

Atmos. Meas. Tech. Discuss., referee comment RC1
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Comment on amt-2021-257

Anonymous Referee #1

Referee comment on "Three-way calibration checks using ground-based, ship-based, and spaceborne radars" by Alain Protat et al., Atmos. Meas. Tech. Discuss.,
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Monitoring and maintaining the calibration of a weather radar network is an important task. Especially for dualpol radars multiple complementing monitoring sources are needed to assess the calibration of a radar. This work considers one particular source to monitor the calibration of ground based weather radars. Using the NASA GPM, it is shown that there is systematic negative bias of the surface bias for all radars, assuming that the GPM is considered as a references. Among the weather radars, the bias to the GPM data varies between -6.6 and -1.3 dB which is significant, but in part appears to be attributed to the differences in hardware and the age of the systems (without actual prove). But there seems to be no attempt trying to explain the large biases. On the other hand, dedicated ship born radar measurements compared to selected radars illustrate a consistence of the measurement within +/-1 dB, which includes the radar Broome. Using shipborne radars to assess the calibration of operational weather radars is unique.

For the radar Broome the authors find a bias of -6.6 dB compared to GPM data. The authors do not attempt to find the source for those biases, and there is no plan laid out on the next steps. The relative consistence of the shipborne radar data and the continental radars compared to the large variability found between the GPM radar data and the ship radar /radar network suggest that a much more thorough investigation is needed before the satellite data can be one source of the calibration monitoring of the Australian weather radar network. In the conclusion (l.303) you state that you want to get "insights into the accuracy" of space borne radar obs "to calibrate national operational radar network". I would argue that you missed this goal. In principle you compare reflectivities doing a careful designed radar/radar comparison without going into the details explaining obviouse differences.

A more thorough literature survey is missing. This should include references on how other met services monitor the calibration of their radars. I would expect at least a brief summary on how the BOM maintains and calibrate the operational radar network, , how the calibration is done on the ships. Since this is a paper that deals with calibration, this is essential to me.

A more general comment: the term calibration is sometimes used in a very loose way. When doing calibration a normed reference is used to determine the calibration. I wouldn't consider the GPM as a "normed reference" (see e.g. wording in l.39) since it is also an remote sensing instrument which has to be calibrated. So I suggest to be more careful with the wording throughout the manuscript.

To conclude, this is in principle is an important investigation, which falls short on assessing sources for calibration errors and the observed relative differences between the sensors. Without such an assesement, the results remain inconclusive.

Some more specific comments:

How do you do the frequency correction from Ka -> C band? Or is there already a C-Band product you can use?

l 95: what is "dark art" about calibration???

l 115: Please include the solar monitoring results for the Berrimah and Geraldton radar. That would be helpful to understand possible error sources.

I miss the Geraldton radar in the results. Why is it missing? (it is given in Figure 1)

l.116: raw reflectivities: I assume you mean unfiltered data, no clutter correction applied, no range averaging? Please state clearly what you mean with "raw"

l 121 ff: there is no need to separate in HM type depending the height of the radar bin?

Why not?

L 404: Table 2: please include the names of the radars instead of the numbers... makes it easier to read.

L 417: Figure 2: no data for Learmonth? why showing this graph?

L 426: Figure 3: from the caption, the difference in (a) and (b) is not explained. Please describe briefly, as the captions should be self explaining. Or refer to the text.

Dampie with 6.3 dB bias (Fig 2) : did you check the calibration procedure? How often are radars calibrated in the network? Should be mentioned somewhere. A 6.3 dB bias is dramatic.

L 271 "natural variability of the calibration figure": I would suggest to reserve the term calibration for a "real calibration" where you compare against a normed reference. Here you consider a relative adjustment (so far you quantify the difference, but you seem to suggest the satellite could be taken as the truth).

You only discuss the relative differences between satellite and surface/ship based observations. A bias of 3 dB for your ship based radar compared to GPM is significant. I'm a bit surprised that you don't try assess the possible source of the bias. I assume that this instrument has more staff to do a more thorough investigation on the technical aspects of calibration, to really pin down (or rule out) the origin of the bias, checking all relevant elements of your radar hardware, and use the sun as reference to verify your receiver calibration. This should include also a check of the GPM data, perhaps using other data sources like disdrometer measurements (if available)

Assessing the calibration of a radar is a multisource task. I think you have all the ingredients together and you should go through the exercise to assess the absolute

calibration of your radars. If you have the numbers together it may be an elegant approach to use a space born sensor to make an relative adjustment of your radar calibration.

I wonder how the GPM products compare to rain gauge estimates in Australia? Any hint? Would be worthwhile in the literature survey.