

■ ECMWF Report on ERS-2 RA for August 2000 ■

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

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Date: 8 September 2000

Overview:

This month around 14023 observations arrived at ECMWF every 6 hours of which 78.56% passed the quality control. Data coverage was slightly reduced only twice (see figure 1), otherwise the coverage was good. Note that we are talking about data which have arrived at ECMWF before they were needed for the operational data assimilation.

Backscatter:

ERS-2 $\langle \sigma_0 \rangle = 11$ dB (large peak around 11 dB)

Wind Speed Comparison with ECMWF wind speeds (bias):

ERS-2 global: 0.447 m/s

ERS-2 northern hemisphere: -0.032 m/s

ERS-2 tropics: 0.428 m/s

ERS-2 southern hemisphere: 0.788 m/s

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Wind Speed Comparison with buoy wind speeds (bias):

ERS-2 global: -0.51 m/s
ERS-2 northern hemisphere: -0.52 m/s
ERS-2 tropics: -0.53 m/s

Wave Height Comparison with ECMWF wave heights (bias):

ERS-2 global: 0.008 m (lowest waves measured: 0.6m)
ERS-2 northern hemisphere: 0.077 m
ERS-2 tropics: -0.048 m
ERS-2 southern hemisphere: 0.003 m

Wave Height Comparison with buoy wave heights (bias):

ERS-2 global: 0.0 m
ERS-2 northern hemisphere: 0.02 m
ERS-2 tropics: -0.20 m

Remarks:

The Altimeter worked normally.

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.

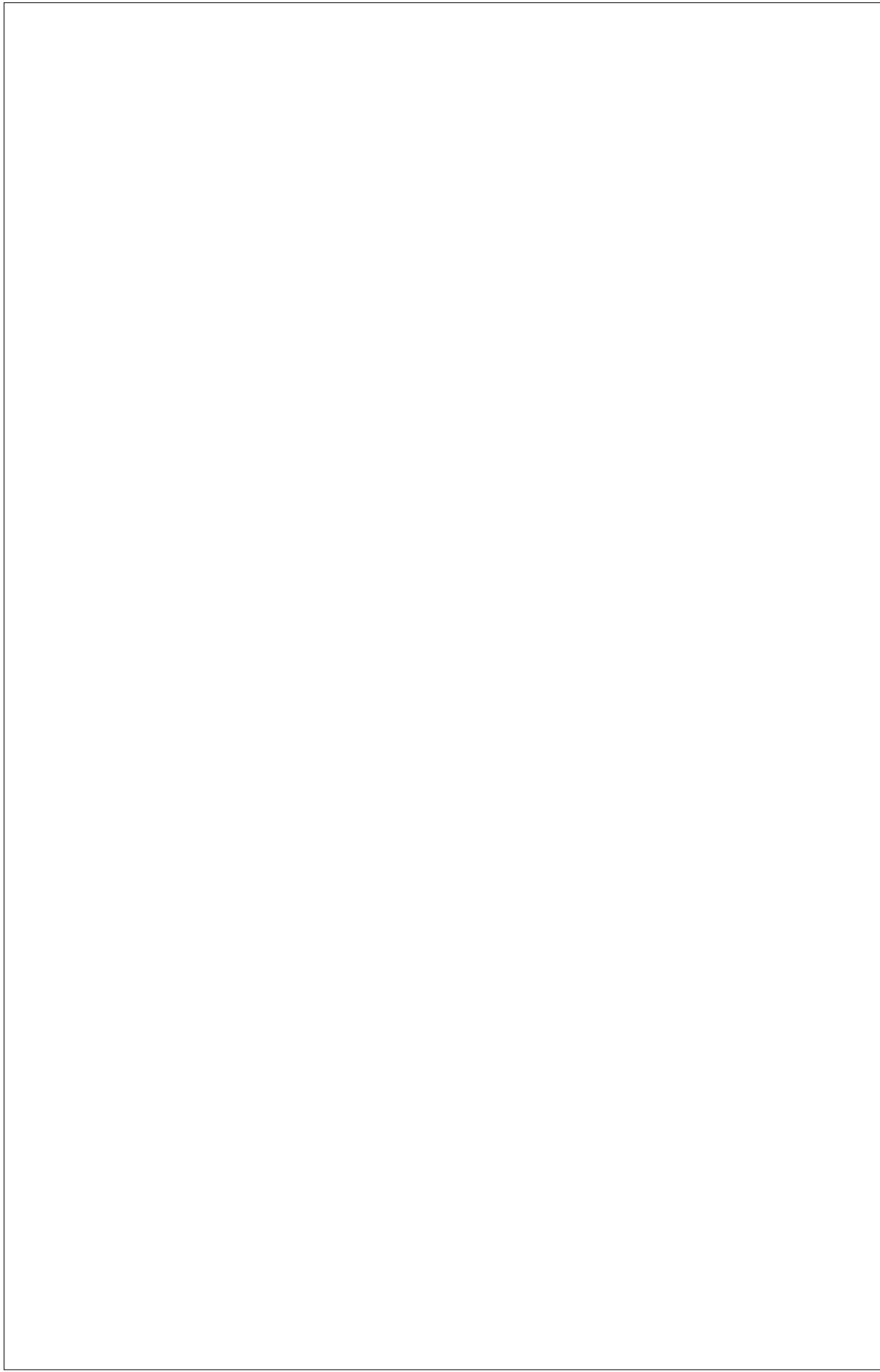
Figure captions:

- Figure 1: Time series of data reception for ERS-2 Altimeter data for August 2000.
- Figure 2: Distribution of the ERS-2 Altimeter Backscatter after QC for August 2000.
- Figure 3: Distribution of the ERS-2 Altimeter wind speeds after QC for August 2000.
- Figure 4: Distribution of the ERS-2 Altimeter wind speeds after along track averaging for August 2000.
- Figure 5: Global distribution of ECMWF ocean surface wind speeds for August 2000.
- Figure 6: Comparison of ECMWF wind speed results with ERS-2 Altimeter wind speed data for August 2000 (global).
- Figure 7: Comparison of ECMWF wind speed results with ERS-2 Altimeter wind speed data for August 2000 (northern hemisphere)
- Figure 8: Comparison of ECMWF wind speed results with ERS-2 Altimeter wind speed data for August 2000 (tropics)
- Figure 9: Comparison of ECMWF wind speed results with ERS-2 Altimeter wind speed data for August 2000 (southern hemisphere)
- Figure 10: Comparison of buoy wind speed observations with ERS-2 Altimeter wind speed data for August 2000 (global).
- Figure 11: Comparison of buoy wind speed observations with ERS-2 Altimeter wind speed data for August 2000 (northern hemisphere).

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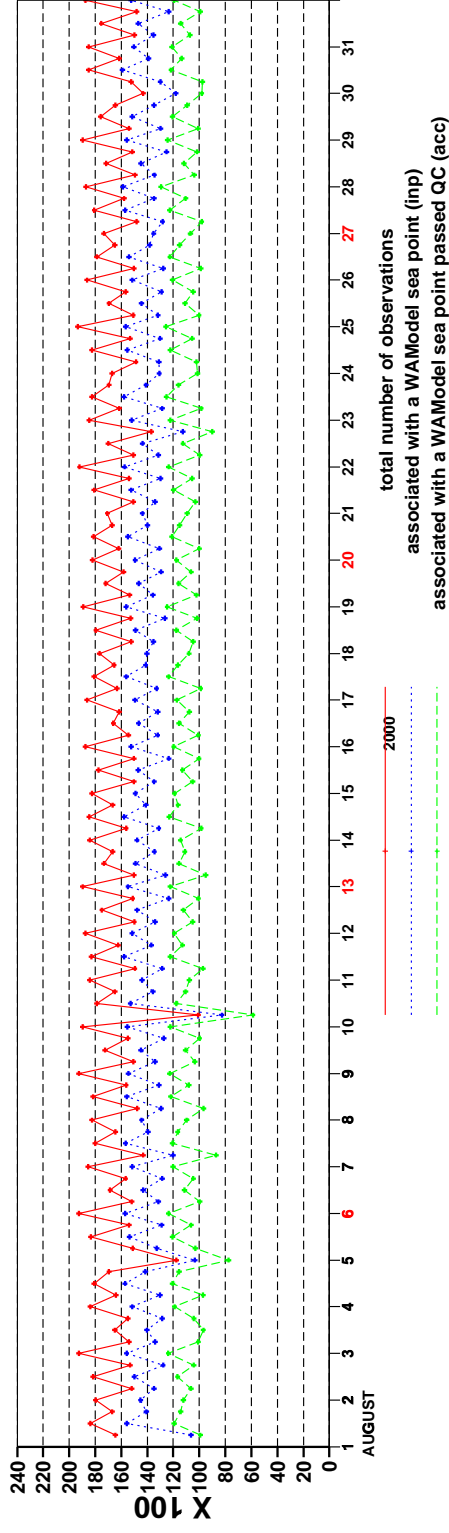
- Figure 12: Comparison of buoy wind speed observations with ERS-2 Altimeter wind speed data for August 2000 (tropics).
- Figure 13: ERS-2 Altimeter wind speeds: Timeseries of bias (ERS-2 - model) and scatter index (SI).
- Figure 14: Distribution of the ERS-2 Altimeter wave heights after QC for August 2000.
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- Figure 17: Comparison of ECMWF wave height results with ERS-2 Altimeter wave height data for August 2000 (global).
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- Figure 24: ERS-2 Altimeter wave heights: Timeseries of bias (ERS-2 - model) and scatter index (SI) for August 2000.
- Figure 25: ERS-2 Altimeter wave heights: Timeseries of bias (ERS-2 - model) and scatter index (SI) from December 1996 to August 2000
- Figure 26: ERS-2 Altimeter wind speeds: Timeseries of bias (ERS-2 - model) and scatter index (SI) from December 1996 to August 2000

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ERS 2/ALTIMETER: NUMBER OF OBS, GLOBAL.



