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Atmospheric Measurement Techniques Discussions

Interactive comment on "First Light Multi-Frequency Observations with a G-band radar" *by* Katia Lamer et al.

Anonymous Referee #1

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The paper presents the first observations of clouds and precipitation with a G-band (167 GHz) radar in combination with radars at lower frequencies. The authors present initial results from the radar collected in both icy precipitation and in rain. They conclude with recommendations for further applications of G-band radars in atmospheric science.

The paper is a useful contribution as a first demonstration of a new techonology for atmospheric observations. As the authors themselves note, this does not purport to be a comprehensive study as it presents a rather limited dataset. The presentation of the results is straightforward and clear. I only have some fairly minor comments that should be considered before final publication.

Title: Maybe this should mention that this is a cloud/precipitation application? For

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example, "First Light Multi-Frequency Observations of clouds and precipitation with a G-band radar". Yes, it makes it a bit more wordy but G-band radars have been used in other contexts before.

Line 17: "scatters" -> "scatterers"

Lines 97-98: It would be nice to mention the location of the SBRO here also in more intuitive terms (i.e. New York state, USA).

Line 124: "due to increased atmospheric absorption": this sentence is not quite clear, is there increased absorption on the 167 GHz channel or on the other channel that was not used (I assume the latter)?

Line 130: You mention here when the VIPR was removed but I don't see it mentioned anywhere when the observations started.

Line 145: "spectra" should be singular "spectrum"

Lines 236-238: Besides points 1-3, what about the microphysical changes between the lowest radar-observed altitude and the surface?

Line 252: Is there an explanation for the rather large coefficient for SKYLER?

Line 309: "While Ka- and W-band signals lack sufficient differential scattering to gain further information about such small ice crystals, our observations suggest that G-band signal can": This doesn't make grammatic sense, please rephrase

Line 317: "converge" -> "convergence"

Lines 317-318: "considerable water condensate mass in the atmospheric column": probably, but what about attenuation by the icy hydrometeors?

Lines 343-345: Has the self-similar Rayleigh-Gans approximation been validated for G-band? If so, references should be added. This frequency range has been explored relatively little with models so one should be a bit careful before trusting the results.

Line 355: It seems to me that even a 0.5 dB shift could align the density maximum with the yellow line quite well.

Line 358: "This suggests that the particles observed are not represented the scattering libraries used and calls for further research.": I agree with the "calls for further research" part but I think it would be appropriate to consider other causes before declaring that the scattering libraries are at fault. The deviation of the data from the theoretical curves is not that large, so it could be explained by e.g. remaining calibration bias or incorrect assumptions about the particle size distribution.

Lines 359, 364-365: Perhaps it would be worth pointing out that unrimed particles are consistent with the lack of cloud liquid water that you find.

Lines 363-364: Can the estimate about the fall speed be confirmed by the Doppler? The gravity wave pattern may complicate things but maybe you could e.g. average over one period of the wave.

Line 373: The fall speed here would suggest more rimed particles, again consistent with having more liquid water.

Line 423: "Longer frequencies" -> "longer wavelengths"?

Lines 466-468: The Rayleigh-plateau method is only useful for ground-based studies, right? Not e.g. airborne radars.

Line 477: There is more differential signal, but wouldn't the increased uncertainty in attenuation be a limiting factor?

Line 489: See my comment for line 358.

Figure 8: The color map you are using in this plot is creating false contours. For example in panel c near the melting layer, the reflectivity transitions from light blue to light green through dark green. This creates a narrow band of dark green that falsely looks like a very narrow peak. This effect is one of the reasons why the scientific

community tends to be moving away from the rainbow-scale color maps. You may want to consider doing this plot and panels a-c of Fig. 4 using a perceptually uniform colormap.

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