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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Impacts of cloud and precipitation processes on maritime shallow convection as simulated by an LES model with bin microphysics" *by* W. W. Grabowski et al.

Anonymous Referee #1

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This study aims to extend the analysis presented in previous work by Wyszogrodzki et al. (2013), who examined the impacts on cloud and rain when a collision kernel that includes the effects of turbulence was used in a bin microphysics LES model. The results in this present study, however, mostly focus on differences between simulations that differ in CCN concentrations, which somewhat limits the novel aspects of this work. Evaporation of cloud droplets near the edges of clouds and condensate off-loading are shown to determine the differences in cloud top height distributions for simulations with differing CCN concentrations. The study also investigates whether the numerically determined effects of turbulence on shallow convective clouds and rain could be evalu-

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ated by observations. It is argued that the temporal variability of the shallow convective cloud fields,nd the resolution and uncertainty range of satellite observations mean that it is not possible to evaluate the impacts of turbulence that are seen from modeling studies.

Major comments

1. Some of the main ideas could be developed further. The abstract states that a clear feedback has been documented between the cloud processes and the environment, however, this feedback has not been fully explained or demonstrated. For example, what are the processes that result from the more efficient condensate off-loading and how do these change the environmental profiles?

2. Given that the single cloud simulations of Wyszogrodzki et al. (2013) are used as the basis for explaining the results shown in Section 3, it would be useful to include a discussion of the condensate off-loading mechanism described in the two sets of single cloud simulations in Wyszogrodzki et al. (2013).

3. To extend the results of Wyszogrodzki et al. (2013) and explain the difference in cloud top heights between simulations that use different collision kernels, an additional figure that is the same as Figure 5 but for the N30 GRAV run needs to be included and discussed. Does the comparison of the turbulent and gravitational kernel simulations show a change in the buoyancy that confirms the condensate off-loading mechanism acting to increase cloud buoyancy and therefore cloud top heights? This should be explicitly addressed.

4. Further analysis of Figures 4 and 5 (plus the additional figure from the point above) would add to a more thorough explanation of the physical processes involved that determine the differences in cloud top heights between simulations with differing CCN concentration and also different collision kernels. For example, the authors briefly touch on some of the effects seen in the scatter plots, such as entrainment, but this could be extended and would provide more insight into the effects of CCN concentration and

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choice of collision kernel.

5. An additional 2 panels in Figure 7 that show the differences between the GRAV30 and TURB30 cases should be included to help illustrate the differences in cloud fraction due to more efficient condensate off-loading that occurs with the use of the turbulent collision kernel.

6. Page 19854, first paragraph: While this discussion is valid for summarizing the cloud top height differences between simulations with different CCN, it does not explain the difference in cloud top heights for simulations with differing collision kernels but the same CCN concentration. For these cases the explanation cannot be due to a shift between the cloudy updrafts and the cloud-edge downdrafts as the downdraft shift in this study has been attributed to the CCN and cloud droplet size difference. Perhaps there is the additional effect of more cloud water in the turbulent cases producing more evaporation.

Minor comments

1. Page 19848, line 13: This should refer to Figure 7.

2. Page 19848, lines 24-25: The NOCOAL case is not shown in Figure 1.

3. Page 19852, line 21: Van Zatem should read Van Zanten.

Interactive comment on Atmos. Chem. Phys. Discuss., 14, 19837, 2014.