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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Cloud chamber experiments on the origin of ice crystal complexity in cirrus clouds" *by* M. Schnaiter et al.

Anonymous Referee #1

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This study provides some nice laboratory measurements which can be used to infer the surface texture of ice crystals. However, the manuscript in its present form needs some improvements in terms of clarity. Jargons are used to introduce some parameters, but the physical meanings of these parameters are not clearly explained. It is challenging to apply the results/findings of this study to the simulation of the optical properties of ice crystals in a straightforward manner. Below are some specific comments for the authors' consideration in the revision process.

1) On page 9, the physical meaning of the parameter known as "combined roughness measure" or "the normalized energy feature parameter ke" is difficult to understand, even after repeated reading (including reading Appendix A). The authors cited Lu et al. (2006) for the definition of ke. In the revised manuscript, would it be possible to give a

clear physical meaning of this parameter?

2) In Table A1, "energy" and "combined roughness" are used. What exactly are the "energy" and "combined roughness" here?

3) On page 9 and in Figure B1, the reviewer does not understand the motivation to correlate the parameter "sigma" and ke. Here the sigma is used to define a Gaussian particle with global distortion, whereas, in light scattering computations involving ice crystals, surface roughness is locally defined (see the following two papers):

Macke, A., J. Mueller, and E. Raschke, 1996: Single scattering properties of atmospheric ice crystal, J. Atmos. Sci., 53, 2813–2825.

Yang, P., and K. N. Liou, 1998: Single-scattering properties of complex ice crystals in terrestrial atmosphere. Contr. Atmos. Phys., 71, 223–248.

Note, most ice crystals are faceted particles. Thus, the ke-sigma relation shown in Figure B1 should not be generalized to realistic ice crystals. Some further studies may be required to apply the parameter ke to the computation of ice crystal optical properties.

4) On page 3, "For a better assessment . . .(Baran, 2009)": For the authors' information, a comprehensive review of ice cloud optical properties and radiative forcing has been recently published, where the effect of particle surface roughness is discussed from remote sensing and radiative forcing perspectives:

Yang, P., K. N. Liou, L. Bi, C. Liu, B. Q. Yi, and B. A. Baum, 2015: On the radiative properties of ice clouds: Light scattering, remote sensing, and radiation parameterization. Adv. Atmos. Sci., 32(1), 32–63, doi: 10.1007/s00376-014-0011-z.

5) An asymmetry factor of 0.78 is questionable (see the abstract). The measurements do not provide the scattering functions in the forward and backscattering angles. The theoretical values in Fig. 7 is based on a combination of spheres and roughened hexagonal columns. The scattering maximum near 170 degrees may be an artifact. There

may be other phase functions that can fit the measurements in the scattering region between 20-160 degrees, which may give quite different asymmetry factor values.

Interactive comment on Atmos. Chem. Phys. Discuss., 15, 30511, 2015.