

***Interactive comment on “Modelling atmospheric structure, cloud and their response to CCN in the Central Arctic: ASCOS case studies” by C. E. Birch et al.***

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Reviewer general comment:

The paper addresses relevant scientific issues associated with Arctic Climate. The study is competent and well presented. Although there are no novel concepts or ideas due to the limitations of the aerosol scheme with the chosen model the conclusions are sound and highlight issues with use of this type of model in the Arctic environment. Methods and assumptions are clearly described as are the interpretations. Clarity of figures is adequate. The lack of sensitivity to CCN, except at exceptionally low concentrations, is interesting. It is hardly surprising that use of a fixed CCN concentration

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cannot reproduce cloud observations.

Response:

We thank Reviewer #1 for the review and the very positive evaluation of our manuscript. Responses to the individual comments are given below.

Reviewer comment 1:

Can the authors provide a better discussion of the sensitivity of their model with respect to the auto-conversion parameters used and whether these were tuned in any way for this study? How sensitive are these compared to the CCN changes?

Response:

The model can be very sensitive to the auto-conversion parameters. For standard CCN concentrations and warm stratocumulus (i.e. outside of the low-CCN regime discussed in this paper) the auto-conversion in the MetUM has been shown to produce too much precipitation from cloud (e.g. the VOCALS comparisons in Boutle and Abel, ACP 2012). Auto-conversion is however only a modelling construct of bulk schemes to get condensed water into a "rain" category. It is less relevant in the current study due to the very low CCN concentrations, small drop numbers and low absolute humidity, which means that the atmospheric water content is very likely too low for auto-conversion to be taking place at all.

Reviewer comment 2:

The final paragraph of the conclusions section seems to be more of an advert highlighting ongoing work and the ability of a model not yet available, rather than focusing on current work and limitations.

Response:

The point authors are trying to make in the final paragraph is that from the present study (which looks at only a 3 week period during late summer) it is not possible to assess

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how important the tenuous cloud/low CCN regime really is for the Arctic region. The only way to do this would be to use a model with a prognostic aerosol/CCN scheme, which is not currently available but could be in the near future. This paragraph will be re-worded in the revised manuscript to tone down the advert element and to focus on the limitations of the current work.

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