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

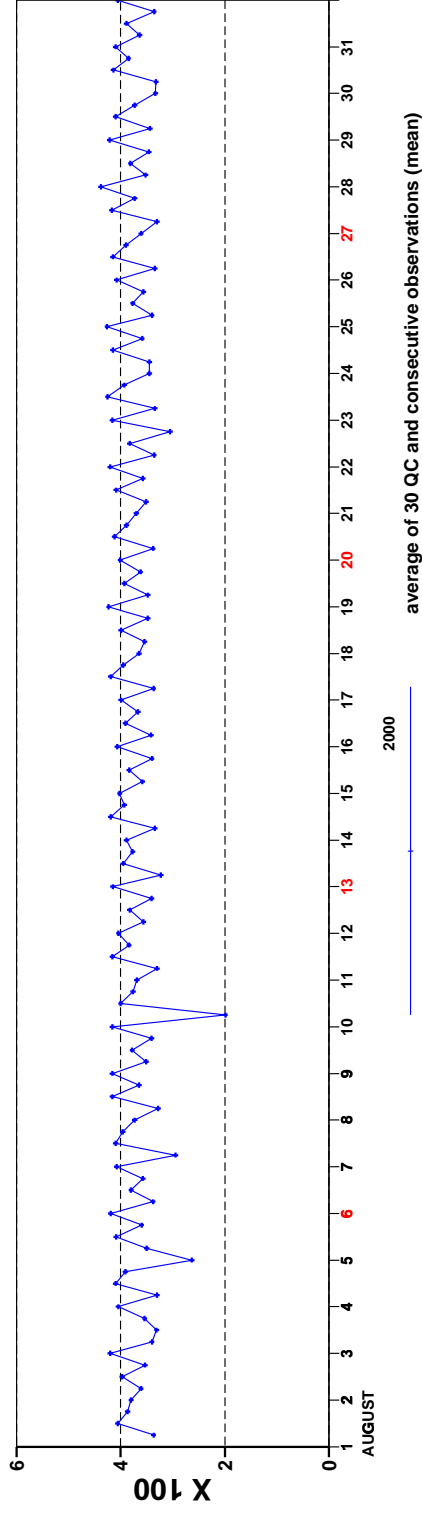


Figure 1: Time series of data reception for ERS-2 Altimeter data for August 2000

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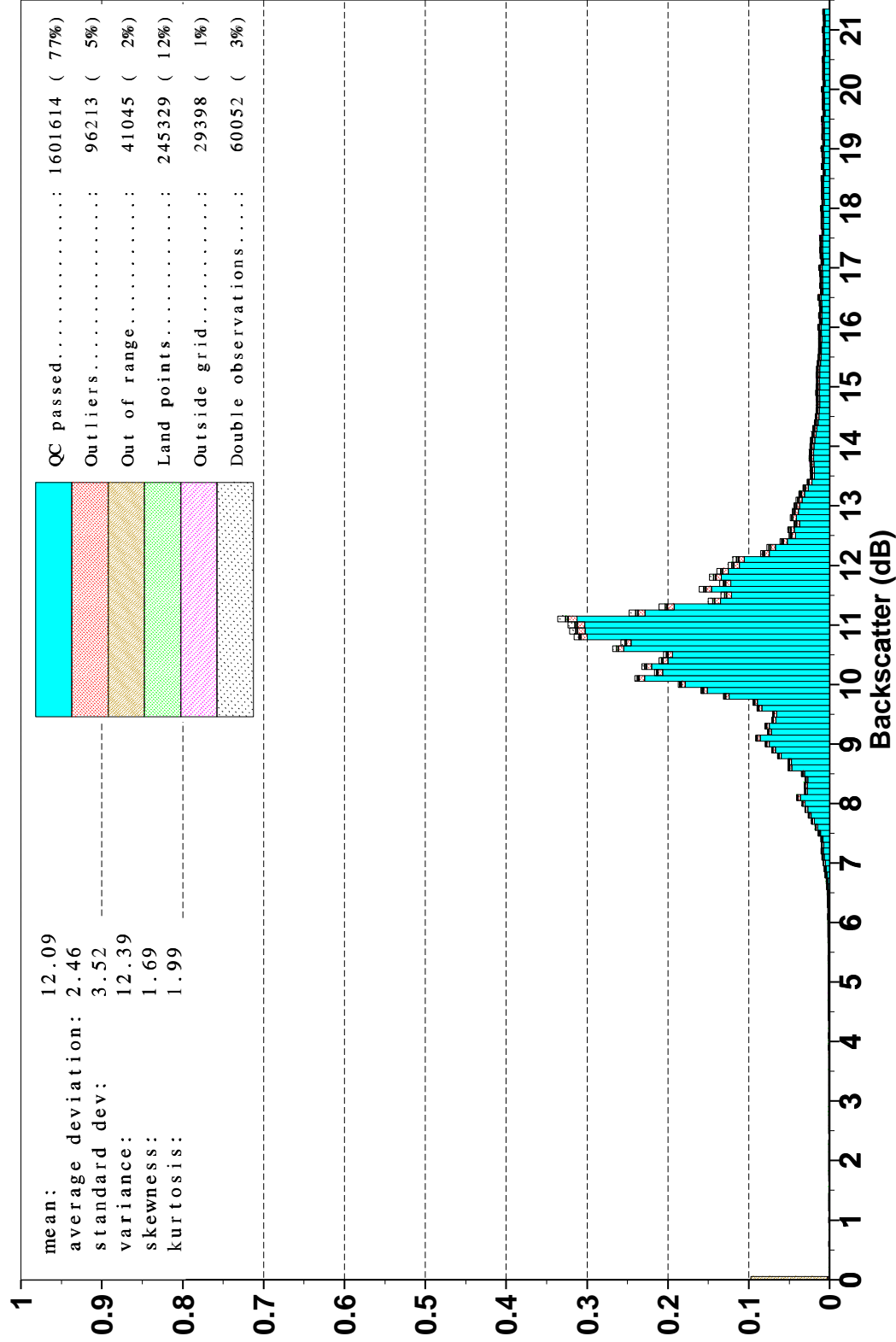


Figure 2: Distribution of the ERS-2 Altimeter backscatter after QC for August 2000

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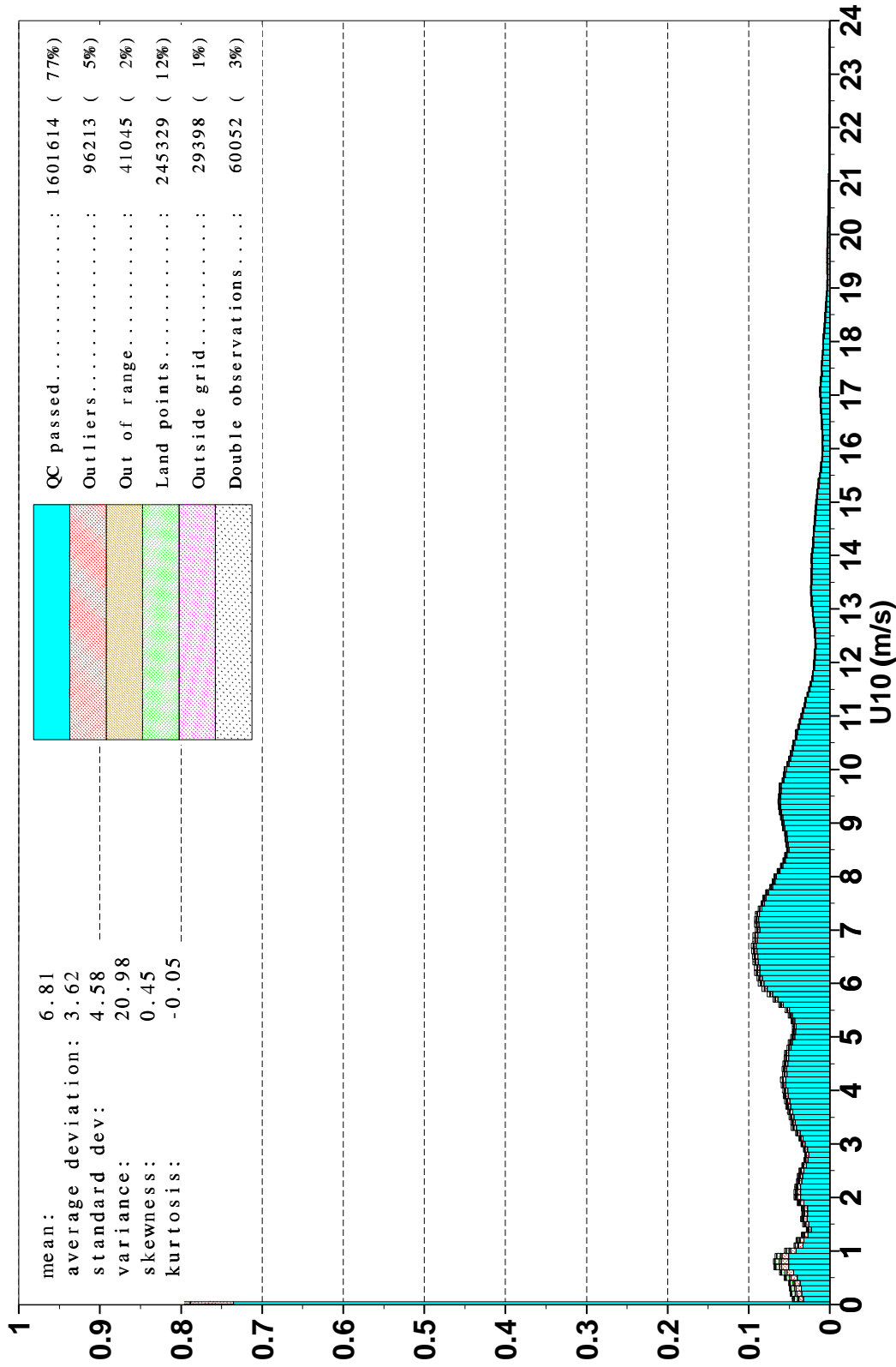


Figure 3: Distribution of the ERS-2 Altimeter wind speeds after QC for August 2000

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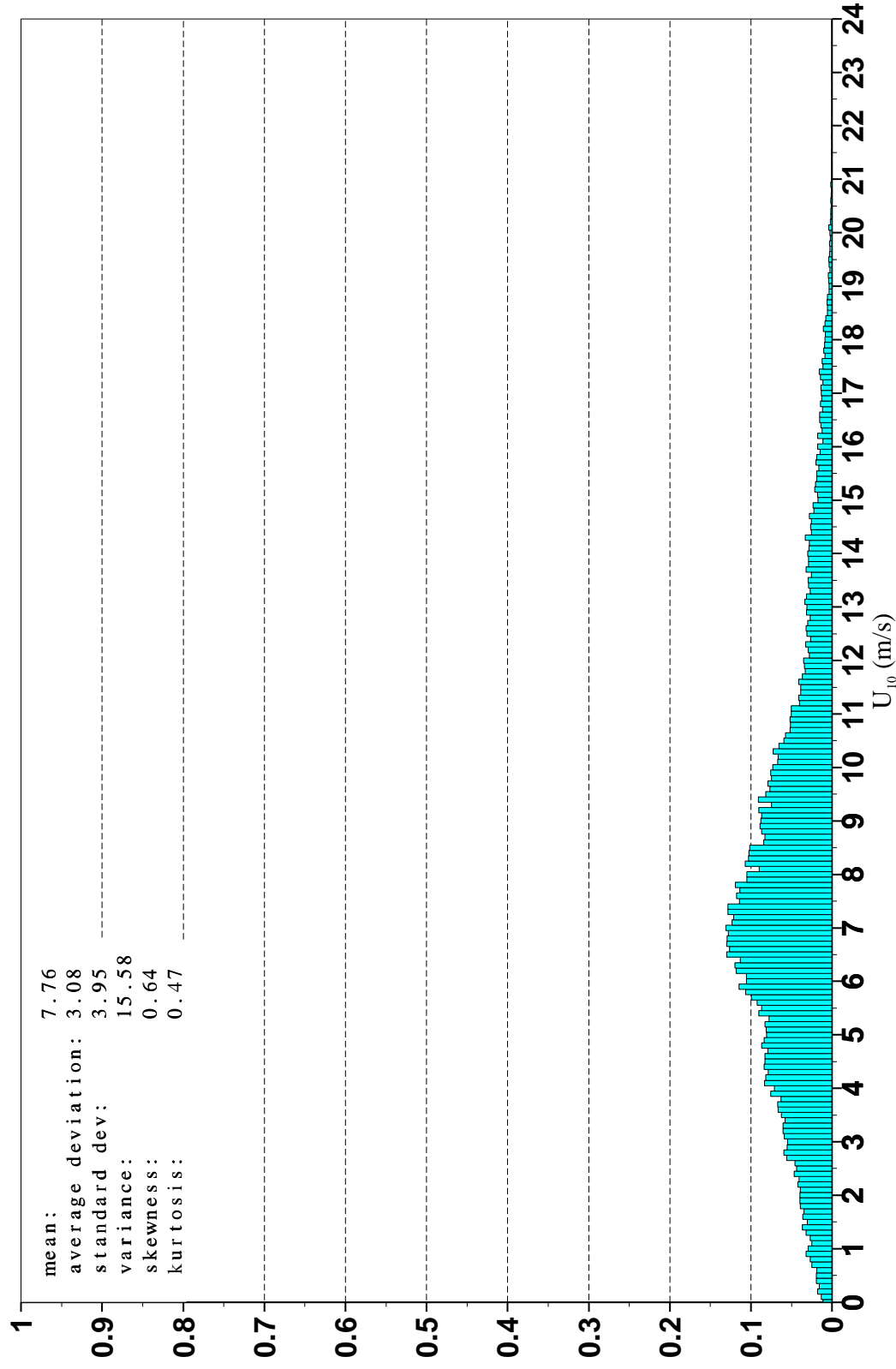


Figure 4: Distribution of ERS-2 Altimeter wind speeds after along track averaging for August 2000

