Review

Journal: Atmos. Meas. Tech. Discussion

Title: Using ground radar overlaps to verify the retrieval of calibration bias estimates from spaceborne platforms

Summary:

This manuscript presents a study that extends previous ground radar (GR) calibration using satellite-based radar (SR). S-band and C-band GRs near Manilla (Philippines) are compared with Ku-band SR from TRMM/GPM to obtain the reflectivity calibration offset of the GRs over the course of four years while taking into account the quality of the GR measurements. The study takes into account the beam blockage and attenuation quality of the GRs and derives a quality index for the GR measurements. As a result, the GR is better calibrated by the SR than without considering the quality and provides improved consistency between the two GRs.

Contribution and Concerns:

There have been several studies in recent years to examine SR calibration of GR over time (e.g., Warren et al. 2018; Crisologo et al. 2018; Biswas and Chandrasekar 2018). This novelty of this study is that it incorporates path integrated attenuation of the GR measurements to improve the effectiveness of the quality-weighted GR calibration method introduced by Crisologo et al. 2018. Also, this study provides a technique for determining the SR-based calibration of GR between the occurrences of satellite overpasses. The topic of this study is of interest to the radar community and others relying on GR measurements.

However, the study seems to have overlooked the fact that SR measurements are not perfect either and one could argue also require a similar quality weighting. Yes, the SR reflectivity measurements used in this paper have been corrected for attenuation and this correction is only an estimate. The 2A25 and 2ADPR algorithms rely on the surface-reference technique (Meneghini et al. 2000) and Hitschfeld-Borden method (Hitschfeld and Bordan 1954) to correct the SR measured reflectivity. These techniques can fail or provide poor estimates when multiple scattering and/or non-uniform beam filling may be present, which typically occurs within deep convective precipitation, even at Ku-band (Munchak 2018). As a result, the GR calibration offsets determined by this study may be in error, at least during intense convection. Therefore the authors must address this concern about the quality of the SR measurements, primarily when intense precipitation is included within the matched sample volumes. Therefore the authors must address this concern about the quality of the SR measurements, primarily when intense precipitation is included within the matched sample volumes.

Another thing that could use additional explanation is the results presented in Table 3. The GR becomes less biased with time, and the relative improvement amongst the three interpolation techniques decreases with time. It even seems that some optimal calibration is attained by 2016. The authors should expand on this and suggest plausible causes for these trends.

Recommendation: Minor revision

Minor Comments:

1) Table 1...indicated whether the transmit type of each radar (e.g., SHV or alternating H/V)
2) Section 2.3: NASA, 2017 reference is missing from bibliography
3) Section 2.3: Suggest expanding upon the parameters used from TRMM/GPM instead of simply referring to Table 3 of Warran et al. (2018)
4) Figure 3…clarify the vertical reference of the scans (e.g., what elevation angle or constant altitude)
5) Section 3.6…7th paragraph…subscript Qmatch?
6) Figure 4d…define the dashed line above the histograms.
7) Figure 7…"samples with significant number of matches"…how many is significant?

Biswas, S., and V. Chandrasekar, 2018: Cross-Validation of Observations between the GPM Dual-Frequency Precipitation Radar and Ground Based Dual-Polarization Radars. *Remote Sens.*, **10**, 1773, doi:10.3390/rs10111773.

Hitschfeld, W., and J. Bordan, 1954: Errors Inherent in the radar measurement of rainfall at attenuating wavelengths. *J. Meteorol.*, **11**, 58–67, doi:10.1175/1520-0469(1954)011<0058:EIITRM>2.0.CO;2.

Meneghini, R., T. Iguchi, T. Kozu, L. Liao, K. Okamoto, J. A. Jones, and J. Kwiatkowski, 2000: Use of the Surface Reference Technique for Path Attenuation Estimates from the TRMM Precipitation Radar. *J. Appl. Meteorol.*, **39**, 2053–2070, doi:10.1175/1520-0450(2001)040<2053:UOTSRT>2.0.CO;2.

Munchak, S. J., 2018: Remote Sensing of Precipitation from Airborne and Spaceborne Radar. *Remote Sensing of Aerosols, Clouds, and Precipitation*, Elsevier, 267–299.