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Atmospheric Measurement Techniques Discussions

Interactive comment on "Evaluation of gridded Scanning ARM Cloud Radar reflectivity observations and vertical Doppler velocity retrievals" *by* K. Lamer et al.

Anonymous Referee #3

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General comments

This paper presents case studies of the new ARM scanning cloud radar observations and the authors propose methods to gridding the reflectivity and Doppler velocity to a Cartesian grid and subsequently retrieve vertical velocity for two types of clouds. The processed and gridded scanning cloud radar output is then compared to the collocated vertical pointing cloud radar to validate the results. Scanning cloud radar is the new frontier of atmospheric observations and presents considerable challenges as well as opportunities. The authors provides some good backgrounds on the emerging technology compared to existing and previous systems, and the proposed method and results

seem quite promising to enhance the scientific use compared to raw measurements from the scanning cloud radars.

Overall, I find the study fairly well presented, with sections organized to read well. However, as with any case study, how would they generalize the results to be applicable to others is very important, and some work is needed in this paper to address this. For example, the authors presented a few cases from a period of relatively short scan times (∼20 min) to demonstrate Cartesian gridding techniques and vertical velocity retrievals. While the demonstrated cases seem to show the method give reasonable estimates, there are many obvious limitations (specific cloud types, assumptions) as the authors pointed out. How would these limitations affect future implementations to the technique? How should the users be informed of the quality of retrievals, specifically related to vertical velocity? I have listed more detail questions in the major comments. Also, there are many instances of grammatical errors, I may not have caught them all, but the authors should carefully go through the paper to eliminate these to improve the quality. Based on these, I recommend major revision of the paper before it can be accepted for publication.

Specific major comments

Page 6, line 18, how are cloud bases "detected" or determined? It has not been mentioned before. And why 5C? Are you assuming no insects exist below 5°C? And, can you provide more details about how is the linear depolarization ratio used to distinguish insects from clouds, such that a feature mask is truly hydrometeors only?

Figure 2, the lines are confusing to read due to lack of contrast, why not just plot the standard deviations as error bars, or use different colors for cloud vs. drizzle?

Figure 8d, the interpolated vs. polar coordinate reflectivity during certain time seem to have significant differences (e.g. between 1-2 min, 3.5-4.5 min, 10.5-11.5 min), where the polar coordinate data are consistently lower than the interpolated one. Why is that? If the times between two actual observing points (both cloudy) are simply just

interpolated in between, shouldn't we expect that at the time that is not interpolated, the gridded data should be the same with the original data? Similarly such difference is seen in Doppler velocities in Fig. 9d too.

Section 4.1, Since the projection of horizontal wind onto the radar line-of-sight is critical to decomposing horizontal and vertical velocity, and a fundamental assumption is that the radar is scanning perpendicular to the mean wind direction, which is based on 4/day sounding, can you discuss how these prerequisites would impact the result of your vertical velocity retrieval? For example, what if the mean wind direction changes by 30° and thus there is additional horizontal velocity projected on the CW-RHI scans? How much error would it introduce to your proposed retrieval method?

On that related note, such CW-RHI scans can only focus on one particular cloud type at one time. If there is a significant vertical wind shear (e.g. between boundary layer and upper level, very common), how would that affect the other type of clouds that is not being "cross-wind scanned"? The authors need not provide any quantitative analysis, but discussions to these conditions should be provided so that potential users of the data will be aware of the limitations of the proposed method and data product.

Page 17, line 22-24, what does "a large number of points" mean? How large? 80%, 90%? Please be more specific.

Fig. 11b, the retrieved vertical velocity still shows some radial components, especially within $\pm$1 km range. There is no reason to believe the cloud vertical motion to behave this way (i.e. downdrafts across the cloud toward a single point at the ground), can you comment on why this is the case? Fig. 11d did not show such "feature", although the choice of colorbar is a bit confusing as 0 vertical velocity shows up as red, so it is hard to visualize updraft vs. downdraft. Is it possible to adjust that (e.g. equal +/- values center at 0) if you have determined most of ice particles are falling (negative VD) anyway?

Page 19, line 22-26, the standard deviation of VD,V greatly increases beyond just 2 km

range, what does this mean in terms of the accuracy of the vertical velocity retrievals? Does it mean that they should not be trusted at all? Or does it mean it is still usable if the users are willing to accept a certain amount of uncertainty, and what would that uncertainty be? Simply pointing out the obvious that error is larger does not give users much useful information of what to do with it. Further, did you look at other stratocumulus cloud case? Is this a common feature in low clouds? What does it mean when implementing this algorithm to future retrievals in terms of the range/volume of usable vertical velocity retrievals?

Page 22, line 10, have you actually shown in the results that max value interpolation method near cloud edges perform better than the other methods? How would you implement such hybrid interpolation method? What criteria are needed to define a volume that is at/near cloud edges (e.g., fraction of cloud mask)? Please provide more details.

Minor comments

Page 5, line 9, what does "land contamination" mean exactly? Contamination by aerosols? Clouds? It is unclear.

Page 8, line 10, what about sensitivity at 20 km? It should be provided since that is the maximum operating range according to the authors.

Figure 12, some caption seems missing, I assme the "fitted projected horizontal wind contribution (VH,RHI)" is the blue line?

Technical corrections

Page 3, line 10, "...the lack of factual 3-D cloud structure...", do you mean "actual"?

Page 3, line 12, "... in cloud properties retrievals", should be just "cloud property retrievals".

Page 3, line 25, "On the contrary, scanning cloud radars ... deploy innovative scanning

strategies such as . . .", radar cannot "deploy" scanning strategy by itself.

Page 8, line 7-9, this sentence does not read right, I suggest separate the SGP and NSA sites into two sentences to be more clear.

Page 21, line 25, "The suitability of a CW-RHI to addresses the need . . .", should be "to address" the need.

Page 21, line 26, "The Ka-SACR observations are initial post-processed . . .", should be "are initially post-processed".

Page 23, line 5, ". . . are noisy for elevation angle lower that 60° . . .", should be "lower than".

Interactive comment on Atmos. Meas. Tech. Discuss., 6, 9579, 2013.