Atmos. Chem. Phys. Discuss., 13, C12320–C12323, 2014
www.atmos-chem-phys-discuss.net/13/C12320/2014/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Modeling the influences of aerosols on pre-monsoon circulation and rainfall over Southeast Asia" *by* D. Lee et al.

Anonymous Referee #2

Received and published: 17 February 2014

This climate modeling study examines the impact of biomass burning aerosols on pre-monsoon circulation and rainfall over Southeast Asia. A sensitivity approach is used to test the response of modeled atmospheric dynamics, thermodynamics, surface evaporation, cloud microphysical and macrophysical properties to the direct radiative forcing and/or indirect effects of the biomass burning aerosols by turning on or off the regional emissions, and by including or excluding aerosols globally in the radiative transfer calculations. The modeling tool used for this study is the state-of-the-art GEOS-5 general circulation model equipped with a double-moment cloud microphysics scheme that treats aerosol-cloud interactions for both stratiform and convective clouds. Some of the results are just a demonstration of the model's ability to represent aerosol effects, but some are quite new and of interest to the community. The paper is generally well

written and the figures have very good quality. I recommend for publication in ACP only after the following comments are satisfactorily addressed and the manuscript is to be revised accordingly.

General comments:

1) More comprehensive literature review on recent studies of South/Southeast Asian monsoon (rather than the classic papers on aerosol effects, IPCC report, textbook and the authors' own publications) is needed to put this work in the right context.

2) It is mentioned in the paper that QFED emission data are used for biomass burning inventory in the GOCART aerosol model in GEOS-5. What are the injection heights of fire emissions? This is important in determining the vertical distribution of BB aerosols. How about other emissions (besides the fire emissions) and the natural dust and sea salt aerosols? It's necessary to compare BB aerosols and the "background" aerosols (in the ZeroBoth) at least in the region of interest to give an idea of the respective contributions to total aerosols.

3) It is not very clear how the GEOS-5 simulations were conducted and how the monthly or seasonal mean quantities were derived from the model simulations. How were the initial conditions for the ten ensemble members taken? It sounds that each simulation was run for a rather short time period. How is this justified for the comparison of three-dimensional spatial distribution of aerosol and cloud properties?

4) It was assumed in the paper that the surface evaporation decreases in response to BB aerosol forcing, which was used to explain some of the critical model results. This can be easily examined from the model output and should be presented in the paper.

5) The effect of BB aerosols on liquid clouds is the focus of this paper. However, ice cloud is relevant to the radiation budget and changes seen in temperature, moisture and circulation. Is BB aerosol connected to ice nucleation in GEOS-5? As mentioned in the summary and discussion section, aerosol-induced convective invigoration is not

represented in the convective parameterization. How about the impact of additional freezing liquid droplets (due to precipitation suppression) on ice cloud microphysics?

6) Please make better use of acronyms in the paper. Some are inconsistent and redundant (e.g., BB vs. BBA; AIE vs. IE; ADE vs. DE; LCER vs. Reff; CDNC vs. Nc)

7) The BB aerosol impact is amplified by using the high emission in 2007, so some of the conclusions are not applicable to the general climate in the Southeast Asia region. This should be noted in the abstract and summary. It is arguably more reasonable to use the climatological BB emissions instead.

Specific comments and technical edits:

1) P32887, L24-26: among the biomass burning aerosols, organic carbon should have much larger impact on CCN number than black carbon.

2) P32888, L25: GEOS-5 is spelled out later in section 2, but the model is mentioned here for the first time.

3) P32891, L13-16: this sentence has grammar issue.

4) P32891, L20-23: this sentence has grammar issue.

5) P32894, L10: the purpose of using COSP MODIS simulator to process model output should be for a fair model-observation comparison rather than " to enhance similarity with observations".

6) P32895, L6-9: first of all, I don't see the topography in the Figure 4 is enough to lift the BB aerosols. Also, you are looking at the monthly or seasonal mean clouds and aerosols rather than snapshots. What is the "pre-existing clouds" statement based on?

7) P32895, second paragraph: it is more appropriate to place such model description into section 2. Some descriptions of how the five types aerosols are treated in GOCART are needed. For example, how many modes are there in the aerosol module? How are different species in the same mode mixed? Excluding BB aerosols might

affect the way how "background" aerosols are represented in the model.

8) P32896, L10-16: The arguments of "... due to circulation changes induced by BB emission in the preceding months" and "...due to delayed precipitation in March and April" are questionable. Which kind of atmospheric response can last for a month in this region? How long can the clouds last in the model?

9) P32898, L14: change "cloudless" to "clear sky".

10) P32899 and Figure 9: How were the temperature and tendency terms averaged temporally and spatially? It is not intuitive to derive the temperature change from the net change in heating rate shown in the figure. What causes the cooling below 900mb and the warning above 200mb?

11) P32901, second paragraph and Table 3: what does the indirect effect under clear sky mean?

12) P32902, L1: this sentence needs revision.

13) P32902, L17: "due to enhanced BBA activation" is inaccurate here. It's simply due to the presence of addi

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Interactive comment on Atmos. Chem. Phys. Discuss., 13, 32885, 2013.