MONITORING STATISTICS OF ERS-2 SCATTEROMETER FOR ESA (Project Ref. 12893/98/NL/PR)

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1 - INTRODUCTION:

From 12 December 2001 onwards, ESRIN has redistributed ERS-2 scatterometer data to a selected group of users. The quality of this experimental gyroless product was for cycle 69 monitored at ECMWF in a way that is very similar to the monitoring as it was performed before the on-board failure of 16 January 2001.

This ERS-2 scatterometer data was not used in the 4D-Var data assimilation system at ECMWF. Therefore, monitoring tools had to be updated. Instead of one-hourly collocated first-guess winds (FGAT), a 3-hourly time resolution (FG3H) at full model resolution (40km) was the best available. Distances of sigma0 triplets to the cone and de-aliased winds (i.e., solution closest to FG3H) were computed using the original version of CMOD4, rather than the sigma0- and wind-bias corrected version on which the at ECMWF inverted ERS-2 scatterometer winds used to be based. A somewhat stricter quality control on land and sea-ice was applied. Besides this QC no rejection criterion was applied other than that data should pass the ESA quality flag and that the CMOD4 wind inversion algorithm should be successful. The impact of this set of changes was assessed for the stable period within cycle 60, i.e., from 21:01 UTC 8 January 2001 to 02:59 UTC 16 January 2001. In the new setup, about 4 percent more data was monitored. The sigma0 bias level compared to the simulated sigma0's based on the FG3H winds was in absolute sense about 0.1 dB lower than when compared to the sigma0's based on the FGAT winds. The trend of the biases as function of incidence angles was unaltered. On average, distances to the cone appeared to be larger, indicating that the cone defined by the

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CMOD4 version used at ECMWF fits sigma0 triplets better than the original CMOD4 cone does. Therefore, normalization factors had to be updated. For node 1-2 and node 8-12 the change was small. For the other nodes normalization factors were increased up to 20%. The effect on the scatterplots of first guess winds versus UWI winds was found to be modest (bias changed from -0.65 m/s to -0.62 m/s; the standard deviation remained 1.60 m/s). The volume of strong FG3H winds was slightly smaller than for FGAT winds. It may be concluded that the newly developed monitoring tools are in good agreement with the previous ones and that they are equally able to present a clear view on the quality of ERS-2 scatterometer data.

The ECMWF assimilation system was not modified during cycle 69.

ERS-2 STATISTICS FROM 12 DECEMBER 2001 TO 24 DECEMBER 2001

During cycle 69, gyroless data was received between 09:18 UTC 12 December 2001 and 20:58 UTC 24 December 2001. The quality of this data was monitored using the updated tools and was compared to the similarly monitored data for the stable period within cycle 60 (see above). The sigma0 bias level (compared to simulated sigma0's based on ECMWF model first guess winds) of the descending and ascending tracks has a much larger negative bias than it used to have. This especially applies for higher incidence angles of the for and aft beams (see Figure 1). Only for the mid beam, the increase of the negative bias is limited and, in addition, fairly independent on incidence angle. A large difference between the ascending and descending bias for the aft beam is found for the gyroless data, as well as a very large difference between the biases of the for and aft beams. Note that the standard deviation of the mean bias levels is still similar to the level it used to be.

For the higher nodes the distance to the cone history shows peaks for four short periods (see Figure 2). Three of these peaks (around 12 December 2001, 21 December 2001 and 24 December 2001) correspond to periods of low quality altimeter wind data on the Southern Hemisphere (not shown), which is usually an

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indication for enhanced solar activity. For the other peak (16 December 2001) this relation with altimeter data was not observed. The distances (which are based on the new normalization factors) are larger than one, and increase towards higher nodes. Also the percentage of data that does not pass the ESA quality flag, or for which the CMOD4 inversion is not successful, increases towards higher nodes. This, together with the large biases shown in Figure 1, indicates that, especially for the higher nodes, the fit of the sigma0 triplets to the CMOD4 cone has worsened.

The UWI winds have an average bias of -1.09 m/s, which was -0.62 m/s for cycle 60. The bias is -1.20 m/s for nodes 1-2 (was -1.00 m/s) down to -1.25 m/s for nodes 15-19 (was -0.52 m/s). Biases are smallest for nodes 8-10 (-0.91 m/s). The standard deviation is on average 1.86 m/s (was 1.59 m/s), and increases from 1.79 m/s (was 1.63 m/s) for nodes 1-2, to 1.94 m/s for nodes 15-19 (was 1.61 m/s). The deterioration in performance is largest for the higher nodes, which used to represent the best quality winds. Now, the situation is opposite, unfortunately. The four peaks in the distance to the cone plots are also present in the wind speed time series. They appear as large negative biases (up to -3 m/s). Similar results apply to the de-aliased CMOD4 winds. The (scatterometer - model) direction standard deviations were ranging between 40 and 60 degrees for the UWI data (average value 53.3 degrees, was 52.2) and between 15 and 25 degrees (average value 21.3, was 20.0) for their de-aliased counterparts. The directional bias is close to zero for both UWI and de-aliased CMOD4 products. Therefore, the skill in wind direction basically remained the same as before the gyroless period.