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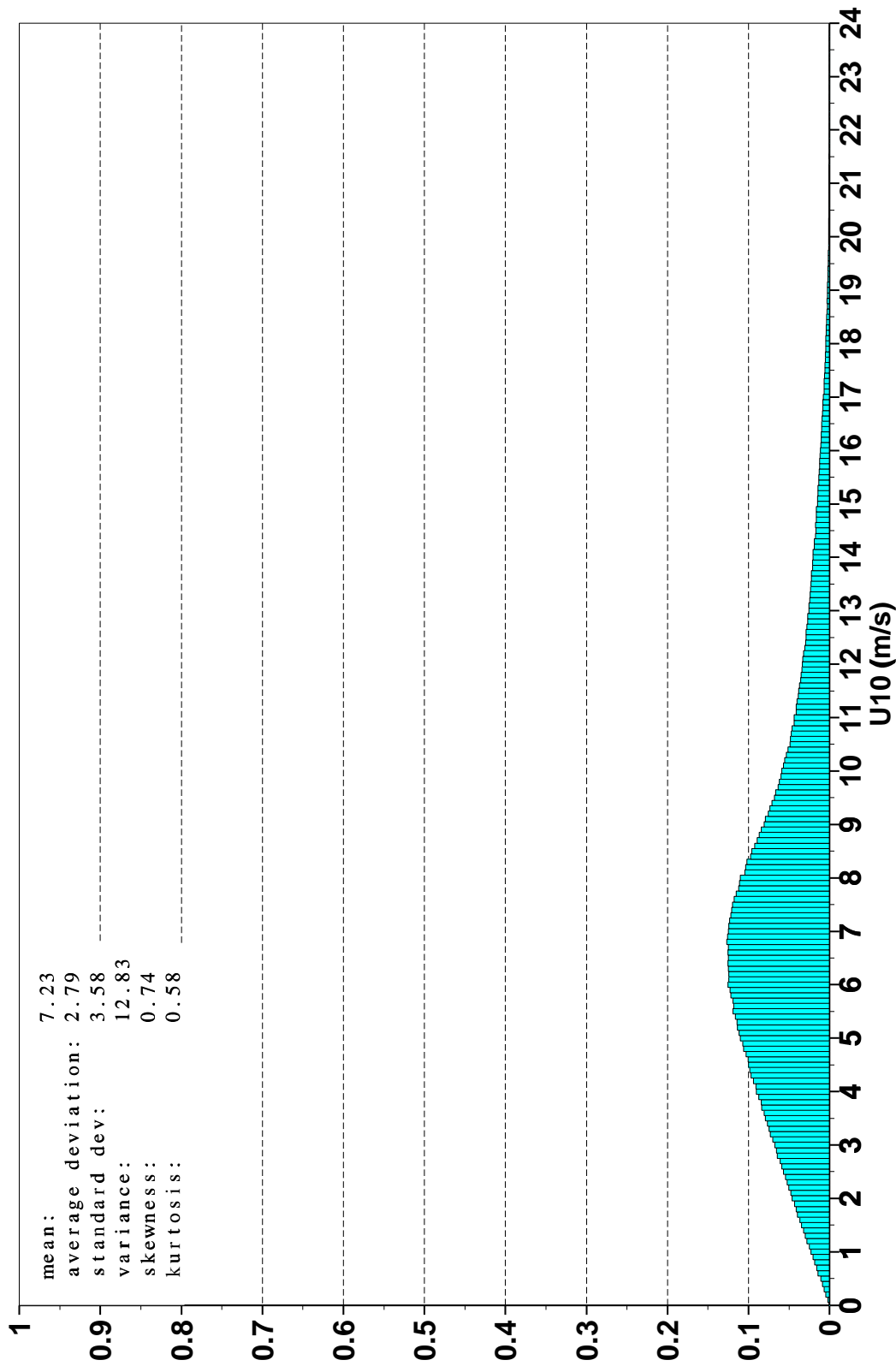
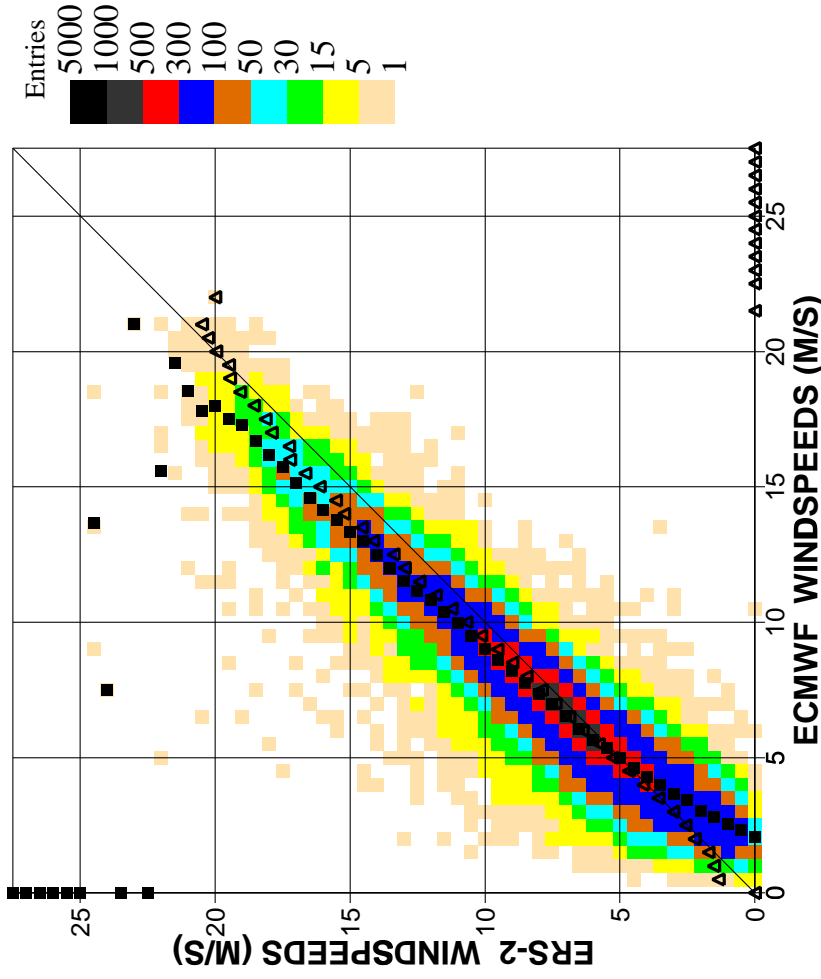


Figure 5: Global distribution of ECMWF ocean surface wind speeds for August 2000

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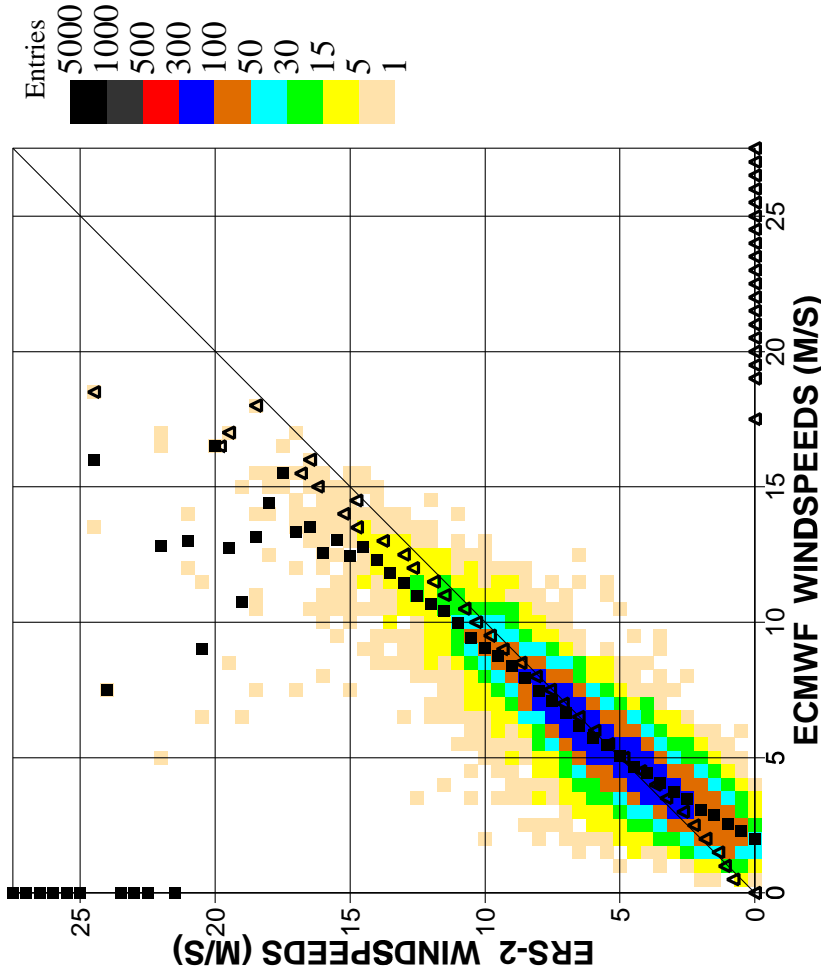


STATISTICS

ENTRIES	46144
MEAN ECMWF	7.3099
MEAN ERS-2	7.7569
BIAS (ERS-2 - ECMWF)	0.4469
STANDARD DEVIATION	1.4794
SCATTER INDEX	0.2024
CORRELATION	0.9296
SYMMETRIC SLOPE	1.0794 (0.0020)
REGR. COEFFICIENT	1.0784 (0.0020)
REGR. CONSTANT	-0.1260 (0.0161)

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

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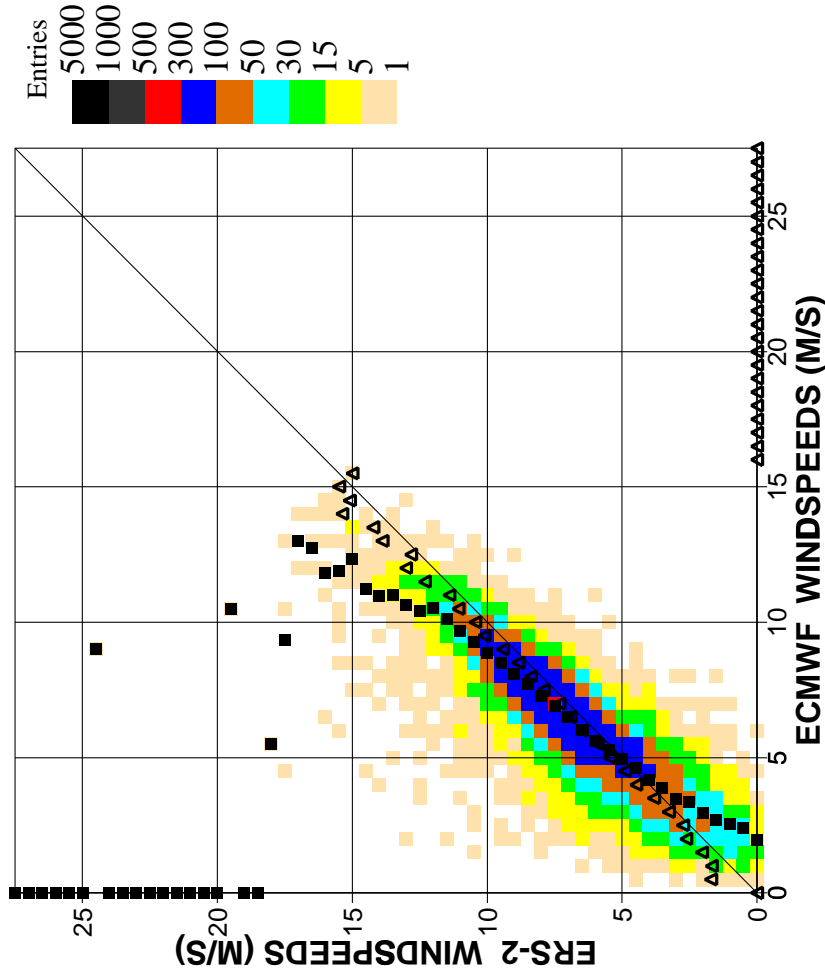


STATISTICS

ENTRIES	12865
MEAN ECMWF	5.7658
MEAN ERS-2	5.7343
BIAS (ERS-2 - ECMWF)	-0.0315
STANDARD DEVIATION	1.3937
SCATTER INDEX	0.2417
CORRELATION	0.8938
SYMMETRIC SLOPE	1.0339 (0.0049)
REGR. COEFFICIENT	1.0911 (0.0048)
REGR. CONSTANT	-0.5569 (0.0304)

