

Interactive comment on “Mesoscopic surface roughness of ice crystals pervasive across a wide range of ice crystal conditions” by N. B. Magee et al.

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I found this to be a well written manuscript, with the measurement procedures and results clearly described. The authors note that roughening leads to a featureless phase function, but there is also a growing body of work that shows that ice particle roughening influences passive and active polarimetric measurements, e.g., POLDER/PARASOL and the depolarization measurements by the lidar on the CALIPSO platform. The use of roughened particles also improves the interpretation of polarized measurements. The current study clearly demonstrates that most ice particles will have some amount of roughening and that the roughening can take many

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forms as demonstrated in the figures and supplemental material.

Questions:

1. what percentage of ice particles demonstrate roughening? Were the transported crystals (section 3.3) the primary source of smooth faceted particles?
2. Is there a way to discriminate conditions that lead to smoother versus more roughened particles? The reason for this question is that one often observes cirrus haloes and other optical phenomena, but more generally when updraft velocities are low. It would be useful if the authors could relate their observations to natural cirrus if possible.
3. page 8401, paragraph beginning on line 13: we find that ice particles in environments of high updraft velocities (e.g., convection) tend to demonstrate characteristics consistent with the most roughening (e.g., Cole et al. 2013; 2014) in passive remote sensing using polarization data. Perhaps the severe roughening is caused by the formation mechanism for aggregates (i.e., crystals colliding with ridges radiating outwards from point of impact). Please comment.

Minor comments:

please define exactly what is meant by “mesoscopic roughening”.

A small point but please consider changing the phrase “in order to” to simply “to” throughout the text - the words “in order” are unnecessary.

page 8398, line 8: sentence is awkward. Suggest removing the word “further”

page 8400, line 19: occured should be occurred

page 8401, line 2: obserations should be observations

page 8404, line 9: unprecentended should be unprecedented

page 8404, line 12: Please define what is meant by “ice Ic/ice Ih combinations”? Some readers may be unfamiliar with Ic or Ih nomenclature.

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page 8404, line 20: occurrence should be occurrence

page 8405, line 12: surface should be surface

page 8405, line 13: experiments should be experiments

Figure 4 caption, page 8416: scalloped should be scalloped

Potential articles to improve the discussion about impact of roughening on the interpretation of polarization measurements:

Baran, A. J. and L. Labonnote, L.: On the reflection and polarization properties of ice cloud, *J. Quant. Spectrosc. Ra.*, 100, 41–54, 2006.

Chepfer, H., Goloub, P., Riedi, J., de Haan, J. F., and Hovenier, J. W.: Ice crystal shapes in cirrus clouds derived from POLDER-1/ADEOS-1, *J. Geophys. Res.*, 106, 7955–7966, doi:10.1029/2000JD900285, 2001.

Cole, B., P. Yang, B. A. Baum, J. Riedi, L. Labonnote, F. Thieuleux, and S. Platnick, 2013: Comparison of PARASOL observations with polarized reflectances simulated using different ice habit mixtures. *J. Appl. Meteor. Clim.*, 52, 186-196.

Cole, B., P. Yang, B. A. Baum, J. Riedi, L. Labonnote, 2014: Ice particle habit and surface roughness derived from PARASOL polarization measurements, *Atmos. Chem. Phys.*, 14, 3739-3750, doi:10.5194/acp-14-3739-2014. (this paper should be updated in the references as it is now published)

Interactive comment on *Atmos. Chem. Phys. Discuss.*, 14, 8393, 2014.