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Atmospheric Chemistry and Physics Discussions

Interactive comment on "The impact of Great Basin Desert dust on the summer monsoon system over southwestern North America" *by* C. Zhao et al.

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This paper describes model-simulated effects of dust on the North American Monsoon circulation and precipitation. The paper shows that model represents at least the long term mean aerosol conditions are well represented in Arizona, and the model overall represents the conditions during the active phase of the NAM well. The model indicates that there are important changes in the circulation and moisture fluxes and changes the surface and TOA radiation balance that influence the preciptiation distribution. The paper overall is sound in my opinion, however I do have some suggestions for minor revision, futher explanation, and a bit of clarifying analysis that are detailed below.

1. 31737, L27: I suggest using a more technical term rather than "stacked up". Also, in describing the NAM results (and Fig. 1), it seems that the highest dust concentrations are in AZNM mountains and the eastern side of the Mexican plateau (not on the western side), which seems to contradict the abstract.

2. 31739, L2: Please specify which version of WRF-Chem you are using.

3. 31740, L 15-20: It should probably be made more clear that the second indirect effect of aerosol on clouds and precipitation (effectively decreasing effective radius with increasing aerosol) are included (is that correct?), including aerosol scavenging, but the radiative effects (i.e. changes on decreased effective radius on cloud albedo) are not included. In this way, precipitation efficiency changes with changes in AOD are represented. Have you tried a run where all indirect effects are turned off? This would isolate the role of the tropospheric heating versus changes due to precipitation efficiency.

4. 31743, L6: should be "mostly located in Arizona, Fig. 1".

5. 31744: Can these and subsequent figures be zoomed in over the NAM region? I think it is unnecessary to show the eastern US and more detail could be shown.

6. 31744: L10: It seems as though the model tends to underestimate the southerly flow in Arizona from the Gulf of California relative to NARR. However, the NARR tends to overestimate the Gulf of California LLJ (Mo and Berbery 2004).

7. 31744: L15-29: It is encouraging to see that the model appears to simulate the seasonal mean AOD correctly, however, it would be even more encouraging to see the daily statistics compared in a more rigorous way (with IMPROVE and AERONET). Averaging the monsoon season together as presented in Fig 3 does not meaningfully relate variability because all outliers are averaged away, and the monsoon onset and withdrawal dates vary so much for the NAM.

8. 31746, L8: Also see Nesbitt et al. (2008, JHM), Gochis et al. (2009, Atmosphera)

for comparisons of remotely sensed precipitation estimates in the NAM.

9. 31747, L10: Also see Schiffer and Nesbitt (2012, J. Clim., early release) for a discussion of the moisture fluxes during the NAM. This includes discussion as to the southerly vs. easterly fluxes as discussed later in the paper.

10. 31748, L8: You should probably point out that the changes over the core region were not stastically significant.

11. 31748, L18: Dust can also act as CCN.

12. 31748, 23: Please revise to "As in Fig. 7, ..."

13. 31751, L10: There are no results on the diurnal cycle presented in the paper, can you refer to a figure?

14. General (minor) comment: It would be useful to see some more plan view diagnostics, like how the structure of the monsoon high, position of the low level jets, and moisture convergence are changed between the WRF-Chem runs with and without dust forcing. The vertical cross sections are interesting, but do not relate how the monsoon structures might change (easterly vs. southerly moisture fluxes, etc.). Perhaps a topic for a future study. In this way, the changes could be related to known meteorological modulators of NAM precipitaiton (e.g., Higgins 2004, Schiffer and Nesbitt 2012, etc.).

Interactive comment on Atmos. Chem. Phys. Discuss., 11, 31735, 2011.