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Atmospheric Chemistry and Physics Discussions

Interactive comment on "The relative importance of macrophysical and cloud albedo changes for aerosol induced radiative effects in stratocumulus" *by* Daniel P. Grosvenor et al.

Anonymous Referee #2

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This manuscript presents a numerical study of aerosol effects on cloud, precipitation and radiation in stratocumulus region within the VOCAL experiment area. By running the Met Office UM model at 1-km grid spacing with the newly developed CASIM microphysics scheme and a sub-grid cloud scheme, the authors investigated the aerosol impacts under different background concentrations. It was found that a regional model running at 1-km grid spacing with a sub-grid cloud scheme driven by the realistic meteorological conditions is able to reproduce the observed properties of the stratocumulus and aerosol impacts stratocumulus through both macro- and microphysical responses when the loading is low and mostly through microphysical changes when the loading is high.

The manuscript is well written and organized. The questions explored here are of great interests of the community. The findings are interesting and novel, which makes it appropriate to be published in ACP. I would like the authors to consider the following points before the paper is accepted.

1. The title should reflect the fact that this is a numerical study.

2. Thorough validation of the model results against various observations is a key part of the paper to put more confidence in the simulated aerosol impacts. Therefore, environmental conditions simulated by the model should be validated as well. I suggest the authors to show the ship-borne sounding comparisons.

3. LES simulations driven by mesoscale models than incorporate large scale dynamic and thermodynamic structure are not that uncommon now. Chow et al. (2006) demonstrated the approach. Xue et al. (2014, 2016) showed that LES simulations of actual events reproduced observational features very well. Therefore, discussions about LES v.s. regional model in pages 3 and 32 should be adjusted.

4. What type of data from UM N512 was used to drive the 1-km simulations, analysis or forecast data (Section 2.1)?

5. The model data should apply the same way as how GOES-10 gets the 2D Nd field to calculate the 2D Nd field (Section 3.2.1).

6. Sections 3.2.3 and 3.2.4 should be simplified. Too much detail now.

7. Why don't you use all available satellite data to plot the LWP PDF in Fig. 8? The data sample in current Fig. 8 is very limited based on just one snapshot.

8.The 1X1 degree region in the model is too large to compare with the ship-borne radar CFAD. The W-band radar will not cover such a big area. A cloud regime matching technique can be used to choose the right area in the model results.

9. The RHcrit in the sub-grid cloud scheme should be a function of aerosol loading so

that the aerosol impact on sub-grid cloud can be addressed.

Some technical suggestions:

Page 1, lines 18 to 19 and later in Page 24: ... to within delta fc = 0.04 ... It is the fc difference not the fc itself.

Page 5, line 23: ... since the presence of some liquid ...

Page 7, line 2: ... investigate its impact. You shouldn't know whether it is important or not.

Page 8, caption of Figure 2: should the box be blue not white?

Page 17, line 20 and page 19 last line: ... for the entire of the ...

Page 20, line 5: ... similar to those observed by CERES.

Page 20, line 6: ... unlikely to be the result of cloud fraction ...

Page 20, line 7: ... distribution for this and higher ...

Page 26, line 6: ... and that leads to lower boundary layer.

Page 31, line 16: Please reword this sentence.

Page 31, line 30: , which was responsible ...

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