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Interactive comment on "X-band dual-polarized radar quantitative precipitation estimate analyses in the Midwestern United States" *by* Micheal J. Simpson and Neil I. Fox

Anonymous Referee #3

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Manuscript Review Comments to amt-2017-439

Title: X-BAND DUAL-POLARIZED RADAR QUANTITATIVE PRECIPITATION ESTIMATE ANALYSES IN THE MIDWESTERN UNITED STATES

General Comments: This manuscript evaluates a large number of dual-polarization radar rainfall relations for an X-band radar deployed in central Missouri, USA. Rain gauge data collected during August 2015 to August 2017 are used for quantitative evaluation purposes. Overall, this topic well fits the scope of AMT. However, the manuscript is not well presented. Many fundamental issues in X-band QPE are missing. Following are some of my major concerns and minor comments. In addition, there are small typos

here and there but since I am recommending a rather substantial revision, those issues can be left for a later time. The authors are encouraged to re-submit this manuscript after addressing the following issues.

Major Concerns:

1. Technically, I do not see anything novel in this work. Most of the sciences and principles have already been published in previous studies. Some of the analysis procedures are very similar to what has been used before. However, this manuscript reads like there are not many X-band studies in the literature, which is awkward. The introduction is very roughly written, without referring to proper previous studies. The uniqueness of this manuscript might be its study domain. Unfortunately, the authors fails to elaborate this point.

References:

Anagnostou, M. N., E. N. Anagnostou, and J. Vivekanandan, 2007: Comparison of raindrop size distribution estimates from X-band and S-band polarimetric observations. IEEE Geosci. Remote Sens. Lett., 4, 601-605.

Chandrasekar, V., Y. Wang, and H. Chen, 2012: The CASA quantitative precipitation estimation system: a five year validation study, Natural Hazards and Earth System Sciences, 12, 2811-2820.

Chandrasekar, V., H. Chen, and B. Philips, 2018: Principles of high-resolution radar network for hazard mitigation and disaster management in an urban environment. J. Meteor. Soc. Japan, 96A, https://doi.org/10.2151/jmsj.2018-015.

Chen, H., Lim, S., Chandrasekar, V., and Jang, B.-J., 2017: Urban Hydrological Applications of Dual-Polarization X-Band Radar: Case Study in Korea, Journal of Hydrologic Engineering, 22, E5016001, 10.1061/(asce)he.1943-5584.0001421.

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Kalogiros, J., M. N. Anagnostou, E. N. Anagnostou, M. Montopoli, E. Picciotti, and F. S. Marzano, 2014: Evaluation of a new Polarimetric Algorithm for Rain-Path Attenuation Correction of X-Band Radar Observations Against Disdrometer Data. IEEE Geoscience and Remote Sensing Letters, 52, 1369-1380.

Marzano, F. S., G. Botta, and M. Montopoli, 2010: Iterative Bayesian retrieval of hydrometeor content from X-band polarimetric weather radar. IEEE Trans. Geosci. Remote Sens., 48, 3059-3074.

Matrosov, S. Y., D. E. Kingsmill, B. E. Martner, and F. M. Ralph, 2005: The utility of X-band polarimetric radar for quantitative estimates of rainfall parameters. J. Hydrometeor., 6, 248-262.

Shakti, P. C., M. Maki, S. Shimizu, T. Maesaka, D.-S. Kim, D.-I. Lee, and H. Iida, 2013: Correction of Reflectivity in the Presence of Partial Beam Blockage over a Mountainous Region Using X-Band Dual Polarization Radar. J. Hydrometeor., 14, 744-764.

Shi, Z., H. Chen, V. Chandrasekar, and J. He, 2018: Deployment and Performance of an X-Band Dual-Polarization Radar during the Southern China Monsoon Rainfall Experiment. Atmosphere, 9(1), 4, doi:10.3390/atmos9010004.

2. Details about X-band radar data quality control are NOT enough. In addition, Kdp estimation and attenuation correction are completely neglected. These are all key aspects for X-band QPE. After reading this manuscript, the readers are even sure if the X-band radar data quality is enough for quantitative applications.

3. The authors included a huge number of rainfall relations in the evaluation without explaining why. Many of the relations are wrong (if applied at X-band). Why do you need so many R-Kdp relations? Why are you even implementing S-band R-Kdp relations? Which relation was derived using local raindrop size distribution data?

Other Comments:

4. Page 1, Line 23: However, the literature as to their long-term performance is lacking.

This is not true. Please rephrase the writing. Also refer to the references listed in Major Concern #1.

5. Page 4, Lines 39-40: Most of the references are not current. A few widely used dual-pol rainfall algorithms are suggested here.

References:

Chen, H., V. Chandrasekar, and R. Bechini, 2017: An Improved Dual-Polarization Radar Rainfall Algorithm (DROPS2.0): Application in NASA IFloodS Field Campaign. J. Hydrometeor., 18, 917-937.

Cifelli, R., V. Chandrasekar, S. Lim, P. C. Kennedy, Y. Wang, and S. A. Rutledge, 2011: A new dual-polarization radar rainfall algorithm: Application in Colorado precipitation events. J. Atmos. Oceanic Technol., 28, 352-364.

Giangrande, S.E., and Ryzhkov, A.V., 2008: Estimation of rainfall based on the results of polarimetric echo classification. J. Appl. Meteorol. Climate, 47, 2445-2462.

Ryzhkov, A.V., T.J. Schuur, D.W. Burgess, P.L. Heinselman, S.E. Giangrande, and D.S. Zrnic, 2005: The Joint Polarization Experiment: Polarimetric Rainfall Measurements and Hydrometeor Classification. Bull. Amer. Meteor. Soc., 86, 809-824.

6. Page 2, Line 48-49: However, the cost . . .are much larger. . ..

Please use proper reference (i.e., McLaughlin et al. 2009).

Reference:

McLaughlin, D., D. Pepyne, B. Philips, and Coauthors, 2009: Short-Wavelength Technology and the Potential For Distributed Networks of Small Radar Systems. Bull. Amer. Meteor. Soc., 90, 1797-1817.

7. Page 4, Line 82: . . .normalized standard error (NSE). . .

NSE has been expanded too many times all through this manuscript. Please pay attention to the usage of acronyms.

8. Page 4, Line 84: . . . relatively few articles on X-band. . .

There are many X-band QPE studies. Please rephrase the writing. Again, the uniqueness of this study should be emphasized (particularly the local precipitation microphysics).

9. Page 4, Line 93: Over 100 different algorithms were implemented. . .

This is very strange! Do you really need 100+ algorithms? The authors should pay more attention to the algorithms that can better reflect local rainfall microphysics. Most of the relations are taken from other papers that focused on different regions. Some of the algorithms used in this study were not even designed for X-band. . . A detailed investigation of local precipitation microphysics will be helpful.

10. Page 5, Lines 105-106: . . .X-band radars will allow further indications as to whether they should be installed in regions devoid of optimal NWS WSR-88D coverage.

The description on such aspect is weak. The authors may want to rephrase this sentence or refer to other studies.

11. Page 7, Lines 162-163: R and Z . . . should be independent of radar wavelength.

This is true only when you are assuming Rayleigh scattering. Please clarify!

12. Page 9, Line 210: $p<0.10$

What is p? Probability?

13. Page 23, Figure 2. Please include corresponding rainfall products derived from this radar.

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