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Interactive comment on "Can liquid cloud microphysical processes be used for vertically-pointing cloud radar calibration?" *by* Maximilian Maahn et al.

Anonymous Referee #2

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This paper presents three detailed methodologies for the calibration of vertically-pointing millimeter wavelength radars at high latitude ARM sites. The authors make an important and novel contribution which is timely and emerges from an active area of research, has the potential for post-hoc application to many datasets from ARM and other radar deployments—and which may help to reveal significant and sudden changes in radar offsets within those records. The results are well-supported by the methodology, including careful consideration of different sources of uncertainty. The manuscript is well-written and includes a thorough literature review; while the paper runs quite long and requires careful reading, this reviewer does not readily identify any sections which could easily be moved to appendices for the sake of brevity without sacrificing clarity,

but any efforts the authors can make in this regard would be well-spent.

With some attention to the minor comments below, I recommend this paper is accepted for publication.

1 General comments

The paper could be made more reader-friendly in two ways:

1. The figures are frequently dense with information and difficult to parse:

   - As a colour-blind reader, reading this paper would be much improved if all figures were drawn with thicker lines and increased panel sizes. This simple change drastically helps distinguish colours, especially as some figures include many lines.

   - Some additional thought is needed to make the key information salient in the figures. In Figs. 5, 6 & 8 the black crosses and black curves would be more easily discerned if they were heavier than the surrounding lines. The black and gray dots demarking the progress of the model in Figs. 1 and 2 may be more easily visible as alternative symbols or vertical lines, or perhaps complemented by labels. If the purple points in Figs. 1 and 2 do not add any information not amply represented by the smoothed orange lines, I suggest they could at least be made lighter or transparent to reduce the clutter in the most important parts of these figures.

2. The narrative of the paper can be difficult to follow. I commend the authors for writing that is precise and free of errors, but especially because this is a detailed (and detail-oriented) paper, the reader would be grateful for additional 'signposts'. As an obvious example, the title of the paper poses a question that could

be much more explicitly answered in both the abstract and the conclusion. Else-where, at key points such as the beginnings of the sub-sections of the results, it would help to very clearly state (or repeat) how the previous section motivates what follows. This must be difficult feedback to implement as the manuscript is al-ready relatively long, but just a few well-placed sentences would greatly enhance the readers' experience of this paper. Throughout the methodology and results sections it may also be possible to enhance the narrative by paring away some detail, but I appreciate this is a paper that requires detail.

2 Specific comments

- P1, L6: "We identify reference points of these relationship..." Reference points are used only in the skewness and Doppler velocity relationships, not in the LWP method.

- P4, L3: Introducing the calibration offset O in (1), at the end of the paragraph outlining the structure of the paper, seems out of place. O could be just as easily introduced in a brief introduction to Section 3, as it is not referred to in Section 2.

- P26, L22: in considering the differences and offsets between the two drizzle autoconversion calibration methods, would it be helpful to use the box model to estimate the Doppler velocity at drizzle-onset (i.e. $W^{\gamma=0}$), the variability of which might provide some measure of the inherent variability between the two methods?

3 Typos

- P6, L11: should be "...controlled..."

- P19, L5: should be "O^{LWP} varies..."

- P19, L7: should be "...compensate for the variability..."

- P21, L4: should be "...less than the 2 dB..."

- P21, L13: should be "...Kollias et al. (2019)."

- P26, L10: should be "...by Protat et al. (2011)."

- P27, L9: should be "...prior to submission."