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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Consistent response of Indian summer monsoon to Middle East dust in observations and simulations" *by* Q. Jin et al.

Anonymous Referee #1

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This paper, "Consistent response of Indian summer monsoon to Middle East dust in observations and simulations", investigates the magnitude and spatial structure of changes in precipitation over the Indian sub-continent in response to dust aerosol using observations and the WRF-Chem model. The authors attempt to clarify the conflicting dust-rainfall responses from previous studies (e.g. Vinoj et l. 2014, Solmon et al., 2015, Jin et al., 2014) and determine the mechanism via a suite of simulations within the WRF-Chem model.

This is a well-written paper with well constructed experiments leading to a convincing argument for the mechanism through which dust from the Middle East influences the precipitation. I have a couple of comments on the uncertainty and other minor issues, but other than that I recommend the paper for publication.

The uncertainty in dust refractive index is not explored within the research. As atmospheric heating is the key driver of the response in this study, it would be interesting to know how much the uncertainty in imaginary refractive index modulates the precipitation response. Has any effort been made to explore this?

The change in rainfall over India is quoted to be 0.44 mm/day for the ensemble mean. I think it is important to include the standard deviation for this, based on the ensemble members, to provide some context for the uncertainty relative to the quoted fractional change in precipitation ($\sim$10%).

pg 15577 ln 23 - are there any estimates for the uncertainty on these refractive indices values?

pg 15580 ln 29 - it might be more clear to say something like "each with and without dust aerosol" rather than "two dust options", when listing the ensembles.

pg 15581 ln 3 - should this be "RRTMG SW" rather than "RRTMG LW"?

pg 15584 ln 9 - How do the 7% and 17% fractions of coarse dust relate to the improved and widely-used dust size distribution parameterization discussed in Kok et al. (2011)? This puts more dust mass at coarse sizes than traditional GCMs.

pg 15585 ln 1 - "To compare... with model simulations", this is a little confusing when the data shown in the figure is observational. Consider revising the wording.

pg 15586 ln 9 - "Goddard and YSU, respectively"

pg 15589 ln22 - "previous studies", but only one reference is listed.

Figure 3 - Do you know how much of the difference between MISR and MODIS is explained through sampling differences with MISR generally having more than 5 times fewer retrievals?

Figure 7 - replace "donations" at the end of the caption with "descriptions"? I'm curious, do you get an even higher ensemble mean correlation coefficient if you average all

members except the YSU PBL scheme that seems to perform poorly?

Figure 9 - this figure is not very clear. I recommend altering the green and red line colors as they will probably be indistinguishable in grayscale (and also to people with common color blindness). Also, the ensemble mean for ALLF and NDST are pretty similar to each other, such that including dust doesn't appear to significantly improve agreement with observations much beyond correction of the low bias. True? However, there is quite a lot of spread between the ensemble members - do any of the ensembles lead to better temporal correlation with the observed rainfall?

References

Jin, Q. J., Wei, J. F., and Yang, Z. L.: Positive response of Indian summer rainfall to Middle East dust, Geophys. Res. Lett., 41, 4068–4074, 2014.

Solmon, F., Nair, V. S., and Mallet, M.: Increasing Arabian dust activity and the Indian Summer Monsoon, Atmos. Chem. Phys. Discuss., 15, 4879–4907, doi:10.5194/acpd-15-4879-2015, 30 2015.

Vinoj, V., Rasch, P. J., Wang, H. L., Yoon, J. H., Ma, P. L., Landu, K., and Singh, B.: Short-term modulation of Indian summer monsoon rainfall by West Asian dust, Nat. Geosci., 7, 308–313, 2014

Interactive comment on Atmos. Chem. Phys. Discuss., 15, 15571, 2015.