Answers to reviewer #2 (L. Ricciardulli)

We greatly appreciate the reviewer's efforts to improve the paper.

1. General comment, "… the authors could present some results also in a more physical space, described by the wind speed and the incidence angle. I think that it would make their article more appealing to researchers using other scatterometers than ASCAT, having different viewing geometry. Their method and their conclusions anyway reflect the fact that the skill of the ambiguity removal process can be improved only for certain wind speed regimes and viewing angles."

The problem addressed is a retrieval problem of statistical nature. In the most basic form, three backscatter values provide a probability map as a function of wind speed and direction. It is a combination of GMF, its cone geometry, viewing geometry and retrieval function that determine the probability, location and number of local wind vector solutions in this basic probability map. Retrieval problems are clearly well addressed in the retrieval space, which is the cone space. This is in principle also feasible for other scatterometers, but indeed more complex due to the varying viewing geometry.

2. Specific comment 1, Page 8840 line 17: I would add here that ASCAT measures the backscatter ratio sigma0. Even if it is obvious, it helps for defining sigma0.

Done. The following sentence has been included in the manuscript: "An important tool for interpreting data is the visualization of the three Normalized Radar Cross Section (NRCS or $\sigma°$) measurements (named triplet) …"

3. Specific comment 2, Page 8840 line 20: As stated by the other referee, it would be good to specify that ASCAT has a double swath of 41 WVC (at 12.5 km) each, symmetrical with respect to the position across the swath. This should also be specified when presenting the figures where the WVC is limited to 1-41, instead of 1-82.

This has been clarified in the introduction and the corresponding figure captions.

4. Specific comment 3, Page 8841 lines 1-2: Shouldn't it be the other way around? The cone surface should be representing the GMF, which is the best fit to a ground truth wind vector. The measurement triplet is just a point close to the surface.

"The latter surface is described by the forward model or Geophysical Model Function (GMF), which represents the best fit to the measured triplets." The GMF actually connects the three measured backscatter values with the true wind vector and a MLE value. In other words, the coherence of the backscatter triplets in the measurement space is indeed described and predicted by the GMF. A better GMF fit to the measured triplets provides a better wind retrieval. Obviously, the two coordinates that describe the GMF surface obviously need to be optimally related to wind speed and wind direction too to get good winds, but this can be seen as an orthogonal ad therefore rather independent problem.

5. Specific comment 4, Page 8841 line 12: I suggest taking the opportunity here to specify that WVC 1 is at the outer edge (high incidence angle).

Done.

6. Specific comment 5, Page 8841 lines 12-13: Again, I would be more explicit about the fact that the axis of the cone represents wind speed.

Indeed, the major axis of the 3D cone represents wind speed. However, in the 2D illustration, we present a cross-section of the 3D cone surface, corresponding to a roughly constant wind speed (~8 m/s). Actually, wind direction variations determine the location of the triplets in this view.

7. Specific comment 6, Page 8845 lines 7-13: What is the time-collocation window for TMI and the buoys?

The ASCAT-TMI collocations ranged from September 2008 to February 2012. The collocation criteria for TMI rain data are less than 30-min time and 0.25◦ spatial distance from the ASCAT measurements. It has been clarified in the article.

8. Specific comment 7, Page 8845 lines 21-23. It would be useful to show the weak wind direction modulation for GMF at the low wind speeds compared to higher speeds, if the manuscript length allows it.

Since the weak wind direction modulation for GMF at low wind speed has been shown in several papers, we believe it makes more sense to refer to them. The following sentence has been adapted to the reviewer' suggestion: "At low wind speed conditions, ASCAT (and scatterometers in general) have poor wind direction skill, i.e., low sigma0 anisotropy or wind direction modulation (Stoffelen and Anderson, 1997), and thus no dual-ambiguity high-quality wind direction solutions are expected"

9. Specific comment 8, Page 8845 lines 23-24. Why triplets outside the cone correspond to good retrievals? What is the physical explanation for this? Can this result be placed in a less ASCAT-specific context?

