

Interactive comment on “Estimates of Mode-S EHS aircraft derived wind observation errors using triple collocation” by S. de Haan

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Dear reviewer,

I would like to thank you for the very helpful, good and valuable comments and the time you have taken for evaluating my manuscript. I think I have answered all questions raised. Below you will find my response to your remarks and questions. I included your review items in *italic* for clarity.

With kind regards,
Siebren de Haan

C5795

The response to the review:

- *I feel the reader would benefit greatly from a paragraph introducing how this work fits within the existing publications on aircraft derived data.*

I have updated par 2.1 with a more information on aircraft derived data relevant to this study.

- *There is currently no discussion of the time period or quantity of data used other than in the figures and a brief mention of “9 months” in section 3.2. This should be added. There may be some seasonal effects which cannot be seen due to the short time or limited amount of data for each season. It would be interesting to investigate any season effect although this would be a significant increase in the work and is more appropriate for a future study. Some comment on this should be added.*

Good comment. I added a sentence at the end of section 2 and in the conclusions

- *I am also missing a futher discussion of the source of the data, I assume it is from the MUAC control centre as used for the authors previous work. Was there any attempt to correct any of the data as detailed in some of the authors previous papers and technical reports? This information is required to fully understand the quality assessment.*

Good suggestion; I added the sentence:

"To obtain high quality wind information, the heading and airspeed are corrected as described in DeHaan (2011,2013)."

- *Radiosondes are conspicuous by their absence throughout. These are often considered to be the best method for observing profiles of the atmosphere. It would be useful to know why these observations were excluded from the study.*

I added reasoning for the lack of radiosonde:

C5796

"Although radiosonde observation are regarded as a reference in meteorology, these observations are not exploited in this study. At present, due to budget cuts, only one launch per day at 00UTC is performed. At that time the number of aircraft landing at or departing from Schiphol airport is very low (that is 01LT or 02LT depending on summer- or winter- time) and thus this will hamper the number of collocation, especially in the boundary layer. Furthermore, the distance between the radiosonde launch site (De Bilt) and the airport is more than 30 km."

- *P12634 L16: It is unclear as to what the error estimates refer to, whether it is the error in the wind components, wind speed, vector error etc... In section 1 both the vector error and horizontal component error are used from previous studies. It would be useful to note this difference more clearly in the text and to discuss later how these should be compared to draw out the conclusions more firmly.*
- *It is mentioned on page 12636 that temperatures can be derived from the Mode-S EHS data set, it would be interesting to know why no attempt was made to do a similar triple collocation study using the temperature data which is known to have a more complicated and interesting error characteristic.*
- *P12635: ACARS and AMDAR data are the same (although often ACARS is used to refer only to North American data), this is not clear from the text.*

I added the sentence: "Note that AMDAR and ACARS are referring to the same type of data."

- *P12635: In the previous collocation studies it would be useful to know the limiting horizontal distances used to compare to this study. I believe the author has conducted a study using the triple collocation method to compare AMDAR/Mode-S/NWP, this should be referenced in the text.*

I added the reference, although it was not a triple collocation in the same sense as this article.

C5797

- *P12636 L16 and L21: I would suggest introducing tracking and ranging radar and secondary surveillance radar at the same time. At the moment this section is a little unclear. Radar is introduced twice in two paragraphs. I would recommend rewording the end of the first paragraph in section 2.1 to be a less specific and introduce the details of the origins of the Mode-S EHS data in paragraph 2.*

I reworded the section as suggested

- *P12637 L21: It would be useful for those who are unfamiliar with Radar to mention how the height above the ground will change with distance due to both the beam angle and curvature of the earth.*

I added a sketch and the sentence:

"The radar beam will have an increasing height with increasing distance to radar due to the curvature of the earth."

- *P12637/12638: It would be good to include the altitude range over which the Sodar works.*

Another reviewer suggested to add a table summarizing the observations. this table includes the Sodar range

- *P12638 Section 2.3: In table 1 the observations that are assimilated into Harmonie are included, it would be useful to know whether the ECMWF model assimilates any of the observations used in this study.*

I added some words on this in section 2.3:

"Note that lateral boundary conditions are ECMWF forecasts, generated from an (global) analysis using a large variety of observation types (SYNOP, radiosonde and satellite information)."

