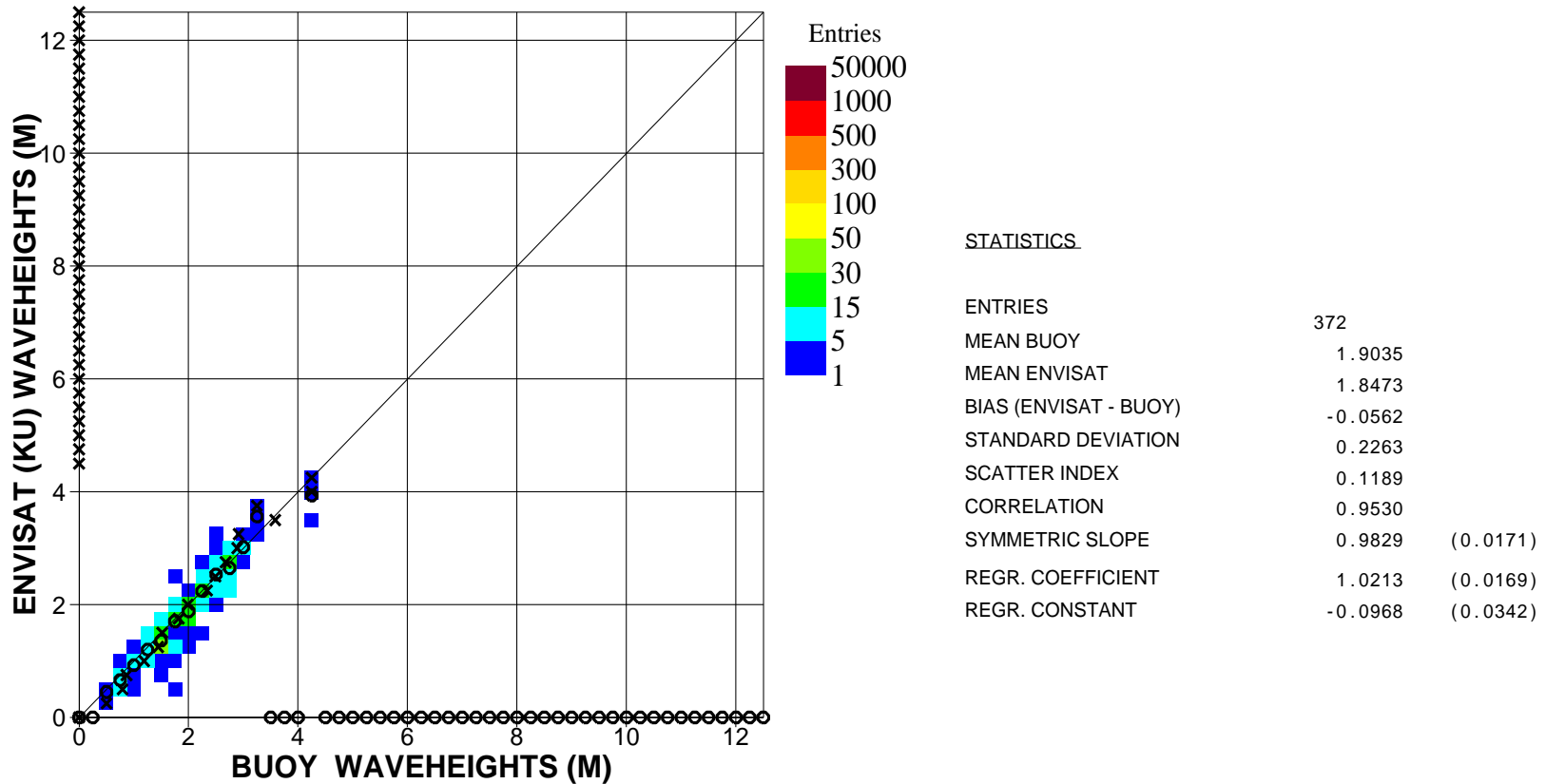


Figure 32. Comparison between ENVISAT Altimeter Ku-Band and buoy significant wave heights for April 2010 (Tropics)

■
Saleh Abdalla

■ ECMWF Report on ENVISAT RA-2 for April 2010 ■

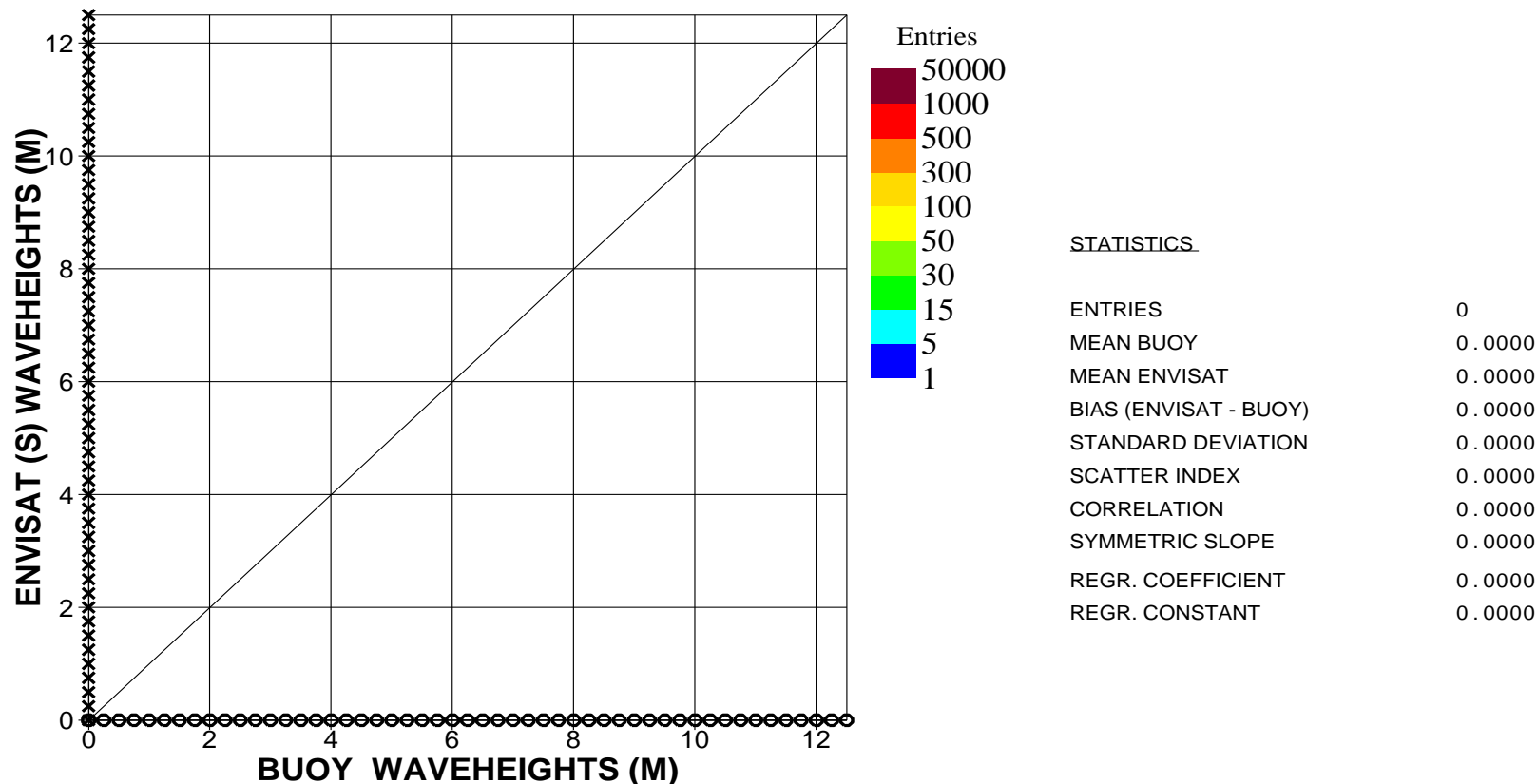


Figure 33. Comparison between ENVISAT Altimeter S-Band and buoy significant wave heights for April 2010 (Global)