Triplets outside the cone generally correspond to more anisotropic backscatter measurements than those inside the cone. These are known to correspond to stable air flows without much turbulence or disturbance. Therefore, they lead to good quality retrievals. This has been tested and confirmed for ASCAT-type viewing geometry scatterometers (i.e., ERS-1, ERS-2, and ASCAT) only. Please, check Portabella et al., 2012a for further details. Similar anisotropy measures may be developed for other scatterometers.

10. Specific comment 9, Page 8846 lines 10-11, Figure 3: Why there is this clear discrimination

about triplets inside and outside the cone?

By discrimination, we mean that triplets inside and outside the cone do not overlap in this plot. The discrimination in the vertical is by definition, i.e., triplets inside the cone cannot go beyond the cone surface. In fact, if there is some overlap, it is because the cross section has a certain width (or depth; several infinitely thin cross section planes are projected onto the central one), which causes some dispersion in the plot. The discrimination in the horizontal is mainly at low MLE ratios, i.e., triplets with low MLE ratios can only be located close to the center of the cone. This is due to the viewing geometry and the dual cone shape: 1st and 2nd rank solutions are always 180 degs apart (i.e., at the same side of the cone section but in different manifolds) but whereas 3rd and 4rth rank (if they exist) correspond to solutions approximately 90 degs apart from 1st and 2nd rank solutions (i.e., they reside at the opposite side of the 1st and 2nd rank locations on the cone). At the inner-most WVCs (see new Fig. 3b), the horizontal discrimination is less clear. This is due to a more irregular (less circular) shape of the cone section when compared to outer-most WVCs and more noise.

11. Specific comment 10, Page 8846 Figure 3: From the figure we infer that if MLE1 or MLE2 is negative, the MLE3/MLE1 is high and it should be rejected. Is this always true (any WVC, any wind speed above 4 m/s)? Does Figure 3 refer to WVC-1 and wind speed 8 m/s as Figure 1?

Yes, if MLE1 or MLE2 is negative, or the MLE3/MLE1 is high, then the rejection is performed for any WVC with wind speed above 4 m/s. Figure 3(a) refers to WVC-1 and wind speed 8 m/s as Fig. 1. In the new Fig. 3(b), we show the same plot for WVC-41 and wind speed 8 m/s. It has been clarified in the article.

12. Specific comment 11, Page 8846 lines 25-28: Could the authors show or say how different is the threshold T for various WVC?

In Fig. 3, we add an illustration of the ratio $|MLE_3/MLE_1|$ for the most inner-swath WVC, i.e., number 41. The scatter distributions are obviously different for the inner-most and outer-most WVCs. Generally, scatters on the right side of the threshold are assumed to have a similar PDF to 2-sol cases. Since the ratio of scatters inside/outside the cone varies with WVC number, the threshold also varies with WVC. For instance, the threshold T is ~40, 40, 50, 35, and 20 for WVC 1, 10, 20, 30, and 41 respectively.

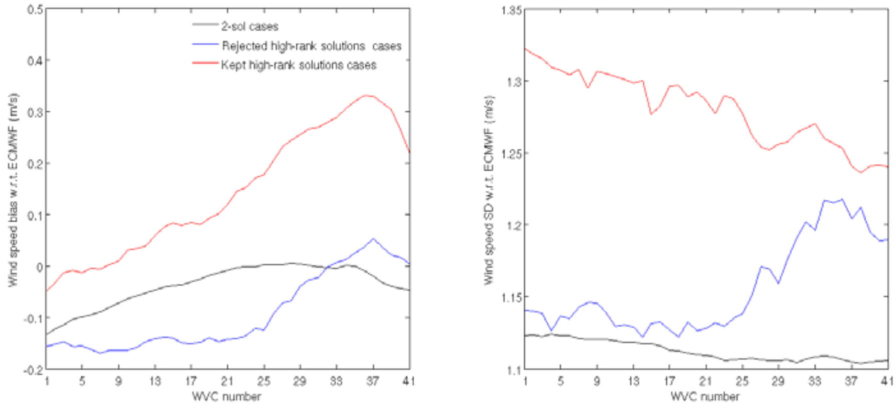
13. Specific comment 12, Page 8847 line 13: Again, mention that inner swath means low incidence angle.

Done.

