Answers to reviewer #3 (Anonymous)

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

1. General comment: It is worth mentioning that the issue addressed in the paper is something that has surfaced or become more obvious in the last few years due to the advancement in AR techniques, particularly with the establishment of AR algorithms using the Multiple-Solution-Space (MSS). …

   We indeed agree with the reviewer that this work benefits from the earlier developments of 2D-Var and in particular the use of probabilities. As such, the following text has been added: "In particular, the Numerical Weather Prediction Satellite Application Facility (NWP SAF) ASCAT Wind Data Processor (AWDP) uses the so-called 2D-Var AR (Vogelzang et al., 2009), an AR technique based on variational data assimilation. In contrast with other AR techniques, 2D-Var better exploits the inversion information content by explicitly using the MLE-based probability of each wind ambiguity to retrieve the selected wind field."

   Currently in AWDP, the 2D-Var AR does not use MSS but only the up-to-four inversion minima as input. The reason for this can be found in (J. Vogelzang et al., *QUALITY OF HIGH RESOLUTION ASCAT WIND FIELDS*, *http://www.google.es/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=0CDYQFjAA&url=http%3A%2F%2Fwww.eumetsat.int%2Fidcplg%3FIdcService%3DGET_FILE%26dDocName%3DPDF_CONF_P_S3_09_VOGELZAN_P%26RevisionSelectionMethod%3DLatestReleased&ei=SownUYnkBY-IhQeOvYG4Bg&usg=AFQjCNFHfGKBHogXl44B-bf8hI76xvmxuQ&sig2=BrIqPt225ppremvEsvP9Rg*). As such, we prefer not to introduce MSS to avoid confusion.

2. P2, Line 13-14: Instead of just 'which represents the measured triplets', it would be appropriate to mention here that the GMF 'is empirically derived (ref to Hersbach) as the best fit to the measured triplets, representing thus an average state of the sea surface roughness in the global ocean, calibrated to 10 m high wind vectors.'.

   Done. Note though that the GMF is actually empirically derived (ref to Hersbach) as the best fit to the measured individual backscatter values and has not been fitted to the triplets. The backscatter values of CMOD5n are calibrated to 10 m equivalent neutral wind vectors.

3. P2, Line 15: Perhaps add here what the retrieval process really consist on, so after '...WVC.' and before 'The radar geometry...', insert 'Thus for a given measurement backscatter triplet and a WVC, the retrieval process consists on finding the wind speed and directions corresponding to the GMF backscatter positions closest to the measurement.' Then in line 17, '...which in general leads to several solutions with similar

values of the wind seep but ambiguous wind directions.' .Then the sentence 'The most likely..... inversion algorithm ' becomes unnecessary.

Done

4. P2, Line 22: This would be a good point to make a reference to the MSS method (see under general comments above).

   See the answer to comment #1.

5. P2, Line 23: There is a reference to Figure 1, but the z-space has not been defined. I think the caption in Figure 1 should make some reference to what this z-space is in relation to NRCS, without going into the complicated formula, which is later introduced in section 2.

   Done.

6. P2, Line 24: Replace 'inner-most' with 'near-swath'

   Done.

7. P2, Line 33: As a reader, the question that would come up is 'Why'? It would be good to add a reference to support this statement, it is not obvious if you don't know about how most AR algorithms work (the use background NWP wind field, etc...).

   A reference to Vogelzang et al. (2008) has been added.

8. P3, Line 10-11: For better reading, move 'on the cone surface' to a position in between 'corresponds' and 'to' in line 11. P4, Line 5: '... is the backscatter simulated with the GMF for a range of possible wind speed and direction combinations, through Eq. (1).' P4, Line 7:'.. as the search, among those _ and _ combinations, for the minimum distance...' P4, Line 8: 'The _ and _ solutions associated with such minima are then sorted...'

   The above comments have been adopted

9. P4, Line 29: 'large MLE values' – I struggled for a while with this statement because in figure 2 they don't look too large, and got confused for a while with the units and which curved you were talking about. I think it would be better to remove 'and large' or replace with 'larger' maybe?

   Agree. The mean MLE value is normalized to be 1 in AWDP. WVCs with MLEs>18.6 are quality controlled. Intuitionally, we talk about a WVC with 'large' MLE when its value is larger than ~20. However, for the specific curve in figure 2, the phrase 'larger' may be better than 'large'.

10. P5, Line 24-27: Here I struggled a bit by looking at Figure 2 to put this statement into context. You have just written above in the paragraph that there are two clearly defined cases represented by the dashed and dotted lines. If they are as clearly defined as Figure 2 indicates, surely an MLE threshold of say, 80, would do the job. But what is not explicitly said and might help to state here is that most cases, as can be seen in figure 1, lie in between of the two regimes, and that is what makes it so difficult to discern between the two (and indeed that is why the reader needs to go on reading this paper beyond this point ïA¸Ł).