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

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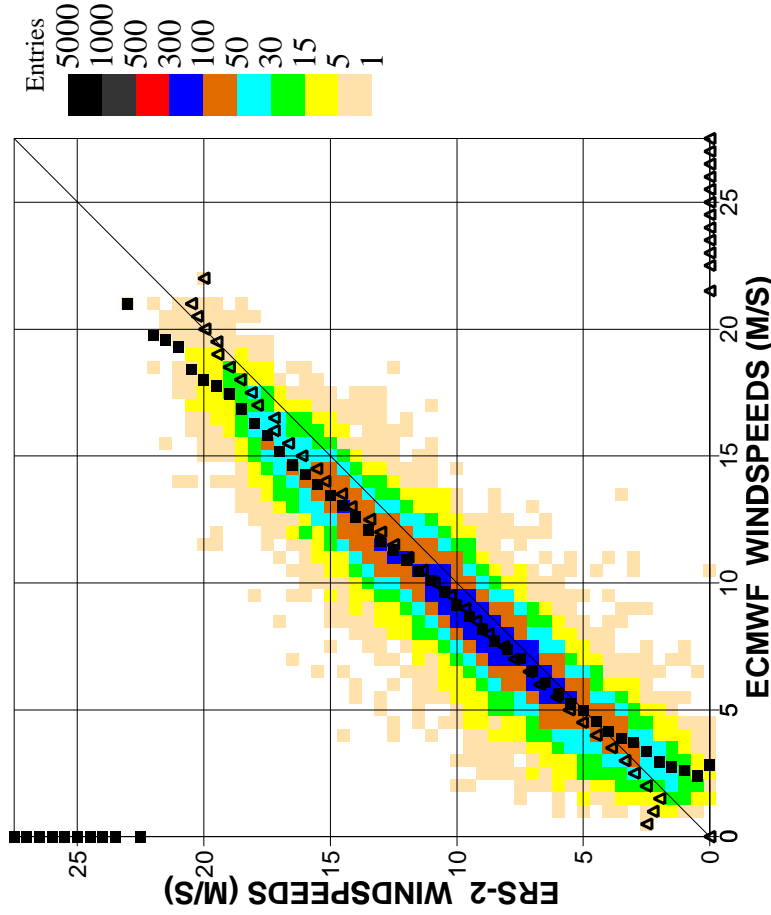


STATISTICS

ENTRIES	14863
MEAN ECMWF	6.3330
MEAN ERS-2	6.7605
BIAS (ERS-2 - ECMWF)	0.4275
STANDARD DEVIATION	1.4141
SCATTER INDEX	0.2233
CORRELATION	0.8477
SYMMETRIC SLOPE	1.0824 (0.0052)
REGR. COEFFICIENT	1.0137 (0.0052)
REGR. CONSTANT	0.3407 (0.0349)

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

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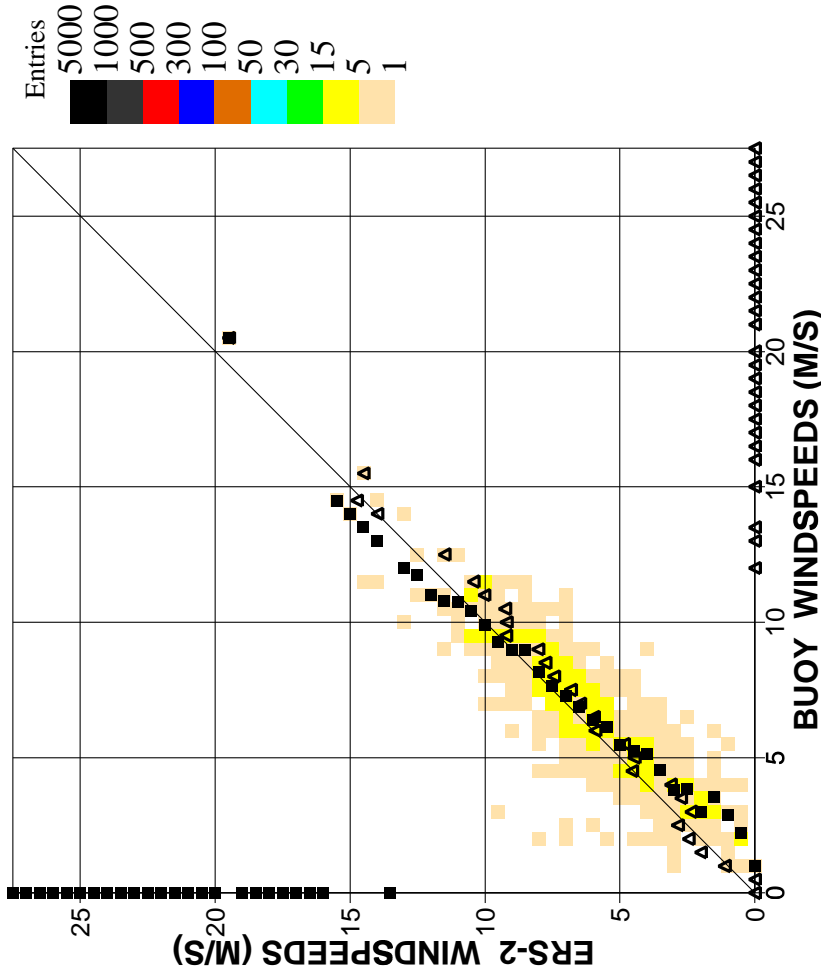


STATISTICS.

ENTRIES	18767
MEAN ECMWF	9.1284
MEAN ERS-2	9.9167
BIAS (ERS-2 - ECMWF)	0.7883
STANDARD DEVIATION	1.4896
SCATTER INDEX	0.1632
CORRELATION	0.9376
SYMMETRIC SLOPE	1.0905 (0.0028)
REGR. COEFFICIENT	1.0442 (0.0028)
REGR. CONSTANT	0.3851 (0.0280)

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

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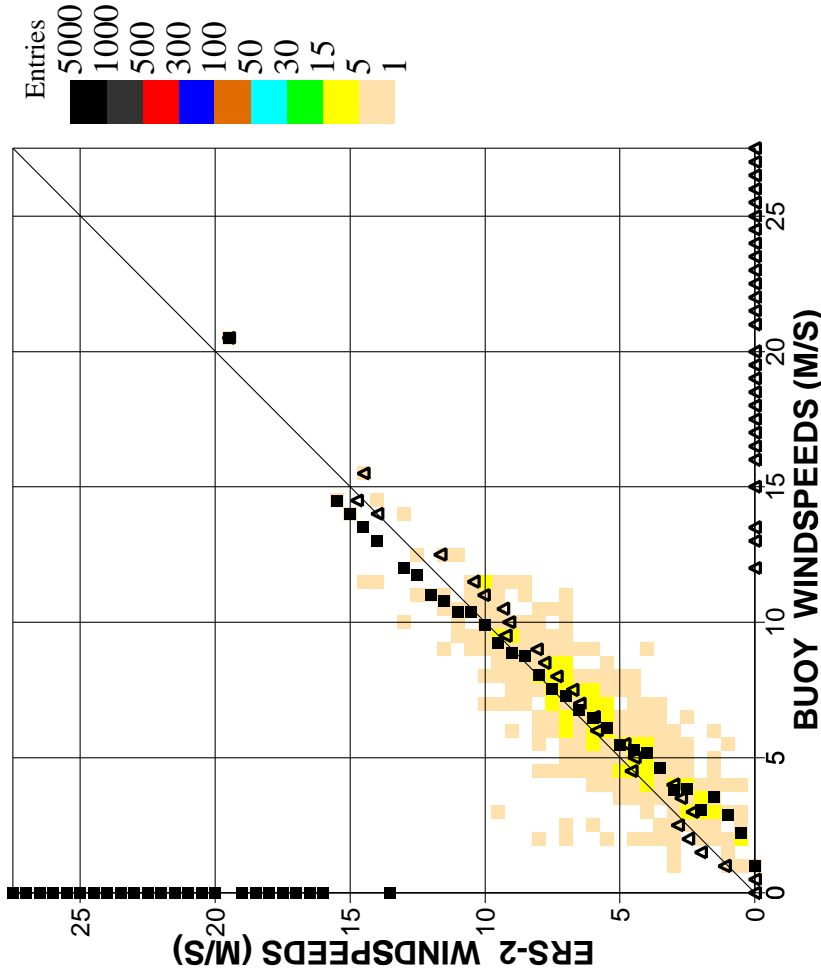


STATISTICS

ENTRIES	631
MEAN BUOY	6.7280
MEAN ERS-2	6.2133
BIAS (ERS-2 - BUOY)	-0.5147
STANDARD DEVIATION	1.4071
SCATTER INDEX	0.2091
CORRELATION	0.8676
SYMMETRIC SLOPE	0.9439 (0.0213)
REGR. COEFFICIENT	0.9271 (0.0212)
REGR. CONSTANT	-0.0241 (0.1530)

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

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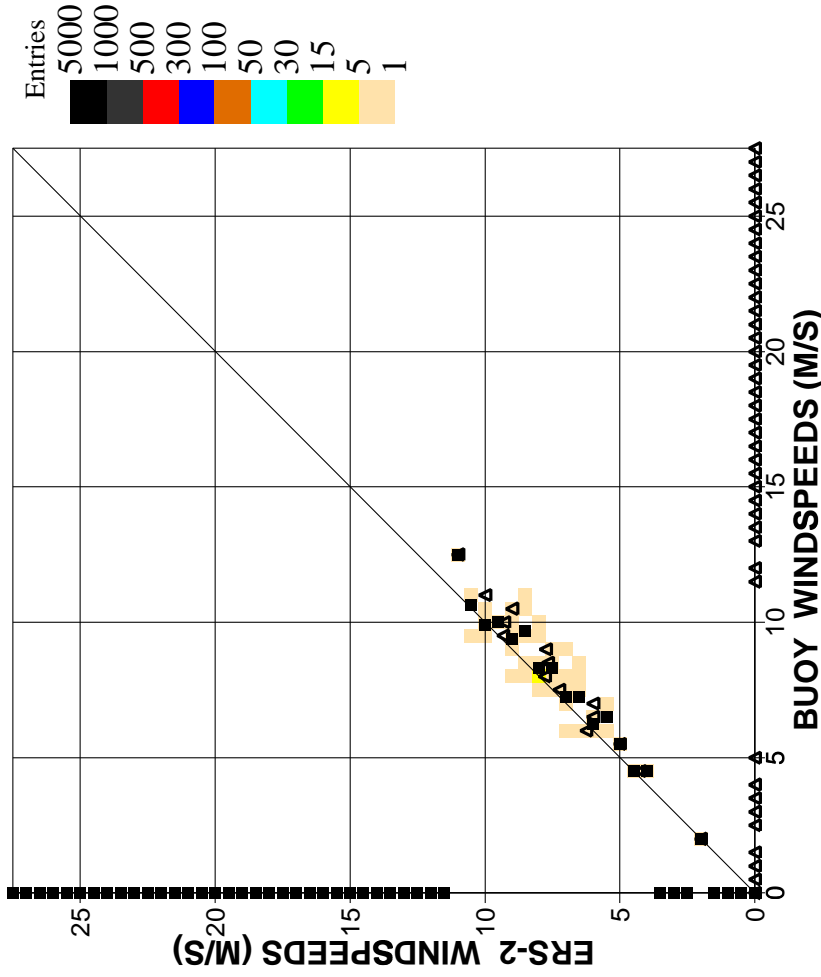


STATISTICS

ENTRIES	560
MEAN BUOY	6.5640
MEAN ERS-2	6.0436
BIAS (ERS-2 - BUOY)	-0.5205
STANDARD DEVIATION	1.4601
SCATTER INDEX	0.2224
CORRELATION	0.8624
SYMMETRIC SLOPE	0.9447 (0.0233)
REGR. COEFFICIENT	0.9321 (0.0232)
REGR. CONSTANT	-0.0746 (0.1639)

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

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STATISTICS	
ENTRIES	65
MEAN BUOY	8.1823
MEAN ERS-2	7.6492
BIAS (ERS-2 - BUOY)	-0.5330
STANDARD DEVIATION	0.8499
SCATTER INDEX	0.1039
CORRELATION	0.8907
SYMMETRIC SLOPE	0.9348 (0.0551)
REGR. COEFFICIENT	0.8325 (0.0535)
REGR. CONSTANT	0.8379 (0.4489)

