

# ■ ECMWF Report on ERS-2 RA for April 2000 ■

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

**By:** Jean Bidlot

**Date:** May 9, 2000

**REMARK:** as already mentioned in previous months, we are concerned by the usually high altimeter wind speed bias. As shown in figure 26, this situation is quite exceptional when compared to previous years. The altimeter wave heights seem to be unaffected by the current problem.

## **Overview:**

This month around 14085 observations arrived at ECMWF every 6 hours of which 80.57% passed the quality control. Data coverage was good all through the month (see figure 1).

This month (11-04-2000), the quality control procedure was upgraded to include a rejection test based on the peakiness factor as provided with the data. All data with a peakiness factor larger than 2 are removed in the first stage of the quality control. This extra test removes erroneous data, mainly in partial sea ice areas and at transitions between land and sea and vice versa. The quality control procedure without the peakiness test was already able to eliminate most of the wrong data points, however, this new test is mostly effective in areas which are partly covered by sea ice as is the case in the arctic ocean in the summer months (see for instance the July 1999 report).

Note that we are talking about data which have arrived at ECMWF, and are within the model sea grid before they were needed for the operational data assimilation.

# ■ ECMWF Report on ERS-2 RA for April 2000 ■

## Backscatter:

ERS-2  $\langle \sigma_0 \rangle = 10.90\text{dB}$  (large peak at around 11. dB)

## Wind Speed Comparison with ECMWF wind speeds (bias):

ERS-2 global: 0.555 m/s  
ERS-2 northern hemisphere: 0.459 m/s  
ERS-2 tropics: 0.375 m/s  
ERS-2 southern hemisphere: 0.723 m/s

## Wind Speed Comparison with buoy wind speeds (bias):

ERS-2 global: 0.09 m/s  
ERS-2 northern hemisphere: 0.13 m/s  
ERS-2 tropics: 0.10 m/s

## Wave Height Comparison with ECMWF wave heights (bias):

ERS-2 global: -0.012 m (lowest waves measured: 0.6m)  
ERS-2 northern hemisphere: 0.055 m  
ERS-2 tropics: 0.043 m  
ERS-2 southern hemisphere: -0.026 m

## Wave Height Comparison with buoy wave heights (bias):

ERS-2 global: -0.11 m  
ERS-2 northern hemisphere: -0.10 m  
ERS-2 tropics: 0.16 m

## Remarks:

See first page.

## 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.

## **Figure captions:**

Figure 1: Time series of data reception for ERS-2 Altimeter data for April 2000.

Figure 2: Distribution of the ERS-2 Altimeter Backscatter after QC for April 2000.

Figure 3: Distribution of the ERS-2 Altimeter wind speeds after QC for April 2000.

Figure 4: Distribution of the ERS-2 Altimeter wind speeds after along track averaging for April 2000.

# ■ ECMWF Report on ERS-2 RA for April 2000 ■

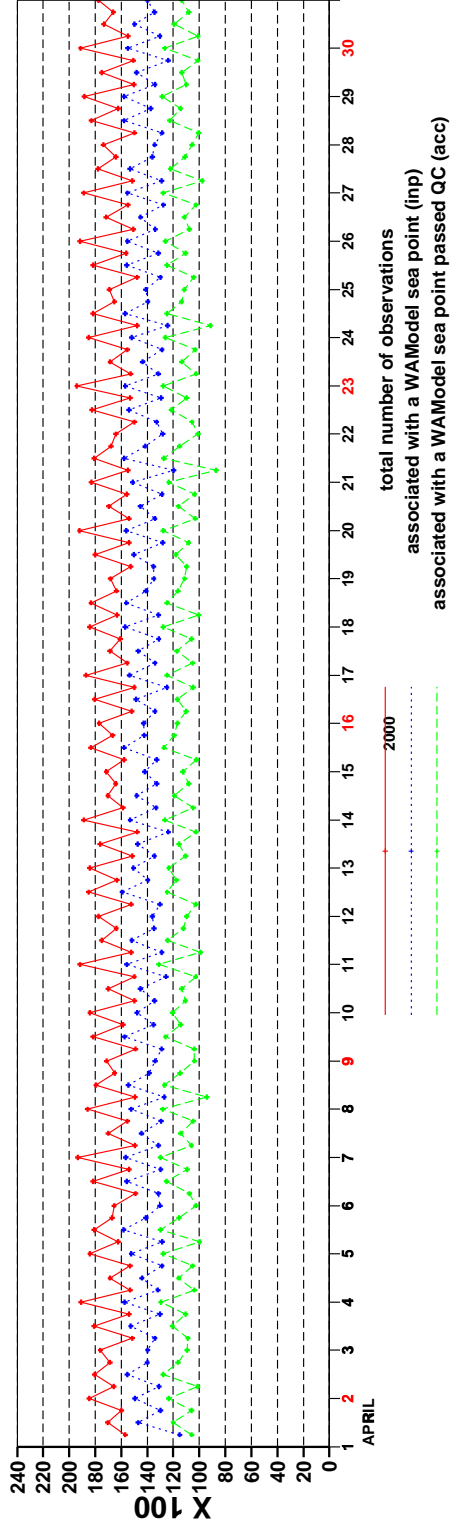
- Figure 5: Global distribution of ECMWF ocean surface wind speeds for April 2000.
- Figure 6: Comparison of ECMWF wind speed results with ERS-2 Altimeter wind speed data for April 2000 (global).
- Figure 7: Comparison of ECMWF wind speed results with ERS-2 Altimeter wind speed data for April 2000 (northern hemisphere)
- Figure 8: Comparison of ECMWF wind speed results with ERS-2 Altimeter wind speed data for April 2000 (tropics)
- Figure 9: Comparison of ECMWF wind speed results with ERS-2 Altimeter wind speed data for April 2000 (southern hemisphere)
- Figure 10: Comparison of buoy wind speed observations with ERS-2 Altimeter wind speed data for April 2000 (global).
- Figure 11: Comparison of buoy wind speed observations with ERS-2 Altimeter wind speed data for April 2000 (northern hemisphere).
- Figure 12: Comparison of buoy wind speed observations with ERS-2 Altimeter wind speed data for April 2000 (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 April 2000.
- Figure 15: Distribution of the ERS-2 Altimeter wave heights after along track averaging for April 2000.
- Figure 16: Global distribution of ECMWF wave heights for April 2000.
- Figure 17: Comparison of ECMWF wave height results with ERS-2 Altimeter wave height data for April 2000 (global).
- Figure 18: Comparison of ECMWF wave height results with ERS-2 Altimeter wave height data for April 2000 (northern hemisphere)
- Figure 19: Comparison of ECMWF wave height results with ERS-2 Altimeter wave height data for April 2000 (tropics)
- Figure 20: Comparison of ECMWF wave height results with ERS-2 Altimeter wave height data for April 2000 (southern hemisphere)
- Figure 21: Comparison of buoy wave height observations with ERS-2 Altimeter wave height data for April 2000 (global).
- Figure 22: Comparison of buoy wave height observations with ERS-2 Altimeter wave height data for April 2000 (northern hemisphere).
- Figure 23: Comparison of buoy wave height observations with ERS-2 Altimeter wave height data for April 2000 (tropics).
- Figure 24: ERS-2 Altimeter wave heights: Timeseries of bias (ERS-2 - model) and scatter index (SI) for April 2000.
- Figure 25: ERS-2 Altimeter wave heights: Timeseries of bias (ERS-2 - model) and scatter index (SI) from December 1996 to April 2000

# ■ ECMWF Report on ERS-2 RA for April 2000 ■

Figure 26: ERS-2 Altimeter wind speeds: Timeseries of bias (ERS-2 - model) and scatter index (SI) from December 1996 to April 2000.

# ECMWF Report on ERS-2 RA for April 2000

ERS 2/ALTIMETER: NUMBER OF OBS, GLOBAL.



ERS 2/ALTIMETER: NUMBER OF MEAN DATA, GLOBAL.

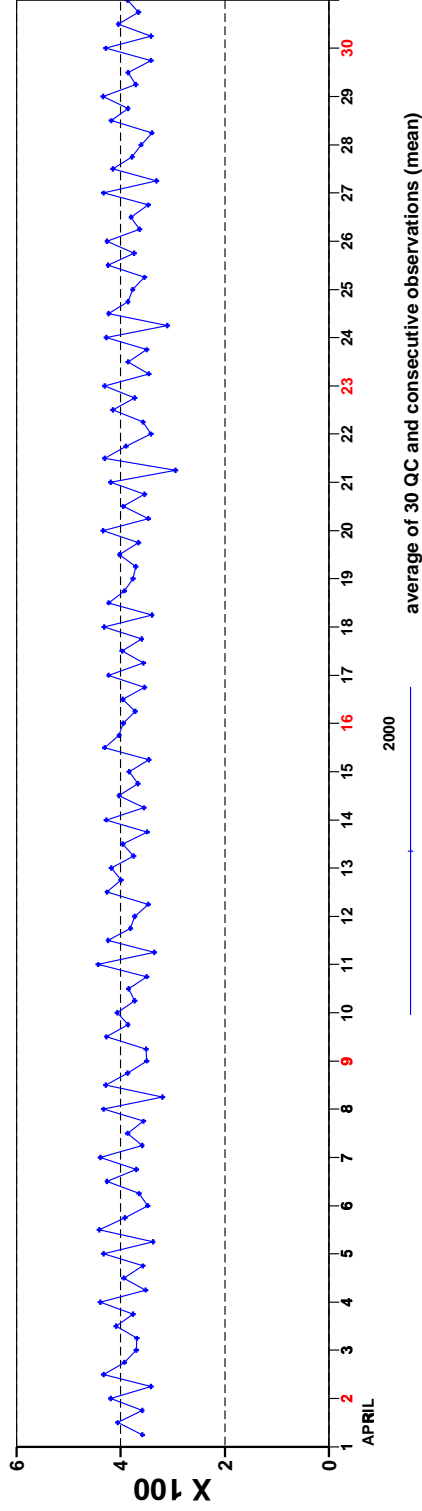


Figure 1: Time series of data reception for ERS-2 Altimeter data for April 2000

# ECMWF Report on ERS-2 RA for April 2000

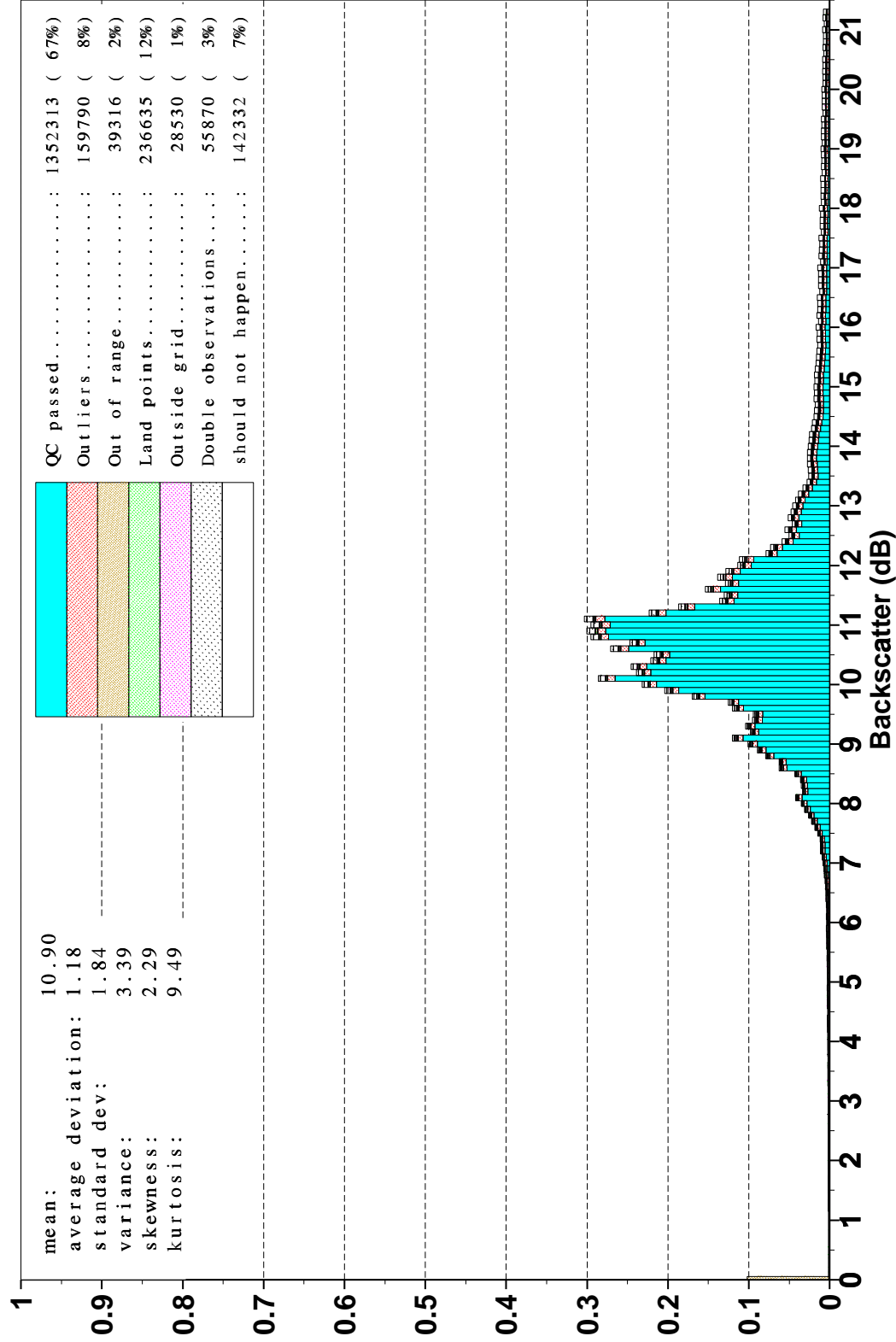


Figure 2: Distribution of the ERS-2 Altimeter backscatter after QC for April 2000