■
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

■ ECMWF Report on ENVISAT RA-2 for April 2010 ■

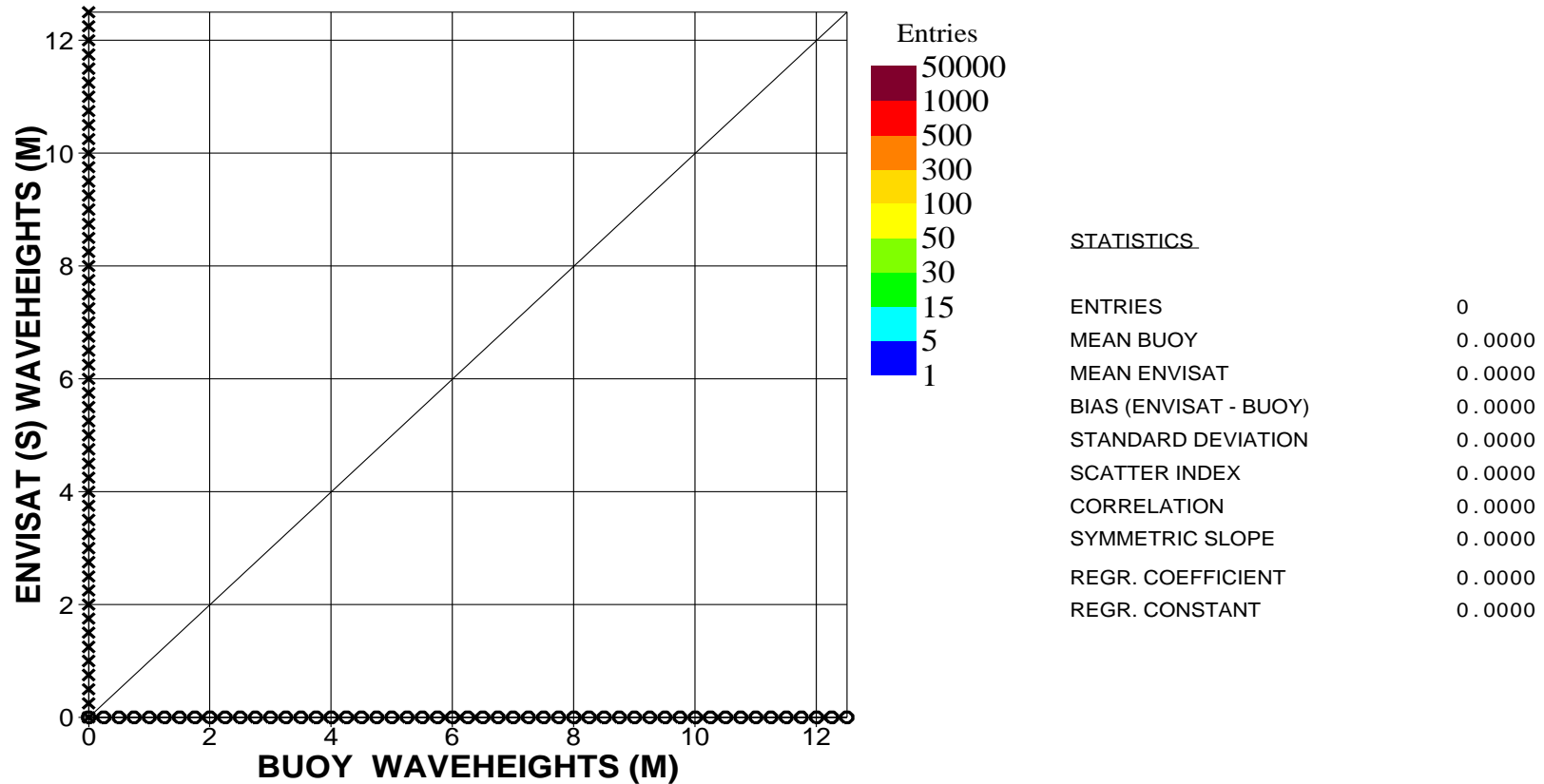


Figure 34. Comparison between ENVISAT Altimeter S-Band and buoy significant wave heights for April 2010 (N.Hem.)

■
Saleh Abdalla

■ ECMWF Report on ENVISAT RA-2 for April 2010 ■

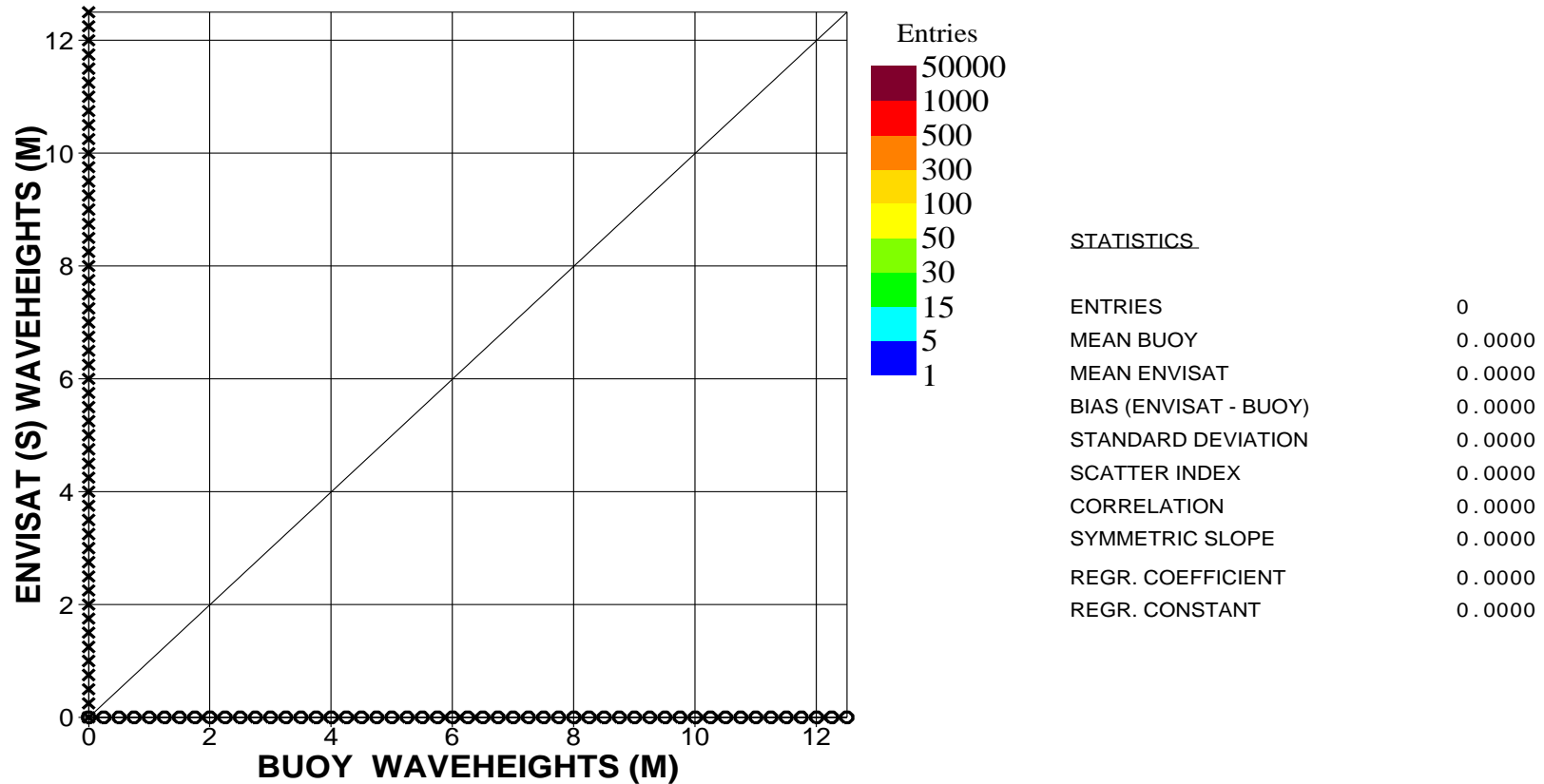


Figure 35. Comparison between ENVISAT Altimeter S-Band and buoy significant wave heights for April 2010 (Tropics)