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

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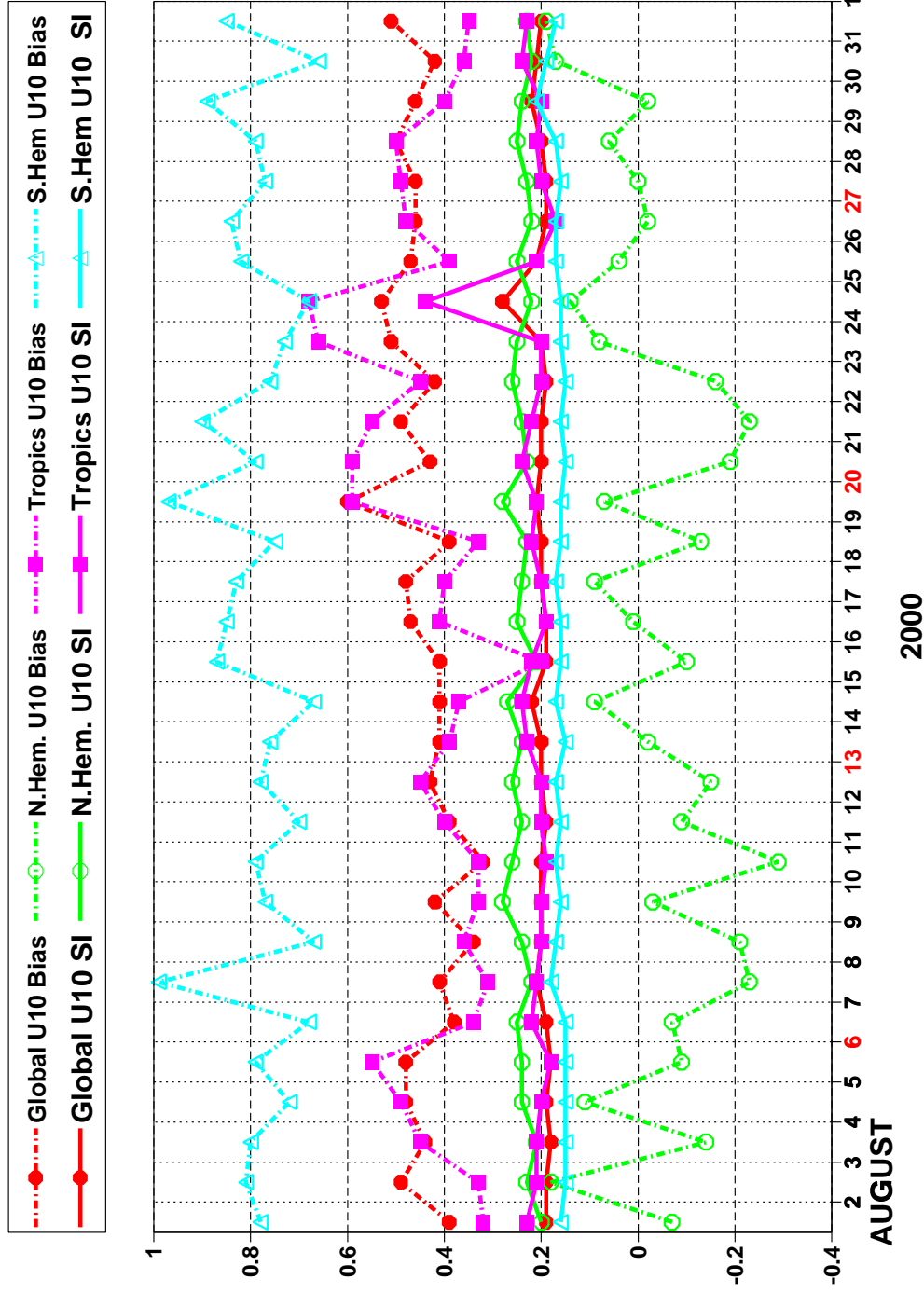


Figure 13: ERS-2 Altimeter wind speeds: Timeseries of bias (ERS-2 - model) and scatter index (SI)

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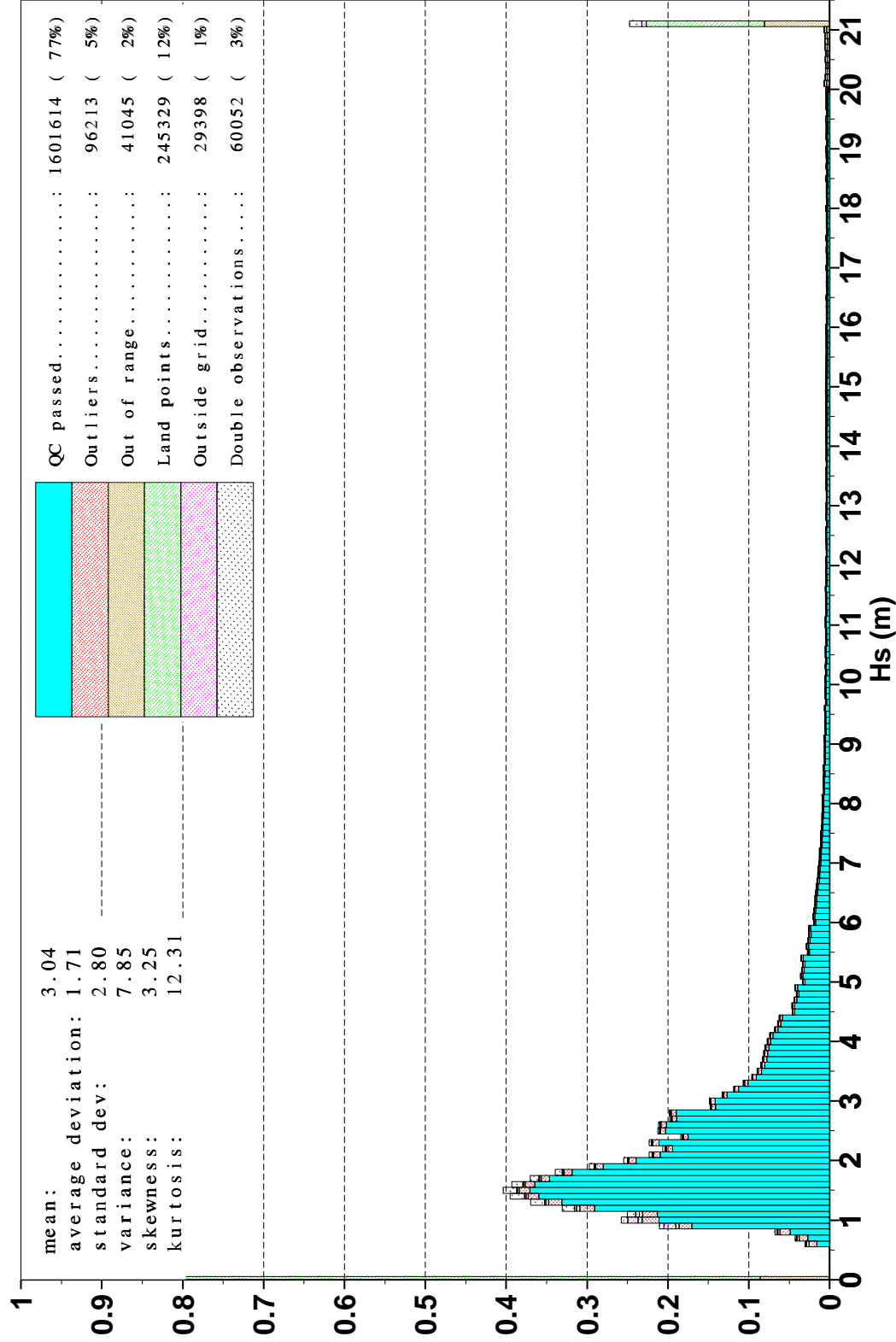


Figure 14: Distribution of the ERS-2 Altimeter wave heights after QC for August 2000

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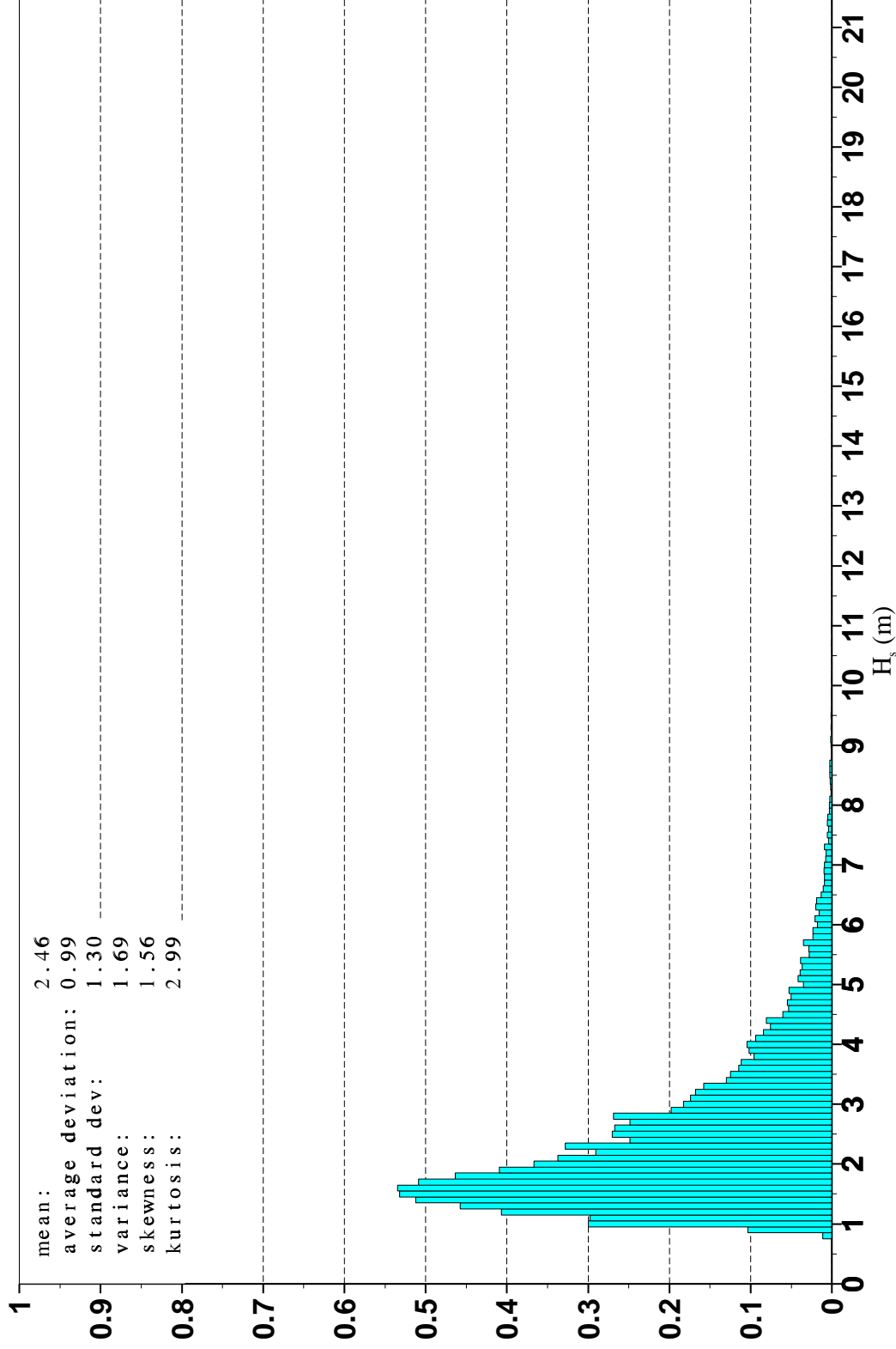


Figure 15: Distribution of ERS-2 Altimeter wave heights after along track averaging for August 2000