The scatter plot of model 10 m first-guess wind speeds versus UWI wind speeds shows a larger bias (-1.09 m/s) compared to the plot from cycle 60 (-0.62 m/s). Also the standard deviation is larger (1.88 m/s, was 1.60 m/s). If the 4 lower quality periods would not have been included, however, the deterioration of both bias and standard deviation would be less. Note that for the gyroless product there is a fair amount of low wind data with collocated first-guess winds that are much stronger. This trend does not depend on node number and is not introduced by data observed during the 4 lower quality peaks. The direction scatter plot looks similar to the results from the cycle 60 (bias from 1.0 to 0.0 degrees, and standard deviation from 50 to 51 degrees).

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2 - FIGURE CAPTION

Fig. 1: Ratio of < σ0**0.625 > over < CMOD4(First Guess)**0.625 > converted in dB for fore beam (solid line), mid beam (dashed line) and aft beam (dotted line) as a function of incidence angle for descending and ascending tracks. The thin lines indicate the error bars on the estimated mean. First Guess winds are based on the in time closest +3h, +6h, +9h, or +12h T511 forecast field, and bilinearly interpolated in space.

Fig. 2: Mean normalised distance to the cone computed every 6 hours for nodes 1-2, 3-4, 5 to 7, 8 to 10, 11 to 14 and 15 to 19 (solid curve close to 1 when no instrumental problems are present). The dotted curve shows the number of incoming triplets in logarithmic scale (1 corresponds to 60000 triplets) and the dashed one indicates the fraction of complete sea-located triplets rejected by the ESA flag, or by the wind inversion algorithm. (0: all data kept, 1: no data kept).

Fig. 3: Mean (solid line) and standard deviation (dashed line) of the wind speed difference UWI - First Guess for the data retained by the quality control.

Fig. 4: Same as Fig. 3, but for the wind direction difference. Statistics are computed only for wind speeds higher than 4 m/s.

Fig. 5-6: Same as Fig. 3 and 4 respectively, but for the de-aliased CMOD4 data.

Fig. 7: Two-dimensional histogram of First Guess and UWI wind speeds, for the data kept by the quality control. Circles denote the mean values in the y-direction, and squares those in the x-direction.

Fig. 8: Same as Fig. 7, but for wind direction. Only wind speeds higher than 4m/s are taken into account.

FIGURE 1

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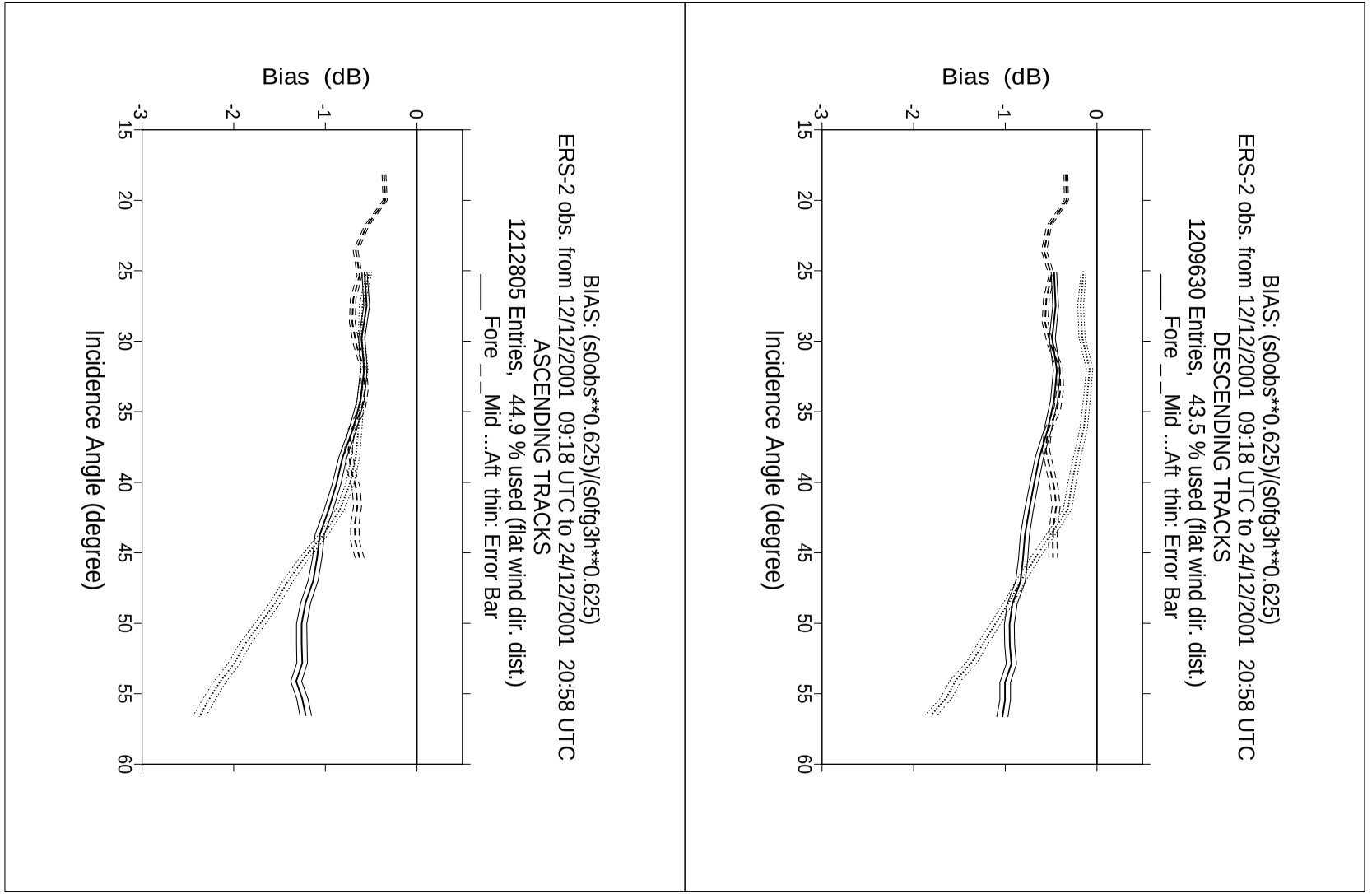