■
Saleh Abdalla

ECMWF Report on ENVISAT RA-2 for April 2010

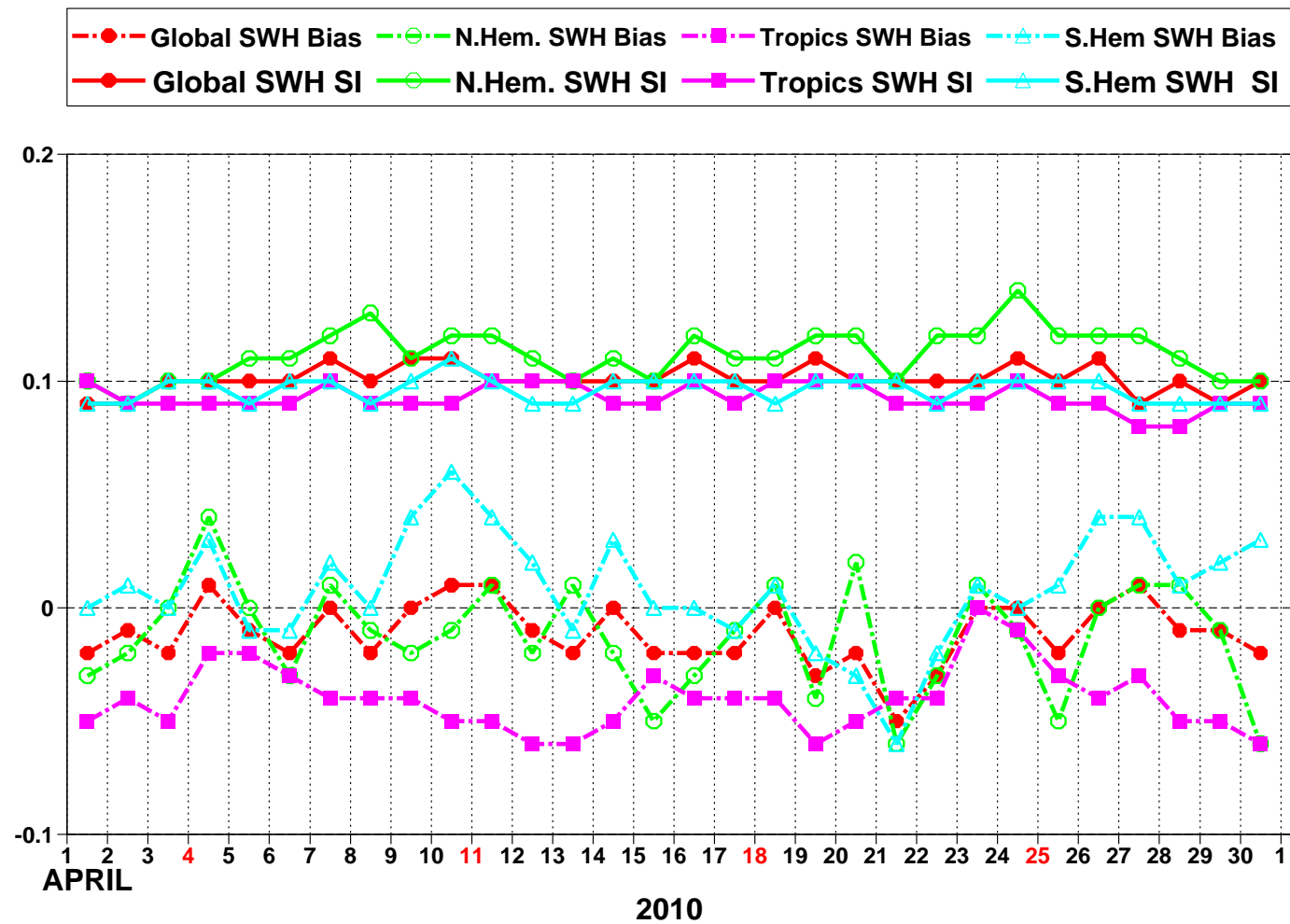


Figure 36: ENVISAT Altimeter Ku-band wave heights: Timeseries of bias (ENVISAT - WAM_FG) and scatter index (SI)

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

ECMWF Report on ENVISAT RA-2 for April 2010

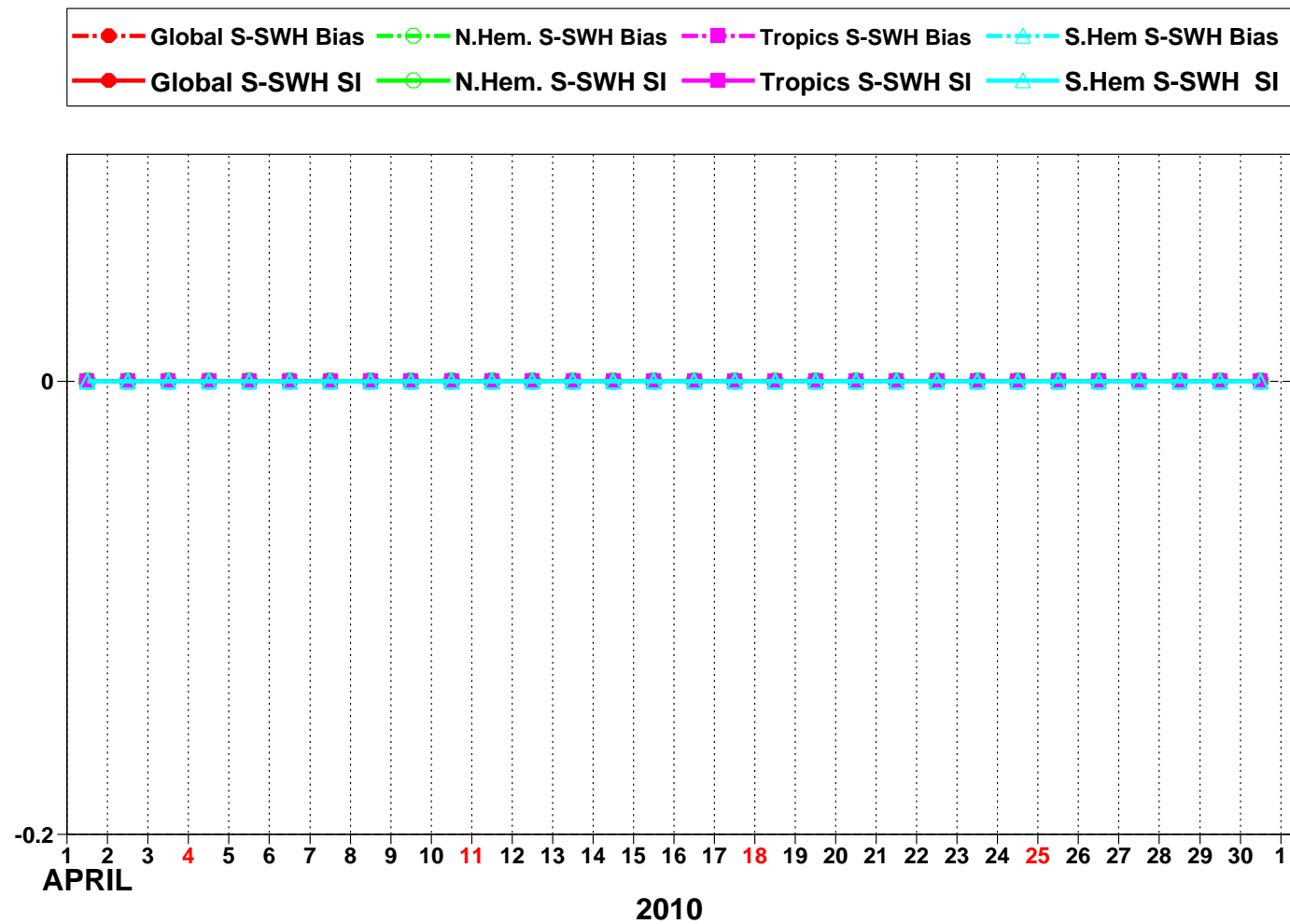


Figure 37: ENVISAT Altimeter S-band wave heights: Timeseries of bias (ENVISAT - WAM_FG) and scatter index (SI)