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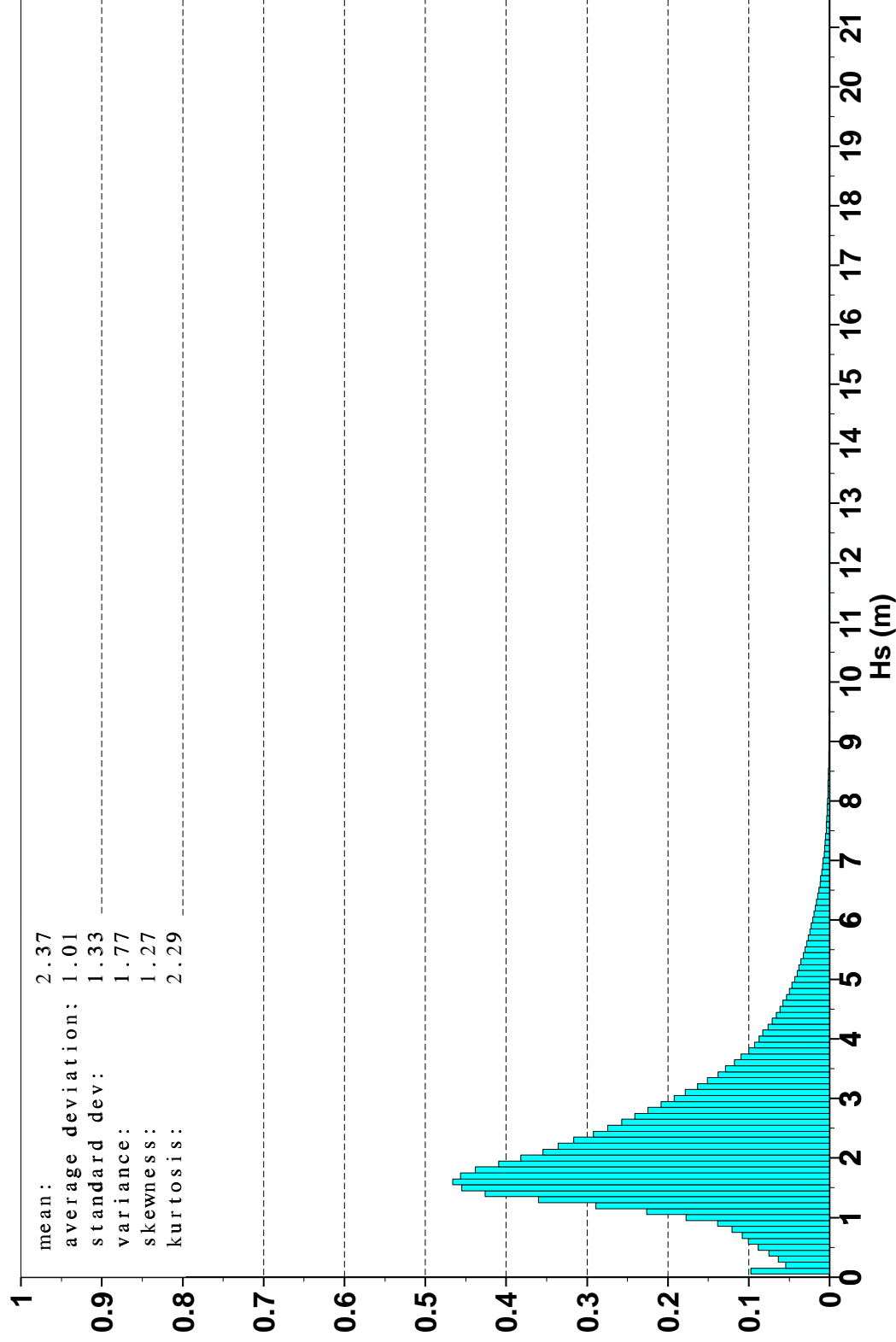
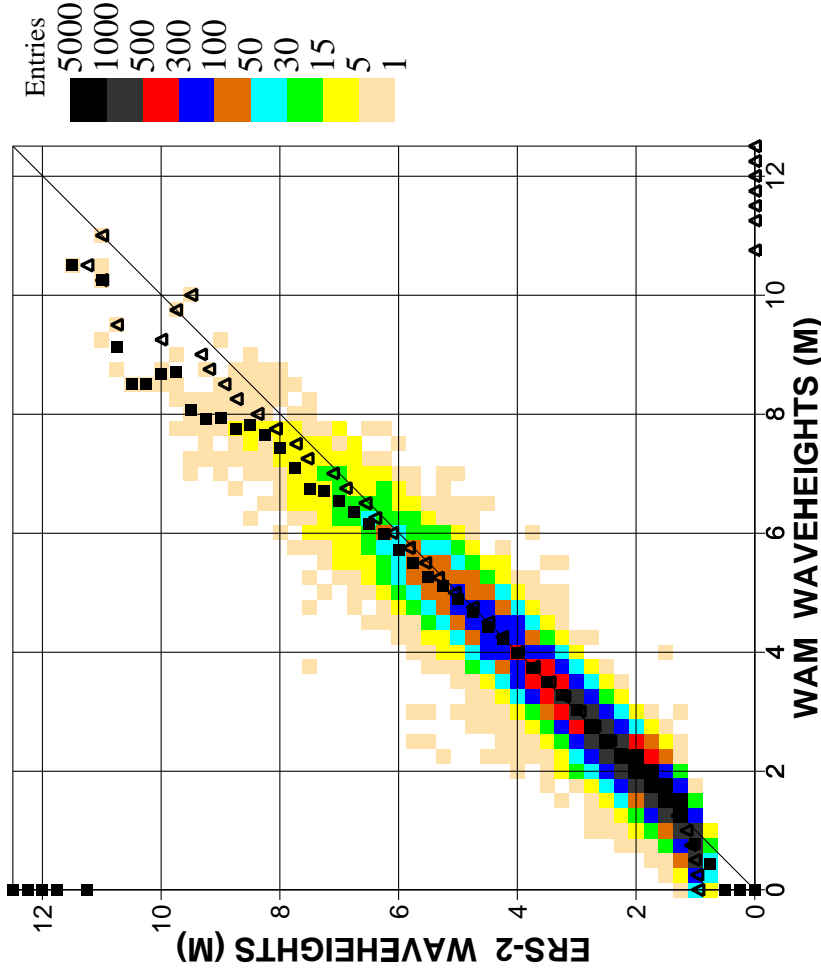


Figure 16: Global distribution of ECMWF wave heights for August 2000

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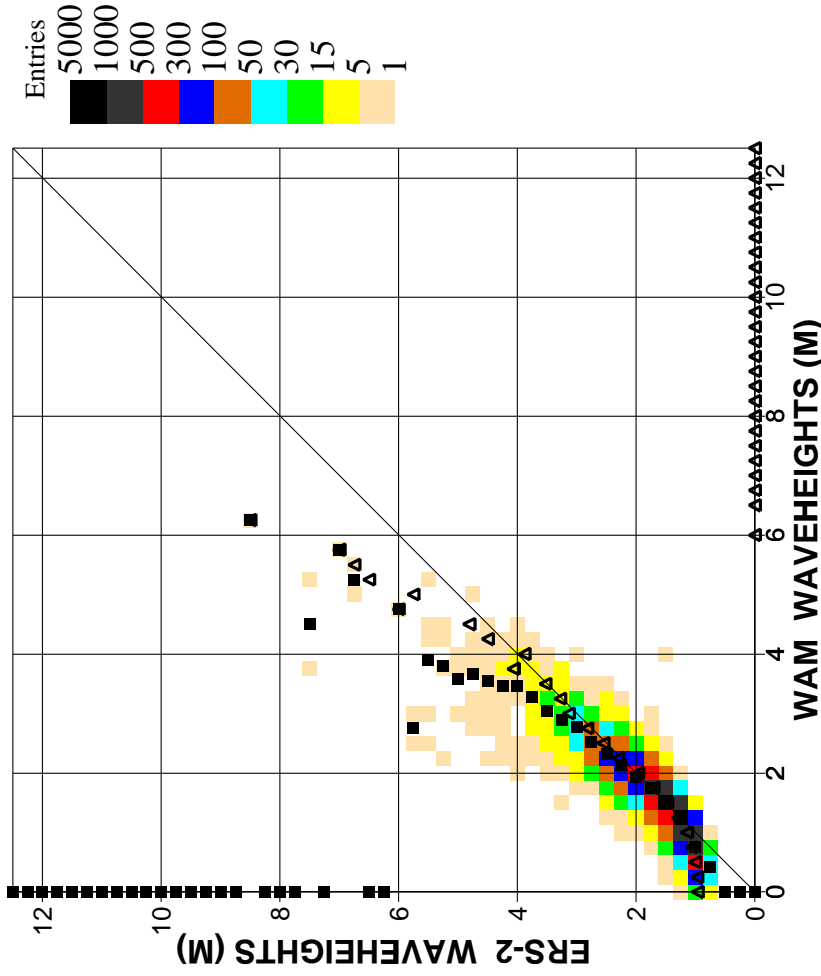


STATISTICS

ENTRIES	46144
MEAN WAM	2.4496
MEAN ERS-2	2.4572
BIAS (ERS-2 - WAM)	0.0076
STANDARD DEVIATION	0.3056
SCATTER INDEX	0.1247
CORRELATION	0.9720
SYMMETRIC SLOPE	1.0055(0.0011)
REGR. COEFFICIENT	0.9857(0.0011)
REGR. CONSTANT	0.0426(0.0031)

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

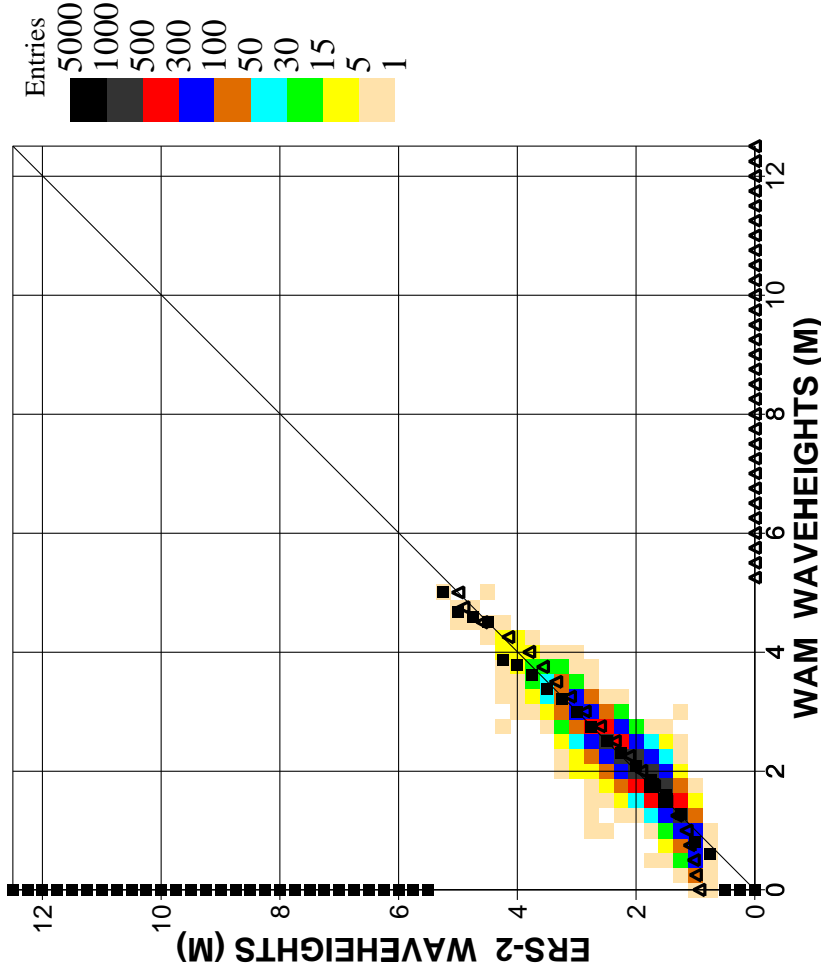
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STATISTICS	
ENTRIES	12865
MEAN WAM	1.4916
MEAN ERS-2	1.5685
BIAS (ERS-2 - WAM)	0.0768
STANDARD DEVIATION	0.2758
SCATTER INDEX	0.1849
CORRELATION	0.8873
SYMMETRIC SLOPE	1.0394 (0.0042)
REGR. COEFFICIENT	0.8508 (0.0039)
REGR. CONSTANT	0.2994 (0.0063)

