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Interactive comment on "Parameterization of single-scattering properties of snow" *by* P. Räisänen et al.

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This paper aims to provide a parameterized set of single scattering properties for surface snow. Although the resulting model is rather ad hoc, availability of such a model would be of benefit to the snow radiation modeling community, as often still models based on perfect spherical grains are used. The paper is well-structured and clear and I recommend it for publication in The Cryosphere.

I do have a few minor suggestions and questions for the authors to consider to improve the paper:

Page 881: line 19: It is noted that, since absorption is weak at 0.8 micron and particles are in the GO regime, the modeled phase function is only weakly sensitive to size.

However, it should be noted that many of the habits in the Yang et al. database have geometries (i.e. component aspect ratios) that depend on size. This means that 1) some of the obtained fits in Figure 3 probably do somewhat depend on the chosen size distribution and 2) a combination of habits that provides a good fit given a certain size could be producing a poor fit (i.e. unrealistic phase function) when applied to another size because the different geometry. However, the droxtal that is used does not depend on size, and neither does the fractal by Macke et al. It is unclear to me from the Yang et al. papers whether the aggregates of 10 plates have geometries that depend on size. However, that appears not to be the case, as the asymmetry parameter for non-absorbing wavelengths do not appear to depend on size (for large sizes), as they would if the geometries would significantly change with size. This is then a (unintentional?) benefit of the authors' final choice of habits.

Page 886: Equations 7 and 8: I assume the Beta's are a function of size parameter x here. Please add "(x)" for clarity.

Page 887: line 22: I think a reference to Macke et al. (1996) would be useful here.

Page 890: Equation 12: I replotted Fig. 1 in van Diedenhoven et al (2014) and would like to confirm that this definition of absorption parameter also results in a better overlap between the single scattering albedos at several wavelengths calculated for a hexagonal crystal with aspect ratio of 1 as compared with the case using the definition of van Diedenhoven et al (2014). Thank you for this insight.

Page 890: Equation 13: How are the parameters in this equation determined? Are these determined using a least-squares fit?

Page 890-891: You state that g "increases slightly with increasing size parameter x_vp even at non-absorbing wavelengths (in the size parameter region where the geometric optics is not yet fully valid)." This is probably due to the fact the diffraction asymmetry parameter becomes increasingly less than 1 for decreasing size. I suggest adding that note if you agree.

Page 891: Equations 15 and 16: I suggest adding a reference to Macke et al. (1996).

Page 892: Equation 19: Is there any reference for this approximation? How was it determined? Diffraction is mostly determined by the projected area of a crystal, so a parameterization in terms of x_vp is unexpected. It may be noted that an alternative approximation was given by Eq. 14 in van Diedenhoven et al. (2014).

Page 892: Equation 22: Where is this form based on? How are all parameters in this equation determined?

Page 894: Equation 27: How are all parameters in this equation determined?

Page 894: line 6: Why is the Legendre expansion replaced by a polynominal? Could the terms b_n be directly determined from a_n or are they determined by a separate fit? Does the form of Eq. 28 also ensure normalization?

Page 896 and further: The phase function was parameterized as simplified parameterization and a full parameterization. An even simpler parameterization would be just taking a Henyey-Greenstein phase function with the parameterized g. I think it would be useful to show the improvement that the additional terms bring compared to using a Henyey-Greenstein phase function. The HG results could be included in Figs. 10, 12, 13 and 14.

Figure 2a: The images appear to show many rounded crystal edges, which are signs of melting or sublimation. This can significantly affect the optical properties. Please add a discussion about the conditions of the snow pack at the time of the measurements in section 3. Can this be considered old snow?

Appendix A: You might want to note that the Q_ext for fractals equals 2 for all sizes.

Interactive comment on The Cryosphere Discuss., 9, 873, 2015.