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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Modelling micro- and macrophysical contributors to the dissipation of an Arctic mixed-phase cloud during the Arctic Summer Cloud Ocean Study (ASCOS)" *by* Katharina Loewe et al.

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General comment:

This paper demonstrates impacts of dry air advection, cloud droplet number concentration, and ice crystal number concentration on dissipation of Arctic mixed-phase clouds. The results clarified that increase in cloud droplet number concentration, resulting from increase in aerosol concentration, would be more important for dissipating process of mixed-phase clouds. The results obtained in this study would be of value in understanding formation and dissipation processes of Arctic mixed-phase clouds. However, this study seems to lack evaluation of model results. I recommend describing how well

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the simulations represented realistic mixed-phase clouds over the Arctic in revising version.

Major comments:

1. How was this observed case identified as mixed phase? The case in this study was selected from the summer season, and temperatures through the cloud would not be below the freezing level enough. In fact, the simulated cloud by control run produced rain. So, I suspect that temperatures within the cloud could be partly above the freezing level, and the cloud droplets were not supercooled. Please show evidences from observations that the selected case certainly contained mixed-phase cloud (e.g., lidar, MWR, and ceilometer measurements).

2. How well did the model simulate the observed mixed-phase cloud? Did the simulated clouds well simulate the observation? Please evaluate the simulations and show how the simulated results represented the observation in terms of, for example, LWP (LWC/IWC), cloud base/top heights, horizontal distribution of clouds, ice particle number concentration, etc. The control simulation produced significant amount of rain. -Is this realistic? The evaluations of those simulations would help to make the results from sensitivity experiments more robust.

3. How representative is the chosen case of Arctic mixed-phase clouds over the Arctic? Are the clarified mechanisms unique in the Arctic region, or can they be extended to apply to other environments such as mid latitude?

Minor comments:

1. P. 4, line 20, “smoothed from 12 km to 22 km”: Are these numbers meaning altitudes? 2. Figures 3, 7, 9, and 10: Did those profiles indicate model domain average? 3. P. 5, lines 21-22, “The θ profiles imply that . . .”: I cannot see this in Fig. 4. It seems to me that θe showed this characteristics. 4. P. 6, line 7, “the LWP is slightly smaller (approximately 8 g mˆ-2 after 4 h)”: I suppose that this sentence mentioned the CDNC

2 simulation. If so, I think that a value of “8 g mˆ-2” in LWP is significantly smaller than that from the control simulation; it does not look like “slightly smaller”. 5. I recommend referring a Heike Kalesse’s (2016) paper titled “Understanding rapid changes in phase partitioning between cloud liquid and ice in stratiform mixed-phase clouds: An Arctic Case Study”. This paper also mentioned a dissipation mechanism of Arctic mixed-phase cloud observed at Barrow, AK, on the basis of observation and partly model analysis. (Kalesse et al. 2016, Mon. Wea. Rev., doi: http://dx.doi.org/10.1175/MWR-D-16-0155.1)

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