# ECMWF Report on ERS-2 RA for April 2000

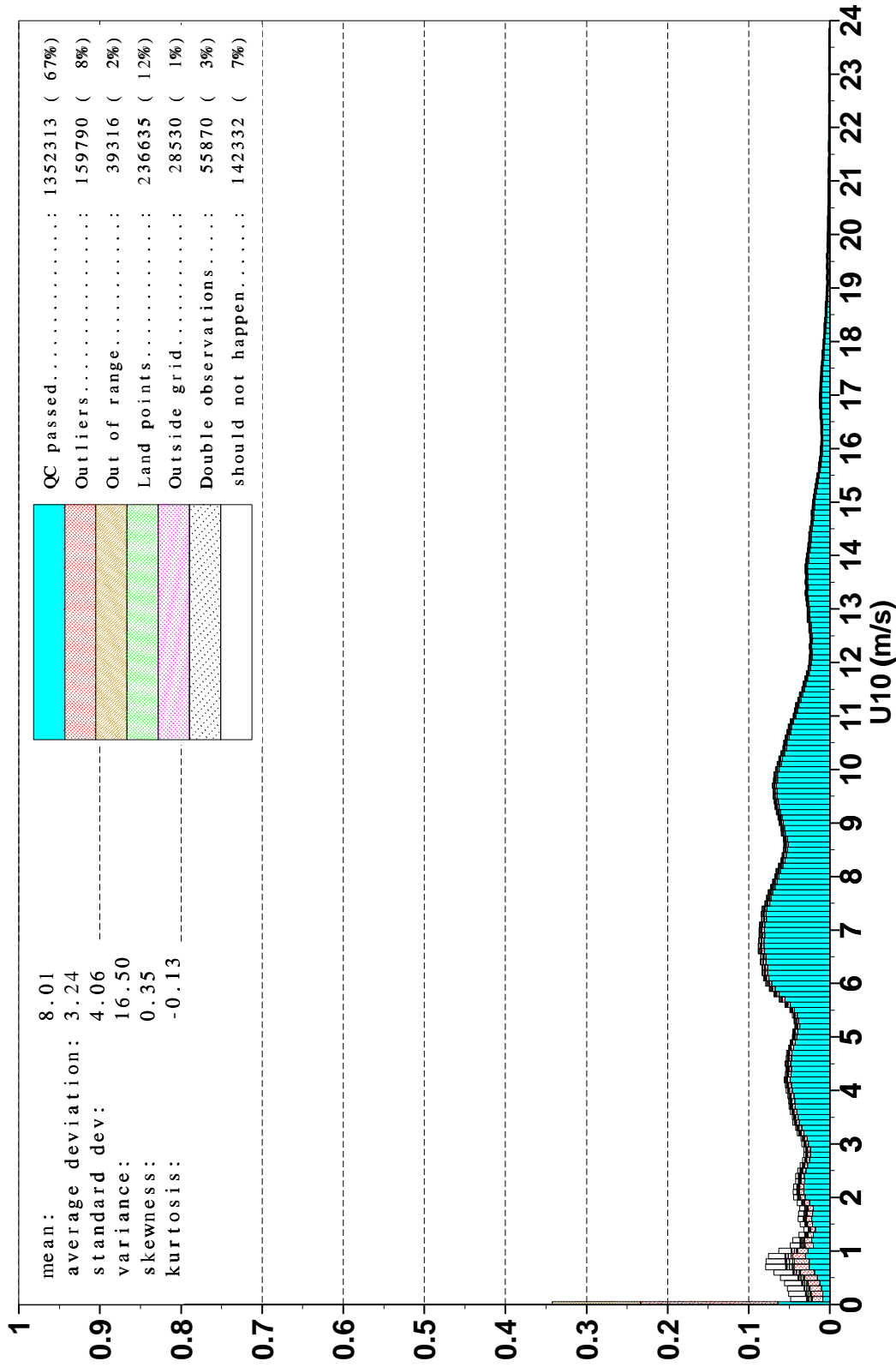


Figure 3: Distribution of the ERS-2 Altimeter wind speeds after QC for April 2000



# ECMWF Report on ERS-2 RA for April 2000

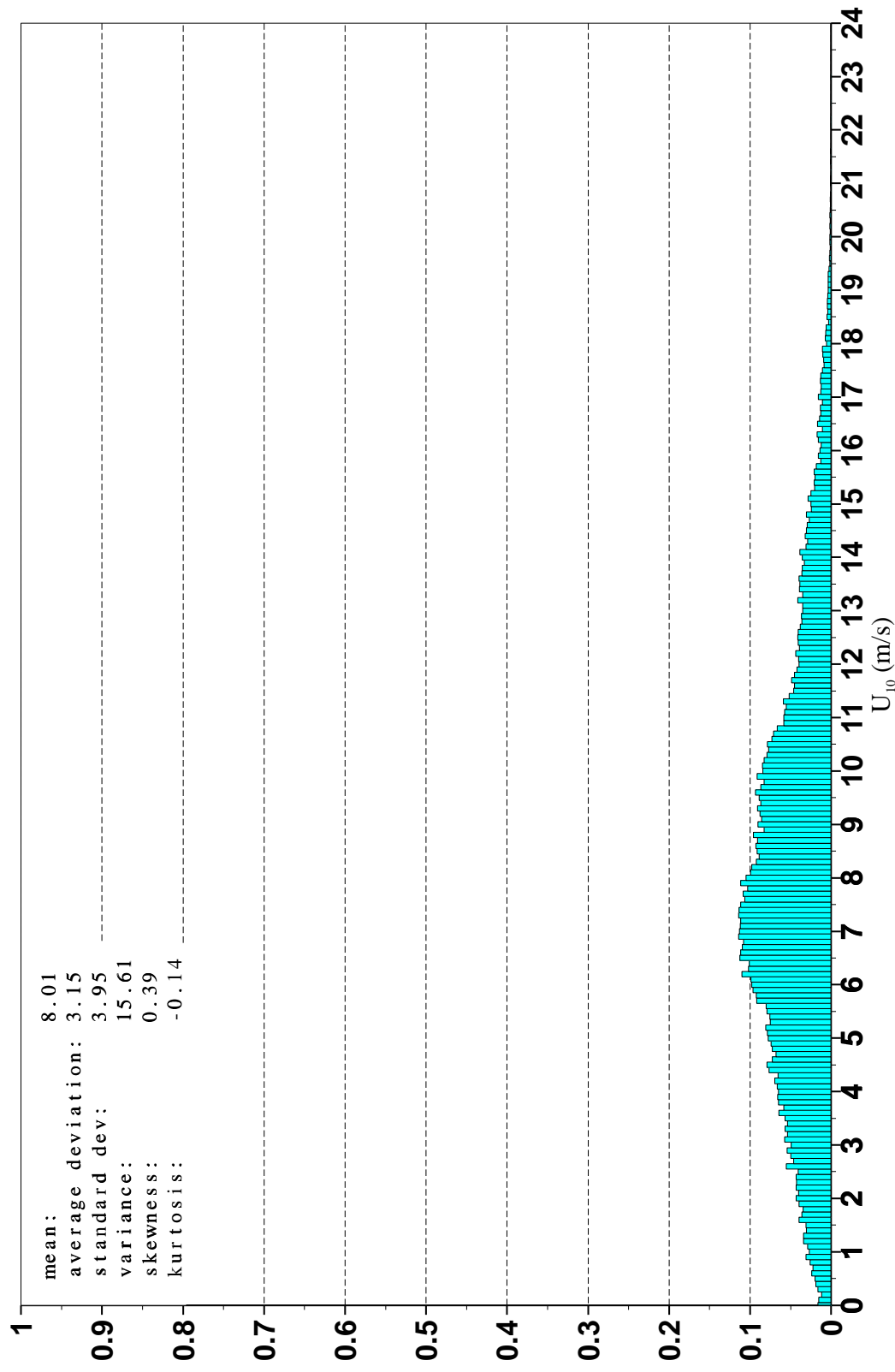


Figure 4: Distribution of ERS-2 Altimeter wind speeds after along track averaging for April 2000

