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Atmospheric Measurement Techniques Discussions

Interactive comment on "How to estimate total differential attenuation due to hydrometeors with ground-based multi-frequency radars?" *by* Frédéric Tridon et al.

Anonymous Referee #3

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This is a clearly written and carefully presented manuscript describing a novel and useful method for processing zenith-pointing ground based multiple-frequency radar observations, a configuration used across many field sites, which produce important and ongoing data series. The automated method for identifying the "Rayleigh plateau" in multiple-frequency radar reflectivity profiles of clouds reduces major uncertainties inherent in simpler threshold-based methods, while demonstrably increasing the number of gates identified as containing Rayleigh scattering ice, a result I would like to see better quantified in this paper. The estimated path-integrated attenuation based on this method compares very favourably to liquid water path estimates from microwave radiometers, and the authors point out the potential of this methodology to form the basis

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of a profiling liquid water content retrieval in synergy with microwave radiometers and additional radar frequencies.

Subject to some minor revisions, I recommend the paper for publication.

Major comments:

In the time-height plots of Z and DFR for the two cases (Figs 5 & 10), the shading and black contour show the difference between a Z < -10 dBZ threshold and their method. It seems that this under-plays what should be a major result of the method described in this paper. Could you quantify the fractional or absolute difference between the two methods for identifying the Rayleigh plateau? Building on the very clear discussion in the introduction, it would be good to quantify not just the additional gates gained, but also the gates that would have been treated as Rayleigh scattering by a threshold method, and which the new method can identify as containing a small number of larger ice particles.

Minor comments:

- P2, L22-3 "...but also for differences in models. . ." is a subclause, and need some punctuation.

- Fig. 1: the legend uses GHz definitions for radars frequencies, rather than the Ka- / W- / G-band nomenclatures used throughout the paper. It's worth being consistent.

- Fig. 3 & L215–6. Best be clear that the "very low reflectivities" here are at the Ka-band. These first examples of the method might be illustrated more clearly by including an additional panel showing the Ka and W-band radar reflectivities for these profiles, then the DFR and the gradient of DFR, rather than referring the reader to Fig. 9.

- Figs. 5 & 10. It seems a small thing, but it greatly helps interpretation of these time series figures if the x-axes of all panels are aligned.

- L278–280: "As seen in Fig. 6, no LWP is derived during rainy periods (before 01:00,

between 07:00and 08:00, 9:00 and 13:00 and after 16:00 UTC)..." Should this refer instead to Fig. 7c?

- L390–97: It's worth pointing out both possibilities for the mismatch in attenuation; however, does the extensive multiple-frequency Doppler radar literature on this case suggest one is more likely than another?

- Fig. 7, P13, L294-7; can you please clarify in the text and the caption of Figure 7 if the same temperature is assumed in Fig. 7 as in Fig. 5?

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