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Interactive comment on "A general database of hydrometeor single scattering properties at microwave and sub-millimetre wavelengths" *by* Patrick Eriksson et al.

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General Impressions[1]

The manuscript "A general database of hydrometeor single scattering properties at microwave and sub-millimetre wavelength" offers specifics on the most detailed and wide-ranging scattering database currently available. This dataset is a valuable resource to the radiative transfer community. The decisions and resulting limitations are

[1]Given that I am a user of this dataset who has evaluted the current version and previous beta versions, and a user of and contributor to the ARTS model, for the sake of transparancy, I am foregoing anonimity for this review.

explicitly stated and justified, e.g., limiting size parameter for computational reasons or the choice of liquid water permittivity model, and the uncertainty analysis is forthcoming. My primary issues deal with some of the analysis concerning radar applications, and the paper requires a bit of copy editing. Otherwise, this manuscript should be published once the detailed comments below are addressed.

Specfic Comments

Page 2, lines 11-12: The suggestion here is that the optical properties necessary for passive radiative transfer do not apply to active. There are numerous cases where more than just reflectivity is necessary. First , for all but the longest wavelengths in the microwave regime, extinction will impact observed reflectivities. In practice, radars transmit polarized radiation, where $I = 1$ and any other single element is either $+1$ or -1. For example, precipitation radar are often polarized horizontally $Q = -1$ and/or vertically $Q = 1$ with respect to some reference frame. This results in the entire top-left block of the phase matrix (terms 11, 12, 21 and 22) being required for reflectivity, differential reflectivity (Z_{hh}/Z_{vv}), and linear depolarization ratio (e.g., Z_{vh}/Z_{vv}). Higher order terms of the Stokes vector, phase matrix, and extinction matrix are necessary when considering reference frame rotations (3D RTM), other polarimetric radar variables (ρ_{hv}, K_{dp}), or multiple scattering effects. Multiple scattering can be observed at a wide range of frequencies, including at X-band in the presence of hail (Battaglia et al., 2016).

Page 5, line 31: Azimuthally-random could also apply to cases where β is not a Dirac delta function, e.g., for an arbitrary flutter distribution with a mean canting angle of zero.

Page 6, line 14: Specify the value used for ρ.

Page 7, line 21 and Page 9, Table 2: Why is "melting" included when it is not in the database? Azimuthally-random is mentioned in the text, but has been excluded from

this table. Melting should be removed.

Page 8, Table 1: Why do the liquid spheres go to such a large size? This is unphysical, since drops break up by about 8 mm in diameter.

Page 10, line 10, through page 12, line 9: The discussion of size parameter limit lacks any consideration of radar reflectivity. In the Rayleigh regime, reflectivity is proportional to the sixth moment of the size distribution, and while this D^6 dependence diminishes at larger size parameters, there are still significant contributions from larger particle sizes that can offset the lower probabilities. Plots similar to the extinction plots (Fig. 3 and Fig. 4) would be useful for understanding the size parameter limit with respect to reflectivity.

Page 12, line 11: In reference to Table 4, I count 35 frequencies.

Page 17: When calculating phase or matrix, a good consistency check is comparing Z_{12} and Z_{21}, with the caveat that these terms can be signficantly smaller, numerically, than Z_{11}. Since these two terms should be equal for randomly oriented particles, a comparison can provide a check of the orientational averaging.

Page 22, line 19: Standard deviation is not typically used to describe a gamma distribution.

Pages 29 through 31, Section 5.4: The discussion of triple frequency signatures should use D_{veq} or D_e the equivalent liquid (or mass) diameter for the size distribution, instead of D_{max}. An exponential distribution in D_{max} space becomes a much more complicated modified gamma distribution in D_e space (Petty and Huang, 2011). By using D_e, the slope parameter Δ in (19) is guaranteed to be consistent for all particle habits, with mass being equal when the size distribution is integrated over the same size limits.

Page 30, lines 5-6: What is the reference temperature used?

Technical Items (typos, grammar, spelling, etc.)

The list below should not be considered fully inclusive, and the authors should review the manuscript carefully.

Page 1, line 9: “diameter” → “diameters”

Page 2, line 30: The entire sentence is a bit awkward.

Page 3, line 2: “on the same time as” → “and”

Page 3, line 4: Awkward. Suggestion: Move “that” to between “simulations” and “can”

Page 3, line 8: Awkward. Suggestion: Remove “that” and change “so far has been” to “being”

Page 3, line 12: Remove the comma from after “role”

Page 3, line 13: Change “that” to “those”

Page 4, line 1: “There is” → “There are”

Page 5, line 31: “tilt angles” should be singular

Page 6, line 2: “for next” → “for the next”

Page 14, Subsection Heading: Capitalize “toolkit”

Page 14, line 19: “off-sets” → “offsets”

Page 14, line 27: Move “also” to between “is” and “handled”

Page 14, line 28: “should be to generate” → “is for generating”

Page 14, line 29: “on to” → “onto”

Page 15, line 12: Remove comma from between “gridded” and “particle”

Page 21, line 6: Move “third party” to before “Aggregate”

Page 21, line 8: “later” → “latter”

Page 21, line 13: “kept track off” → “tracked”

Page 21, line 14: “generation of snow aggregate” → “aggregation” or “simulated aggregation”

Page 21, line 22: “tool-kit” → “Toolkit”

Page 21, line 23: “hexagonals” → “hexagons”

Page 22, line 16: “toolkit” → “Toolkit”

Page 27, line 13: Remove the comma from between “on” and “that”

Page 28, line 4: “back-scattering” → “backscattering”

Page 29, line 5: “back-scattering” → “backscattering”

Page 35, line 9: “back-scattering” → “backscattering”

Page 35, line 10: “cut-off” → “cutoff”

References

Battaglia, A., Mroz, K., Lang, T., Tridon, F., Tanelli, S., Tian, L., and Heymsfield, G.M. 2016: Using a multiwavelength suite of microwave instruments to investigate the microphysical structure of deep convective cores. *JGR: Atmos.*, **121**, 10.1002/2016JD025269.

Petty, G., and Huang, W. 2011: The modified gamma size distribution and nonspherical particles: key relationships and conversions. *J. Atmos. Sci.*, **68**, 10.1175/2011JAS3645.1.

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