# ECMWF Report on ERS-2 RA for April 2000

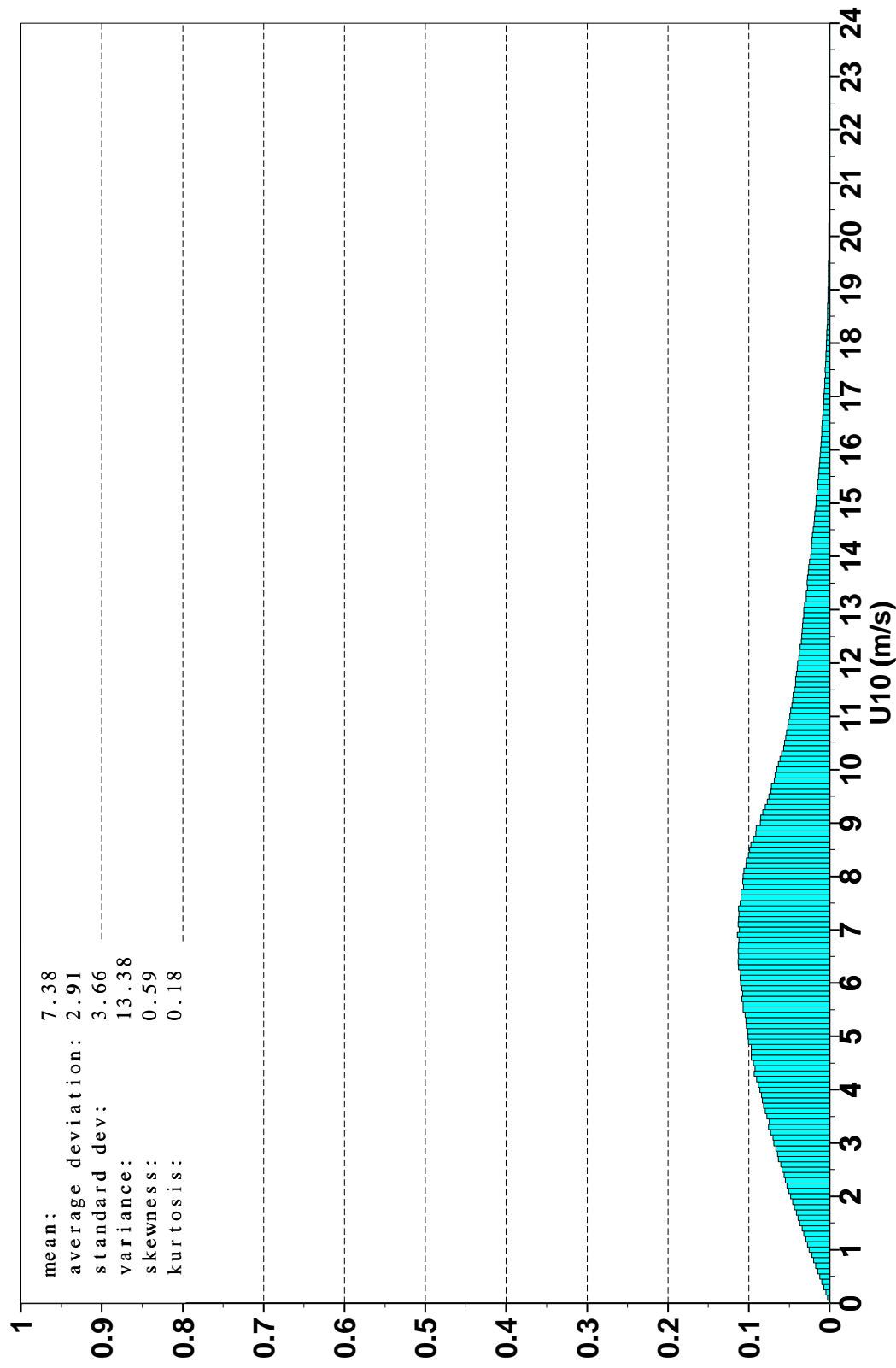
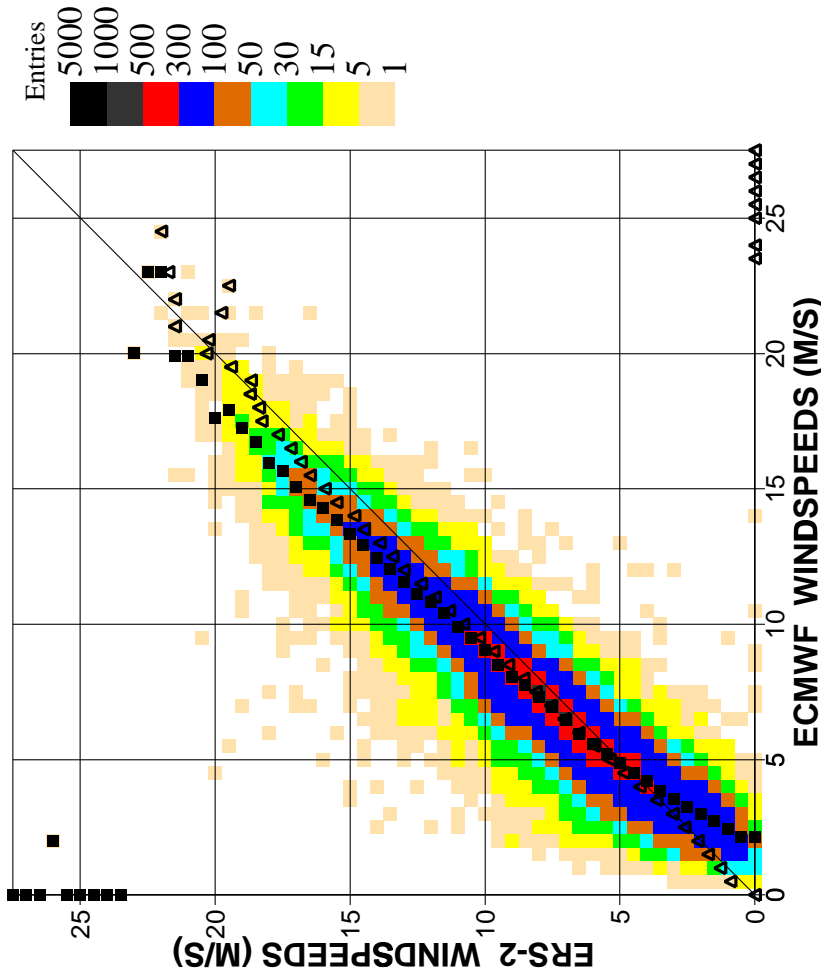


Figure 5: Global distribution of ECMWF ocean surface wind speeds for April 2000

# ECMWF Report on ERS-2 RA for April 2000

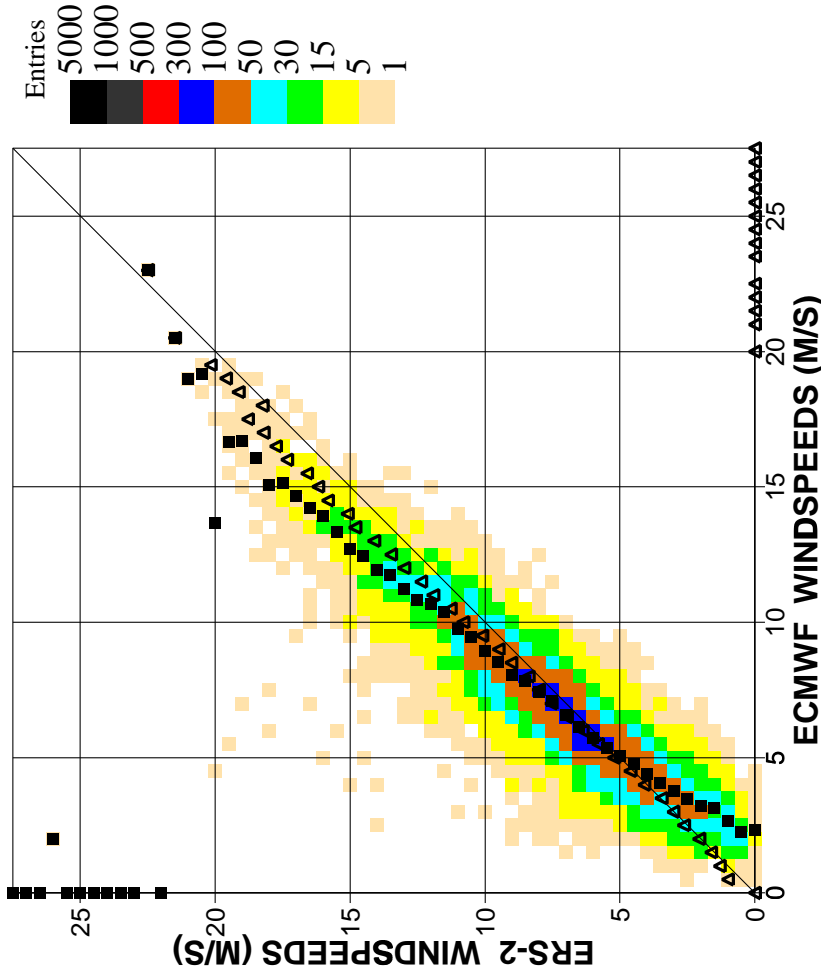


**STATISTICS**

ENTRIES	45523
MEAN ECMWF	7.4536
MEAN ERS-2	8.0084
BIAS (ERS-2 - ECMWF)	0.5548
STANDARD DEVIATION	1.4600
SCATTER INDEX	0.1959
CORRELATION	0.9310
SYMMETRIC SLOPE	1.0872 (0.0020)
REGR. COEFFICIENT	1.0661 (0.0020)
REGR. CONSTANT	0.0623 (0.0161)

Figure 6. Comparison of ECMWF wind speed results with ERS2 Altimeter wind speed data for April 2000 (global)

# ECMWF Report on ERS-2 RA for April 2000

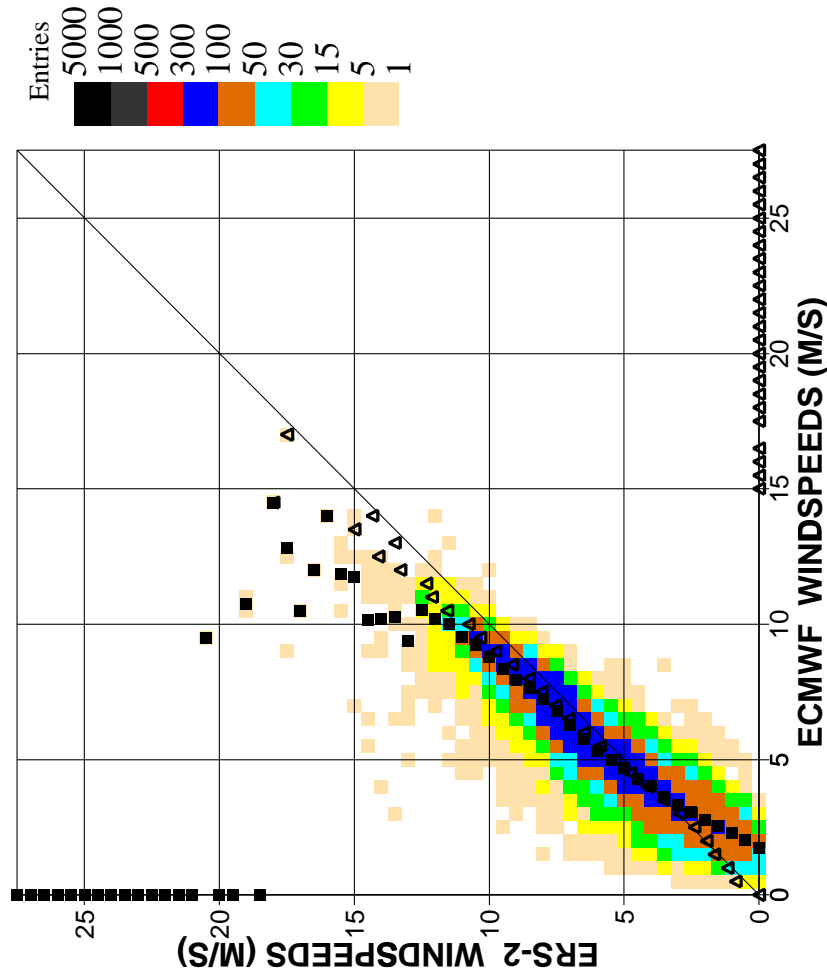


## STATISTICS

ENTRIES	10760
MEAN ECMWF	7.2119
MEAN ERS-2	7.6710
BIAS (ERS-2 - ECMWF)	0.4591
STANDARD DEVIATION	1.5943
SCATTER INDEX	0.2211
CORRELATION	0.9081
SYMMETRIC SLOPE	1.0874 (0.0049)
REGR. COEFFICIENT	1.0975 (0.0049)
REGR. CONSTANT	-0.2441 (0.0383)

Figure 7. Comparison of ECMWF wind speed results with ERS2 Altimeter wind speed data for April 2000 (n.hem.)

