

REVIEW REPORT

Review of amt-2016-14

By H. -L. Kim, M.-K. Suk, H. -S. Park, G. -W. Lee, and J. -S. Ko

Manuscript Title – Dual-polarization radar rainfall estimation in Korea according to raindrop shapes using a 2D Video Disdrometer

GENERAL REMARK

In this study one year of 2D Video Disdrometer (2DVD) data collected in Korea has been used to establish: *i*) a new axis ratio versus diameter relation and *ii*) weather radar algorithms for rainfall retrieval optimized for that area. They verified the adequacy of the new axis-ratio comparing the rainfall rate estimated through different radar rainfall algorithms and assuming different axis ratio relations. Furthermore the Authors compared the rainfall retrieved from a Bislsan S-Band dual-polarization radar and from 2DVD through the obtained algorithms with the one measured by a rain gauge nearby. Finally in order to improve the radar estimates, they used the 2DVD data to adjust the horizontal reflectivity and differential reflectivity measured by S-band radar. I recommend the publication of the paper on Atmospheric Measurement Technique (AMT) after the revision. Shown below some specific comments and questions.

SPECIFIC REMARKS

1. Pag. 6, line 10: Why the Authors used the fall velocity-diameter relation of Brandes et al. (2002) to compute the rain rate and the one of Atlas et al. (1973) to filter out the outliers? Defend this choice or use the same relation.
2. Pag. 6, line 12: How did the authors define an event? please provide some information regarding the criterion used.
3. Pag. 6, line 26: How many events have been discarded by the quality control process?
4. Pag. 7, lines 1-3: In the literature there are several different methods to distinguish between stratiform and convective rain. Can the Authors provide some information regarding the criterion used?
5. Pag. 7, Line 19: Can you provide some information regarding the choice of a third order polynomial? Did the Authors try also other relations (such as linear or a fourth order polynomial)? Can the Authors provide some information regarding the performance/goodness of the fitting (such as R^2)
6. Pag. 8, line 13: Can the Authors defend the choice of using $D_{\max} = 7$ mm in the T-matrix simulation instead of using the maximum drop diameter measured by 2DVD in each DSD?
7. Table 3: Please note that some correlation coefficients of Table 3 are very poor (0.01) please check this values.
8. Pag. 10, lines 5-6: “This means that raindrops in South Korea are more oblate than the others”. Please rewrite this sentence, it is “too strong”. I think that there are not enough information to justify it.
9. Pag 10, line 21: “Corr = 0.01”. Please check this value.

10. Table 3: In terms of MAE, RMSE and corr., it seems that the use of different axis-ratio does not have a huge influence, in particular the use of “new axis ratio” (that is optimized for the area) does not highly improve the three statistics. Can the Authors defend this issue?
11. Pag 11, Line 11: Why the statistical validation has been performed only on 18 events. How do you chose them?
12. Table 4: As for Table3, also in this case the use of the “new axis ratio” does not produce an high improvement, in particular with respect to the relation of Pruppacher and Beard (1970). Please comment this issue.
13. Pag. 12 Line 1-2: the sentence is not clear to me. Which are the “DSD results”? How the Authors can say that, based on the results provided, “ K_{dp} is less sensitive to DSD variation and uncertainties in raindrop shape”? Please explain in more detail.
14. Pag. 12, line 7: I suggest to show some plots regarding the performance of the algorithms for $R > 5 \text{ mm h}^{-1}$
15. Pag. 12 line 9-10: This is known in the literature (such as Vulpiani et al. 2015 among others), please provide some reference.
16. Pag. 12, line 11-15: “the polarimetric rainfall relations based on the new axis-ratio relation also were better than the others”. Please explain how you can say that they are better. I think that this paragraph is about a crucial issue however it is not clear to me. I suggest to rewrite in order to explain the improvement of the new axis ratio in the rainfall retrieval.
17. Section 4.2.3: I think that the word “calibration” is misleading, the procedure explained in the paragraph is not really a calibration procedure, in my opinion it is more an adjustment of radar variables based on a ground truth (2DVD data). Pleas reformulate it. Moreover, the Authors did non compute the “calibration bias” for K_{dp} , why?
18. Pag. 12, line 18: why do you use only 8 events for this analysis? Can you use all the 18 events selected for the validation? I noticed that in the 8 selected events there aren't convective events. Why?
19. Pag. 12, Line 19-21: This is just a suggestion. Instead of doing two scatterplots for each event (namely Figure 8 *c* and *d* for one event and Figure 9 *c* and *d* for another one) the Authors can plot the results for all the events in two graphs (one for Z_h and one for Z_{dr}).

EDITORIAL REMARKS

1. Pag. 1, Line 16-17: “The shapes of a raindrops have a direct impact on rainfall estimates”. Although the sentence is correct in my opinion it is necessary to add that also the number, the dimension (diameter) and fall velocity of the raindrops play a central role.
2. Pag. 1, Line 20: I suggest to write “raindrop size distribution” instead of “raindrop shapes”.
3. Pag. 2, Line 2; what does it means “DSD statistics”? These worlds are used several times in the manuscript, but it is not clear the exact meaning. Please clarify it.
4. Pag. 2, line 24-25: “This is because the shape of raindrops is one of the most sensitive parameters for representing the DSD properties of the rain”. Please consider to reformulate this sentence or to put one or more reference. There are other important parameters (e.g. diameter, number of drops ecc) that should be mentioned.
5. Pag. 3, lines 7-10: Please check this sentence, single polarimetric radar does not provide Z_{dr}

6. Pag. 3, Line 24: I think that “four” should be substitute to “three”
7. Pag. 6, Line 3-4: This sentence should be moved to pag. 5 Line 25 after “...Atlas et al. 1973”. Furthermore it is not clear the meaning of “the normal distribution”. Please reformulate it.
8. Pag. 7, Line 13-14: similar to my previous comments, I think that the sentence “this relation is one of the most sensitive parameters for representing the rainfall properties” is “too strong”. Can you provide some references or reformulate it?
9. Table 5: check the format of the date.

REFERENCE

Vulpiani, G., L. Baldini, and N. Roberto. "Characterization of Mediterranean hail-bearing storms using an operational polarimetric X-band radar." *Atmospheric Measurement Techniques* 8.11 (2015): 4681-4698.