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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Influence of anthropogenic aerosols on the Asian monsoon: a case study using the WRF-Chem model" *by* X. Jiang et al.

Anonymous Referee #1

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Using three 6-month simulations with the WRF-Chem model, this paper examines the impact of anthropogenic and biomass burning aerosols on radiation fluxes, cloud, precipitation and atmospheric circulation during the Asian Summer Monsoon in 2008. However, the reviewer has some major concerns about the experiment designs and results (see below). Meaningful and helpful results are also lacking in this study.

Major comments:

1. This study gives just one simulation for each case in 2008. The statistical significance of the results can't be tested. So we cannot be able to tell the differences

are real signals induced by aerosols or just noise associated with internal variability of model or interannual variability of climate. Then the question is how meaningful of the conclusions of this study if they vary year by year or case by case. Therefore, the reviewer strongly recommends that the authors should extend the current simulations with a number of ensembles to consider the internal variability of model and interannual variability of climate. The difference between two experiments should be accompanied by a test of the significance.

2. In terms of the choice of year 2008, there was emission control around Beijing due to the Olympics. I am not sure year 2008 is a good choice to represent the aerosol impacts in regional climate over Asia, especially that the emission sources in the WRF-Chem simulations are from INTEX-B (based on 2006) and RETRO (climatological) datasets.

3. Figure 2 and Figure 3: The model simulated AOD are significantly underestimated comparing to the observations, especially over India in Figure 2 and over AERONET sites in Figure3. Does the significant underestimation of AOD have any influence on the simulated climatic effect of aerosols in these regions?

4. Please quantify the aerosol-induced changes of clouds and precipitation.

5. Figure 11:

Firstly, to me, the evolution of precipitation is better represented in daily mean precipitation than in accumulative precipitation. Figure 11a shows that the CTRL is close to observation in the mid of July for accumulative precipitation. However, it also means that the CTRL has more precipitation from June to Mid-July while the CTRL has less precipitation from Mid-July to the end of August, comparing to observations. The EXP reproduces better precipitation evolution to me in the monsoon season.

Secondly, in term of the aerosol-induced precipitation changes, aerosols increased precipitation by ∼90 mm (which is ∼15% to the EXP of ∼590mm) at the end of August

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over IN. Over EA, aerosols decreased precipitation by ∼120 mm (which is ∼17% to the EXP of ∼710 mm). Considering the model simulated AOD significantly underestimated as shown in Figure 2 and Figure 3, should we expect that aerosols will change precipitation by ∼30% although aerosol effects may not be linear? Could the authors discuss the impact of underestimated AOD? The aerosol induced precipitation changes are much larger than the changes shown in other studies (usually less than 10%). Could the authors discuss the discrepancy of the precipitation changes in the literature?

Finally, with the increase of AOD close to observations, we may expect the accumulative precipitation in CTRL will not be close to the observations as shown in Figure 11a and 11b. Is one of the main conclusions ("consideration of the local emissions show an improvement in simulated monsoon precipitation") still valid?

6. P21402L6: Could the model simulations show that aerosols induce a longer life time of clouds?

7. Many important papers in aerosol impacts on Asian monsoon (over India and China) are not cited. In past several years many similar works focusing on aerosol impacts on Asian Summer Monsoon, with both global and regional models, have been done in other groups around the world, a better literature research is needed. See below attached incomplete list.

8. Comparing to previous studies, what's the new insight that readers can get from this study? Please discuss.

Minor comments:

1. Title: The WRF-chem simulations include both anthropogenic and biomass burning aerosols. Previous studies (such as Gu et al. 2006, JGR) have shown that the impacts of anthropogenic and biomass burning aerosols on climate are different. The title is misleading by just including anthropogenic aerosols.

2. P21385L25: Is the Wang et al. (2009) paper listed in the reference section the right

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one the authors are referring to?

3. P21387L5: Studies such as (Lau and Kim, 2006, GRL; Wu et al., 2013, JGR) shows that horizontal distribution of aerosols is also important to the pathway of aerosol impacts on regional climate.

4. P21387L6: The CALIPSO data provides vertical distribution of aerosol extinction and it can be used for the model evaluation.

5. P21388L23: Is water considered as one of aerosol species?

6. P21392L8-9: This sentence is not necessary here. Suggest removing it.

7. P21392L15: Studies have shown that dust contributes to ~35% of the total aerosols over eastern China (Zhang et al. 2012, ACP) in the pre-monsoon season and dust could have significant impacts on regional climate there.

8. Figure 2: Is there any specific reason that April and July are selected for comparison? Why not comparing all the simulated months for both pre-monsoon and monsoon seasons?

9. Figure 3: There are many AERONET sites in Asia covering the simulated region. Why are all the 8 selected sites over eastern China? As India is one of the two interested regions in this study, AERONET sites over India should be selected for comparison. Change "May-August" to "March-August".

10. P21393L25-27: This hypothesis can be validated by including the EXP results in the comparison of surface air temperature.

11. Figure 5: Why does it only show precipitation over land?

12. P21396L14: It is more accurate to call the highlighted region as Eastern China.

13. P21396L15-16 and L22-23: The vertical distributions of aerosols are not shown in the manuscript.

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14. What is the horizontal and temporal resolution of the PERSIANN data? Which TRMM dataset is used in this study, and what is its horizontal and temporal resolution?

15. P21397L25: The spatial distributions of precipitation from PERSIANN and TRMM don't look "very similar" to me, especially for the pre-monsoon season.

16. P21398L1-3: Is there any reference showing that PERSIANN is better than TRMM? It is not clear to me why higher spatial resolution will induce better quality of precipitation. Which satellites are used in the PERSIANN dataset? If the TRMM 3B42 dataset is used in this study, it also includes multiple satellite products. Please clarify.

17. P21398L18-19: How good is the simulated dust aerosol?

18. P21399L3-15: I don't see the correlation of OLR and precipitation in Figure 10c and 10d.

19. Please give the units of all variables in all the plots.

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