# ECMWF Report on ERS-2 RA for April 2000

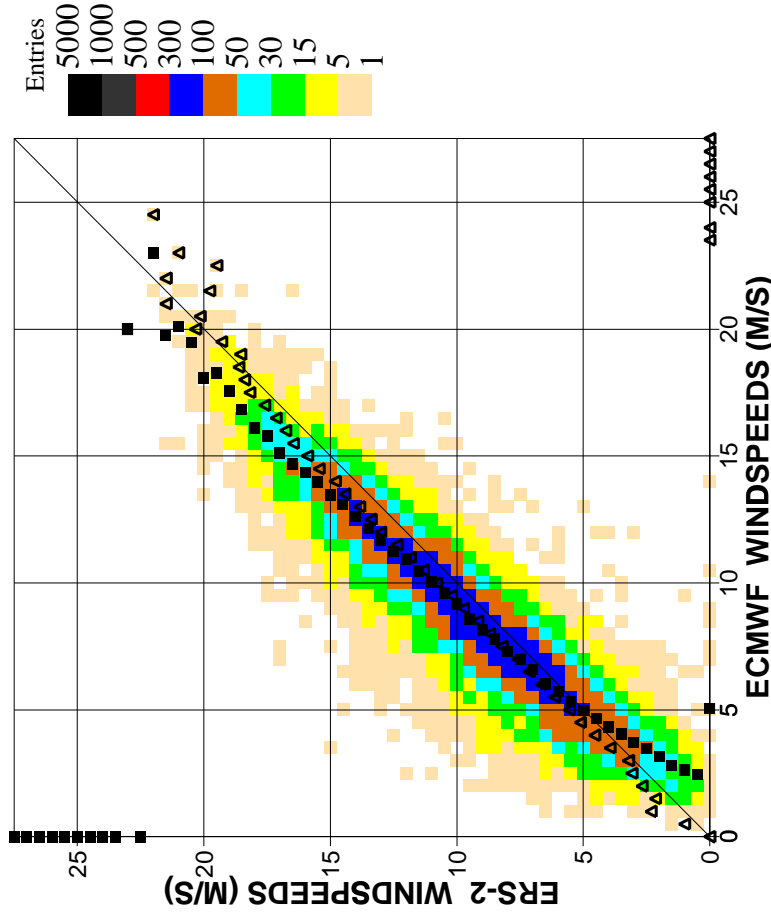


### STATISTICS

ENTRIES	14199
MEAN ECMWF	5.5772
MEAN ERS-2	5.9523
BIAS (ERS-2 - ECMWF)	0.3752
STANDARD DEVIATION	1.2378
SCATTER INDEX	0.2219
CORRELATION	0.9068
SYMMETRIC SLOPE	1.0928(0.0044)
REGR. COEFFICIENT	1.1140(0.0043)
REGR. CONSTANT	-0.2609(0.0263)

Figure 8. Comparison of ECMWF wind speed results with ERS2 Altimeter wind speed data for April 2000 (tropics)

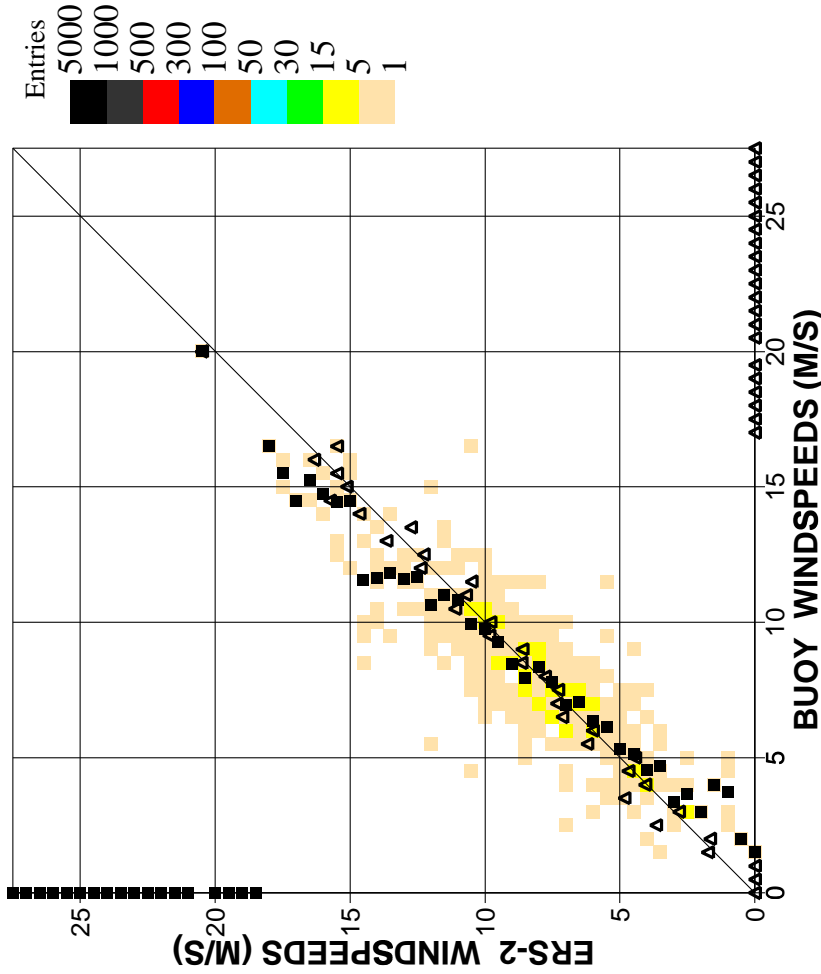
# ECMWF Report on ERS-2 RA for April 2000



**STATISTICS.**

ENTRIES	20892
MEAN ECMWF	8.8357
MEAN ERS-2	9.5586
BIAS (ERS-2 - ECMWF)	0.7229
STANDARD DEVIATION	1.5046
SCATTER INDEX	0.1703
CORRELATION	0.9271
SYMMETRIC SLOPE	1.0856 (0.0029)
REGR. COEFFICIENT	1.0274 (0.0029)
REGR. CONSTANT	0.4810 (0.0274)

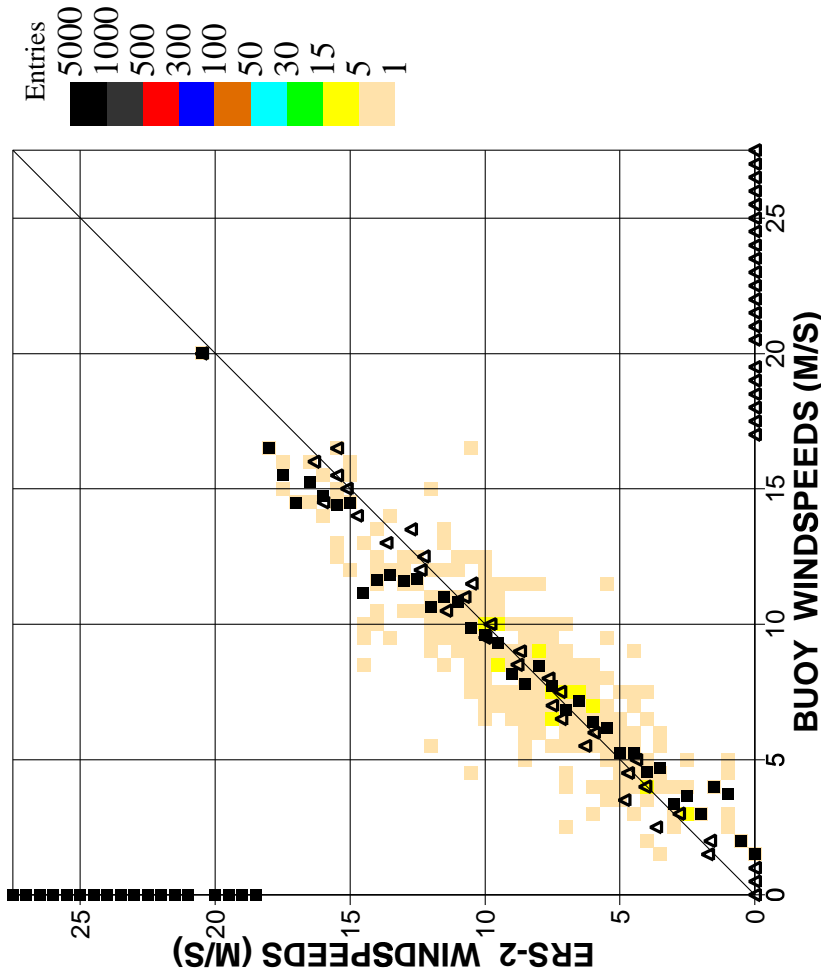
Figure 9. Comparison of ECMWF wind speed results with ERS2 Altimeter wind speed data for April 2000 (s.hem.)



STATISTICS

ENTRIES	467
MEAN BUOY	8.1319
MEAN ERS-2	8.2244
BIAS (ERS-2 - BUOY)	0.0925
STANDARD DEVIATION	1.5903
SCATTER INDEX	0.1956
CORRELATION	0.8809
SYMMETRIC SLOPE	1.0247 (0.0247)
REGR. COEFFICIENT	0.9847 (0.0245)
REGR. CONSTANT	0.2169 (0.2127)

Figure 10. Comparison of buoy wind speed observations with ERS2 Altimeter wind speed data for April 2000 (global)

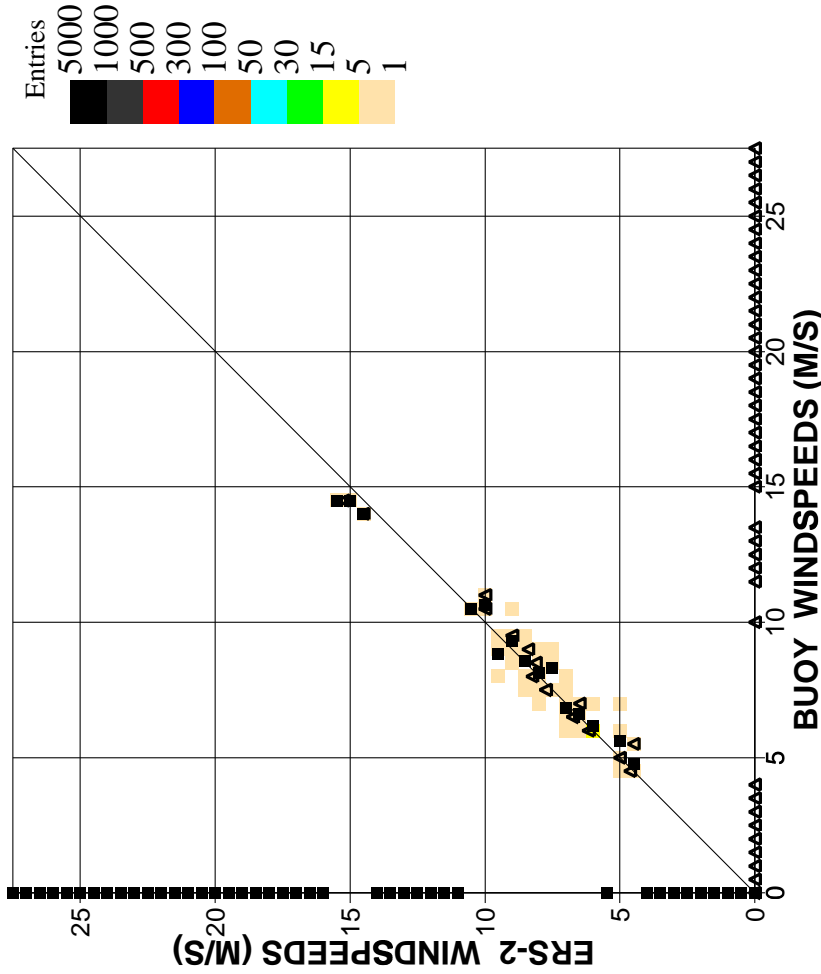


STATISTICS

ENTRIES	400
MEAN BUOY	8.1532
MEAN ERS-2	8.2862
BIAS (ERS-2 - BUOY)	0.1331
STANDARD DEVIATION	1.6878
SCATTER INDEX	0.2070
CORRELATION	0.8771
SYMMETRIC SLOPE	1.0307 (0.0272)
REGR. COEFFICIENT	0.9856 (0.0271)
REGR. CONSTANT	0.2501 (0.2362)

Figure 11. Comparison of buoy wind speed observations with ERS2 Altimeter wind speed data for April 2000 (n.hem.)





