General comments
The manuscript presents a statistical analysis of polarimetric radar data and in-situ (disdrometer) observations collected over several years in Australia. The topic is relevant for the readership of AMT and the availability of such dataset is very important for future studies. I appreciate that data (and code) are made available. My concerns about this study are related to its objective, in my view not clearly defined, and to the methodological aspects that should be more thoroughly presented. In particular, I expect to see a critical discussion of a few crucial points (comparison of point-measurements with radar volumes, beam broadening effects, gridding of polar data, see the points listed below). I overall recommend a major revision of the manuscript.

We thank the reviewer for their valuable comments. Their suggestions greatly improved the readability of the paper. In particular, the introduction now makes it clearer that the retrieval development and statistical analysis are useful for providing long-term datasets for model validation. In response to other reviewers, we have also revised the PCA section to be easier to interpret by presenting a cross-covariance matrix between the original radar moment and principal component phase space.

We also corrected many typographical and grammar mistakes. We have addressed the reviewer's specific concerns below.

1. The stated objective of this manuscript is to provide (improved) information for validation of global circulation models. However, i do not see any tentative in this direction. The research presented here is a statistical analysis of disdrometer data and radar data in a tropical region. The goal is therefore not clearly defined and it needs some rephrasing / revision.

We have added text in the second and fifth paragraphs of the introduction emphasizing that developing improved rainfall estimates is useful for GCM validation. The goal of the paper is emphasized in the first paragraph of page 4:

"*Creating accurate multidecadal, climate-research quality rainfall rates datasets at TWP Darwin at C- and X-band, as men-tioned previously, is useful for evaluating and improving model predictions. Lately, more radar rainfall estimators at shorter wavelengths have been developed. However, these estimators use data from relatively short field campaigns or a handful of case studies of extreme events. In this regard, these efforts are valuable but potentially not well-matched to the challenges of creating multidecadal datasets at TWP Darwin with a mixture of typical and extreme rainfall events. This therefore stresses the importance of further assessing R retrievals for CPOL and other ARM radars at the ARM TWP site for developing such long-term datasets. To accomplish this task, this study uses four years of co-located two dimensional video disdrometer (VDIS) and CPOL data at the ARM TWP site, providing a longer and therefore hopefully more representative dataset than used in prior Darwin-based studies."*

More detailed specifics of each change are noted in the annotated version of the manuscript with the list of changes made.

2. Should also the distance with respect to the radar be taken into account in your analysis? With in mind attenuation, beam broadening, partial beam filling, it is an important parameter. See also specific comment 3 below.

The CPOL radar has a 1 degree beamwidth.
The range of the gate considered in the comparison from the CPOL radar is 30 km. We now state this in lines 32 to 35 of page 4:
"*At 30 km range, the gate dimensions are 250 m by 260 m, much smaller than a convective cell so the effects of nonuniform beam filling should be minimal. In addition, R estimation errors at C-band due to beam broadening are on the order of 0.2 mm/hr at 30 km range (Gorgucci and Baldini, 2015).***"**

While we acknowledge that analyses of the impact of range on rainfall retrievals are very important, such analyses require a wider rain gauge network than what was available at the ARM TWP site.

We state that we correct for potential (differential) attenuation on lines 9-12 of page 5:
"*The Z-PHI approach provides an estimate of the specific (differential) attenuation (A_{dr}) A_h as a linear function of φ_{dp} that varies depending on the presence of convective "hot spots" (Gu et al., 2011). The A_{dr} and A_h are then integrated along the ray to provide the (differential) attenuation corrected Z_h and Z_{dr}.***"**

3. Section 2.2: i cannot understand a few things in this section. How many disdrometers are used? Where is/are the video-disdrometer(s?) located (a map will help)? . Are they co-located with the radar? Are they distributed in a network? According to which strategy and which assumptions are volume-based radar measurements compared with point-based disdrometer measurements?

Please adapt this section in order to provide the necessary (and very important) information: it is difficult to provide a useful review and relevant suggestions when this aspect is not clear.

We have added a figure showing a map of the location of CPOL and the video and JW disdrometers with discussion in Section 2.

We have also add a sentence in Section 2 denoting our comparison strategy for the rest of the paper:

"*The comparisons in this paper define the point as the average of the data in radial coordinates from the 0.5° PPI scan from the 4 gates closest to the VDIS. This covers a* *horizontal distance of 0.5-1 km from the VDIS and is about 0.56 km above the VDIS at ground level and 30 km away from CPOL. This definition is chosen as it is consistent with the scales considered in past comparisons by Ryzhkov et al. (2005) and Giangrande et al. (2014a).*"

Specific comments

1. P1: CSU, VDIS: undefined acronyms.

Done as suggested.