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

■ ECMWF Report on ENVISAT RA-2 for April 2010 ■

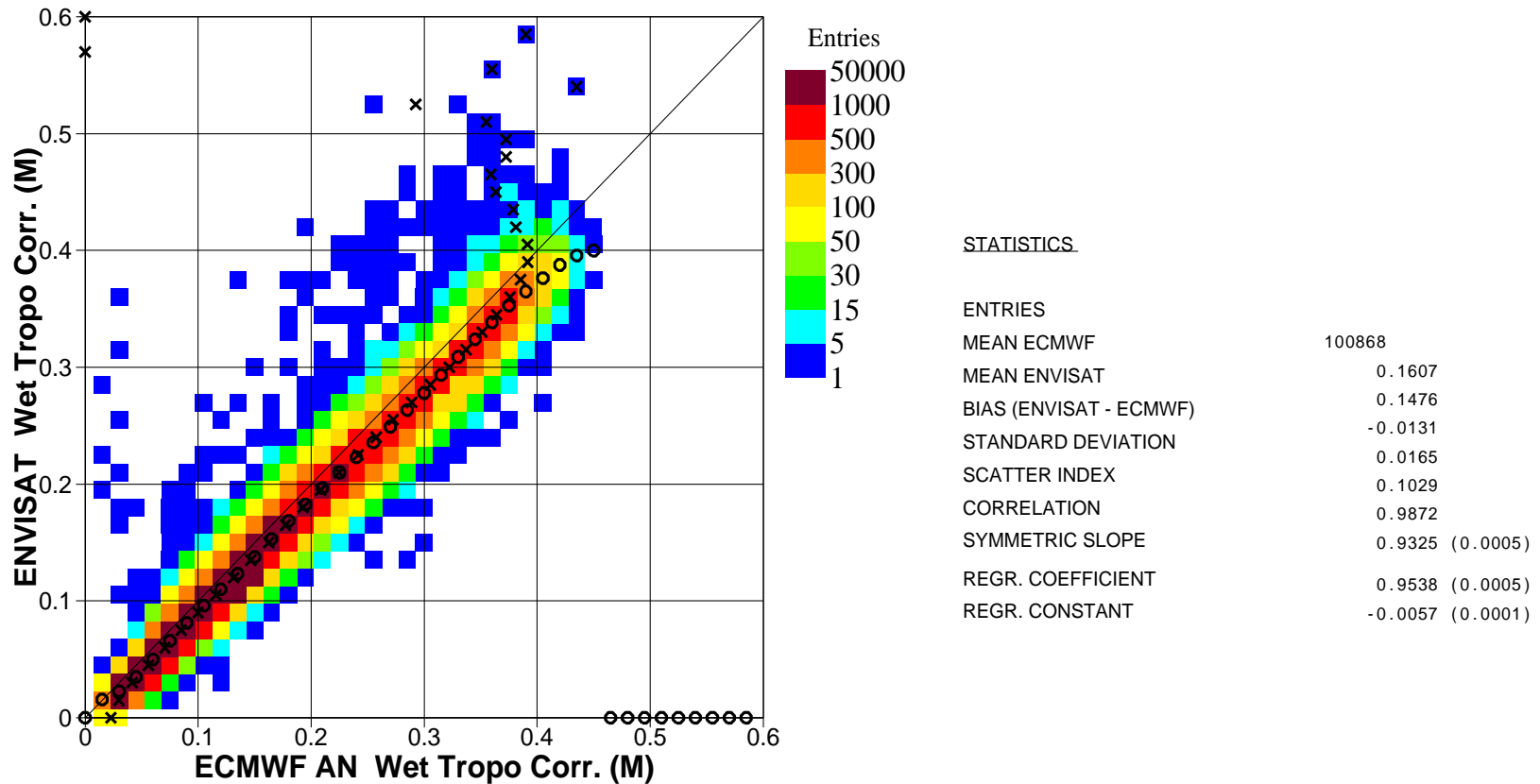


Figure 38. Comparison between ENVISAT MWR and ECMWF (analysis) wet tropo correction for April 2010 (Global)

■ ECMWF Report on ENVISAT RA-2 for April 2010 ■

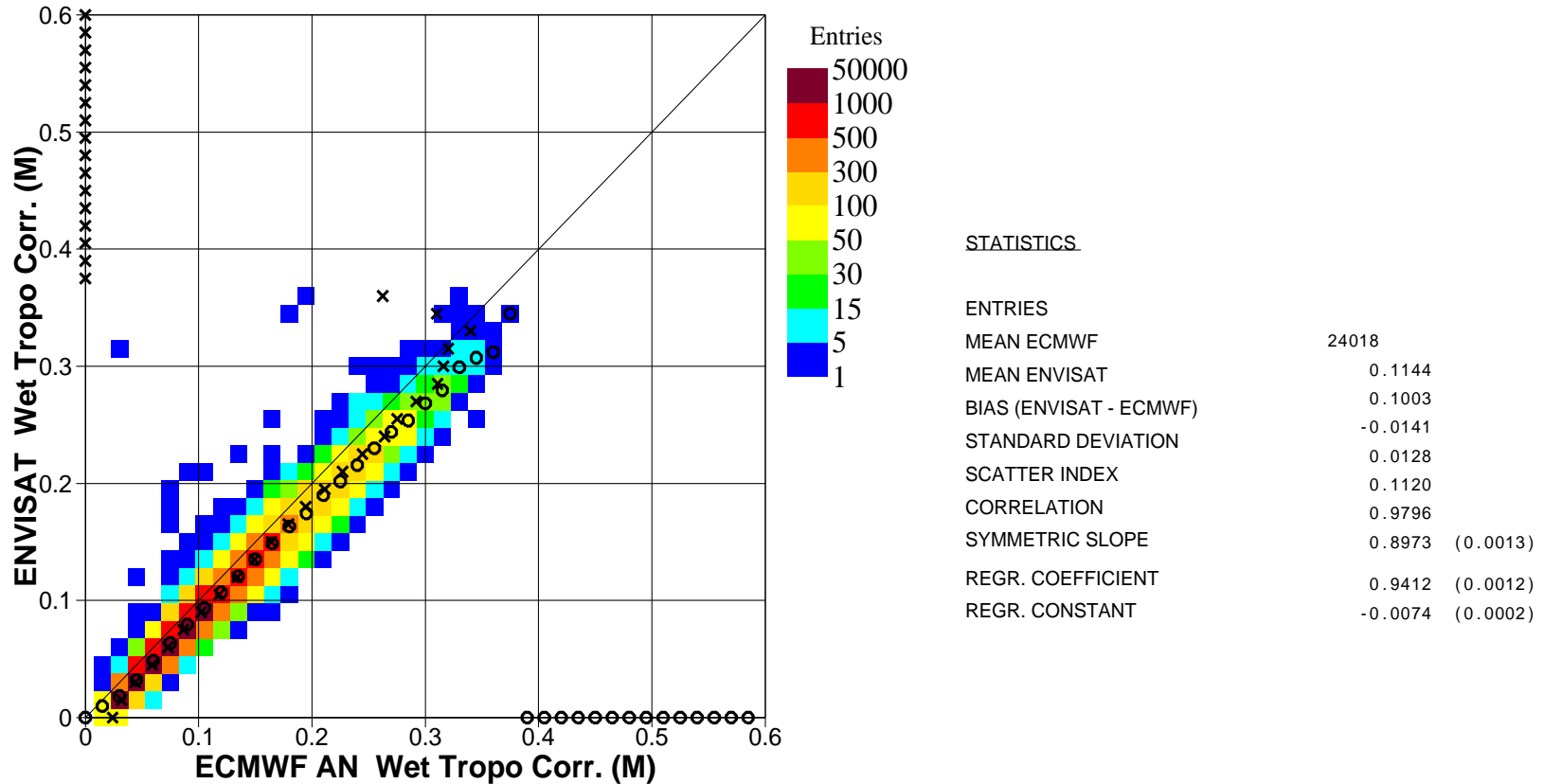


Figure 39. Comparison between ENVISAT MWR and ECMWF (analysis) wet tropo correction for April 2010 (N.Hem.)

