We thank the anonymous reviewer for the helpful comments. These comments helped to substantially improve the manuscript. Below we give detailed answers to the individual reviewer comments in blue.

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?

We agree with the reviewer that the physical meaning of these roughness parameters is difficult to understand. Therefore, we significantly revised Section 2.1.2 of the manuscript by explaining in details how the roughness parameter k_e is calculated from the SID-3 scattering patterns and what the parameter values mean in terms of a physical roughness.

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

These terms are now clearly defined in Section 2.1.2 of the revised manuscript.

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.

In order to show the atmospheric relevance of the Gaussian particle model, we calculated the area ratio α and the effective density ρ_e of the model particles shown in Fig. B1. These values are given in the revised version of Fig. B1. The values are well in agreement with the recent Cloud Particle Imager (CPI) observations of $0.6 < \alpha < 0.8$ for small (< 50 µm) ice particles in Arctic ice clouds (McFarquhar et al., 2013) and ρ_e=700 kgm^{-3} for small ice particles measured in mid-latitude cirrus clouds using the SID-2 instrument (Cotton et al., 2013). Therefore, our idealized optical model is consistent with the most recent microphysical observations and it is justified to use this model to get a first rough correlation between the complexity parameter k_e deduced from SID-3 and the geometrical particle complexity. We are aware of the fact that ice particles are in general faceted (despite frozen droplets for which the Gaussian sphere model might be more realistic (Nousiainen et al., 2011)). Therefore, it is our intention to test the SID-3 complexity analysis with more realistic optical models for hexagonal cirrus ice particles in the future.

Nousiainen, T., Lindqvist, H., McFarquhar, G. M., and Um, J., 2011: Small Irregular Ice Crystals in Tropical Cirrus. Journal of the Atmospheric Sciences, 68(11), 2614–2627. http://doi.org/10.1175/2011JAS3733.1

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

We agree that this review article is important when presenting and discussing the current knowledge of ice particle surface roughenss from remote sensing and radiative forcing perspectives. We have added a citation to this article to the Introduction section.

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 are 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.

We agree with the reviewer that the determination of the asymmetry parameter from a comparison of the nephelometer measurements with a published model scattering function is not justified. Although this might be possible to some extent - either by extrapolating the missing forward scattered intensity based on the method presented by Gerber et al. (2000) or by using the iterative inversion method developed by Oshschepkov et al. (2000) and Jourdan et al. (2003) - the main conclusions from Fig. 7 as listed and discussed in Section 3.3 are still valid. We therefore believe that our results are of high relevance for the real atmosphere. However, we see that the reader might be misguided by giving the asymmetry parameter of the model scattering function in the discussion of Fig. 7 in Section 3.3, and we have revised this section as well as the Abstract and the Conclusions accordingly.

Gerber, H., Takano, Y., Garrett, T. J., & Hobbs, P. V., 2000: Nephelometer Measurements of the Asymmetry Parameter, Volume Extinction Coefficient, and Backscatter Ratio in Arctic Clouds. Journal of the Atmospheric Sciences, 57(18), 3021–3034.

Oshchepkov, S., Isaka, H., Gayet, J.-F., Sinyuk, A., Auriol, F., & Havemann, S., 2000:

Microphysical properties of mixed-phase and ice clouds retrieved from in situ and airborne “Polar Nephelometer” measurements. Geophysical Research Letters, 27(2), 203–212.

Jourdan, O., Oshchepkov, S., & Gayet, J.-F., 2003: Statistical analysis of cloud light scattering and microphysical properties obtained from airborne measurements. Journal of Geophysical Research, 108(D5), 4155 (1–6).