- *P12639 Section 3.1: I do not understand this paragraph. Is the time used for the NWP model the T+3 forecast time from each model run or the T+0 forecast, if*

C5798

T+0 is it a forecast or an analysis that is used?

The paragraph has been rephrased and now reads: "Observations are regarded at the same when the time difference is less than 5 minutes. Note that the model has a three hour cycle (a new run is started every three hours), which reduces the collocation time window to 10 minutes every three hours because we use the three hour forecast only in this study."

- *P12639 L15: GNSS altitude difference to pressure altitude is available from the majority of aircraft in the ADS-B data, is this available in your data stream? If so has any error checking been done to ensure the calculated heights are valid?*

The data did not contain ADS-B data, so no height check could be performed.

- *P12640 L7: You are limiting the atmosphere to situations where the standard deviation of the Radar winds is less than 0.5 m/s does this not remove situations where the atmosphere is very variable when the Mode-S data is likely to have the largest impact due to its high temporal and spatial resolution?*

I added the following sentence to explain the choice of the threshold:

"This threshold was used in order to avoid gross errors in radial velocity due to for example ambiguity problems and clutter."

- *P12642 L19: You say that you've only used data from aircraft reporting a consistent altitude for 100 km, this seems like it would remove all profile data and data at low altitudes, this doesn't seem to be reflected in figures 6 and 9. Is this reduction in the data only for calculated the PSD used in figure 2 if so this should be clarified and a comment added on how this alters the spatial distribution of the data.*

I have added text to explain what I did in more detail:

C5799

"Note that the data set used to calculate the PSD differs from the triple collocation data set, because the triple collocated data set rarely contains points at a stable height over a length of more than 100 km"

- *P12646 L7: I'm not sure I would agree that the triangles are clearly different based on the figure. They are certainly different to the circles and squares, but it seems to be that the circles are a midway point between the triangles and squares, although there is clearly no consistency between the different altitudes. This may be due to the figure. This may be supported by producing a quantification of average difference from the "all" line for each of the six lines.*

The figure is changed with a different line-style: the triangles are larger than the "all"-distribution for low azimuth values and smaller than "all" for azimuth values between 150 and 210

- *P12646 L15: Was any attempt made at using a more scaled distribution so that duplication of data wasn't required?*

Although this is a nice suggestion I did not try a scaled distribution.

- *P12646 L25: Based on the numbers in Figure 9, the number of observations in each of the 10 subsets for the 538hPa level is only 48.7, this is not very many. How does the spread of the data vary if you only split it into say 5 subsets? This assumes that the 487 is the total number of observations (see below).*

I set the number of subsets to 5 and recalculated the statistics and found that the spread and mean did not change very much (in the order of 5%) for all 6 height levels.

487 is indeed the total number of observations in the subset.

- *The conclusions would benefit from a larger discussion of how these results influence the potential uses of the data.*

C5800

I have added some words to the conclusions

- *There appears to be something wrong with the first reference “doi:10.1175/2630-0434(1999)014<1032:AOAWT>2.0.CO;2”*

I updated this reference

- *Figure 1: I cannot find this figure used anywhere in the text. It should either be used or removed.*

Reference to Fig has been added.

- *Figure 2: The font used for the labels is small compared to the body of the document and the other figures.*

Font has been enlarged; I think it is better now

- *Figures 6 and 9: The numbers on the right hand side need to be described in the figure caption.*

Description of the numbers added to the caption

- *P12634 L12: Mode-S EHS needs to be defined, it should also be mentioned in the abstract that this is derived data.*

P12635 L6: AMDAR is used here for the first time without being defined.

P12635 L19: Mode-S EHS introduced here for the first time.

P12635 L16: NWP introduced here for the first time.

I think I explained all abbreviations at first occurrence

- *P12634 L5: The inclusion of “the” between “comparison with” and “model equivalent”*

Changed

C5801

- *P12634 L21: “directly” instead of “direct”*

Changed

- *P12636 L8: “Since a few decades...” should be changed, I would suggest “For a few...”*

Changed

- *P12636 L14: “enHanced” should be “EnHanced” as both the E and H in EHS originate from here?*

Changed

Throughout: you use both “Figure” and “Fig.” To refer to figures.

Changed

Interactive comment on Atmos. Meas. Tech. Discuss., 8, 12633, 2015.

C5802