■
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

■ ECMWF Report on ENVISAT RA-2 for April 2010 ■

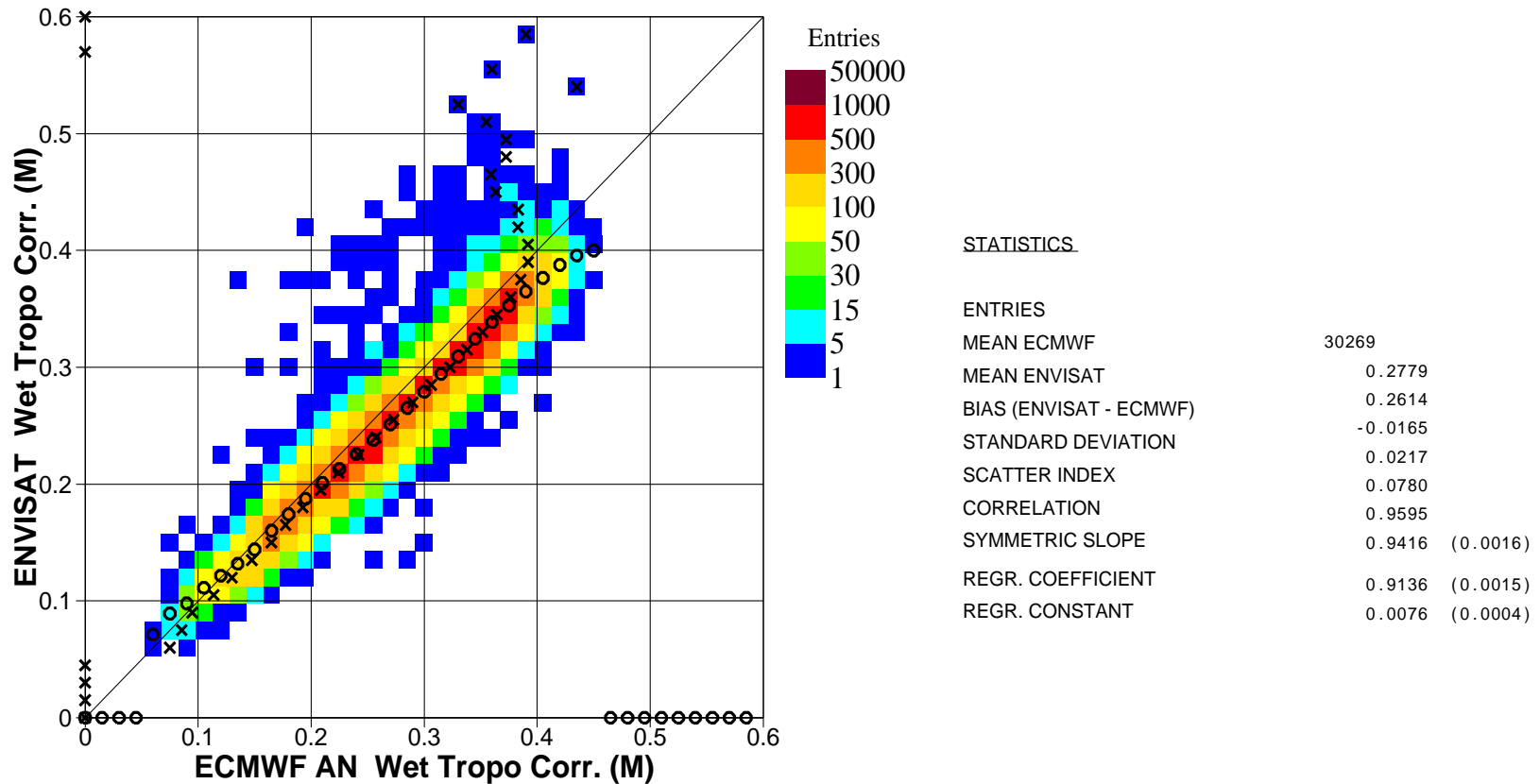


Figure 40. Comparison between ENVISAT MWR and ECMWF (analysis) wet tropo correction for April 2010 (Tropics)

■
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

■ ECMWF Report on ENVISAT RA-2 for April 2010 ■

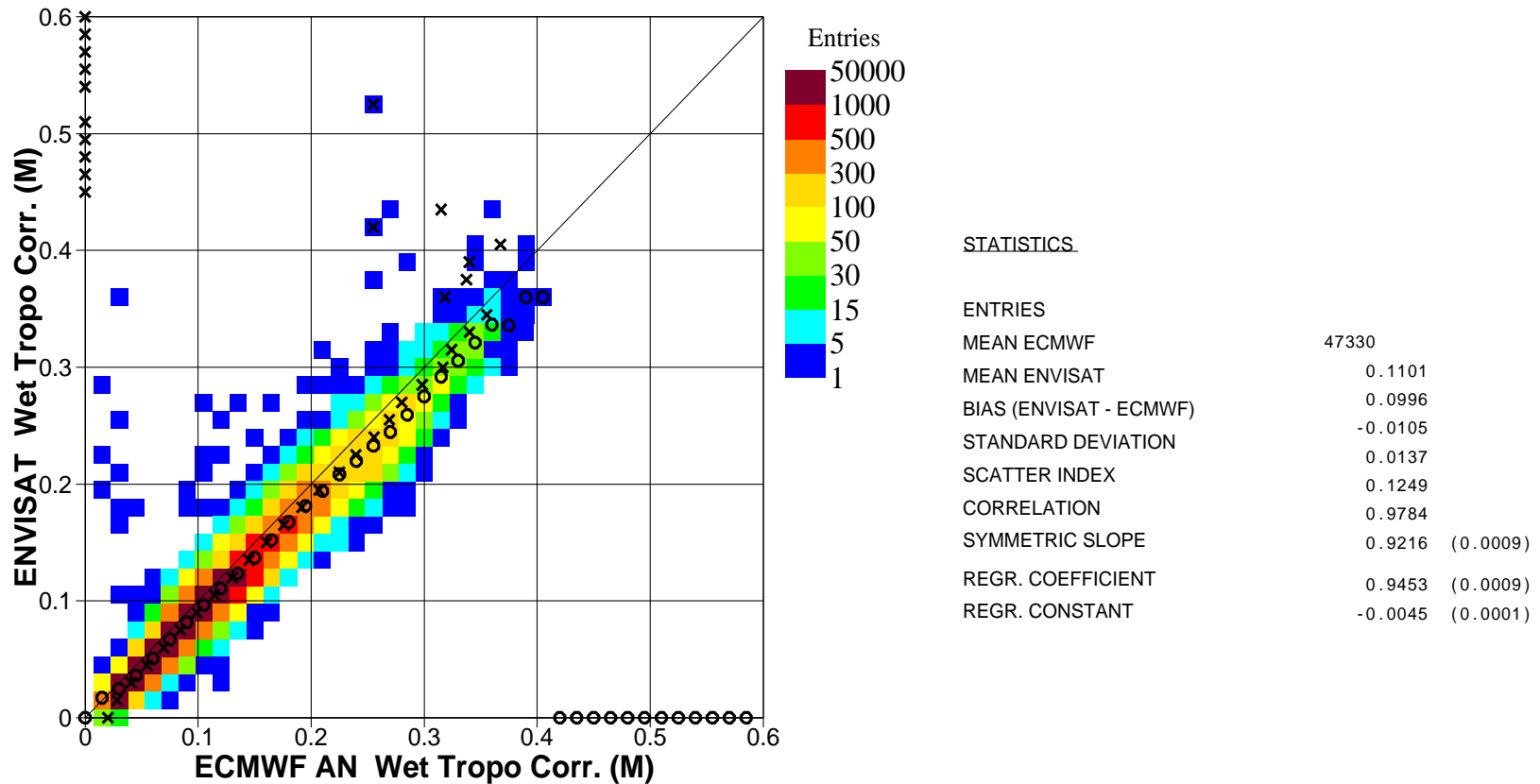


Figure 41. Comparison between ENVISAT MWR and ECMWF (analysis) wet tropo correction for April 2010 (S.Hem.)