**STATISTICS**

ENTRIES	62
MEAN BUOY	8.0452
MEAN ERS-2	7.9435
BIAS (ERS-2 - BUOY)	-0.1016
STANDARD DEVIATION	0.7359
SCATTER INDEX	0.0915
CORRELATION	0.9463
SYMMETRIC SLOPE	0.9897 (0.0427)
REGR. COEFFICIENT	0.9651 (0.0425)
REGR. CONSTANT	0.1795 (0.3549)

Figure 12. Comparison of buoy wind speed observations with ERS2 Altimeter wind speed data for April 2000 (hawaii)

# ECMWF Report on ERS-2 RA for April 2000

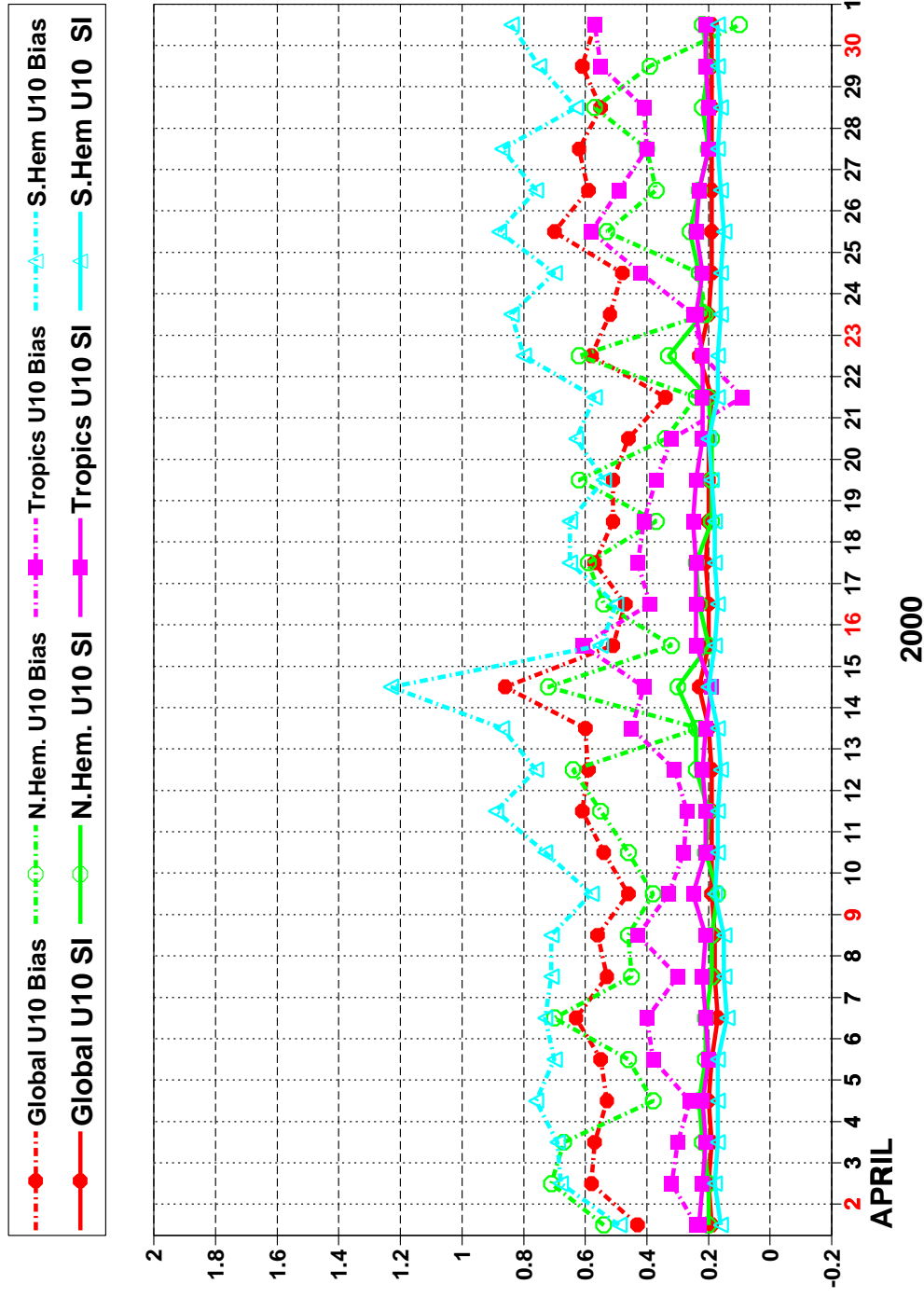


Figure 13: ERS-2 Altimeter wind speeds: Timeseries of bias (ERS-2 - model) and scatter index (SI)

# ECMWF Report on ERS-2 RA for April 2000

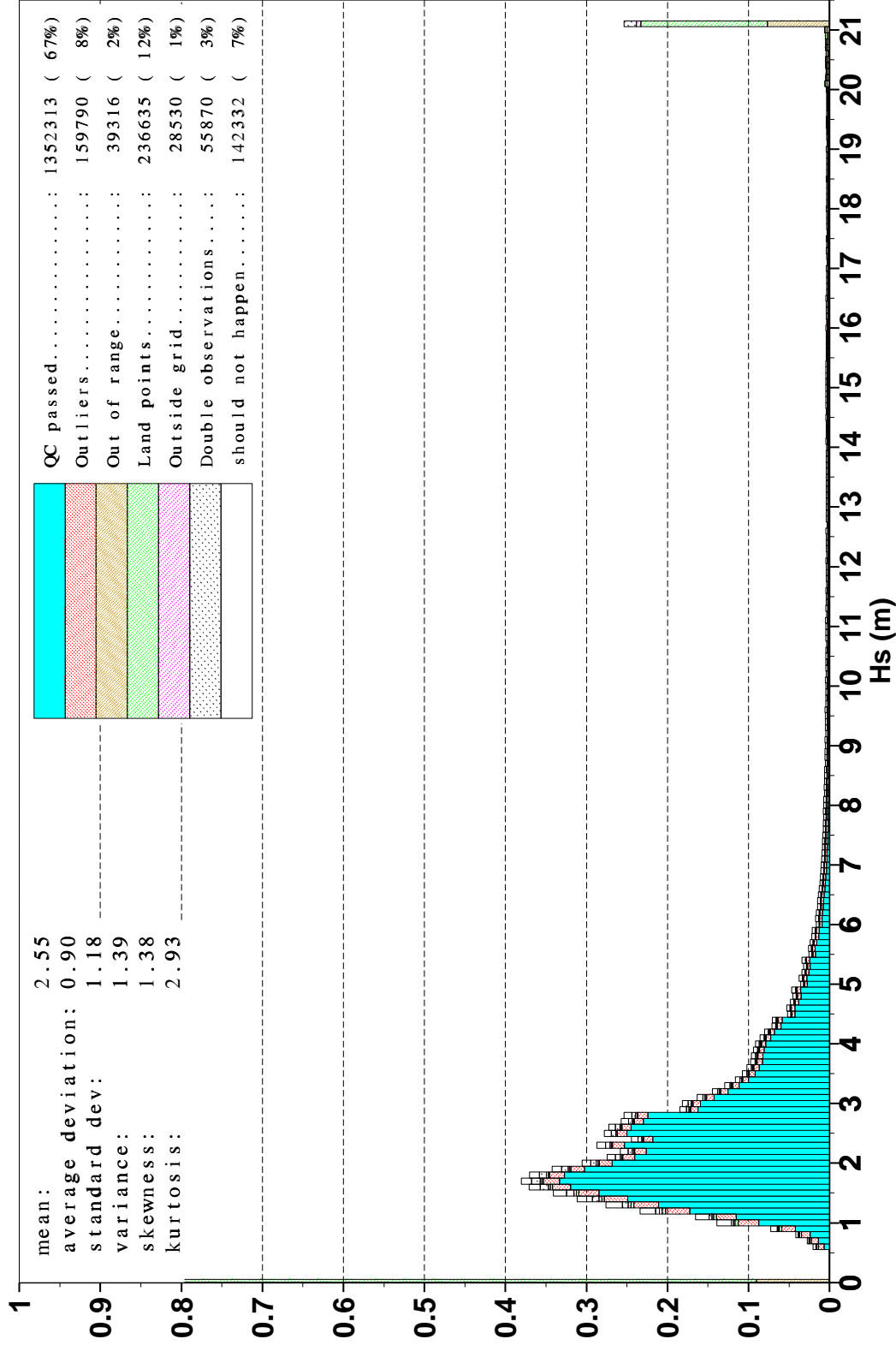


Figure 14: Distribution of the ERS-2 Altimeter wave heights after QC for April 2000

# ECMWF Report on ERS-2 RA for April 2000

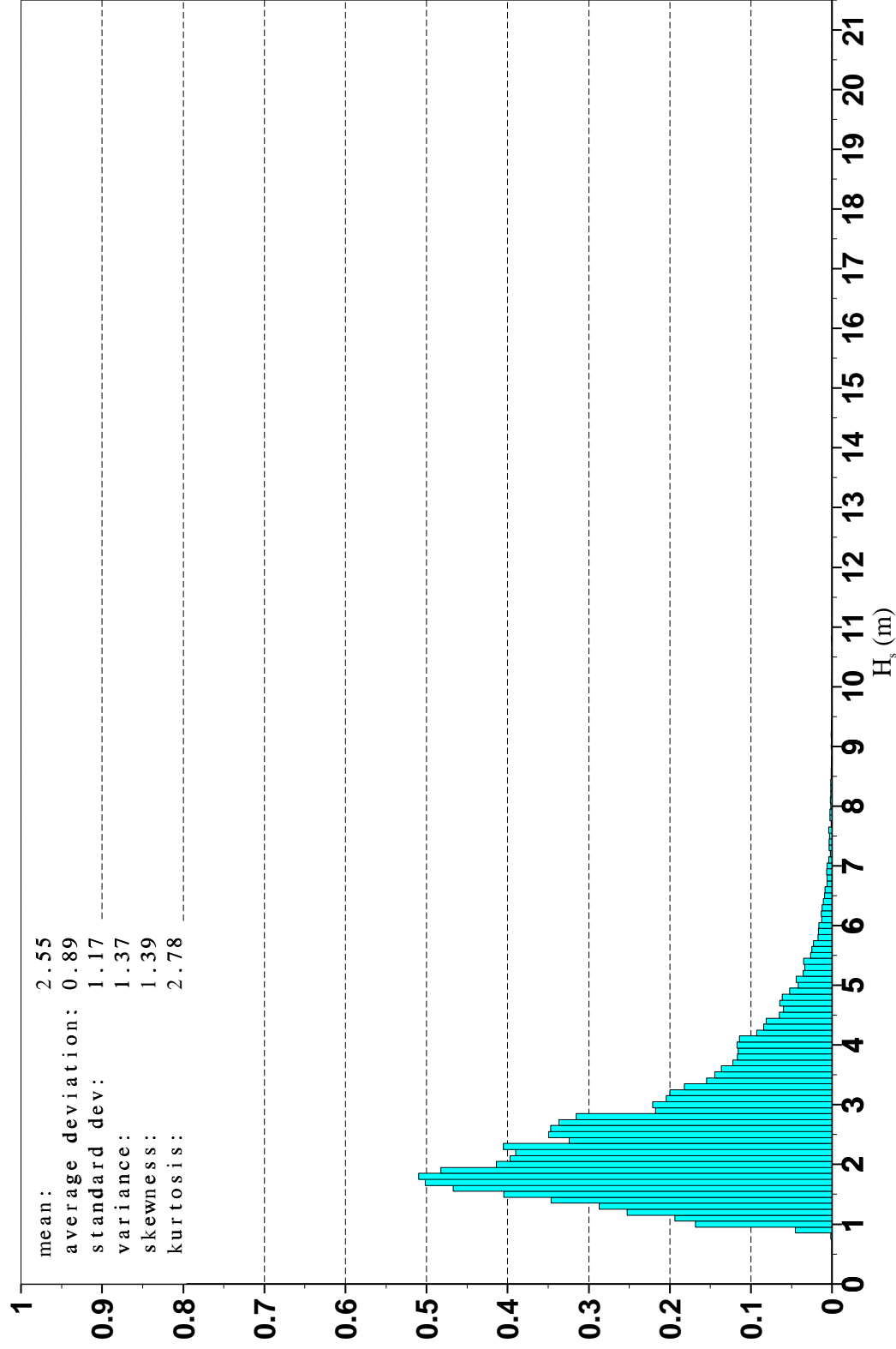


Figure 15: Distribution of ERS-2 Altimeter wave heights after along track averaging for April 2000