FIGURE 2

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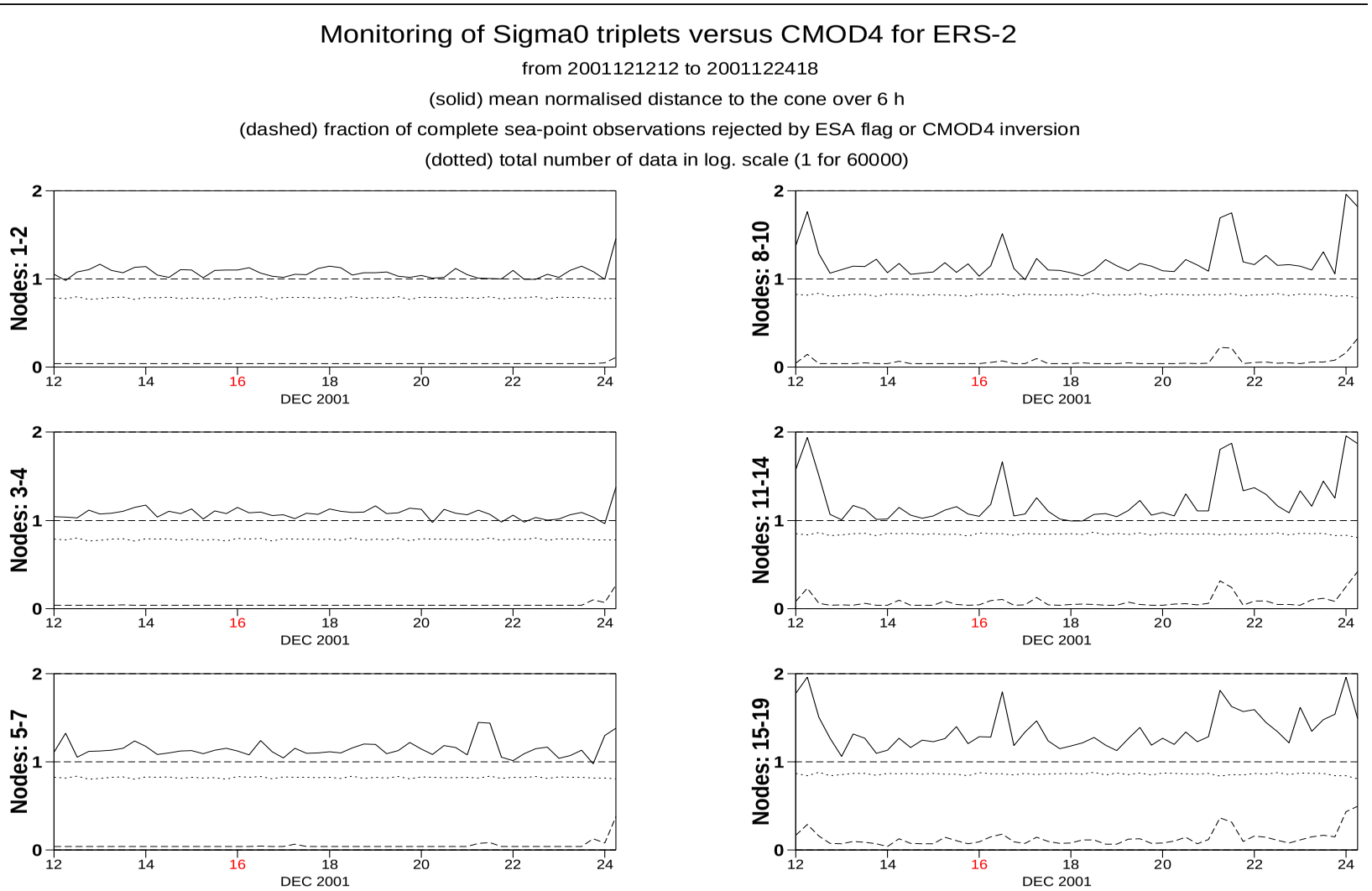

