

Review: Vertical Air Motion Retrievals in Deep Convective Clouds using the ARM Scanning Radar Network in Oklahoma during MC3E

Synopsis:

This paper attempts to highlight the capability of the ARM network to gather and used the wealth of data to attempt to address issues with current radar methodology. Data collected during MC3E is analyzed to show how well the ARM network captured three events. Dual-Doppler 3DVAR technique is used show that the results when compared to vertical profiler data located in the vicinity are similar in magnitude, but for one case discussed upward iterative techniques do not perform as well.

Decision: Accept Major

General Comments:

Overall, the work done in this paper is good, but more discussion and expansions of results is needed to make this paper more robust to justify the conclusions that are trying to be made. Especially in the comparison between traditional dual-Doppler methods and 3DVAR methods. I would like to see more details on the quality control methods used rather than just stating 'standard methods' were used.

Need some expansion on the analysis of results and methodology to help readability. The author used capital lambda (Λ) in the document but in the figures lower case lambda (λ) was used. Please fix as it was confusing. Chapters 5 and 6 need to be expanded on in areas detailed below and reworked to address readability and clarity.

Major:

- 1) 2.2: When using KVNK did you change the objective analysis parameters to deal with the coarser resolution and change in spatial coverage of the data from KVNK. It does not appear you did but I would suggest that maybe it is investigated to not introduce artifacts into the Barnes interpolation.
- 2) Advection correction is ignored for paper, why? Especially with 20 May where KVNK is used. Advection correction has been shown to help improve dual Doppler retrievals. It should be discussed and determined how dealing with advection changes the results between the two retrieval techniques discussed in this paper.
- 3) Page 7 line 8: What is the spatial/temporal distance from the radiosonde profiles to the analysis grid. Does using the radiosondes as the background create issues or biases in the background due to time and distance from the grid as well as the evolution of the environment over time. Why not use a derived sounding from model analysis (e.g. RAP) as the background?

- 4) The results and analysis of the three cases are not identically carried out but they should be. Why is the upward iterative technique only compared to one case and not all three? I think comparisons between all cases should be carried out in a similar manner. As well as, similar panel plots for 20 May that is included with the other two cases discussed. There are no reflectivity plots for 20 May that is similar to the other two cases and there should be. Expansion and reworking of 5.2 and 6 will help improve the strength of the paper.
- 5) I would suggest doing analysis of the differences between the iterative and 3DVAR techniques over all three cases to show differences between the two techniques over three different regimes (QLCS, elevated front, and supercell environments). This would help show the importance of using the 3DVAR technique.

Minor:

Page 2 line 8: Please expand on reasoning why profiling radars provide high detail in time and height and how without the reader knowing which band the radar is operating in how it can sample the most intense convective cores. Feels like there should be a few citations proving this.

In figure 2: Why are there lines of constant height moving radially away from the WSR-88D nearest neighbor distance plot. It looks different than the other radars. I am not sure why similar heights can occur radially outward.

Page 6 line 22: What is the time difference from the air density calculation and the analysis? For example, the air density within the squall line should be very different from the environment ahead of it. When are those values updated and the sensitivity to those changes applied.

Page 8 line 18: Is there a citation or study that shows the velocity measurement error can be 0.5 m s^{-1} . Need to justify using 0.5 m s^{-1} as the top of the error.

Page 9 Line 6: I would switch this paragraph with the one after it to help readability.

Page 9 Line 28: Move the last sentence to the beginning of the sensitivity analysis to give the reader the ability to know where to reference as you describe.

Page 10 Line 18: How the new R_s was determined to be 750 m?

Page 11 Line 20-23: These two sentences seem out of order.

Page 11 Line 25: Move the detail about the time axis for the plots higher up to where the plot is initially discussed near line 20 so the change from the expected axis is noted earlier.

Page 12 Line 19: How do we know that this upwards motion is associated with the squall line convergence zone when there is not plot to give context that relate the two together.

Chapter 6: How many times was the iterative upward technique iterated over the entire column? What was the method used to determine if/when the iterative technique converged on a solution? You mention number of iterations for the 3DVAR technique but none for the upward iterative technique.

Page 14 Line 8-9: This sentence should be removed or changed to not be as strongly worded as there has been other studies where multiband radars have been used together for analysis. See papers resulting from the VORTEX2 field project.

Page 14 Line 27: It is hard for me to accept that the iterative wind retrieval is inferior to the 3DVAR technique from only 1 example and one that did not use advection correction.