# ECMWF Report on ERS-2 RA for April 2000

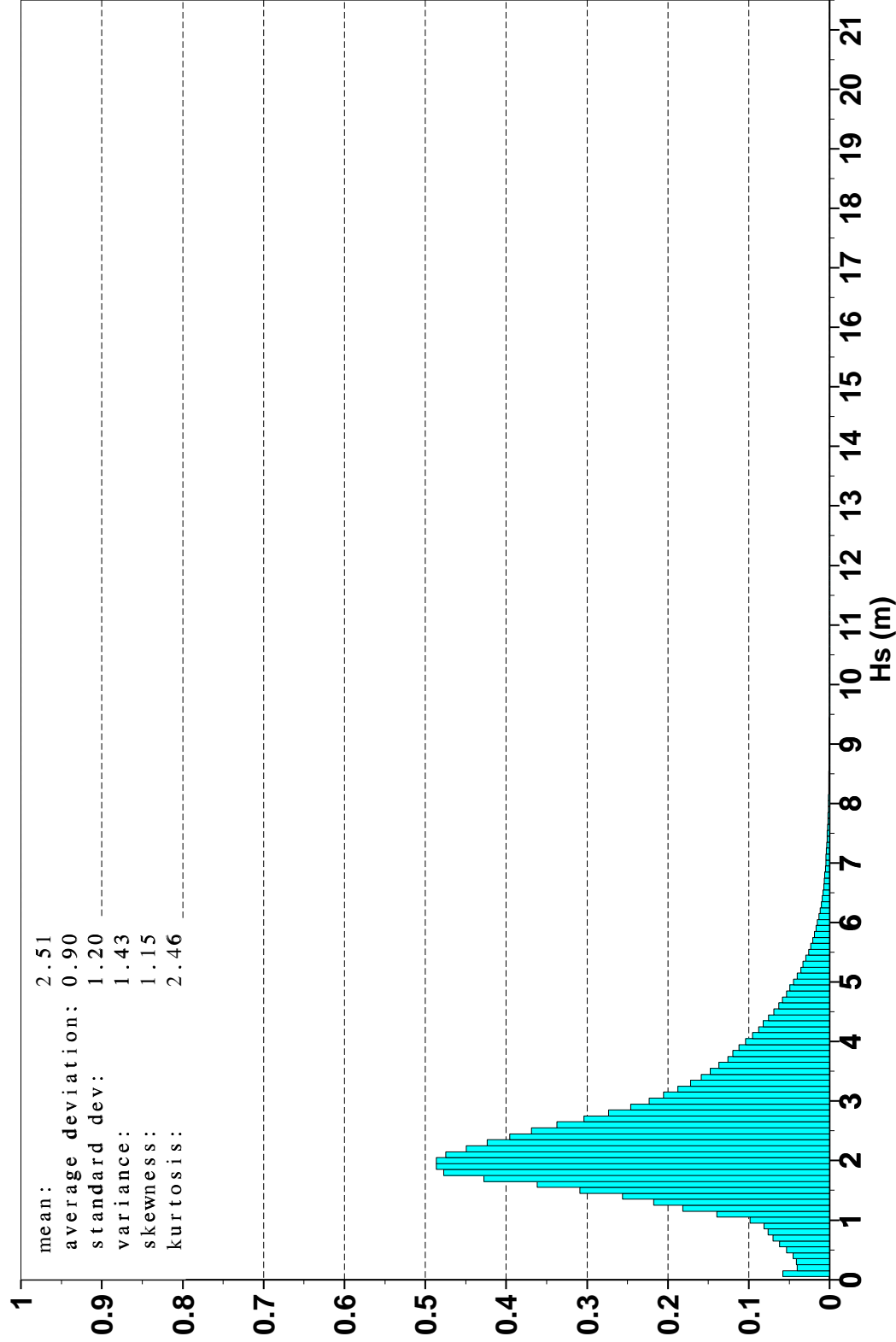
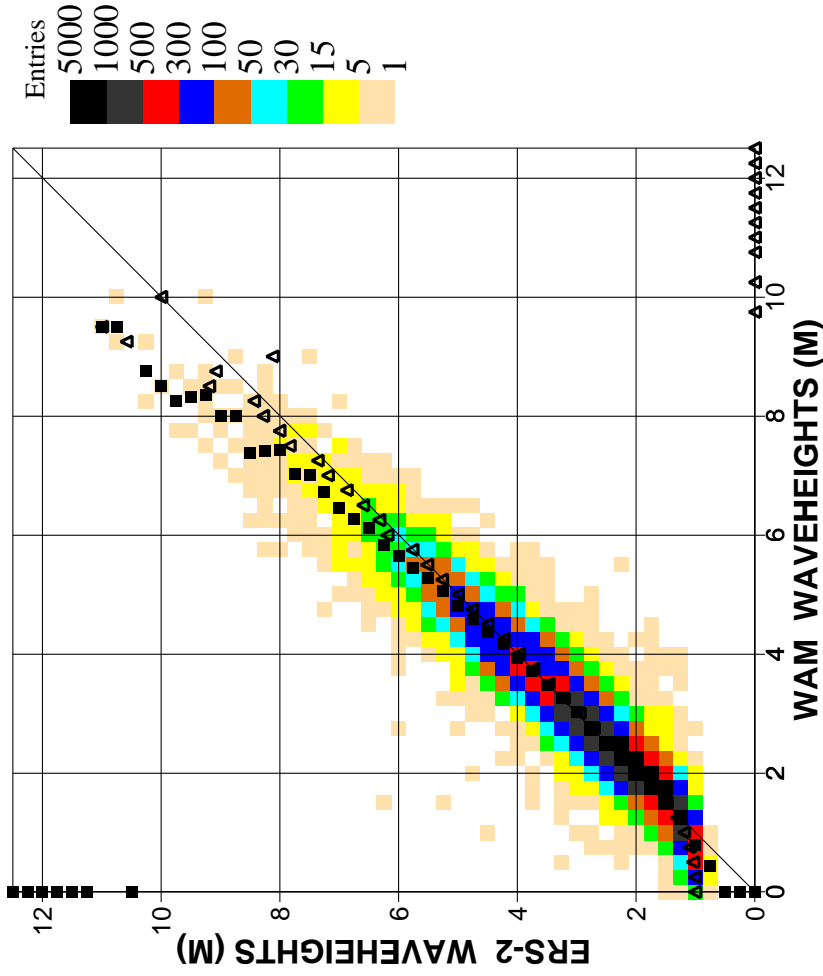


Figure 16: Global distribution of ECMWF wave heights for April 2000

# ECMWF Report on ERS-2 RA for April 2000



STATISTICS

ENTRIES	45523
MEAN WAM	2.5663
MEAN ERS-2	2.5542
BIAS (ERS-2 - WAM)	-0.0121
STANDARD DEVIATION	0.3213
SCATTER INDEX	0.1252
CORRELATION	0.9615
SYMMETRIC SLOPE	1.0011 (0.0013)
REGR. COEFFICIENT	0.9909 (0.0013)
REGR. CONSTANT	0.0114 (0.0037)

Figure 17. Comparison of ECMWF wave height results with ERS2 Altimeter wave height data for April 2000 (global)

# ECMWF Report on ERS-2 RA for April 2000

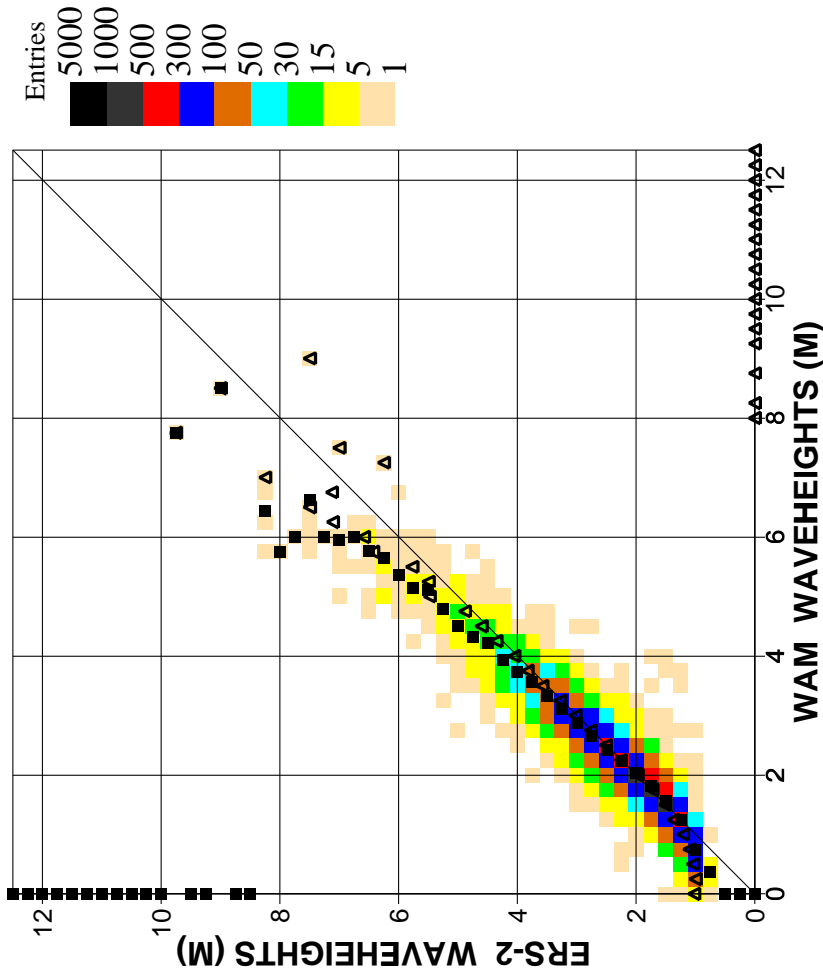


Figure 18. Comparison of ECMWF wave height results with ERS2 Altimeter wave height data for April 2000 (n.hem.)

# ECMWF Report on ERS-2 RA for April 2000

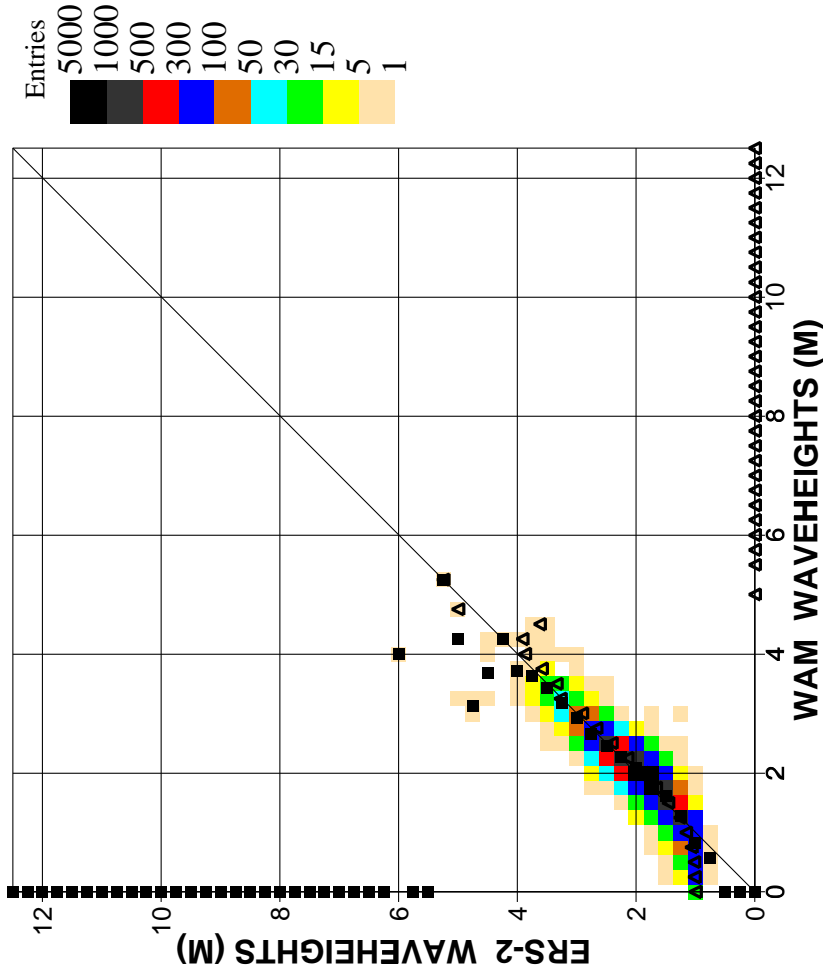
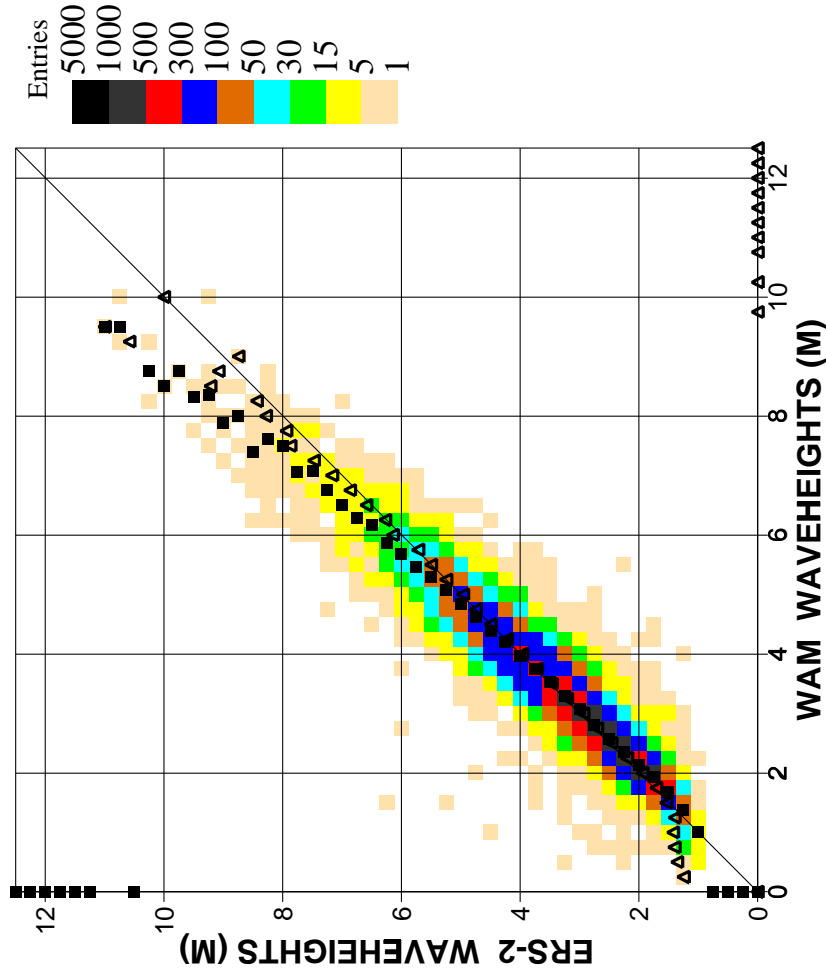