    Agree. The following paragraph has been added in the text. "According to Fig. 2, discriminating between the solid/dotted and dashed curves may be straightforward. However, in Fig. 2, two very distinct types of triplets, i.e., a triplet very close to the cone surface (solid/dotted) and a triplet very close to the centre of the cone (dashed) are represented. However, as shown in Fig 1, a triplet lying in between the surface and the centre of the cone may not show such a MLE cost function distinct behaviour."

11. P6, Line 7: 'Tropical Atmosphere Ocean'; P6, Line 28-29: Replace 'against...Figure 1' with 'for the triplets in Fig. 1, using the same vertical axis'.?

    The above suggestions have been adopted.

12. P7, Line 2 and Figure 3: I am not sure that it helps to include the plot for WVC 41, without doing the same for Figure 1 – particularly, the loss of symmetry in the vertical axis is difficult to visualise in the mind, without seeing the actual cone cross-section... I suggest that either the figure is commented, or the equivalent in figure 1 is added, or it is removed altogether...

    We have added a similar cone-section plot for WVC 41 in figure 1.

13. P7, Line 5: I think (3) is not correct: what you need is two separate conditions separated by and 'AND', i.e., (1) MLE1 < 0 or MLE2 < 0 *AND* (2) |MLE3/MLE1| > T.

    Indeed, the higher ranks of WVCs (with more than two solutions) belonging to either of the following two criteria are rejected in the study:
    (1) MLE1 ≤ 0 or MLE2 ≤ 0;
    (2) MLE1>0 and MLE2>0, and |MLE3/MLE1|>T.
    which means that we really reject spurious high-rank solutions for WVCs with MLE1<0 or MLE2<0 or |MLE3/MLE1|>T. So we think the criterion should be kept as: MLE1 < 0 or MLE2 < 0 *OR* |MLE3/MLE1| > T.

14. P7, Line 6: Figure 2 does not really show this. It shows one case only. Perhaps better to say: 'Figure 2 illustrates with an example how cases with only ...'. However, I struggled to understand the sentence that follows ('High rank solutions ... reside near the cone

surface', because in Figure 2 one cannot see this, only if you understand Figures 1 and 2 together.

We re-phrase this sentence as following:
"Figure 2 shows that most cases with only two solutions reside near the cone surface. High-rank solutions in case of nominal anisotropy also reside near the cone surface."
Figure 1 shows that most cases with only two solutions reside near the cone surface. Triplets with high-rank solutions in case of nominal anisotropy, i.e., those triplets at up-/down-wind and crosswind locations, also reside near the cone surface.

15. P7, Line 12: better understood if you add 'rank-1' before 'PDF'.

Done

16. P7, Line 12-16 and figure 4 in the top left corner: I cannot understand why there is a minimum in this function, could you offer an explanation? I looked it also with Figure 1 in mind, but I cannot figure it out.

Generally, the MLE distribution is almost symmetric with respect to the cone surface (almost the same distribution inside and outside the cone) for triplets with 2 solutions. According to the rejection criterion (comment 11), triplets (with more than 2 solutions) outside the cone are always rejected. Then a threshold T is used to figure out suitable number of triplets inside the cone, so that the MLE distribution is also symmetric with respect to the cone surface for cases with more than 2 solutions. A low threshold T corresponds to high rejecting ratio inside the cone, and vice versa. If T is too low (*high*), there are more (*less*) triplets inside the cone. Then there will be a clear bias of the MLE distribution (PDF) toward negative (*positive*) MLE values.
A minimum in the function (top left corner of figure 4) corresponds to the threshold *T* which figures out the similar number of triplets inside the cone w.r.t. those outside the cone.

17. P9, Line 30: GMF sensitivity to what? Do you mean 'non-linearity'? Please clarify.

… which is driven by the ASCAT measurement geometry and the GMF sensitivity to wind speed and direction changes.

18. P10, Line 2: Insert '... quality control and prior to the ambiguity removal step'.

The rejection is done prior to both QC and AR steps. The reason for this is that the MLE QC check (against the QC threshold) uses the closest-to-background wind solution (and not rank-1).

19. P11, Line 27: This is not a peer reviewed paper available in the open literature. The report is good, I have personally read it before, but if possible it would be good to replace this

reference with a paper published in a journal. If not possible, then the webpage where this technical note is available should be provided for transparency.

Done. The technical note is available from http://www.knmi.nl/scatterometer/publications/. It's not yet published in a journal.

20. P14, Figure 1 caption: as already mentioned above, there is no explanation of the relation between the z-space and the NRCS-space – I feel that at least a sentence is necessary.

Done.

21. P16, Figure 3: as already mentioned, the (b) part does not add anything if the WVC is not introduced previously in figure 1.

As said in comment 12, we added the same cone-section plot for WVC 41 in figure 1.

22. P16, Figure 3 caption: Perhaps better to replace 'triplet position' by 'axis'.

Done.