■
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

■ ECMWF Report on ENVISAT RA-2 for April 2010 ■

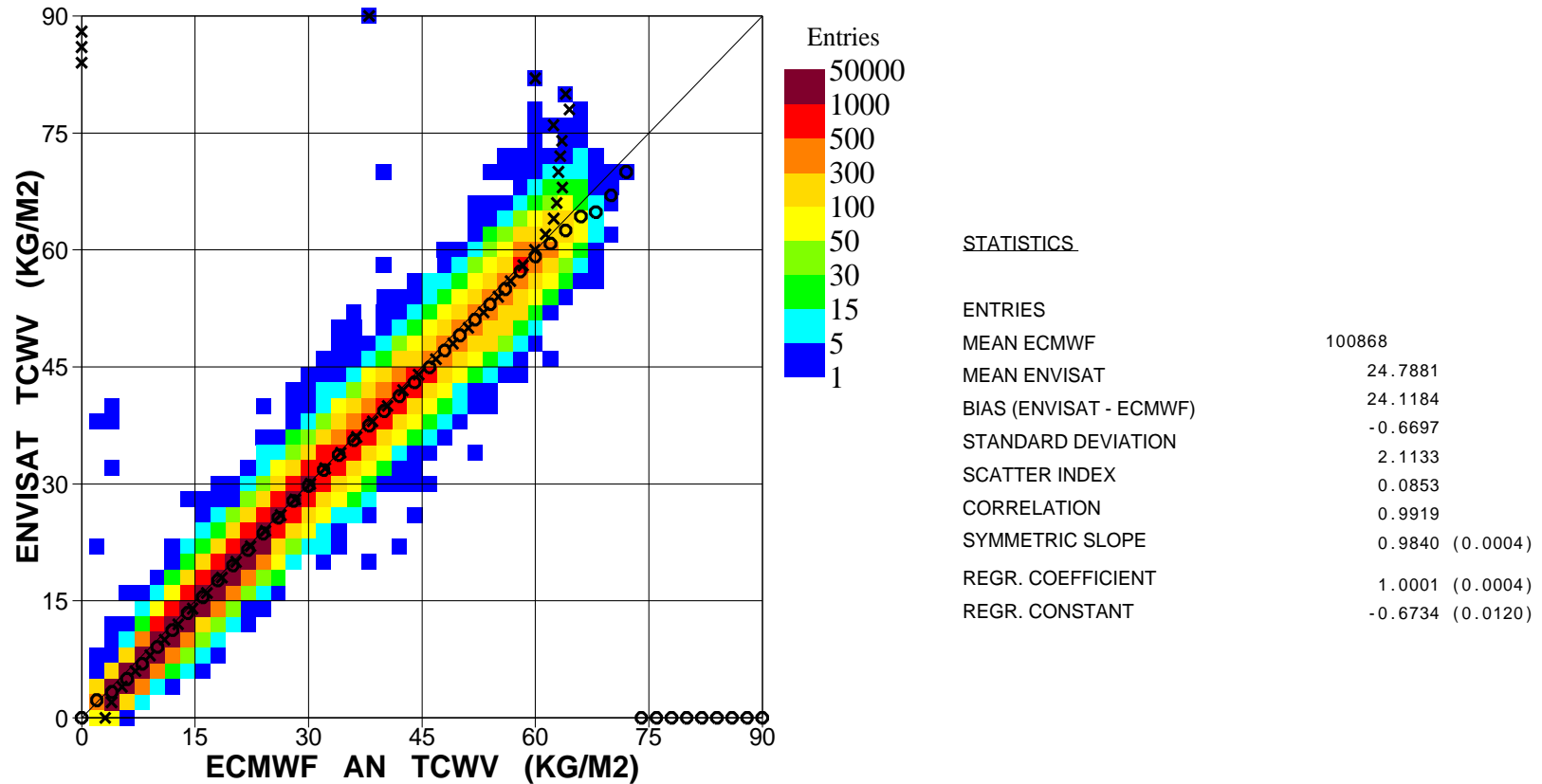


Figure 42. Comparison between ENVISAT MWR and ECMWF (analysis) total column water vapour for April 2010 (Global)

■
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

■ ECMWF Report on ENVISAT RA-2 for April 2010 ■

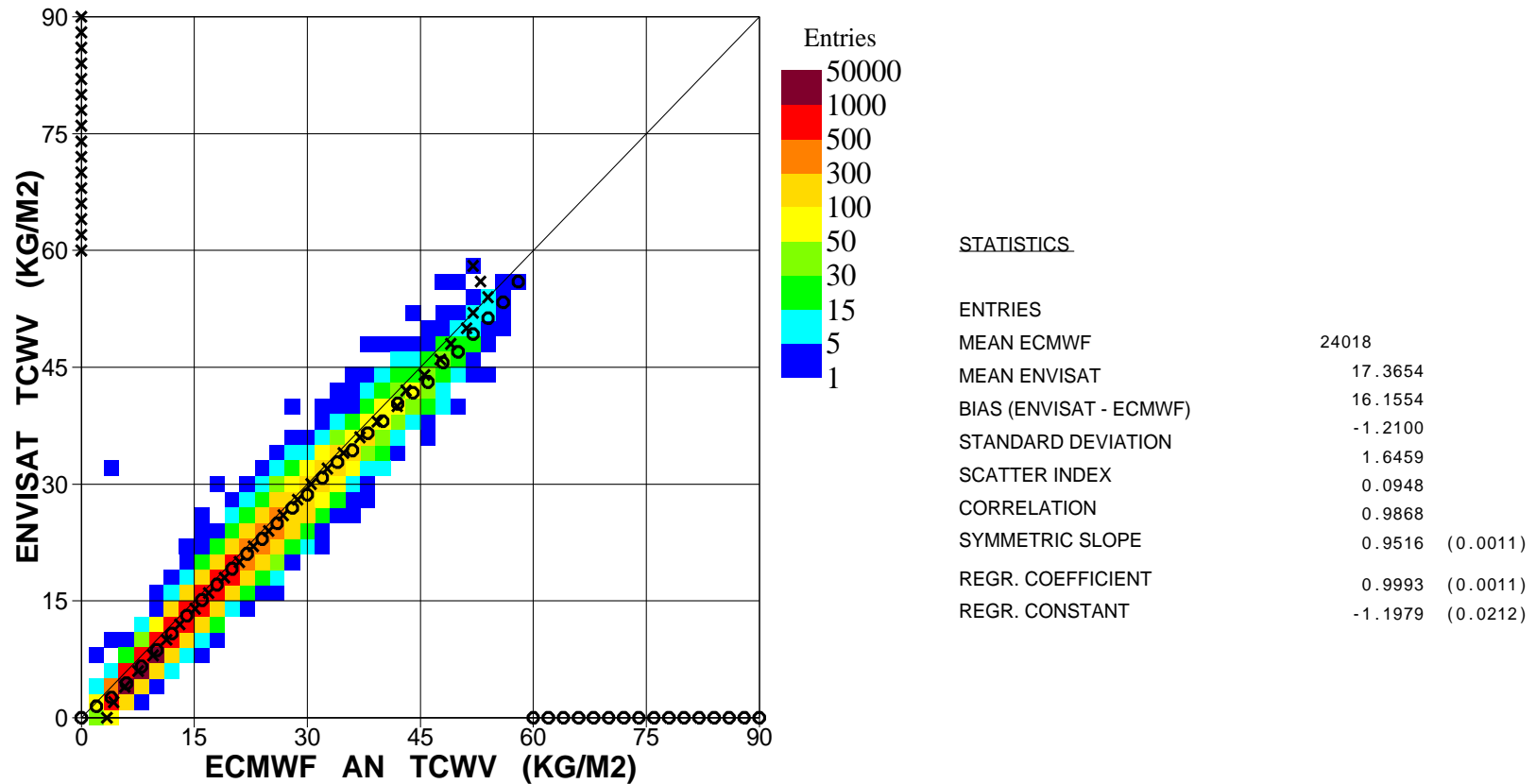


Figure 43. Comparison between ENVISAT MWR and ECMWF (analysis) total column water vapour for April 2010 (N.Hem.)

■
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

■ ECMWF Report on ENVISAT RA-2 for April 2010 ■

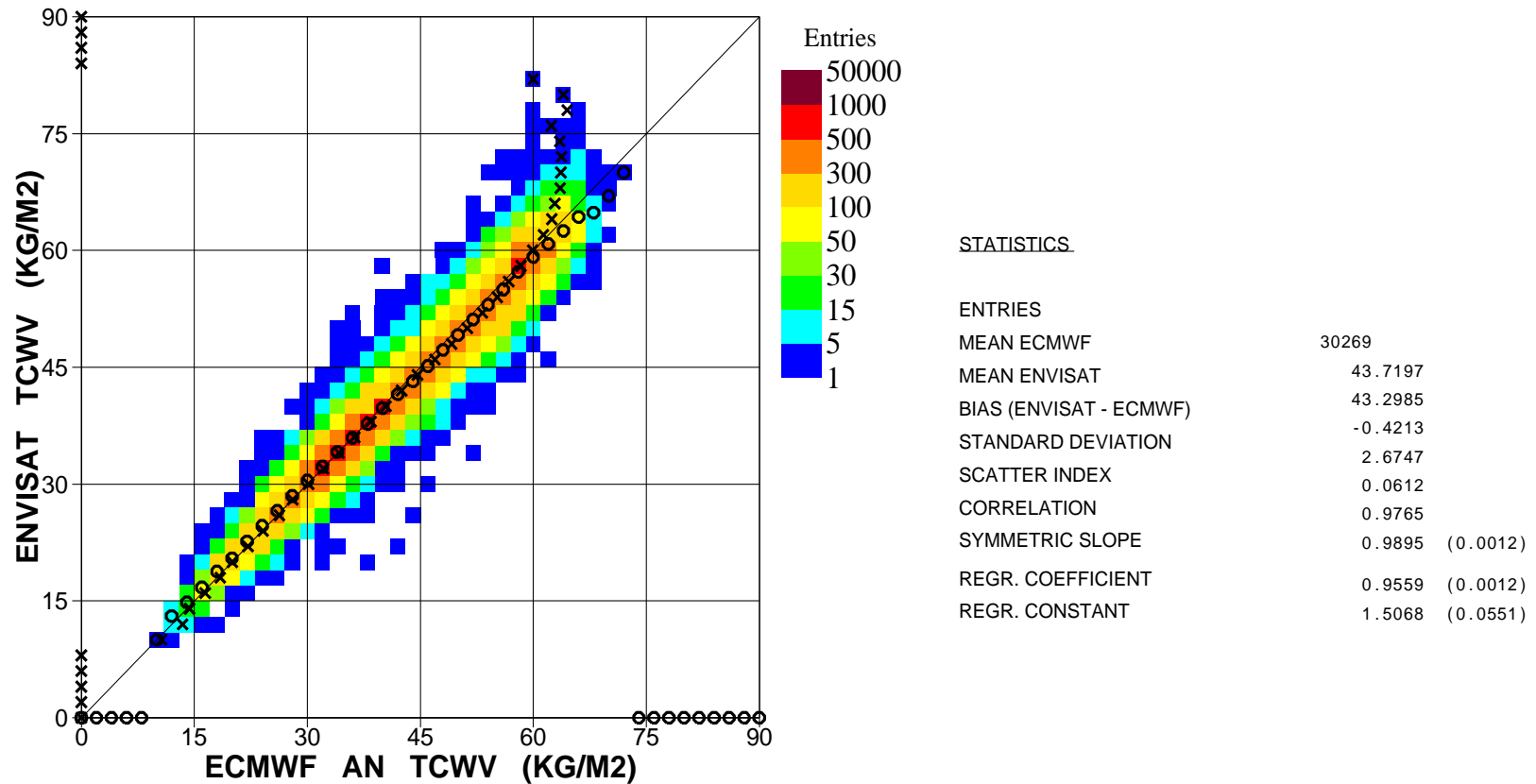


Figure 44. Comparison between ENVISAT MWR and ECMWF (analysis) total column water vapour for April 2010 (Tropics)

