

Interactive comment on “The next generation airborne polarimetric Doppler weather radar” by J. Vivekanandan et al.

Anonymous Referee #3

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Summary: This paper presents a science and engineering design for the next generation airborne precipitation radar to replace the aging ELDORA. The design of the APAR is excellent and well considered, and the instrument is greatly needed in the atmospheric sciences community. The manuscript does a good job of explaining the design and trade-offs involved with an airborne radar platform, and the difficulties in obtaining the required Doppler and polarimetric data quality. A few of the trade-offs and comparisons with ELDORA could be made more explicit, but the manuscript is generally well-written. I recommend only a few minor revisions prior to publication in GIMDS.

General Comments:

C24

1. The trade-offs involved in determining the spatial resolution could use some clarification. For a stationary PAR e-scan the effective angular beamwidth can be essentially the same as the antenna beamwidth, but for APAR there is a trade-off between the number of samples, effective beamwidth, and the along-track resolution due to platform motion. In the conclusions you state that APAR would improve the spatial resolution by a factor of two, but this point is somewhat lost in the technical discussion. It seems that a 200 m along-track would give 10 samples (at 35% overlap), which would require 10 dB SNR for the same data quality. It would be useful to state the beam overlap used in ELDORA for comparison in the effective beamwidth, and state specifically how the spatial (presumably along-track) resolution is improved by a factor of two and whether that involves a loss of velocity quality (but improved attenuation at C-band).

2. It would be good to either combine Figs. 4 & 10, and 5 & 11 for easier comparison, or to take the best single curves (pulse compression and 1 m/s curves) from 4 & 5 to overlay on 10 & 11. This would highlight the advantage in sensitivity, but also the trade-off in number of samples required at C-band. Making Tables 1 & 2 equivalent would also help with the comparison.

3. Eye-eyewall interactions are indeed a valuable target for this radar, and strong mesovortices along the inside edge of the eyewall are believed to have scales on the order of 500 - 1500 m, which would require ~200 m resolution to nominally resolve at the 4-6 dx scale. This radar may be our best hope for resolving these features. The “structures of the hurricane eye” may still be a difficult target for APAR in the clear dry air above the low-level inversion however. Another important aspect of the weather motivation is the microphysics of hurricanes and severe weather. Aircraft typically do not fly in the critical mixed-phase region in these systems, so the polarimetric measurements may provide valuable new data in this region.

4. The trade-off in spatial resolution for LDR is not entirely clear. This variable will have half the spatial resolution of the other polarimetric variables, or does the scan strategy mitigate this in some way? Please clarify. It may also be good to note the science

C25

limitations with LDR only going down to -22 dB.

Minor comments: Abstract L6: suggest "(PAR) has demonstrated"

Abstract: Consider mentioning that APAR will meet or exceed the capabilities of EL-DORA, not just move to C-band.

p3, L3 and Fig. 1 caption: The terms 'inner' and 'outer' rainbands have different meanings than the current context, and typically refer to rainbands in the inner core and at large radii, respectively. In this context the word 'eyewall' should be used for both inner and outer features. Secondly, the data is not 'masked' in the inner eyewall, but the reflectivity is significantly attenuated suggesting the eyewall is weaker than it was.

p5 L5: should be "other than an"

p11 L9: The NSF radar workshop also endorsed a need for airborne radar like APAR, though the enthusiasm is difficult to judge from the report (BAMS, Bluestein et al. 2014).

p11 L24: Missing period.

p12 L11: It might be good to mention the asymmetry is due to the wings and tail.

p13 L28: suggest comma to separate clauses: 'X-band, and X-band cumulative'

p15 L12: It won't affect precipitation echoes, but would affect clear-air and cloudy echoes near the aircraft. This is a fair trade-off though to have better sensitivity at longer range.

p16 L16: You may want to reference Fig. 10 here or combine them as suggested above.

p21 L11: "Optimal" and "currently available" are not really the same. I would suggest "best".

p21 L21: Remove extra comma

C26

p23 L6: Although it is mentioned in the summary it may be good to mention here that you can do staggered PRT with APAR too.

Figure 3: The black beams are just the middle ones, or do they have some other significance? Please note these in the legend or caption.

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