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

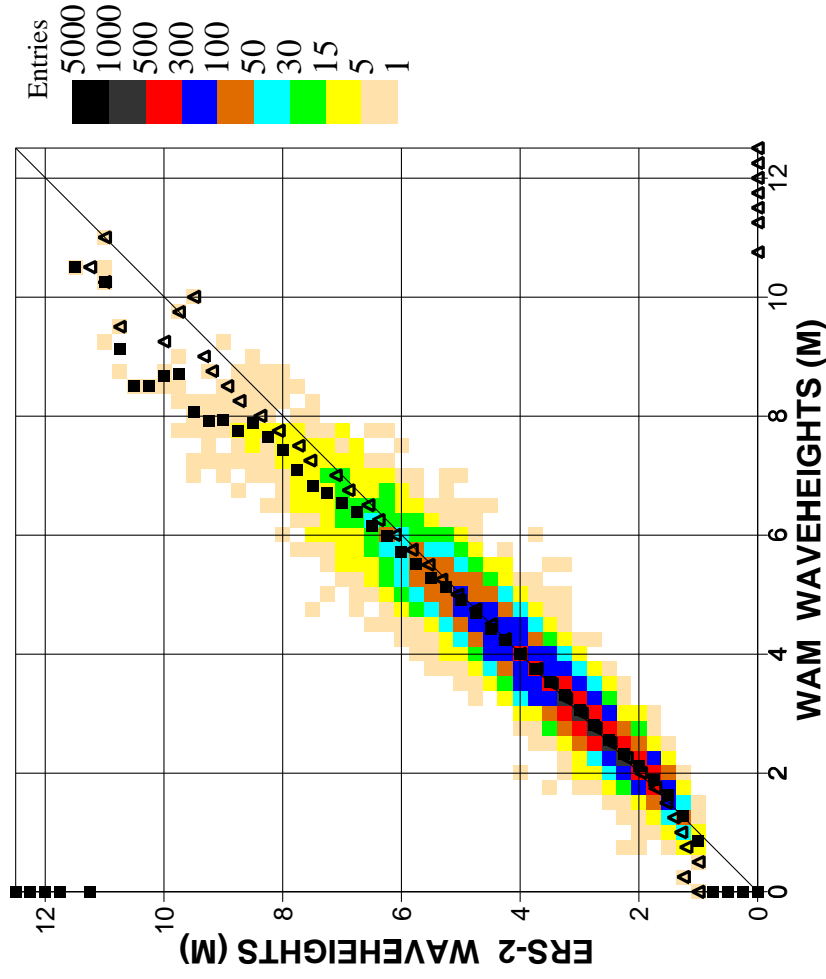
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STATISTICS	
ENTRIES	14863
MEAN WAM	1.9790
MEAN ERS-2	1.9310
BIAS (ERS-2 - WAM)	-0.0480
STANDARD DEVIATION	0.2362
SCATTER INDEX	0.1193
CORRELATION	0.9218
SYMMETRIC SLOPE	0.9717 (0.0031)
REGR. COEFFICIENT	0.8553 (0.0030)
REGR. CONSTANT	0.2384 (0.0061)

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

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STATISTICS

ENTRIES	18767
MEAN WAM	3.4724
MEAN ERS-2	3.4758
BIAS (ERS-2 - WAM)	0.0034
STANDARD DEVIATION	0.3586
SCATTER INDEX	0.1033
CORRELATION	0.9657
SYMMETRIC SLOPE	1.0091 (0.0020)
REGR. COEFFICIENT	1.0295 (0.0020)
REGR. CONSTANT	-0.0990 (0.0075)

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

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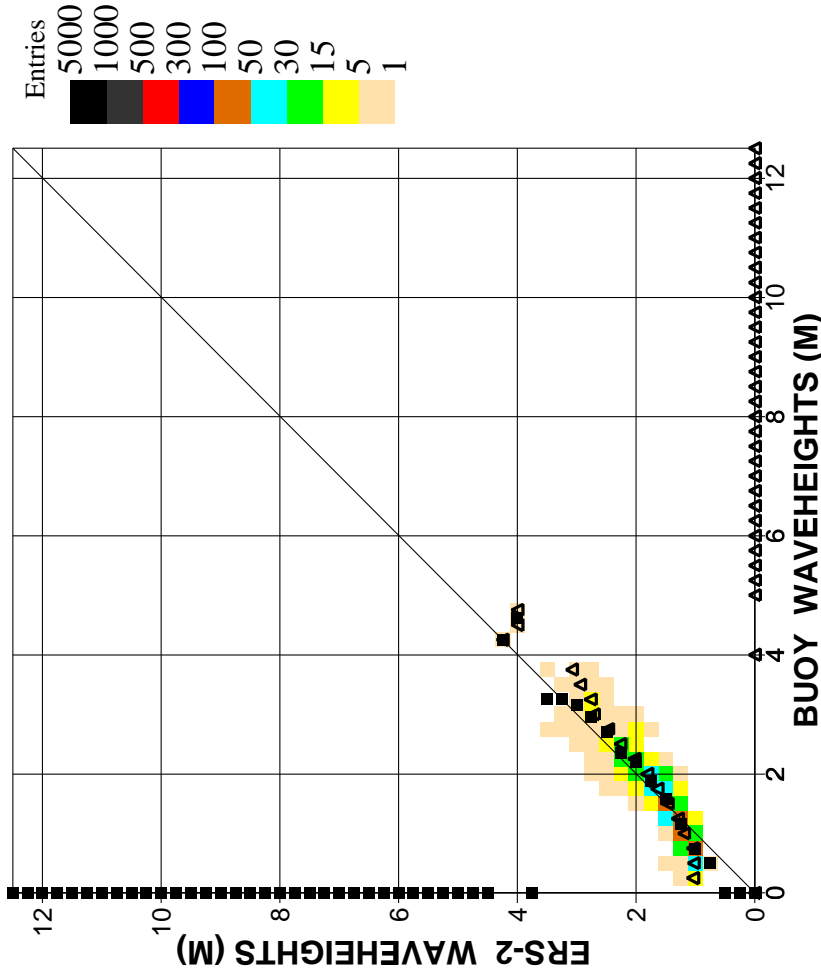


Figure 21. Comparison of buoy wave height observations with ERS2 Altimeter wave height data for August 2000 (global)

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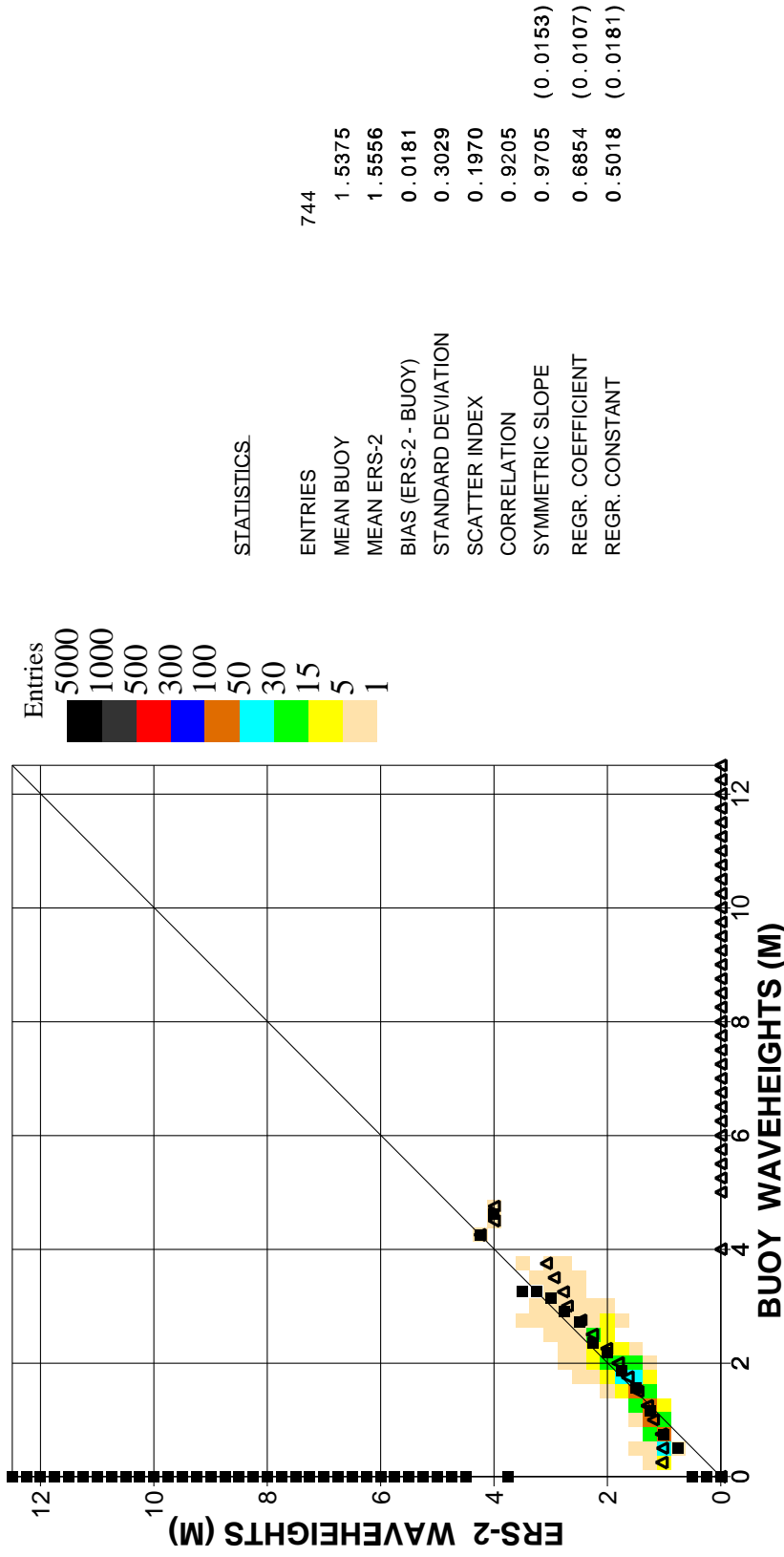
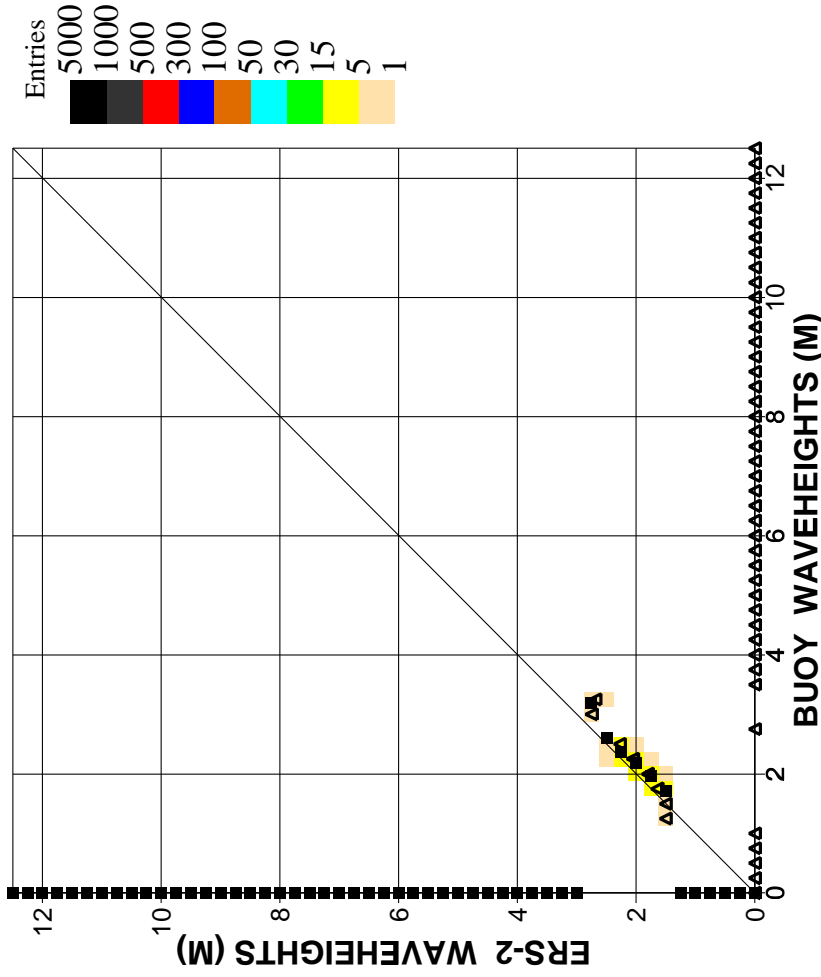


Figure 22. Comparison of buoy wave height observations with ERS2 Altimeter wave height data for August 2000 (n.hem.)