FIGURE 3

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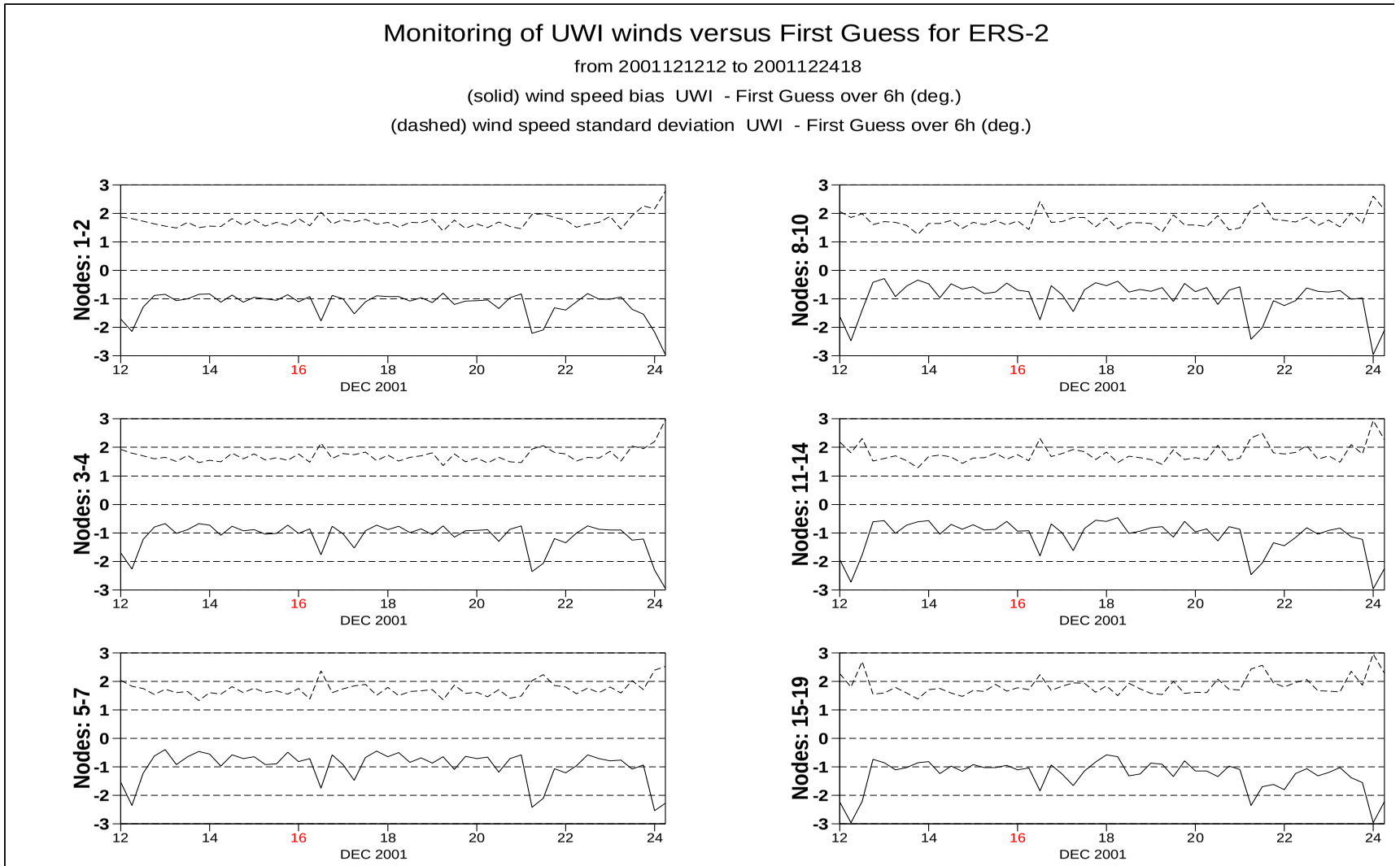