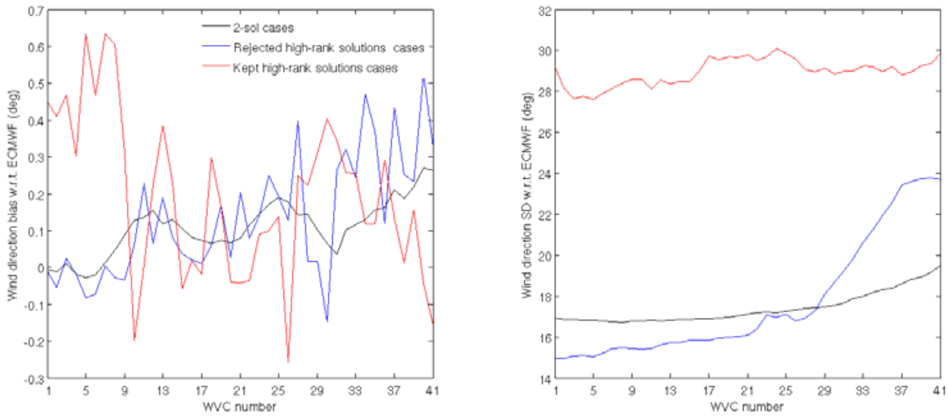
14. Specific comment 13, Page 8847 Figure 5: The RMS might include a wind- or WVC-dependent bias. It would be interesting to see the bias and standard deviation (instead of RMS) compared to ECMWF. Eventually the authors could find a way to show it for three wind regimes: low, moderate and high wind speeds.

It's only possible to show the statistics for three wind regimes for ASCAT-TMI collocations. The following 3 figures show the WVC-dependent bias and SD values. Generally, the bias value of wind speed and the SD values of wind direction/speed have a similar WVC-dependent distribution to Fig.5 in the article. To keep the manuscript concise, we would like to only present the vrms statistics.

A1. Illustrations of WVC-dependent wind bias and standard deviation (SD), for wind speed regime [4 8] m/s.

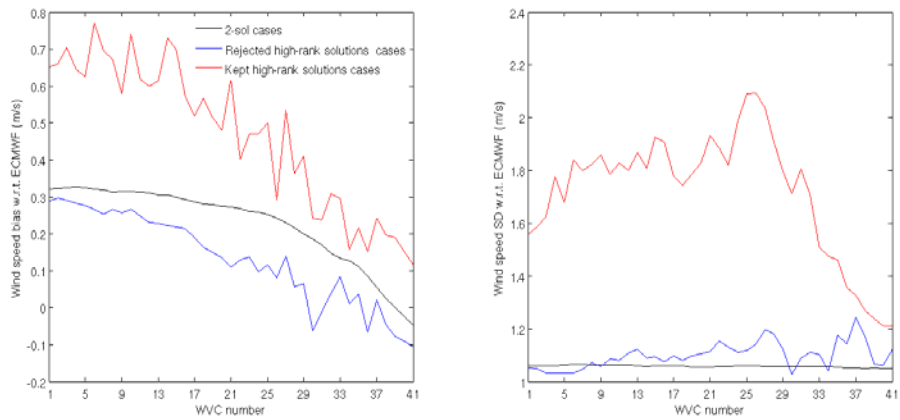


(a) Statistics of wind speed, the left panel shows the WVC-dependent speed bias, the right panel shows the WVC-dependent speed SD.