Figure 19. Comparison of ECMWF wave height results with ERS2 Altimeter wave height data for April 2000 (tropics)



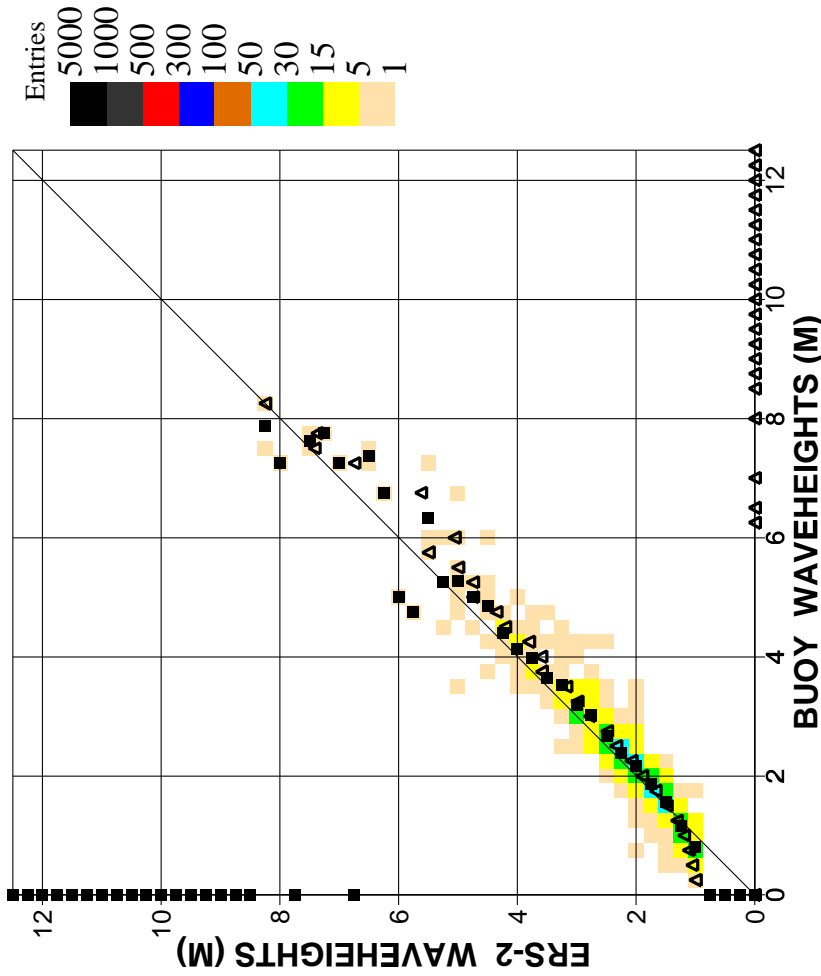
# ECMWF Report on ERS-2 RA for April 2000



## STATISTICS

ENTRIES	20892
MEAN WAM	3.2261
MEAN ERS-2	3.2004
BIAS (ERS-2 - WAM)	-0.0257
STANDARD DEVIATION	0.3651
SCATTER INDEX	0.1132
CORRELATION	0.9551
SYMMETRIC SLOPE	1.0006 (0.0022)
REGR. COEFFICIENT	1.0173 (0.0022)
REGR. CONSTANT	-0.0815 (0.0075)

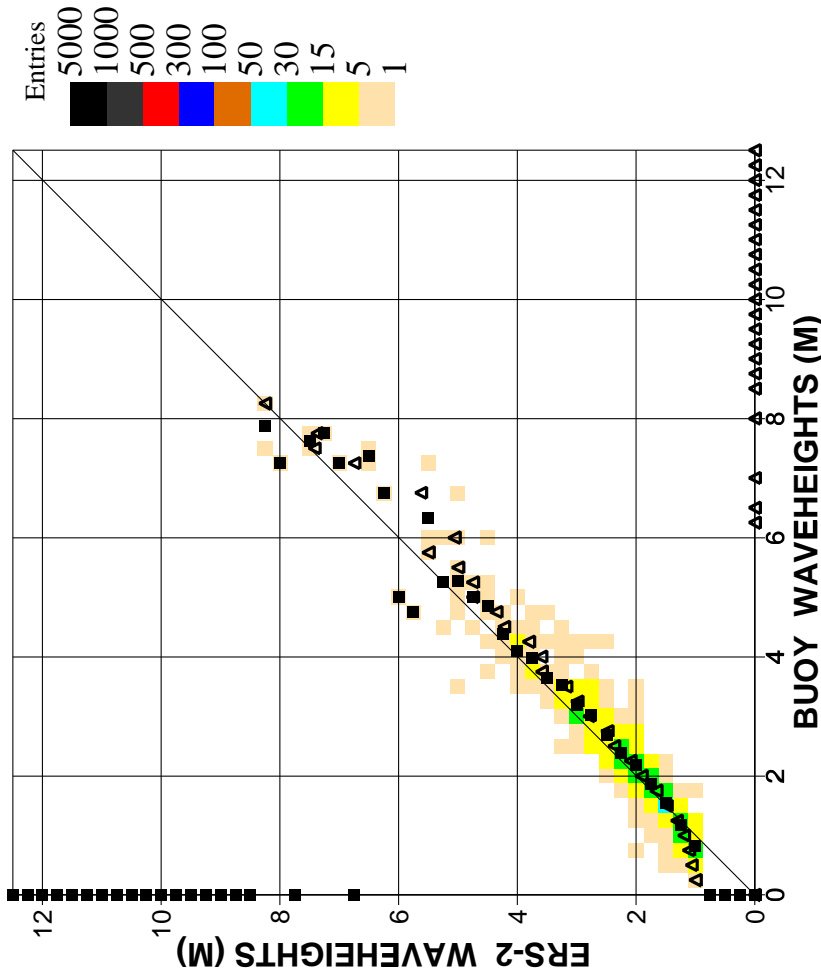
Figure 20. Comparison of ECMWF wave height results with ERS2 Altimeter wave height data for April 2000 (s.hem.)



STATISTICS

ENTRIES	735
MEAN BUOY	2.4001
MEAN ERS-2	2.2948
BIAS (ERS-2 - BUOY)	-0.1053
STANDARD DEVIATION	0.3656
SCATTER INDEX	0.1523
CORRELATION	0.9588
SYMMETRIC SLOPE	0.9432 (0.0099)
REGR. COEFFICIENT	0.8573 (0.0094)
REGR. CONSTANT	0.2371 (0.0254)

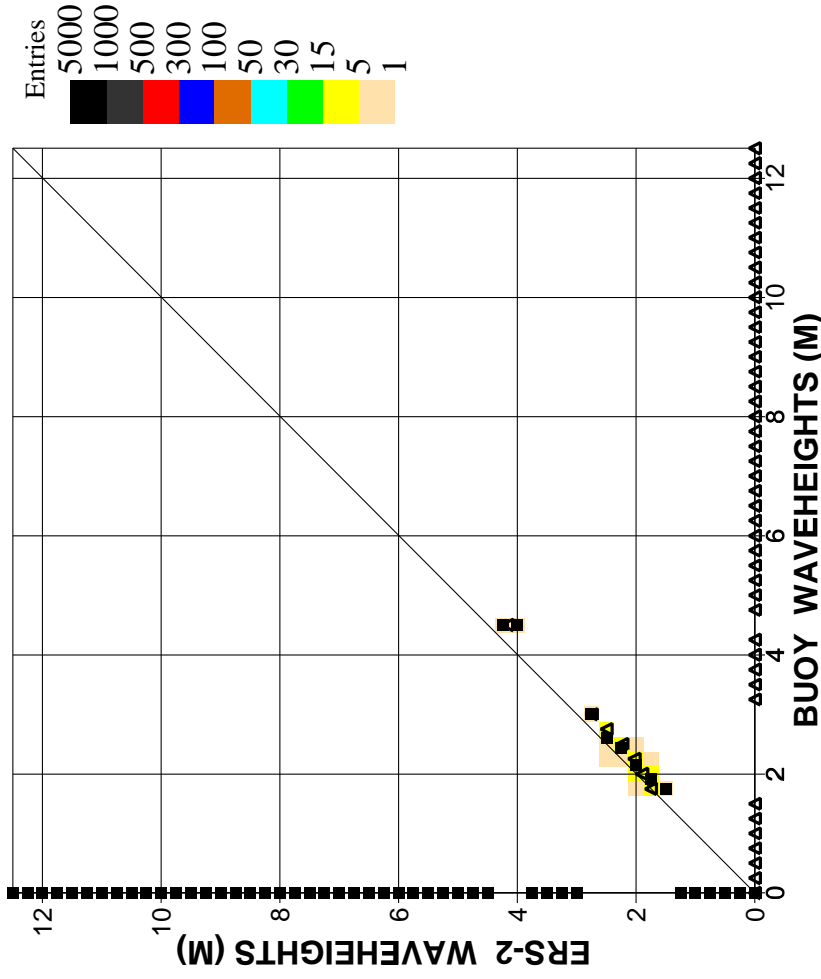
Figure 21. Comparison of buoy wave height observations with ERS2 Altimeter wave height data for April 2000 (global)



STATISTICS

ENTRIES	661
MEAN BUOY	2.4178
MEAN ERS-2	2.3177
BIAS (ERS-2 - BUOY)	-0.1001
STANDARD DEVIATION	0.3803
SCATTER INDEX	0.1573
CORRELATION	0.9588
SYMMETRIC SLOPE	0.9444 (0.0105)
REGR. COEFFICIENT	0.8571 (0.0099)
REGR. CONSTANT	0.2453 (0.0272)

Figure 22. Comparison of buoy wave height observations with ERS2 Altimeter wave height data for April 2000 (n.hem.)



