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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Cloud and boundary layer interactions over the Arctic sea-ice in late summer" *by* M. D. Shupe et al.

Anonymous Referee #2

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This manuscript investigates low-level mixed-phase clouds in the high Arctic using a comprehensive suite of in-situ (both surface and airborne) and remote-sensing measurements. The focus is on the vertical mixing processes that drive these clouds and their potential interaction with the sea-ice surface. The manuscript is well written, with appropriate figures and provides an excellent contribution to the scientific literature. This manuscript is suitable for publication after addressing a few minor comments.

Specific Comments:

Page 13194, lines 12-13. Suggest that you modify sentence to read '..cloud liquid water is effective at emitting longwave radiation into space..'

Page 13194, line 23. Some researchers suggest that ice particles in mixed-phase

clouds are formed in a stochastic process involving homogenous nucleation and do not require the presence of aerosol particles - although aerosol particles are required for the liquid droplets to form in the first place..

Page 13199 line 16-28 Having an arbitrary epsilon threshold (whether 5e-5 m2 s-3 or others tested) may not be the most appropriate way to define the base of the cloud-driven mixed layer. The theta_E profiles in Figs. 3d and 4 suggest that, at 12Z, the mixed layer is much lower than the boundary selected, by about 300 m, which seems plausible when looking at epsilon in Fig. 3d.

Another issue is that the precipitation may not fall as far as the base of the cloud-driven mixed layer. Although this does not seem to be an issue for Case #1, and only between 14-17 UTC for Case #2, it is apparent in Figs. 3 and 12.

Page 13204, lines 14-21. As stated previously, the theta_E profiles in Figs. 3d and 4 suggest that, at 12Z, the mixed layer is much lower than the boundary selected, by about 300 m, which seems plausible when looking at epsilon in Fig. 3d. Is this purely because the radiosonde launch does not coincide exactly, in both space and time, with the base of the cloud-driven mixed layer selected for Fig. 4? The turbulent field does appear to agree with the radiosonde profile, with intermittent gaps of lower values of dissipation rate..

Page 13207, lines 13-14. Could this turbulent layer growth from the surface be a response to advection rather than necessarily in-situ, especially as the surface fluxes were so weak?

Page 13211, lines 7-18. Again, some researchers suggest that ice particles in mixed-phase clouds are formed in a stochastic process (as mentioned on lines 11-12) involving homogenous nucleation and do not require the presence of ice nuclei. This possibility is encompassed by the statement in lines 17-18, so maybe line 8 can be toned down a little.

ACPD

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References. There are some references missing, including Fridlind et al. (2011) and Lance et al. (2011)

Table 1. If the MMCR (millimeter cloud radar) is identical to those deployed elsewhere then the operating frequency should by 35 (34.86) GHz.

Figure 4. It may be worth mentioning in the caption that there is no distinct cloud-driven mixed layer at 0Z (cloud mixed-layer reaches to the surface).

Interactive comment on Atmos. Chem. Phys. Discuss., 13, 13191, 2013.