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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Dust Radiative Effects on Atmospheric Thermodynamics and Tropical Cyclogenesis over the Atlantic Ocean Using WRF/Chem Coupled with an AOD Data Assimilation System" *by* Dan Chen et al.

Anonymous Referee #2

Received and published: 11 March 2017

Chen et al. presented a study focusing on mineral dust radiative effects on thermodynamics and tropical cyclogenesis over the Atlantic Ocean using the meteorology-chemistry coupled WRF-Chem model. A 3DVAR data assimilation system is employed to assimilate MODIS aerosol optical depth (AOD) data to improve model simulation of dust distribution. The study investigated the impacts of Saharan dust layers over the North Atlantic Ocean near the source region and the region further downwind. A main finding is that mineral dust layers either enhance or suppress convection depending on their location relative to the boundary layer.

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Quantifying the dust radiative effects of tropical cycolgenesis is a challenging issue and is of great scientific importance. The study can reduce some of the uncertainties with the help of an aerosol data assimilation system. I have some comments listed below mainly for clarification, which I think the authors shall address before considering publish.

Specific Comments

1) Page 4, Line 2:
"Statistics based on long-term periods . . .". The word "long-term" can be misleading. Suggest change to "summer 2006" that the study was focused on.

2) Page 6, Line 15-20:
Suggest report the statistics (e.g., mean, correlation coefficients) for the comparisons shown in Figure 3.

3) Page 7, Line 10-13:
The definition of "Deep Layer of Dust" is confusing. Its difference with "Elevated Dust" is not clear in the text. From Figure 8 and 9, it appears that the "deep layer of dust" shows concentrated AOD below 800 hPa while also extending to the free troposphere. Please clarify.

4) Page 7, Line 25-30:
Can you explain why there are significant positive temperature anomalies in the dust layer and negative temperature anomalies above and below the dust? I was expecting some negative temperature anomalies because dust is also radiative scattering.

5) Page 8, Line 4-5:
Please provide a definition of "buoyancy for PBL parcels", and explain why they are negatively correlated with the temperature anomalies.

6) Page 8, Line 9-20:
For the “Elevated Dust” in the western region category, again it is not clear to me why the direct (scattering) and semi-direct (absorption) effects of dust could lead to such a strong warming. Please explain in the text.

7) Page 10, Line 10-15:
What does the right panel of Figure 10 show? The dashed line vs. solid line? This should be explained in the text as well as in the figure caption.

8) Page 10, Line 15-18:
In Figure 11, why are there large temperature perturbations in the middle and upper troposphere? Through any mechanical pathway or numerical noises? Please clarify.

9) Page 10, Line 21-22:
Figure 12c-d show the differences of temperature and RH due to associated with the dust radiative effects. How are the difference patterns linked to the case study? This is not described in the text.

10) Page 26, Figure 10:
Please state in the caption what the red dot represents.

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