Reply to Reviewer #3:

Reviewer #3 comments in red italic.

Author reply in black.

Blue bold text refers to Track-Change document line numbers.

Thank you for taking the time to read our manuscript and provide helpful suggestions. Specific comments are entered immediately following the reviewer comments.

Williams et al present a methodology for long-term calibration of UHF radar wind profiles using collocated surface disdrometer observations. They apply their method to an 8-year dataset collected at ARMs Southern Great Planes site. The approach is technically sound and the manuscript is well written, hence I recommend the study for publication after very few minor corrections. The open availability of source code and data already during the discussion phase has to be highlighted positively.

Comments

L32: It should be stated more clearly, that the assumption of negligible attenuation in rain only holds for the rather long wavelength of the radar wind profiler.

Good suggestion. Text was added to clarify that attenuation needs to be accounted for radars operating at higher frequencies. **Please see lines 32-35 in the Track-Change document.**

L42f: The list lacks methodologies, where ground-based radars are cross calibrated with collocated ground-based radars, e.g. Hogan et al 2000, Williams 2012, Kneifel et al 2015, and Radenz et al 2018; Also, for the disdrometer comparison, the more recent work of Myagkov 2020 could be cited.

Yes, our omission; cross calibrating against ground-based radars were not included as a method in the manuscript. Good observation. This methodology was added to the manuscript. The recent work of Myagkov (2020) was also added. **Please see lines 45-47.**

L93: As the scope of the paper is quite technical, it might interest the reader what components where changed following the two hardware failures.

Yes, a reader interested in calibrating radars would also be interested in knowing which components failed. The two failures are included in the text. **Please see lines 112-116.**

L199/Fig 3: At first it was confusing, how the algorithm decides, which of the two peaks is the valid one. Only in Sec 3.1.3 L265f, it becomes clear, that the moments of both peaks are calculated and the 'correct' one is only selected later. Please clarify in the text.

Yes, selecting the 'correct' peak was not described well in the manuscript. An appendix was added to provide more details of the processing steps and to include a flow diagram of the processing steps. The paragraph that contained L199 has been modified. It now describes how the original routine only contained one peak, the extended spectrum has two peaks, and that Appendix A provides details on how a peak is selected. **Please see lines 238-251 and the Appendix on lines 600-625.**

Also, the word 'correct' has been removed from the manuscript. **Please see lines 314, 316, and 317.**

L232: The definition of coherence seems quite vague. It should be stated, that the phase difference of the signals has to vary slowly enough.

Text has been modified. **Please see lines 270-273.**

Fig 5: It seems that the noise oscillates with season before 2017, but ceases to do so after the hardware change. Have you looked into that issue and is it related to hardware temperature stability?

Good observation. We had not noticed that the seasonal variability (due to temperature) went away with the new hardware. We looked into the Data Quality Reports and learned that the air condition system for the equipment shelter was updated in the summer of 2016. Yet, the noise contained to have a seasonal variability in 2016. This indicates that the updated transmitter is more stable than the older unit. Text was added to provide this insight. **Please see lines 344-347.**

L311: Is -1min time lag typical? Could you identify any dependence on horizontal wind?

Good point. Yes, there is a dependence on horizontal wind speed and direction. The disdrometer was located about 100 m from the radar and with a 1-minute resolution. There were times when the surface disdrometer data led the radar data collected at 500 m altitude. This could only happen if the horizontal wind was advecting the rain.

A sentence was added to the Introduction and Section 3.3 clarifying that the wind speed and direction dependence affect the lag between the two time-series data. **Please see lines 65-68 and 373-375.**

Fig 8: It would help to understand the case study, if the 2DVD derived drop size distribution and rain rate would be shown in the figure as well.

Another panel was added to Fig.8 showing disdrometer rain rate and mass-weighted mean diameter (Dm) for this event. **Please see new Fig. 8.**

Also the limits of the colormap should be similar in Fig 8a and Fig 9c.

Good suggestion. The colorbar was extended in Fig. 9c to match the range in Fig. 8a. **Please see new Fig. 9.**

L392: At least the mean relative offset and the standard deviation should also be given for the wind mode beams. One would suspect, that Beam V shows the least offset, as it is pointed vertically as well? Do the offsets change over time?

The manuscript is not very clear. The phrase “results not shown due to space limitations” refers to the event scatter plots and event time-height cross-sections shown for the precipitation long-pulse beam in Figs. 10 and 11. The wind mode beam relative offsets, standard deviations, and variations over time are discussed in Section 4, listed in Table 4, and shown in Fig. 14. To clarify the manuscript, the phrase “results not shown…” was removed and a new paragraph was added. **Please see lines 462-465.**

L418: From Fig 12 the impression arises, that the calibration was stable until early 2013, then changing rapidly until 2014, afterwards being more stable until mid-2015. This would give a change of about 13dB/year, but other years being more stable.

The text was changed to highlight the calibration stability in the first few years followed by a rapid decrease in sensitivity. **Please see lines 490-501.**

Code availability: For long-term availability of the source code, please consider also submitting it to a permanent storage, such as zenodo.

Good idea. Source code added to Zenodo. **Please see lines 635-636.**

Technical issues

L103: "Pulse duration () [ns]" unnecessary set of brackets

Fixed. **Please see line 127.**

L533: "[…] on the DOE ARM archive as a PI Product […]"

Fixed. ***Please see line 645.***

References

Myagkov, A., Kneifel, S., and Rose, T.: Evaluation of the reflectivity calibration of W-band radars based on observations in rain, Atmos. Tech., 13, 5799–5825, https://doi.org/10.5194/amt-13-5799-2020, 2020.

Williams, C. R.: Vertical Air Motion Retrieved from Dual-Frequency Profiler Observations, J. Atmos. Ocean. Tech., 29, 1471–1480, https://doi.org/10.1175/JTECH-D-11-00176.1, 2012

Radenz, M., Bühl, J., Lehmann, V., Görsdorf, U., and Leinweber, R.: Combining cloud radar and radar wind profiler for a value added estimate of vertical air motion and particle terminal velocity within clouds, Atmos. Tech., 11, 5925–5940, https://doi.org/10.5194/amt-11-5925-2018, 2018.

Hogan, R. J., Illingworth, A. J., and Sauvageot, H.: Measuring Crystal Size in Cirrus Using 35- and 94-GHz Radars, J. Atmos. Ocean. Tech., 17, 27–37, https://doi.org/10.1175/1520-0426(2000)017<0027:MCSICU>2.0.CO;2, 2000

Kneifel, S., von Lerber, A., Tiira, J., Moisseev, D., Kollias, P., and Leinonen, J.: Observed Relations between Snowfall Microphysics and Triple-Frequency Radar Measurements, J. Geophys. Res.-Atmos., 120, 6034–6055, https://doi.org/10.1002/2015JD023156, 2015