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STATISTICS	
ENTRIES	67
MEAN BUOY	2.1765
MEAN ERS-2	1.9800
BIAS (ERS-2 - BUOY)	-0.1965
STANDARD DEVIATION	0.1728
SCATTER INDEX	0.0794
CORRELATION	0.9035
SYMMETRIC SLOPE	0.9078 (0.0484)
REGR. COEFFICIENT	0.7668 (0.0451)
REGR. CONSTANT	0.3112 (0.0998)

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

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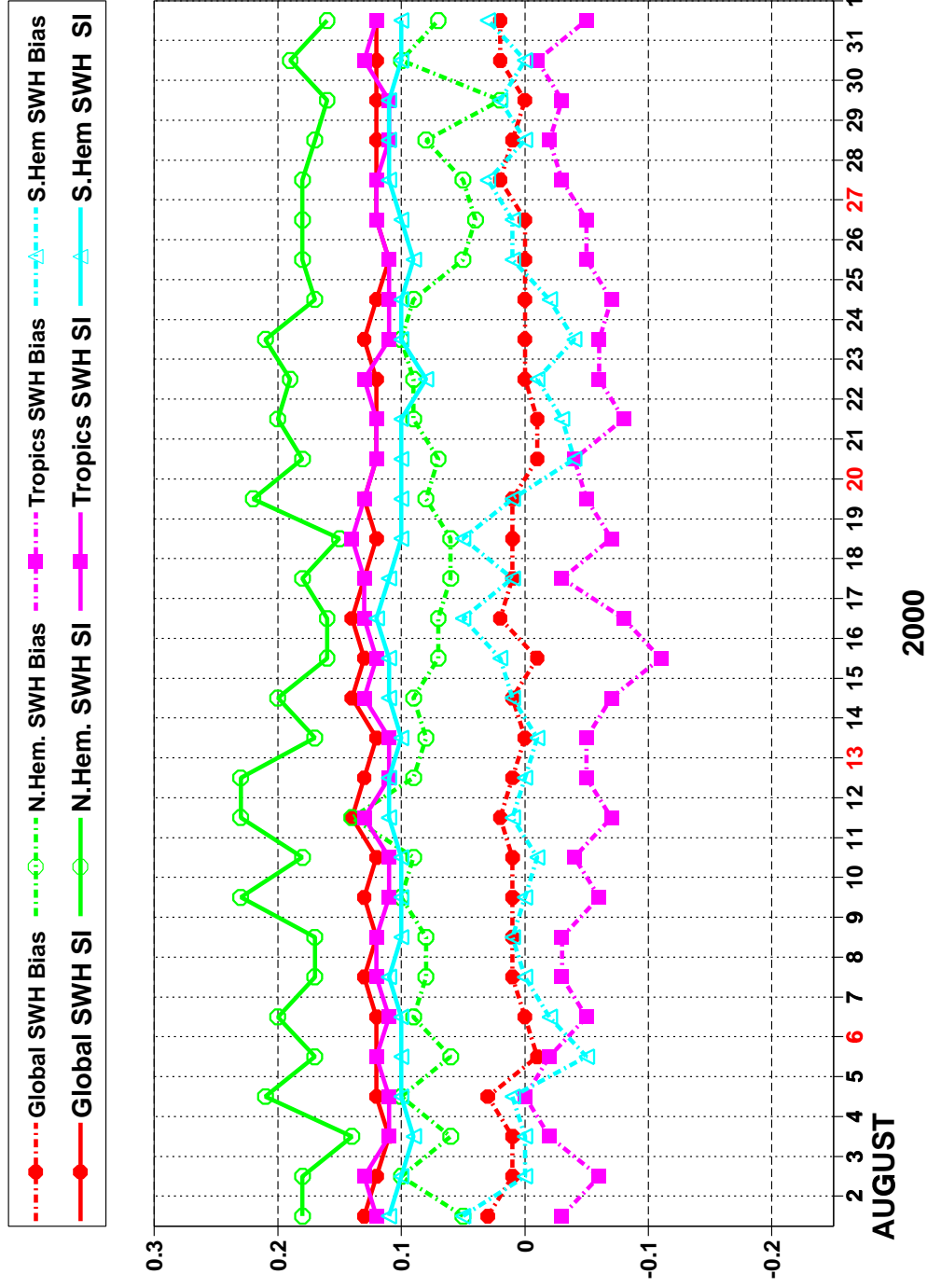


Figure 24: ERS-2 Altimeter wave heights: Timeseries of bias (ERS-2 - model) and scatter index (SI)

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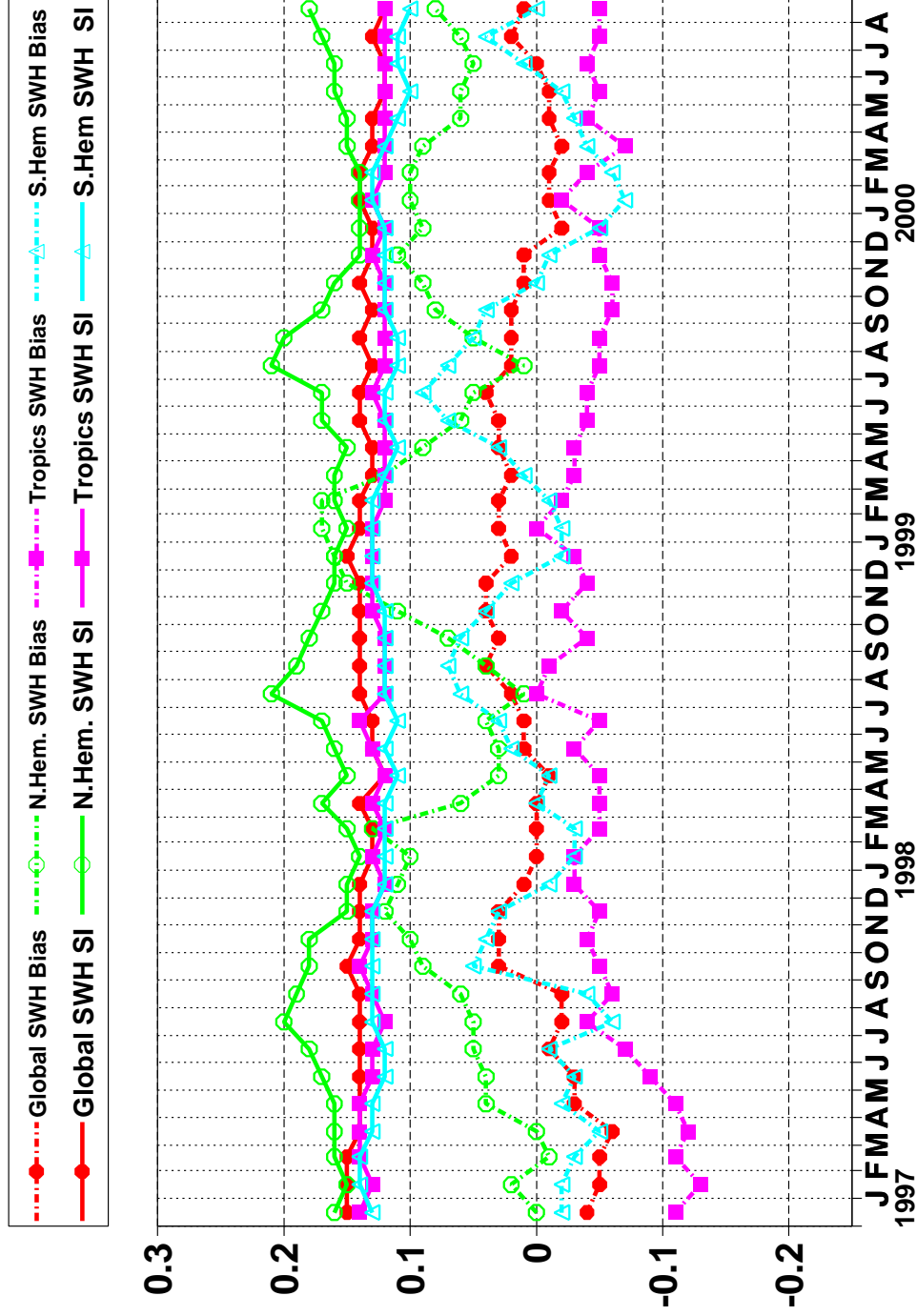


Figure 25: ERS-2 Altimeter wave heights: Timeseries of bias (ERS-2 - mode1) and scatter index (SI)

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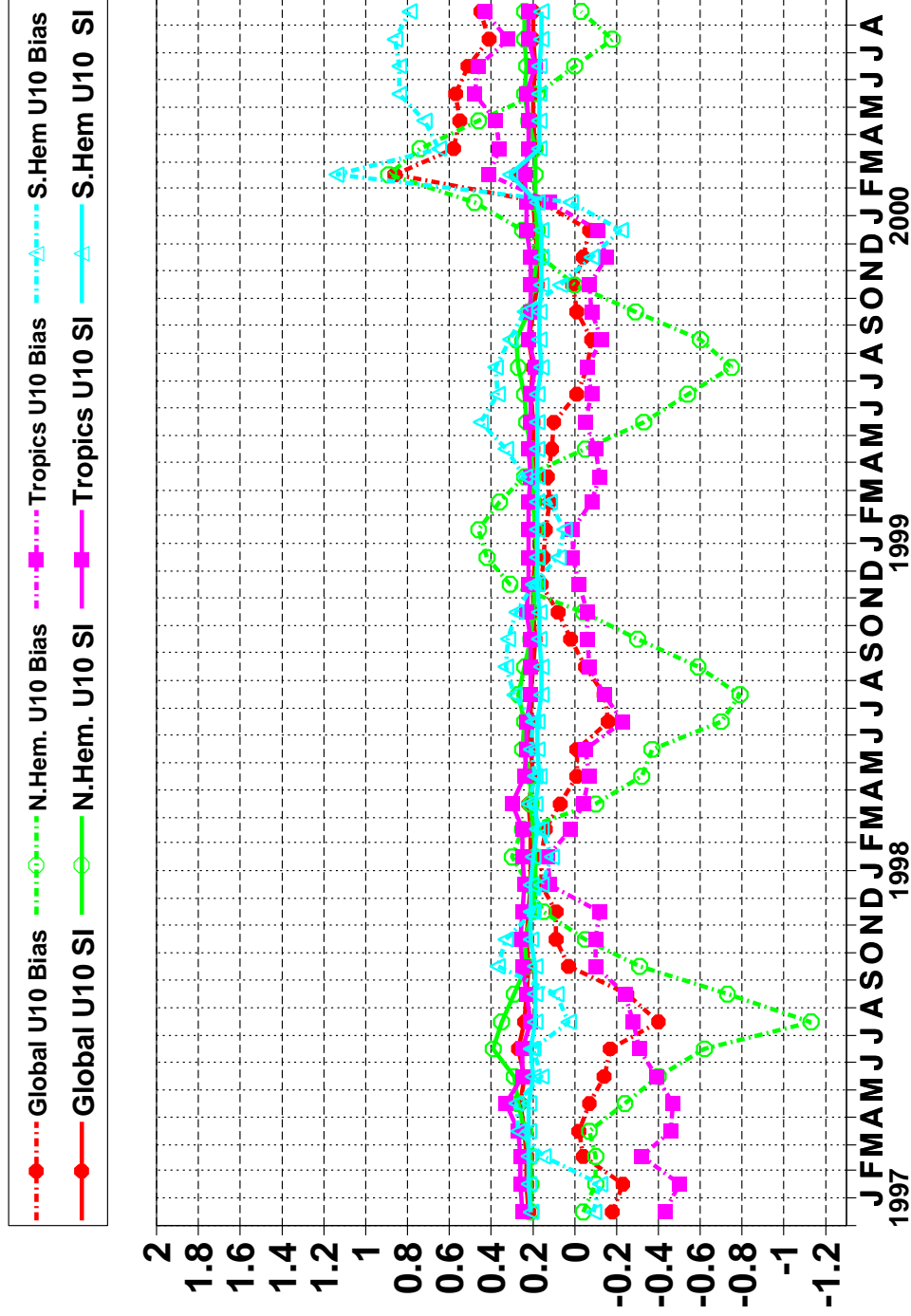


Figure 26: ERS-2 Altimeter wind speeds: Timeseries of bias (ERS-2 - model) and scatter index (SI)