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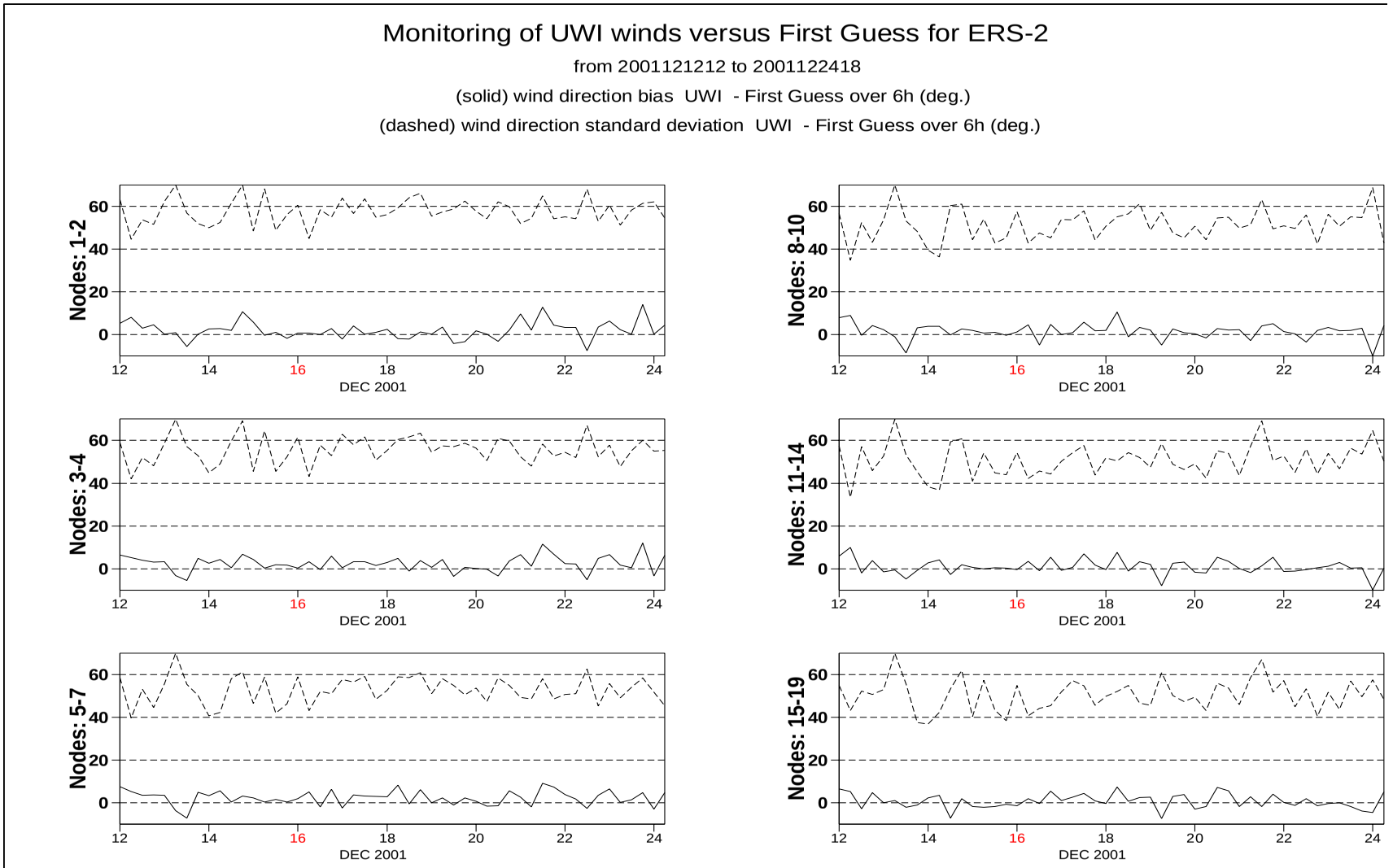

