

## ***Interactive comment on “Modelling the relationship between liquid water content and cloud droplet number concentration observed in low clouds in the summer Arctic and its radiative effects” by Joelle Dionne et al.***

**Anonymous Referee #2**

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This paper uses previously published observations (Leitch ACP2016) of Arctic boundary layers of cloud liquid water content and droplet number to study the response of three autoconversion schemes and then considers the radiative properties of one cloud.

New data analysis demonstrates the linear relationship between cloud drop number concentration and liquid water path for these clouds which is a useful addition to the observational record. A number of samples in cloud were of low droplet number, in the CCN limited regime, referred to as the Mauritsen limit. Only very few samples were

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collected in this regime but the linear relationship appears to hold. As mentioned in the text, there is significant variability within the data, perhaps related to background meteorological conditions. It is therefore difficult to ascertain the significance of the result more broadly.

A main focus of the analysis and result is the comparison of three autoconversion schemes with the aim of investigating the impact of autoconversion on the LWP:CDNC relationship. All three of the autoconversion schemes appeared to perform well, suggesting that the process is in fact well constrained, even for the Arctic. The authors then demonstrate that a combination of two schemes, one for the CCN limited regime, and one for larger concentrations of CCN can improve on the performance of a single scheme across the full phase space. Again, the limited data makes this an intriguing but not completely satisfying result, with no attempt to explain, other than to invoke other processes such as turbulence and mixing.

Once the autoconversion schemes have been considered there is a section that investigates the radiative properties of clouds. The paper seems to lead towards a comparison of the radiative properties of clouds that are and are not CCN limited. However, only a cloud that is above this CCN limit is investigated, to the detriment of the work. Further, following the comparison of autoconversion schemes, these are shown to not have a large impact on the radiative properties of the clouds. The finding that the modelled radiation using the autoconversion schemes is different from observations in the July 8th cloud warrants further investigation and may be a useful result. Having only one such case though, is not likely to be sufficient to inform the modelling community of changes that might need to be made to the representation of aerosol indirect effects.

Numerous tables give details of the linear fit parameters, which whilst required, are not so easy to interpret. I would suggest that some measure of the uncertainty / significance is added to the plots to allow the reader to make an informed assessment. This would be useful on Figures 3, 4 and 5. It may also assist the reader to combine those panels in to a single figure. The aims of the paper should be more clearly stated, and in

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tandem the nature of the conclusions. The main conclusion seems to be that autoconversion is well prescribed, yet the radiative impacts of different schemes differ. It would be a great benefit to include the radiative impact of the clouds below the Mauritsen limit.

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