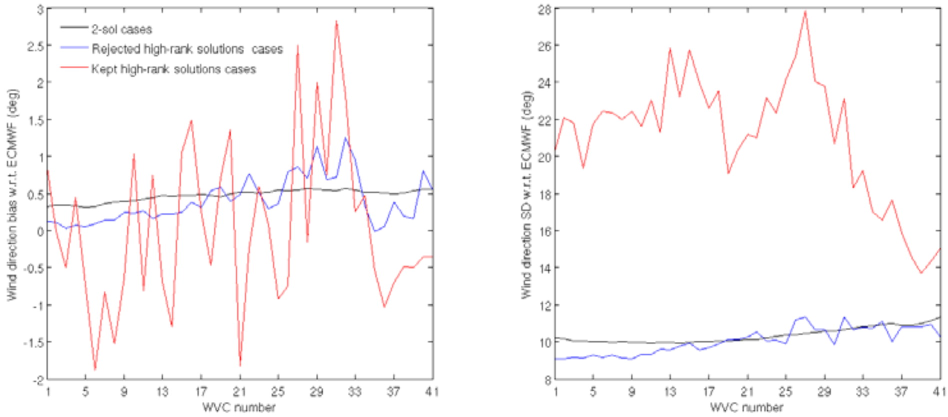


(b) Statistics of wind direction, the left panel shows the WVC-dependent direction bias, the right panel shows the WVC-dependent direction SD.

A2. Illustrations of WVC-dependent wind bias and standard deviation (SD), for wind speed regime [8 12] m/s.

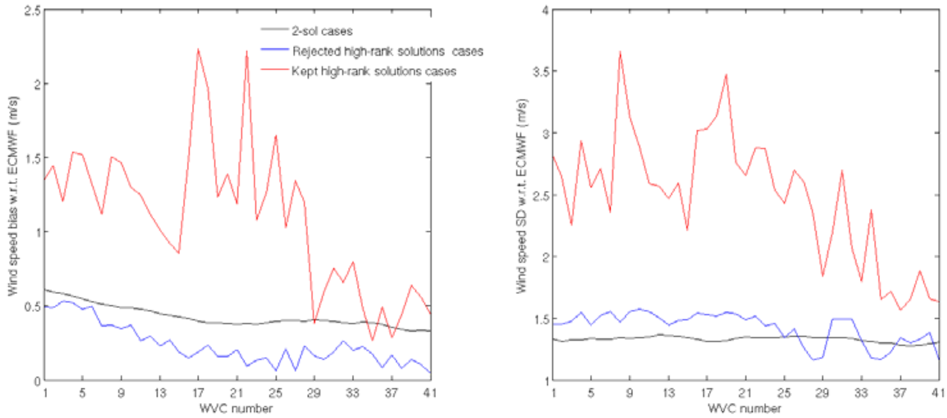


(a) Statistics of wind speed, the left panel shows the WVC-dependent speed bias, the right panel shows the WVC-dependent speed SD.

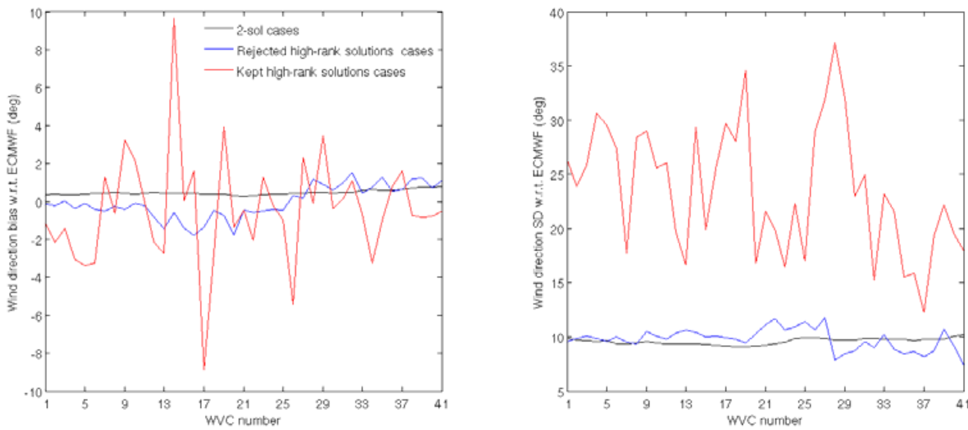


(b) Statistics of wind direction, the left panel shows the WVC-dependent direction bias, the right panel shows the WVC-dependent direction SD.

A3. Illustrations of WVC-dependent wind bias and standard deviation (SD), for wind speed regime >12 m/s.



(a) Statistics of wind speed, the left panel shows the WVC-dependent speed bias, the right panel shows the WVC-dependent speed SD.



(b) Statistics of wind direction, the left panel shows the WVC-dependent direction bias, the right panel shows the WVC-dependent direction SD.

15. Technical corrections

All suggestions have been adopted.