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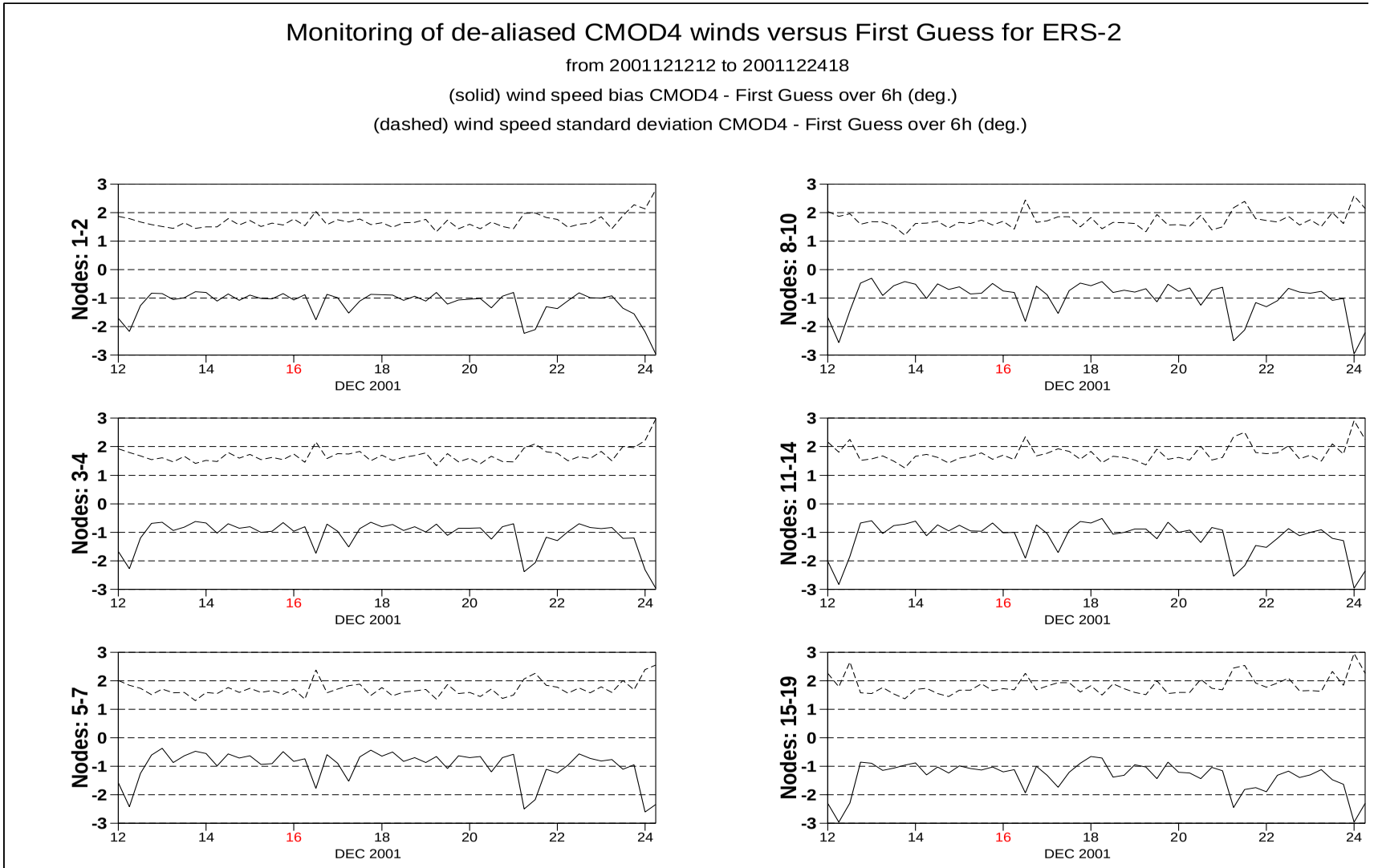

