Atmospheric
Chemistry
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Discussions

Interactive comment on "Effects of aerosol in simulations of realistic shallow cumulus cloud fields in a large domain" *by* George Spill et al.

Anonymous Referee #1

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Review of: "Effects of aerosol in simulations of realistic shallow cumulus cloud fields in a large domain"

Authors: George Spill, Philip Stier, Paul R. Field and Guy Dagan

Recommend minor revisions.

General comment: This manuscript is well-written and concise, and it discusses the impacts of aerosol loading on the albedo and cloud microphysics of trade wind cumuli over a large domain and at moderately high resolution. The results of aerosol effects appear consistent with many other studies, but also highlight differences that are still unclear to the broader community. Some of these differences may arise from variability in microphysics parameterizations rather than domain size or resolution as is empha-

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sized here. With some minor changes, this paper should be ready for publication.

Specific comments:

1. Page 1, Lines 20-21: These sentences seem fragmented and/or run-on. Try clarifying your statements here starting with, "The coupling of trade wind. . .."

2. Page 2, Paragraph from Lines 23-32: You might also cite a paper by Saleeby et al. (2015, doi:10.1175/JAS-D-14-0153.1) that shows increased aerosol concentration leading to more rapid transition from stratocu to deeper cumuli via both enhanced droplet evaporation processes and invigoration. This study used an intermediate sized domain of 100km x 100km at 250m grid spacing.

3. Page 3, Line 17-20: Please include a figure that shows your baseline aerosol profile. Following initialization, can aerosols be advected, lofted, scavenged, etc?

4. Page 3: A few questions here on the model setup. Why does the model go up to 40km when the cloud analysis is focused below 7km? What's the vertical grid spacing in the cloud layer? Are you using open boundaries and nudging the boundaries with the operational analysis?

5. Page 3: Some would argue that 500m grid spacing is too coarse for simulating trade wind cumuli. There's a reason LES simulations are run for trade Cu at super high resolution. How big are your trade wind Cu and do you have enough grid points to adequate resolve these clouds? How many cloudy grid cells do you ultimately have in your analysis? Do you have enough cloudy area for a robust analysis? Just things to consider here with respect to resolution and cloud area. I feel the justification of this grid spacing for trade Cu needs to be a bit stronger.

6. Page 12, Lines 6-7: Perhaps it is not surprising that you do not see much change to the environment since the cloud fraction is so small. Perhaps the thermodynamic profiles surrounding the cloud field change, but this change gets averaged out when computing domain-wide properties. Please comment on this. Are there any changes

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to sub-cloud evaporation and cold pools?

Figures: (Please make fonts clearer and larger in all figures)

Fig 7: Is the size of the colored box or histograms related to the range of values over the duration of the simulations?

Fig 8: Individual histograms are too small to see. Please make these larger and easy to discern.

Editorial comments: 1. Page 2, Lines 15-20: Too many uses of the phrase "a number of". 2. Page 3, Line 21: Error with the word "configuration". 3. Page 4, Line 7: Error with the word "Figure".