STATISTICS	
ENTRIES	67
MEAN BUOY	2.3116
MEAN ERS-2	2.1448
BIAS (ERS-2 - BUOY)	-0.1668
STANDARD DEVIATION	0.1442
SCATTER INDEX	0.0624
CORRELATION	0.9673
SYMMETRIC SLOPE	0.9281 (0.0295)
REGR. COEFFICIENT	0.9011 (0.0293)
REGR. CONSTANT	0.0618 (0.0697)

Figure 23. Comparison of buoy wave height observations with ERS2 Altimeter wave height data for April 2000 (hawaii)

# ECMWF Report on ERS-2 RA for April 2000

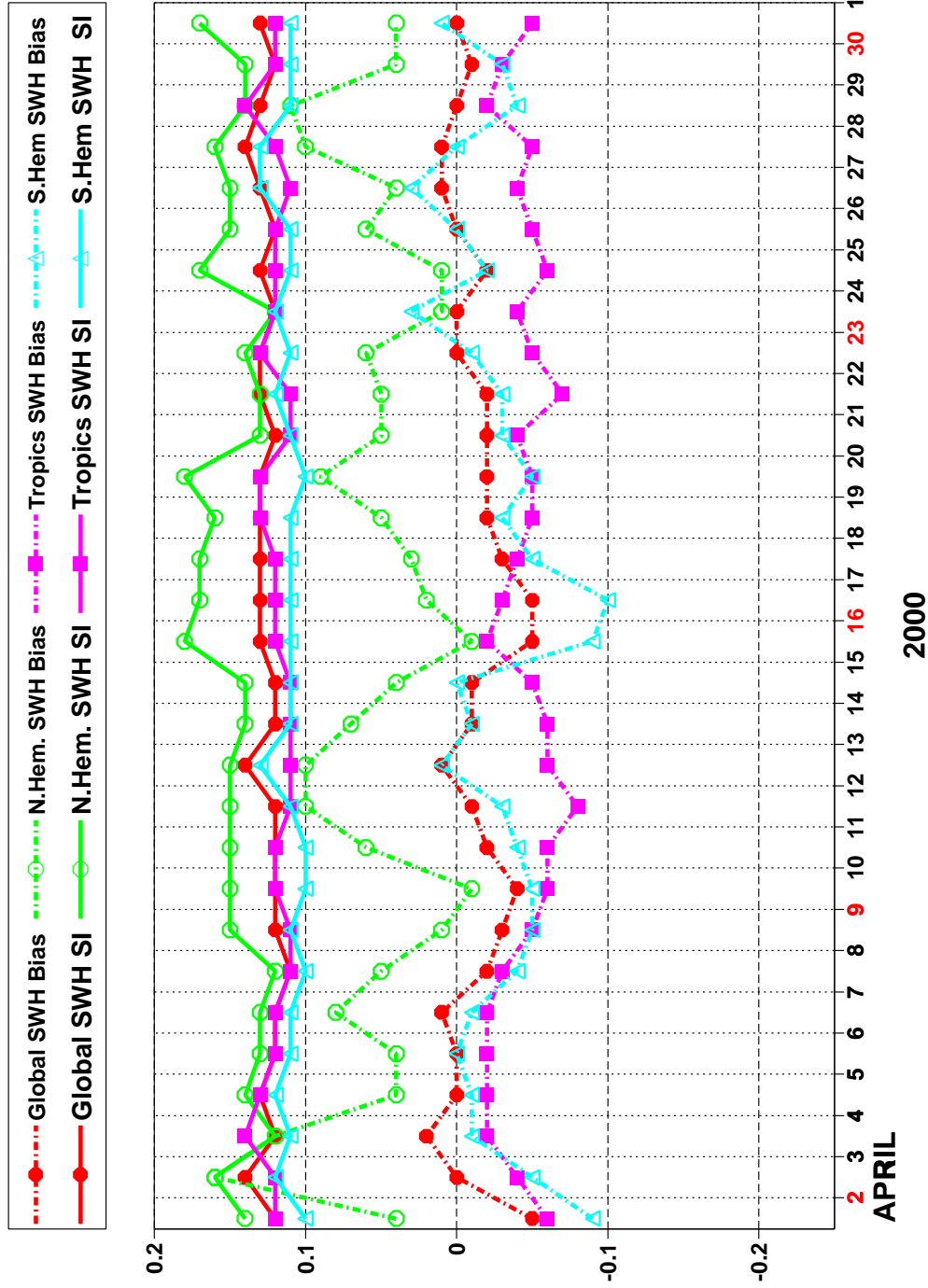


Figure 24: ERS-2 Altimeter wave heights: Timeseries of bias (ERS-2 - model) and scatter index (SI)

# ECMWF Report on ERS-2 RA for April 2000

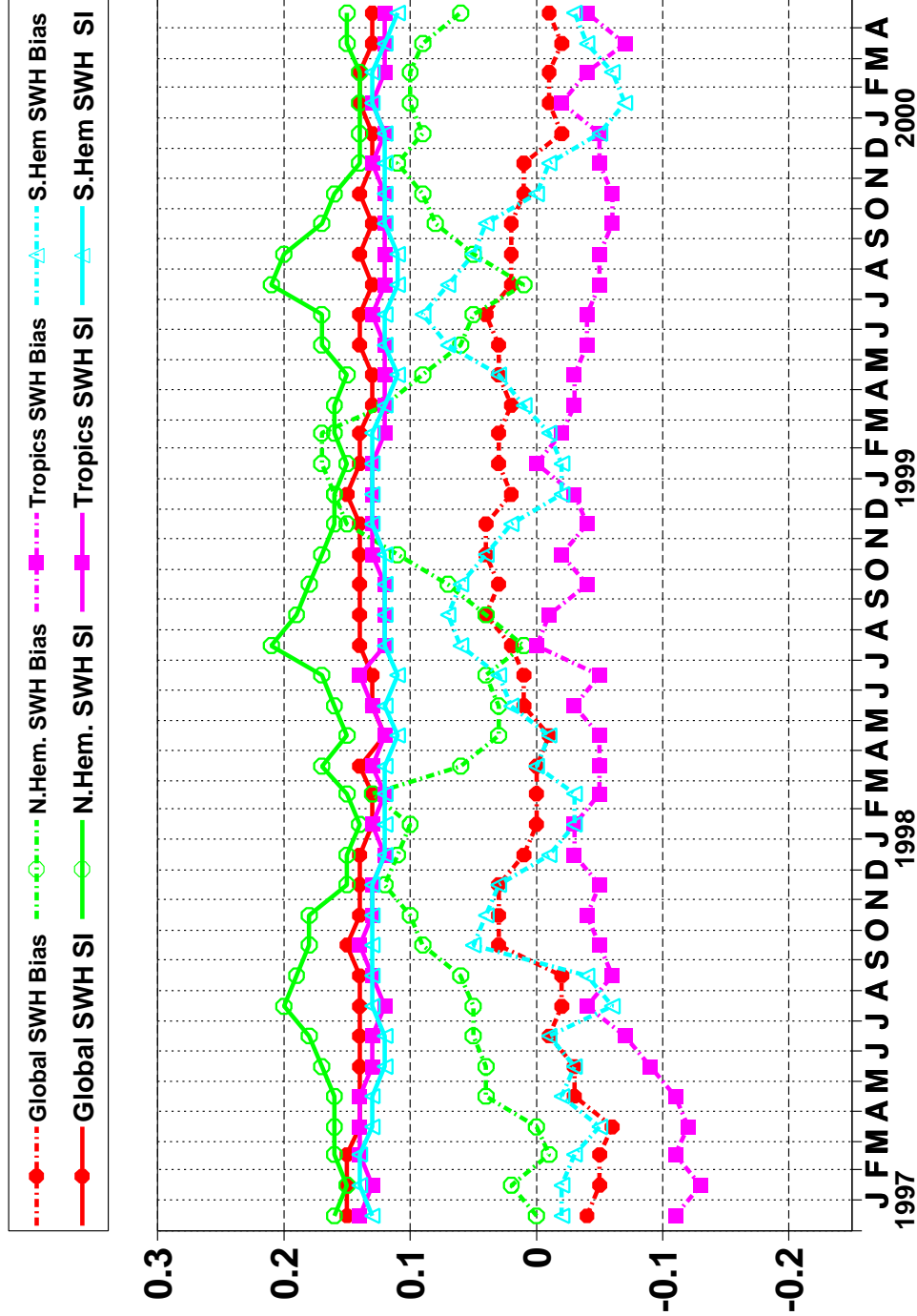


Figure 25: ERS-2 Altimeter wave heights: Timeseries of bias (ERS-2 - mode1) and scatter index (SI)

# ECMWF Report on ERS-2 RA for April 2000

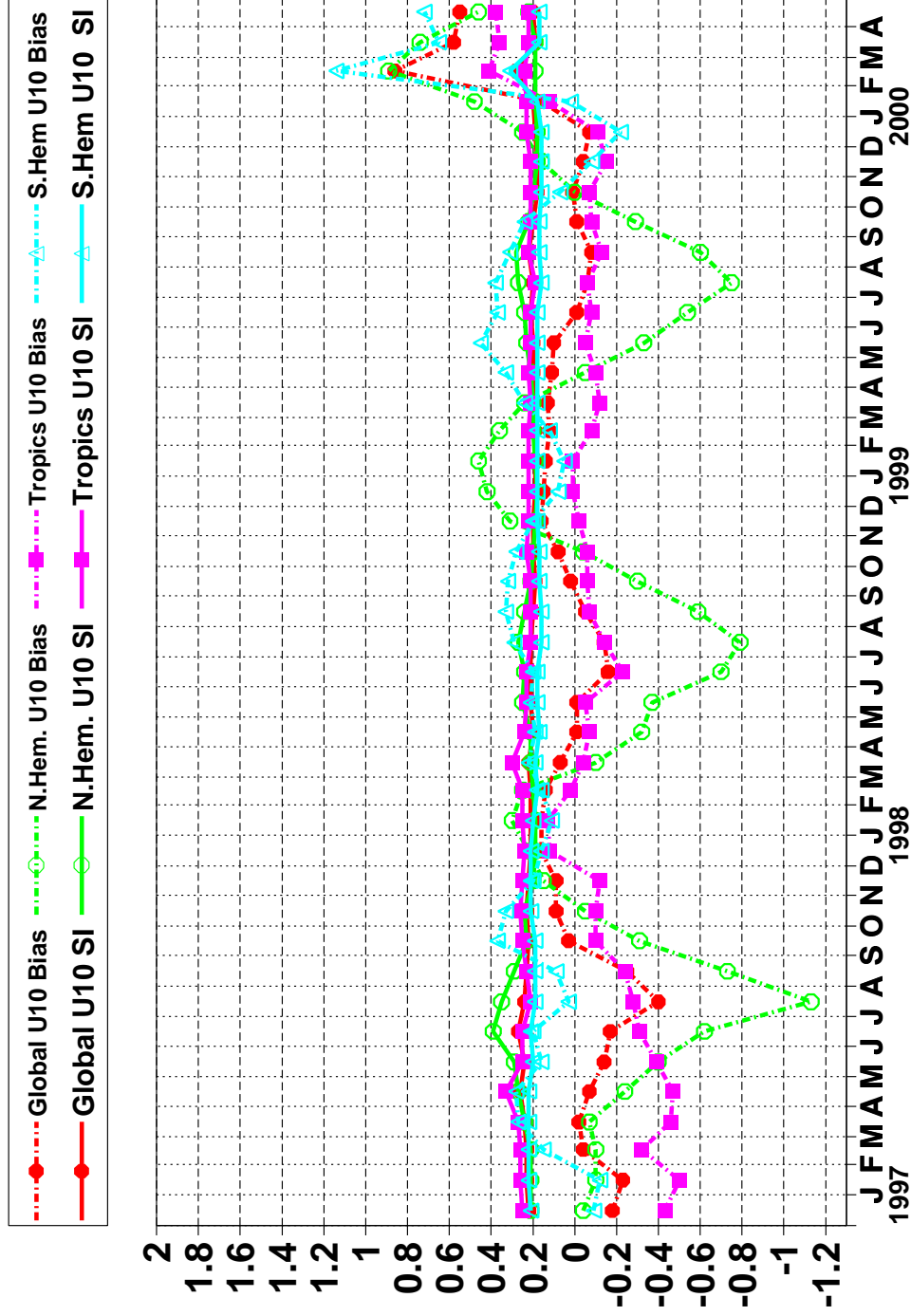


Figure 26: ERS-2 Altimeter wind speeds: Timeseries of bias (ERS-2 - model) and scatter index (SI)