

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

### **Anonymous Referee #2**

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#### General remarks:

The authors provide a wavelength dependent single scattering parameterization based on a optimum habit combination OHC that matches observed light scattering properties at one specific wavelength. The approach is straightforward and represents a further step towards our understanding and application of light scattering at snow particles. However, the authors arrive too quickly to some conclusions where I see a need for more discussion. I therefore recommend acceptance after major revisions.

#### Specific points:

page 876, line 11 - 24: I understand the approach to fit observed scattering properties to model results for certain particle shape habits at a given wavelength and to

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use this habit combination to calculate the scattering and absorption properties at all wavelengths. However, since the reference phase function is constructed at a non-absorbing wavelength (800 nm), the OHC is not or only to a small extent dependent on particle size (as the authors also state on page 881). It mostly depends on particle geometry. The situation is even worse since the polar nephelometer with its observation range between 15 and 162 degree scattering range excludes the forward and backward scattering region that contain the largest information on size.

879, 5: "In fact, this approach does not represent any specific roughness characteristics, but..." Very good! I appreciate this comment very much as the term "roughness" is often misused in the light scattering literature.

879, 15: "blowing snow": Of course, details can be found in Guyot et al. (2013), however, it would be good to provide some information on how representative the observed phase functions are, i.e. homogeneity of the snow conditions, duration of the observations, ...

880, 19 - 26: The authors rather quickly dismiss the scattering peak at 145 degree scattering angle as an artefact and as quantitatively irrelevant. However, if this peak is caused by photodiode problems, how can we trust the rest of the observations? Why should this be limited to an angular region around 145 degree? The authors note that none of the considered particle geometries can reproduce this feature. I suggest to search the light scattering literature to identify which particle geometry could do the job.

881, 23 - 882, 2: I respectfully disagree with the pragmatic approach to completely ignore the observed particle shapes and to adjust the optimum habit combination purely by minimizing a light scattering cost function. The observed snow grains should provide some constraints on the size dependent particle shape variation, see the work by Brian Baum. The authors correctly state on 884 "Thus, the potential dependence of snow crystal shapes on their size is not considered here". I consider this as an unnecessary

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simplification.

Discussion of Fig. 3: From the very interesting comparison of the observed phase function to those of the individual particle geometries I get the impression that the observed 145 degree peak somewhat resembles the 150 degree peak for hexagonal shaped particles.

885, discussion of Fig. 5: Fig. 5a nicely shows that there is a single 3 habit combination that fits the asymmetry parameter best, and that this is not the case for the absorption parameter, because of the rather weak absorption. It looks like there is a set of 5 to 6 3 habit combinations, which provide cost < 0.1 for the absorption parameter. Are those combinations very different from each other? In general, since absorption at 800 nm does not provide much sensitivity on particle habit, as the authors also state several times, I suggest to reconsider to remove the OPC exercise for the absorption parameter.

887, 8: point number 4: I totally agree! But if this is so, why going through all the effort and provide a size/wavelength parameterization that may not be representative for snow particles in general? In my view, the authors too quickly jump from a case study to a general parameterization. Other researchers will happily apply this "DISORT ready-to-use" parameterization to all kind of snow conditions without questioning its applicability.

896: section 7: Don't you need to account for close-packed effects in the radiative transfer calculations?

Conclusions: I think the authors did a good job with the technical set up of the snow light scattering parameterization, but the data basis that is used for that is simply not sufficient. Thus, the work should be more carefully treated as a case study on the effect of different shape assumptions on snow reflectance. The OHC constructed here should not get generalized (as the authors try to encourage the reader on page 902).

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minor:

882, 17: fractal geometry -> tetrahedral geometry

885, 17: The differences in cost function, ... with lowest cost function values... ???

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

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