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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Detailed cloud resolving model simulations of the impacts of Saharan air layer dust on tropical deep convection – Part 1: Dust acts as ice nuclei" *by* W. Gong et al.

Anonymous Referee #1

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This manuscript provides an overall look at how dust acting as IN can modify tropical convection by altering the dominant mechanisms of ice formation. The primary result from this study is that an addition of IN (via dust) leads to primary ice formation by heterogeneous processes that tend to occur at lower elevations in the cloud. This tends to rob the upper levels of excess moisture, thereby, suppressing homogeneous ice formation via droplet freezing and haze droplet nucleation. This is an important result since it can substantially alter cloud top heights, tropical anvil cirrus, and radiative budgets. This idea has been theorized in the past and has been referred to as the "inverse Twomey effect". It is nice to see that this mechanism can be modeled.

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Major comments:

I'm overall pleased with this study. My only concern is that conclusions are being drawn based on a single tropical convective storm. The results would be much more robust if 1 or 2 additional storms with varying thermodynamic profiles were simulated. There needs to be consistency in IN effects across a range of tropical convection before the conclusions are absolute. Furthermore, additional test simulations with varying background CCN concentrations would be beneficial, since this will control the number of cloud droplets and will provide greater competition for vapor growth between CCN and IN. This will also impact the potential for greater homogeneous nucleation by droplet freezing.

Minor comments:

1. Figure 2 is confusing with regard to the figure caption. Please clarify. You mention using dashed and long dashed, but I see only one type of dashed line in the figure.

2. Page 12908, Line 11: The first part of this sentence uses incorrect grammar: "Because of the lower in the saturation over ice"

3. Page 12908, Lines 21-23: Sentence grammar needs correcting.

4. Page 12910, Line 27: Should use the phrase "the accumulated precipitation"

5. Page 12913, Line 18: Should use the word "unitless"

6. Page 12914, Line 18: Need to fix the phase: "calculation the number of contact freezing number"

7. Page 12918, Line 26: "grid size" should be called "grid point spacing"

8. Page 12919, Line 19: Should say "sensible heat flux"

9. Page 12920, Line 22: Should say "domain as the grid points between"

10. Page 12926, Line 20: Should say "deep convection brings large amounts of water"

ACPD

10, C4038–C4040, 2010

When you refer to "grids" it is typically understood that you are referring to the whole domain. "Grid size" refers to the size of the whole domain. "Grid spacing" or "grid point spacing" or "grid cell spacing" would be most appropriate to use to specify the distance between grid points (ie, the delta-X spacing).

Interactive comment on Atmos. Chem. Phys. Discuss., 10, 12907, 2010.