2. P2, L1: I would mention also the other fields where accurate rainfall estimation is crucial: nowcasting, alert issuing, climatology (etc.).

We have added these extra uses in page 2, line 1 as suggested.

3. P2, L21: I find this part slightly over-simplified. Beam broadening should be discussed and explained. While the radial resolution can be of 100m in polar coordinates, this will not be true in Cartesian coordinates when we are far from the radar. The conversion from polar data (radar) to Cartesian grid data seems to me a crucial point to discuss, especially given the goal of the manuscript: provide knowledge useful for comparison with global circulation models.

We use do not use the data in Cartesian coordinates, but rather define a point as the average of the 4 gates closest to the VDIS. In Section 2 (line 1-5, p. 5) we now state this:

"*The comparisons in this paper define the point as the average of the data in radial coordinates from the 0.5° PPI scan from the 4 gates closest to the VDIS. This covers a horizontal distance of 0.5-1 km from the VDIS and is about 0.56 km above the VDIS at ground level and 30 km away from CPOL. This definition is chosen as it is consistent with the scales considered in past comparisons by Ryzhkov et al. (2005) and Giangrande et al. (2014a).*"

4. P2, L35: The other side of the medal of ZDR and Kdp is that: (1) they use two channels, so there is twice the possibility that an hardware issue will affect them, (2) Kdp is not a radar observable, but it needs to be estimated from dp: (Otto and Russchenberg, 2011; Wang and Chandrasekar, 2009; Grazioli et al., 2014), (3) ZDR is affected by differential attenuation and it is affected by the incidence angle (Ryzhkov et al., 2005)

In response to point 1, we have verified that the two channels of CPOL were working correctly for the entire dataset. Since this is implied no text has been added.

In response to point 2, we are aware that Kdp has to be estimated from differential phase and there are sensitivities with errors that are difficult to characterize. However, we do expect that, physically, higher Kdp should indicate the presence of oblate drops which forms the physical basis for dual polarization estimators.

In response to point 3, we apply differential attenuation corrections for ZDR.
In addition, rainfall retrievals typically use a constant elevation (like we do), so incidence angle should not impact the retrieval.

5. P4, L16-20: how are the various elevations combined to provide a proxy of precipitation near ground level?

We use the 0.5 degree PPI scan as a proxy for the precipitation at ground level, as now described in page 5, lines 1-5:

"*The comparisons in this paper define the point as the average of the data in radial coordinates from the 0.5° PPI scan from the 4 gates closest to the VDIS. This covers a horizontal distance of 0.5-1 km from the VDIS and is about 0.56 km above the VDIS at ground level and 30 km away from CPOL. This definition is chosen as it is consistent with the scales considered in past comparisons by Ryzhkov et al. (2005) and Giangrande et al. (2014a).****"***

6. Section 4: i had from time to time some difficulties to understand where the polarimetric variables used in this section where coming from (i.e., simulated from VDIS or measured from the radar). I suggest to clarify this aspect through the manuscript, and maybe use a different notation for simulated variables (like ZH).

We have denoted any simulated variables with a ",s" in the subscript for clarity.

7. P12: data availability. Please provide also the link for the data archive.

We have provided the link to ARM Data Discovery (https://www.archive.arm.gov/discovery/).

8. Kdp: a few words about the estimation accuracy of this parameter should be

Kdp processing methods such as LP smooth the processed result. Therefore, the characterization of the measurement errors of Kdp are not amenable to simple error characterization due to this smoothing.

References

T. Otto and H. W. J. Russchenberg. Estimation of specific differential phase and differential backscatter phase from polarimetric weather radar measurements of rain. IEEE Geosci. Remote Sens. Lett., 8(5):988–992, 2011. doi: 10.1109/LGRS.2011.2145354.

Y. T. Wang and V. Chandrasekar. Algorithm for estimation of the specific differential phase. J. Atmos. Oceanic Technol., 26(12):2565–2578, 2009. doi: 10.1175/2009JTECHA1358.1.

J. Grazioli, M. Schneebeli, and A. Berne. Accuracy of phase-based algorithms for the estimation of the specific differential phase shift using simulated polarimetric weather radar data.
IEEE Geosci. Remote Sens. Lett., 11(4):763–767, 2014. doi: 10.1109/LGRS.2013.2278620.

A. V. Ryzhkov, S. E. Giangrande, V. M. Melnikov, and T. J. Schuur. Calibration issues of dual polarization
radar measurements. J. Atmos. Oceanic Technol., 22(8):1138–1155, 2005. doi: 10.1175/JTECH1772.1.