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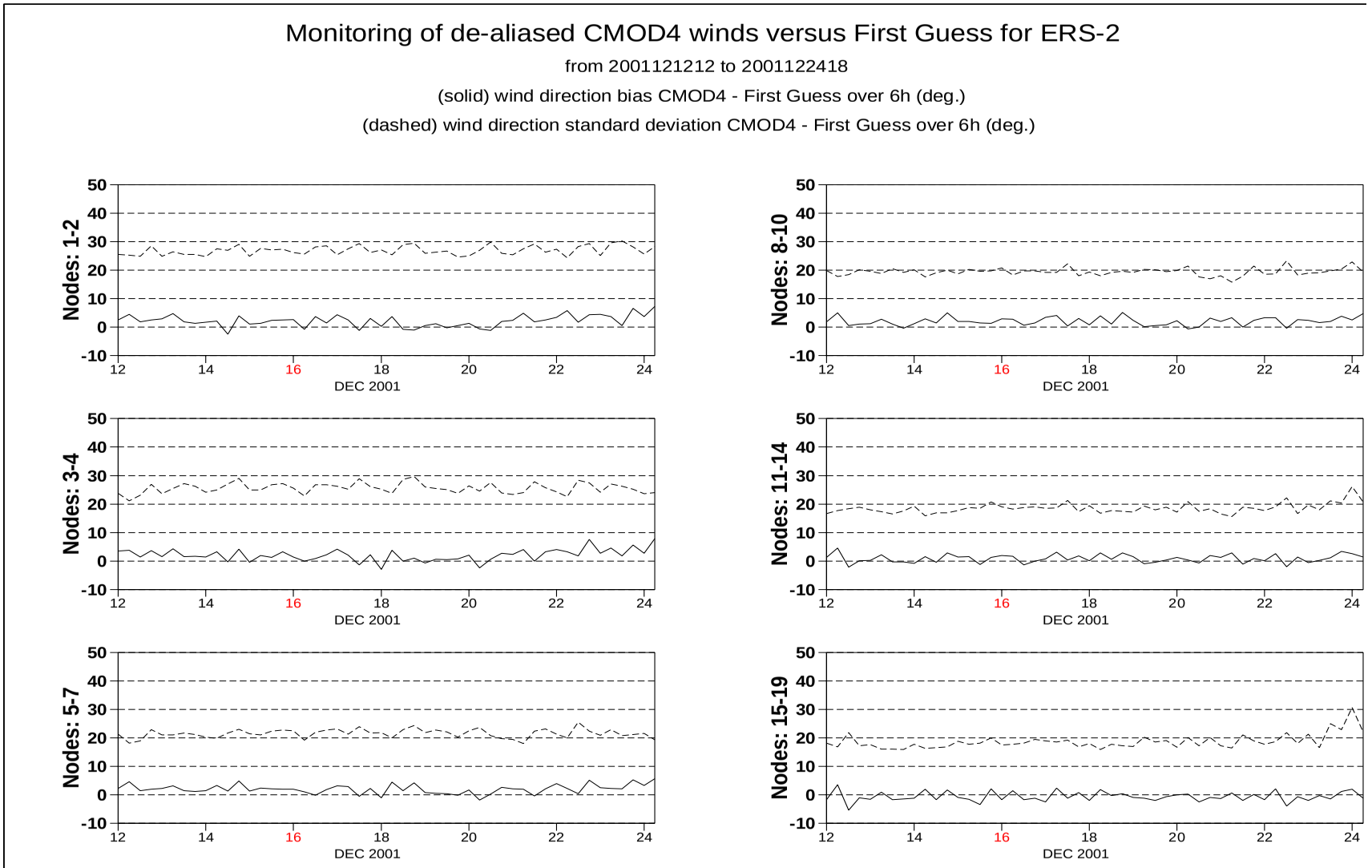

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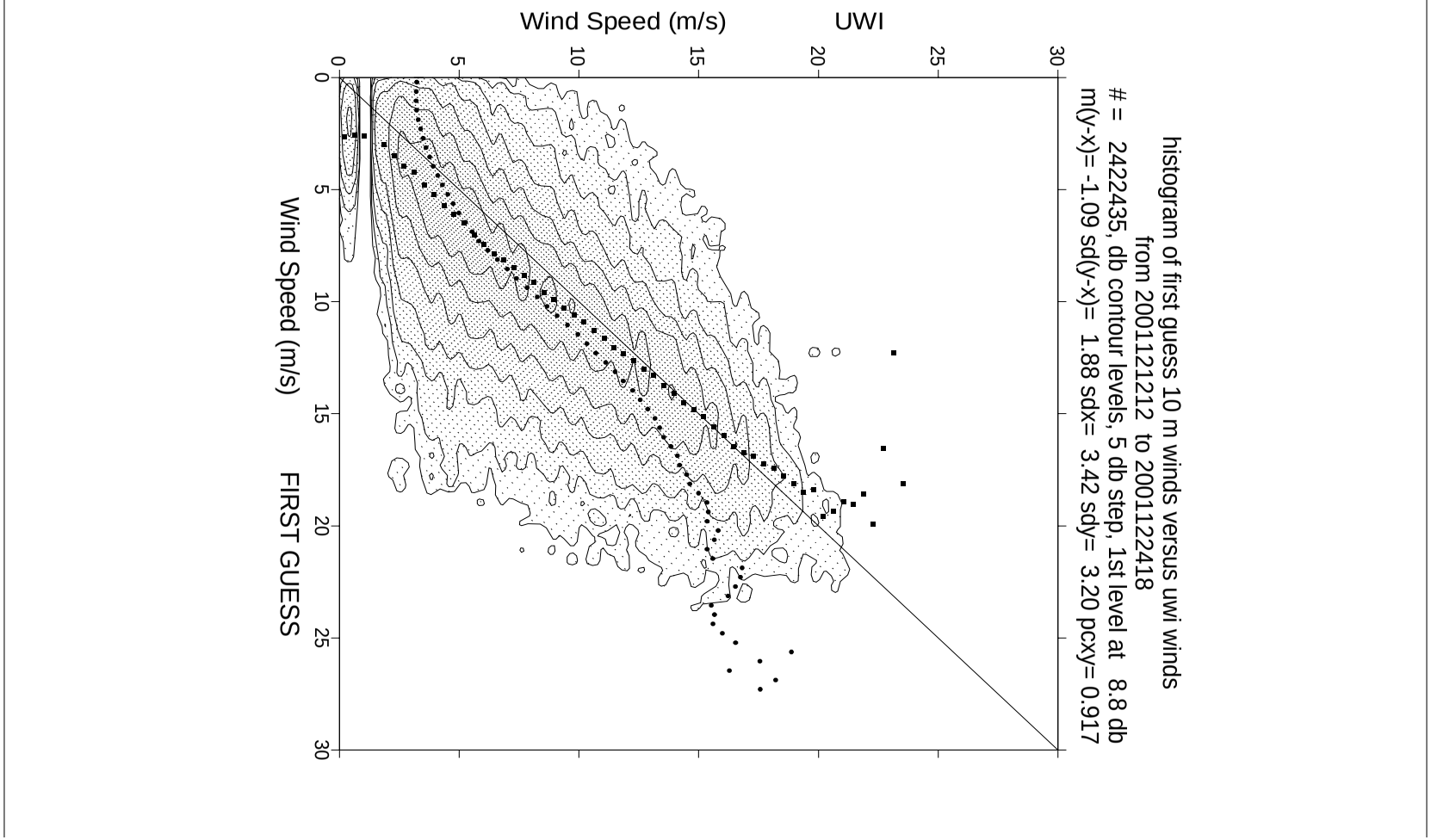

