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Geoscientific Instrumentation Methods and Data Systems Discussions

Interactive comment on "A wing pod-based millimeter wavelength airborne cloud radar" *by* J. Vivekanandan et al.

Anonymous Referee #2

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Comments:

1. Page 122, line 23, Are the authors concerned about the limited Nyquist velocity and was dual PRF for example considered?

2. Page 124, Line 22, " . . .cross polarization lower than 40 dB at the bore sight". According to Figure 4, the cross-pol level at the bore sight is about -38 dB. Also for polarimetric measurements, integrated cross-pol power is used instead of just cross-pol signal at bore sight.

3. Page 126, Section 4.1, the authors discussed the relationship between number of independent samples and Doppler velocity measurement accuracy. In fact, Doppler

measurement accuracy is directly related to the number of pulse pair products integrated, not necessarily independent samples. The adjacent pairs of pulses need to be correlated for Doppler phase estimates. Integration of independent samples is necessary to increase the accuracy of reflectivity and improve SNR.

4. Page 127, Line 20, the sensitivity improvement by integration of 0.1 s (1000 samples). How is 8 dB calculated? For noise estimates, averaging 1000 samples should improve SNR by 15 dB not 8 dB.

5. Figure 7: Add a comment on sensitivity improvement through averaging. Figure 7 implies a 10 dB improvement in sensitivity by averaging 1000 pulses. This conflicts with the 8 dB stated in the text. Make this consistent with response to comment #4.

6. Airborne and spaceborne radar along track resolution is determined by antenna beamwidth, platform ground speed and along track integration time. Page127ïijN̆ Line 27, ". . . along track resolution 20 m. . ." The antenna beamwidth is 0.68 degree, for GV altitude, $\sim$ 45,000 ft, the 3 dB footprint should be $\sim$ 160 m. Counting in the 0.1 s integration time, the along track resolution should be a little larger than 160 m, not 20 m (which is the aircraft travel distance within 0.1 s). Also, Figure 8 needs to be revised since it shows a linear relationship between along track resolution and number of samples.

7. Page 128, Line 19, Noise diode temperature stability better than 0.004 dB over 30 degree C temperature range. Could the authors provide details on this? For reference, NoiseCom NC5000 temperature stability is $\sim$ 0.01 dB/degree C, which means 0.3 dB for over 30 degree C range.

8. Page 129, Section 5.1.2 discusses external calibration using measurements from light rain and presents modeled and measured radar reflectivity from light rain in close range. I don't think this approach is very appropriate for HCR: 1) This approach is based on measurements from light rain at close range, $\sim$ 250 m. Unless the Tx pulse is very short, otherwise, the T/R switch transition time may affect measurement at this

range; 2) How do you to verify the rain rate is within 3-10 mm/hour?; 3) At this close range, rain/condensation on the splash plate and antenna could be significant and affect the calibration accuracy. For an airborne radar like HCR, the convenient way to perform radar calibration is to use surface water, such as lake of ocean. Atmospheric attenuation for that situation could be estimated and corrected by using sounding data or standard atmospheric profile.

9. Page 129, Also did you take into account signal attenuation due to the rain in your calibration? From [Haynes 2009 Rainfall retrieval over the ocean with spaceborne W-band radar], the two-way path attenuation through 5 mm/hr rain could be as much as 6 dB per km, so your measured reflectivity of 1.5 dB below the theoretical at 250 m range could be correct.

10. Page 129, line 10-15, Would it be possible to fly microphysics probes on the GV to provide in situ validation since there is no way to precisely know the rain rates?

11. Page 130, lines 14-15, There is an old paper that discusses this as well (Heymsfield 1988) that maybe can be referenced.

12. Page 133, Line 11, “Along track resolution is normally about 60 m”, which is not consistent with 20 m mentioned in Page 127 even though 20 m does not sound a right number.

13. Table 1, in the line “Sensitivity (-6.5 dB SNR, . . .”, where is -6.5 dB calculated? What are the sensitivity values for scanning mode? What is the cross-track scanning rate (this parameter need to be added into the table). The -6.5 dB SNR thresholding as compared to the 0 dB SNR thresholding for the single pulse case would imply a 6.5 dB increase in sensitivity. Also, what is the reflectivity and Doppler sample spacing in range?

Editorial,

1. Pg 119, Line 16, “Cloud Resolving System” should be “Cloud Radar System (CRS)”.

2. Figure 3 labels are too small to read.

3. Please add unit and legends for the data products (reflectivity, Doppler velocity and spectrum width et al.) in Figure 12, 13 and 14.

4. Pg 127: “A factor of two coarser in range resolution” Maybe reword to “Reducing the range resolution by increasing the pulse length by a factor of two improves sensitivity by 6 dB.”

5. Pg 129: Mean reflectivity should be dBZ (it currently just says dB)

6. Pg 136, Line 21, “The spectrum in Fig. 16 . . .” should be Fig. 15.

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