Final recommendation: The paper is suitable for publication after minor revision.

General Comments

This article provides an in-depth analysis of the wind inversion methodology and wind direction ambiguity selection for the ASCAT scatterometer. Here the authors focus on some previously overlooked high-rank solutions (lower probability). The possible wind solutions (or ambiguities) corresponding to the triplet of backscatter measurements are visualized here in a 3D space described by a cone surface defined by the Geophysical Model Function for the incidence angles corresponding to the three antenna beams. The objective of the paper is clearly stated in the Introduction: "The relevance of the additional 3rd and 4th solutions on the opposite side of the cone has never been assessed. That is, are these so called high-rank solutions meaningful in terms of probability of being true wind or rather artefacts of the inversion procedure?"

In the article the authors describe how they developed an additional Quality Control to retain some credible high-rank solution and reject the spurious ones. They also discuss why their method is not recommended for low wind speeds and for low incidence angles.

I find this article very interesting and well described. My main comment regards the fact that most of the discussions refer to the 3D space defined by the solution cone. In my opinion, 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.

Specific Comments

In my comments below, I am suggesting few sentences to help the readers put the described methodology and results in a less ASCAT-specific and more physical perspective.

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.

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.

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.

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

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

Page 8845 lines 7-13: What is the time-collocation window for TMI and the buoys?

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.
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?
Page 8846 lines 10-11, Figure 3: Why there is this clear discrimination about triplets inside and outside the cone?
Page 8846 Figure 3: From the figure we infer that if MLE_1 or MLE_2 is negative, the MLE_3/MLE_1 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?
Page 8846 lines 25-28: Could the authors show or say how different is the threshold T for various WVC?
Page 8847 line 13: Again, mention that inner swath means low incidence angle.
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.

Technical corrections:
Page 8840 line 6: “residuals”
Page 8840 line 10: the objective “of developing” a method…
Page 8841 line 6: I suggest adding a sentence here like “The most likely solution is selected with a wind inversion algorithm.”
Page 8841 line 27: Any reference about the “Recent research”?
Page 8842 line 17: Introduce what is “z-space”.
Page 8843 line 15: I suggest rewording with “An MLE sign has been defined as follows”.
Page 8845 line 11: Correct typo: “measurements”
Page 8845 line 13: I suggest: “data measured by tropical moored buoys”.
Page 8845 line 19: I suggest “…retrievals below 4 m/s. In contrast, above 4 m/s rejections…”
Page 8846: I suggest using “Probability Distribution Function” instead of “histogram”.
Page 8847 Figure 5: The figure is not clear; the lines are very hard to distinguish.
Page 8850 line 18: correct typo “Bayesian”
Page 8852 Table 1: Correct typo: remove “are”. Also, if possible specify again that WVC 1 is high incidence angle and 41 is low.
Page 8854 Figure 2: correct typo “close to the cone surface at up-/down-wind location”.
Page 8854 Figure 2: It might be helpful to add a couple of arrows to indicate where the 3^{rd} and 4^{th} solutions are. It is described in the text, but the figure provides an immediate visual impact.