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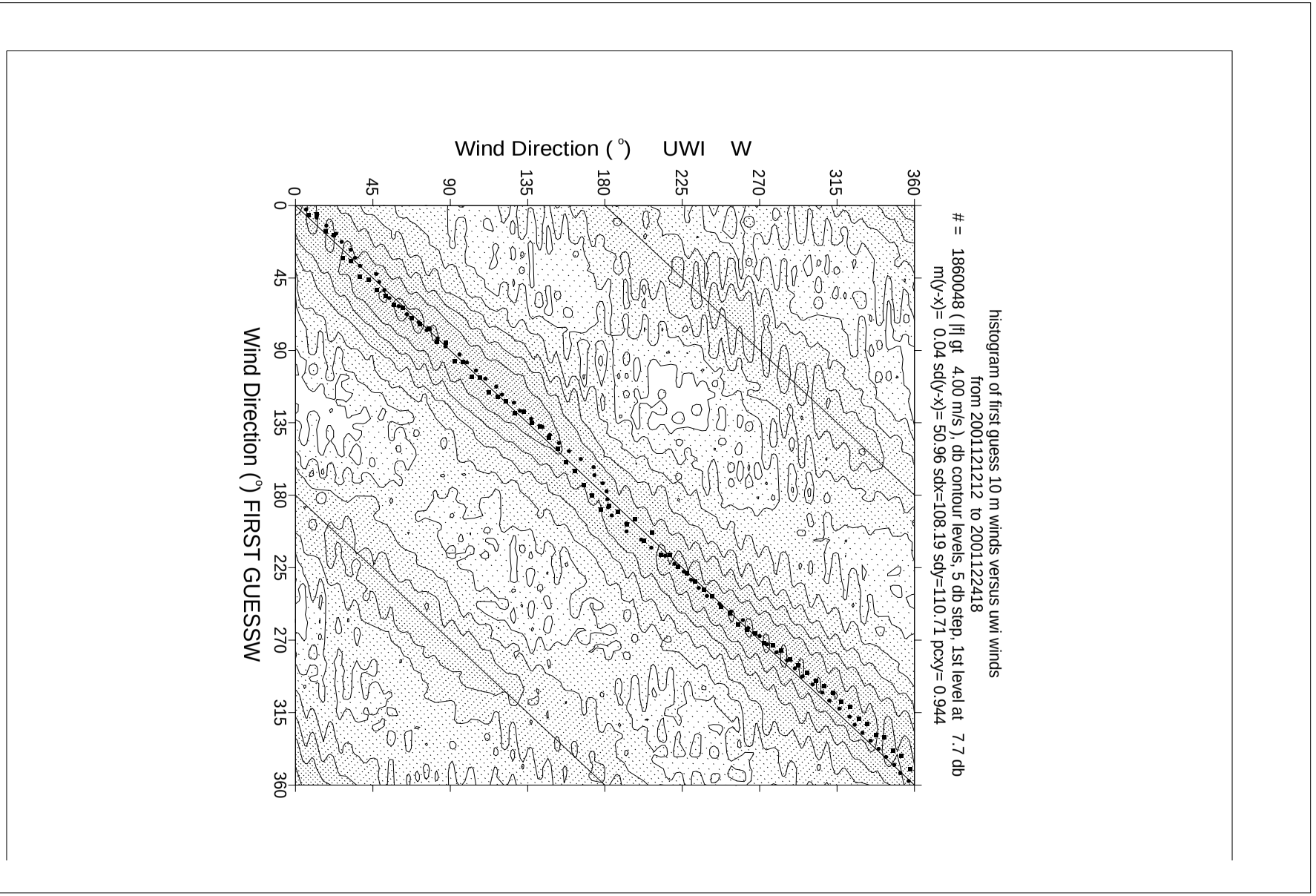

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