■
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

■ ECMWF Report on ENVISAT RA-2 for April 2010 ■

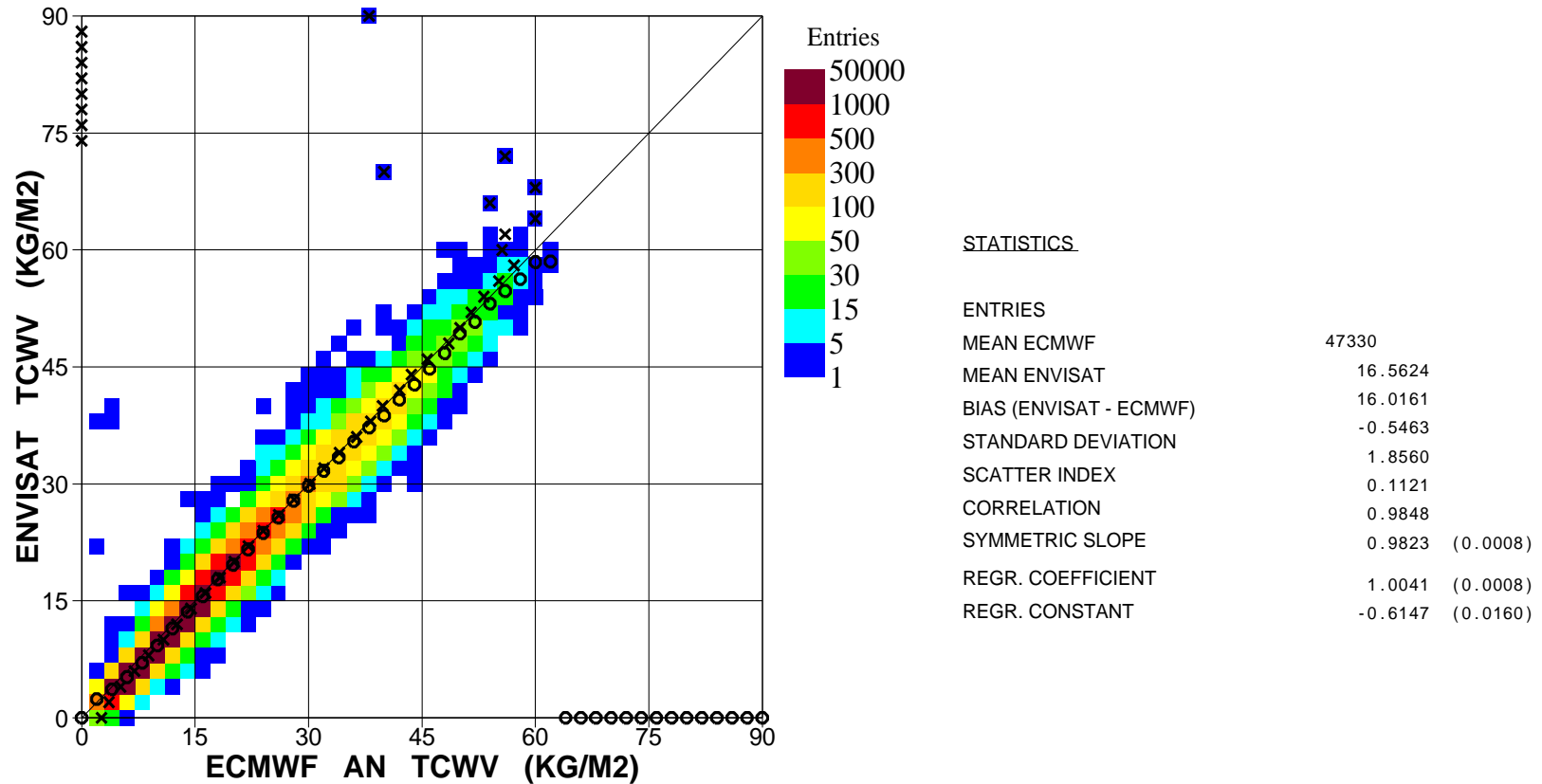


Figure 45. Comparison between ENVISAT MWR and ECMWF (analysis) total column water vapour for April 2010 (S.Hem.)

■
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

ECMWF Report on ENVISAT RA-2 for April 2010

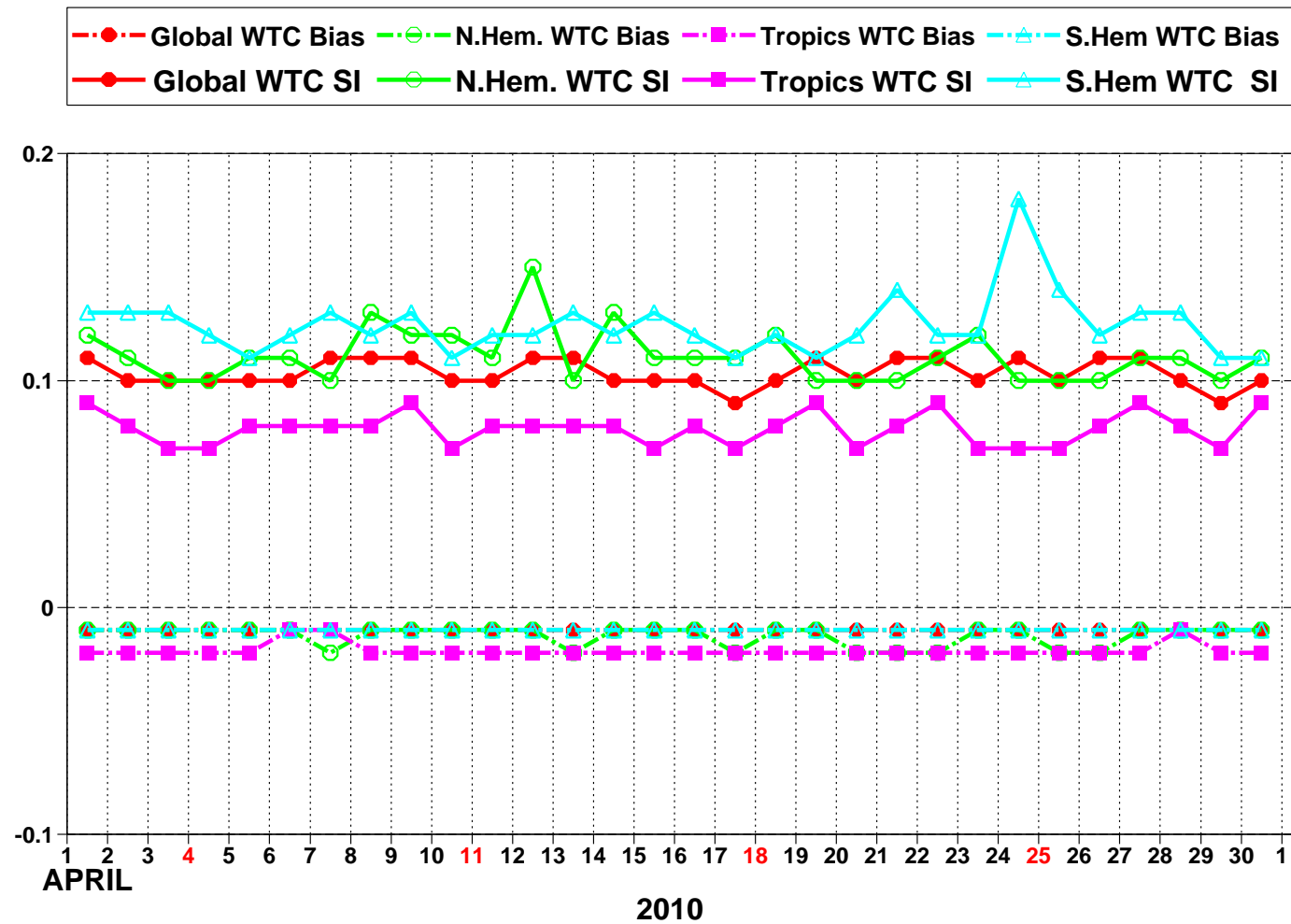


Figure 46: ENVISAT Altimeter wet tropo correction: Timeseries of bias (ENVISAT - ECMWF) and scatter index (SI)

