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Atmospheric Chemistry and Physics Discussions

Interactive comment on "The Structure of Turbulence and mixed-phase Cloud Microphysics in a Highly Supercooled Altocumulus Cloud" *by* Paul A. Barrett et al.

Anonymous Referee #2

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The authors describe an altocumulus cloud that was observed by aircraft. Turbulence and microphysical properties are recorded. Conjectures about the responsible physical processes are made. Only one cloud was observed, but altocumulus clouds are transient, and hence aircraft measurements are rare. So every new observed cloud case is useful. The observations of negative vertical velocity skewness below the liquid cloud base are interesting.

Minor comments:

Abstract: "The turbulence spectrum is observed to have an increasingly negative skewness with distance below cloud top, confirming that longwave radiative cooling from the

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liquid layer cloud is the source of turbulence kinetic energy." Personally, I would choose the more cautious term "suggesting" in lieu of the bolder term "confirming". I have no doubt that cloud-top radiative cooling is relevant, but without a complete budget of TKE, it is hard to know the relative magnitude of each source.

Lines 40–41: "The GCM simulations are found to have too little cloud in the mid-levels, resulting in a warm bias in sea surface temperatures," The authors might also want to mention Hartmann et al. (1992, J. Climate, see Fig. 22 and Table 1), which suggests that thin, mid-level clouds have little net radiative impact at the top of the atmosphere.

Lines 74–75: "which was predominantly from the south and ranged in strength from 6 m s -1 at the southern end of the flight track to 8 m s -1 in the north." It might also be worth recording the mean vertical wind shear within and near the cloud, because wind shear is associated with generation of turbulence.

Figure 8: On this figure or in its caption, please clarify what the diamond symbols mean, and how the reader is to infer whether the profiles are adiabatic by comparing to the many lines drawn on the figure. The description in Lines 218–224 is also a little unclear to me. E.g., a theoretical adiabatic ascent line is drawn starting at 136 m below cloud top. Was there clear, ascending air observed at this altitude? If not, what does the adiabatic line represent?

Fig. 10b: Are the habits of the ice particles photographed by CPI so complex because of aggregation or instead polycrystal formation because of defects (grain boundaries) in the crystals? The text in Lines 256–259 seems to suggest both. Is there a way to distinguish the two?

Fig. 13: "cloud formation through wind shear or gravity wave activity acting at a stable interface in potential temperature" Is it possible that the cloud forms from mesoscale or synoptic-scale lifting rather than gravity waves, and that the cloud-top inversion forms later through cloud-top radiative cooling? Is any estimate of large-scale vertical velocity available?

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