ECMWF Report on ENVISAT RA-2 for April 2010

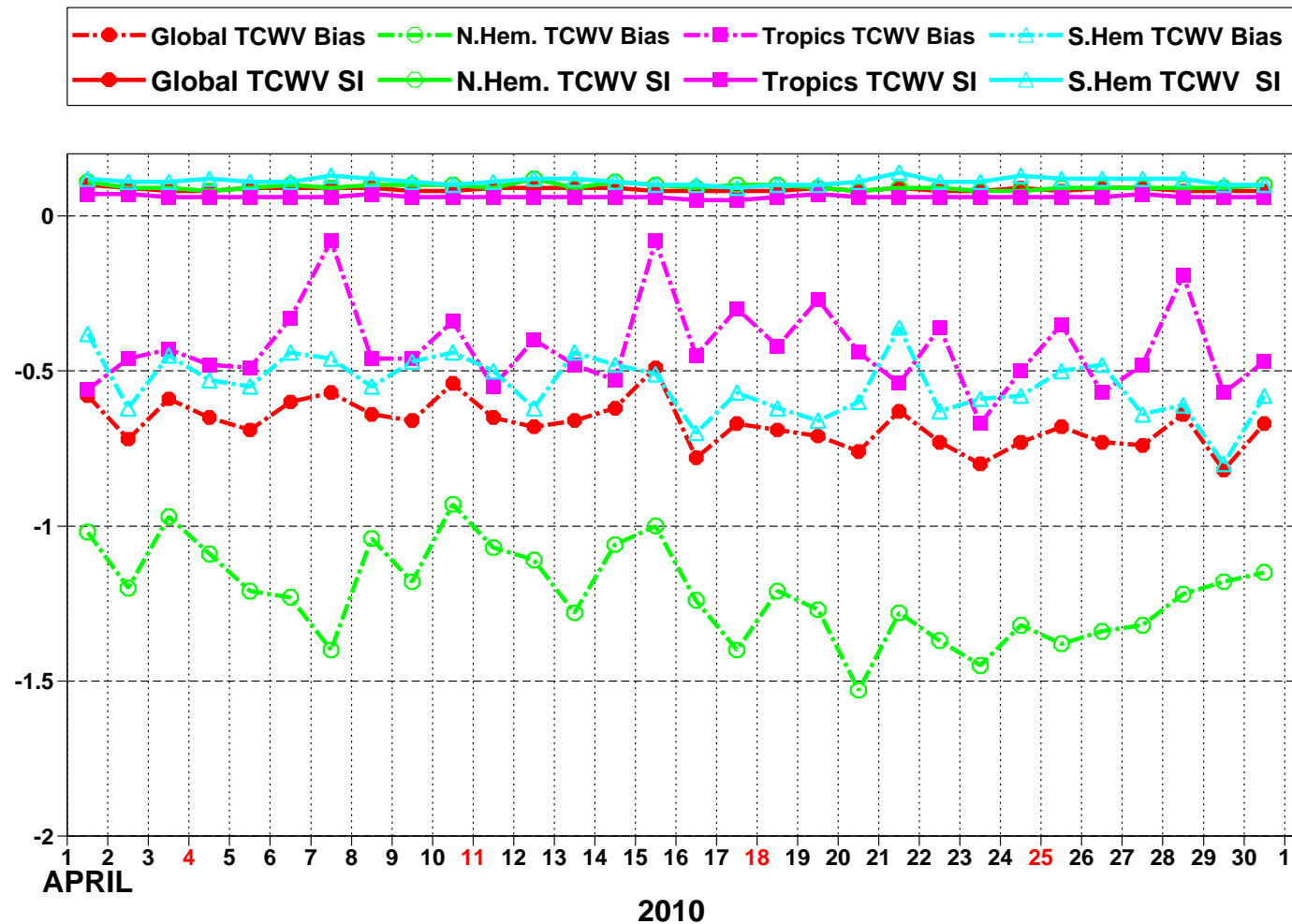


Figure 47: ENVISAT Altimeter total column water vapour: Timeseries of bias (ENVISAT - ECMWF) and scatter index (SI)

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

■ ECMWF Report on ENVISAT RA-2 for April 2010 ■

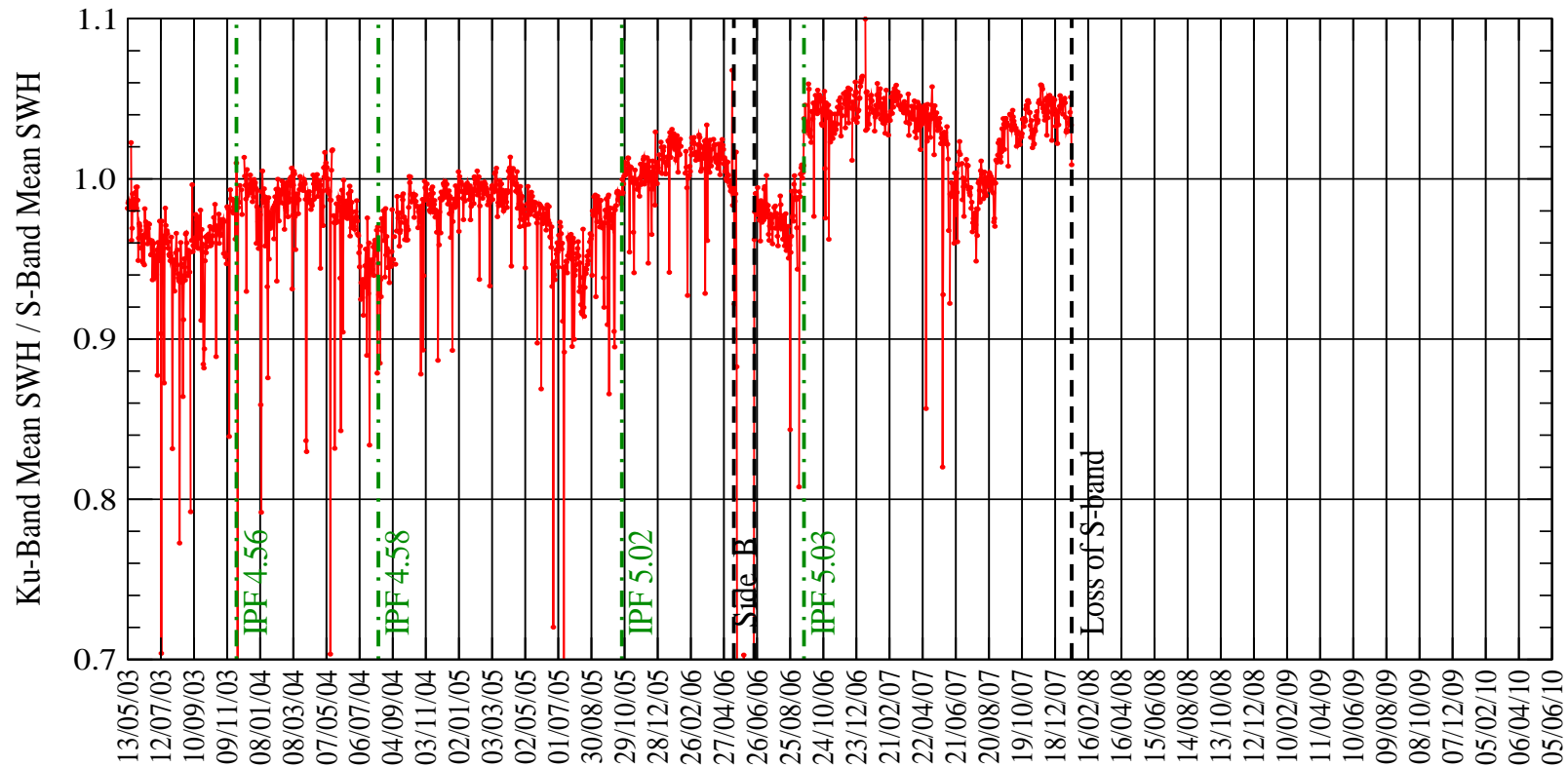


Figure 48: Timeseries of daily global ratio between mean Ku-Band to mean S-Band significant wave heights since the 13th. of May 2003.

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