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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Transport of aerosol pollution in the UTLS during Asian summer monsoon as simulated by ECHAM5-HAMMOZ model" *by* S. Fadnavis et al.

Anonymous Referee #1

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Fadnavis et al. presents transport of aerosols in the Asian monsoon region based on the simulations of global chemistry transport model with detailed analyses of their impact on various physical and dynamical processes in the upper troposphere and lower stratosphere. Aerosol extinction coefficients obtained from the HALOE and SAGE II instruments are also used to compare with the model simulations. I found the results interesting and would like to suggest following comments for the authors might take into consideration.

Major Comments

1. The focus of this paper is not clear. The authors have to present not only the

changes in various processes due to aerosols but also their interaction and mechanisms that are responsible for the feedbacks. This article contains a lot of information but they do not offer one big picture, i.e., what is the main result of this paper?

2. Discussions about changes in large-scale circulations, including Brewer-Dobson circulation, Hadley circulation, and the Asian monsoon circulation, are somewhat misleading. The authors might want to focus on the Asian monsoon circulation and only the relevant features of the large-scale circulations in the UTLS should be included to minimize any confusion. A separate paper can be written on the subject of impacts of large-scale circulation on dynamics of the Asian monsoon.

3. I am not convinced with the discussion of QBO and Rossby wave breaking influencing the transport. First of all, the amplitude of QBO decreases rapidly below $\sim$24 km and the Asian monsoon circulation does not extend above $\sim$18 km. So, in my opinion, there is little overlap between those two and also there is little evidence that QBO has any impact on the Asian monsoon circulation. In addition, the references (Randel and Park, 2006; Bowman, 2006) have little relevance to QBO. I would suggest that discussions about QBO, Rossy wave breaking, and wave drag all have to be presented with convincing evidence or figures.

4. Changes in convection due to aerosol loadings over the Asian monsoon region can be a foundation for the responses in transport and the hydrologic cycle in the UTLS. However, little analysis of convection is presented in this paper (except Fig. 6). Convection in the model (including horizontal and vertical extent) has to be shown with detailed analyses with figures to support all the results presented in this paper.

5. This paper can be shortened significantly by simplifying discussions and reducing detailed explanations of previous studies, which can simply be cited. Also, section 3.2 can be divided into multiple subsections for clarity.

6. Most of the quantitative comparisons are cited from the references (e.g., Liu et al., 2009). Instead, the authors should present the quantitative results from their work first

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and just mention how these results agree or disagree with the previous studies. More quantitative analyses on the impact of aerosols in multiple variables in the model used in this study can be included.

7. The satellite data (HALOE and SAGE II) can be valuable tools to validate the model results quantitatively and add credibility to the work presented here. For instance, adding a figure showing average vertical profiles in the NH subtropics both from the satellite and the model can be useful. Are the aerosol concentrations reasonable/underestimated/overestimated in the model compared to the satellite data?

Minor Comments

The title does not necessarily represent the content of this paper. It should include more specific information, for instance, 'Impact of aerosol increase over the Asian monsoon region as seen in the global model simulation. . .' to better represent this work.

P30082, L12 – The impact of aerosols (on the hydrologic cycles?) in the UTLS region is. . .

P30082, L24 – dramatic levels → dramatic increase in the levels?

P30083, L28 – associated with the ASM (references?).

How does the precipitation change in this study compare with the result of Ramanathan et al. (2005)?

P30084, L6-24 – Is this section about cirrus clouds directly related to this work?

P30086 – more details on the sources of aerosols should be included as they are the main focus of this paper

P30086, L28 – This is a very general statement and I do not know if this statement is necessary.

P30087, L5 – What are the advantages or reasons of carrying out eight-member en-

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semble?

P30087, L15 – 'Although similar features are...year 2003' – This sentence is very vague. What are the similar features and what is the effect of monsoon circulation on aerosol distributions?

P30089, L16-18 – The horizontal extent and the center of the maxima in Figs. 1a-d vary quite a bit. It would be necessary to define a boundary of the Asian monsoon anticyclone and show it on top of the aerosol distributions.

P30089, L19-P230090, L6 – This paragraph seems to be repeated from Introduction without adding new information.

P30090, L11 – satellite observations (references?)

Fig. 2 (and 3) – Adding velocity vectors to at least one of the four plots (as shown in Fig. 1) and also showing the location of the monsoon anticyclone on each plot would be helpful. It is not easy to make connections between transport and the aerosol maxima without the velocity vectors.

P30091, L5-7 – I do not think the relationship between monsoon convection and the vertical transport is presented either in Fig. 2 or Fig. 3.

Fig. 5 – Tropopause and isentropes can be added to this figure for a better presentation. It is hard to tell how well the model reproduces the data. What are the differences between HALOE-model and SAGEII-model?

Fig. 6 – The longitude ranges used for the OLR and the aerosol averages are identical. However, their maxima are not necessarily colocated (see, Fig. 1 and other literatures for the location of convection).

Fig. 9 – The arrows are too small to recognize their direction except in the NH subtropics. Any descending motion is not obvious in this figure due to too many small arrows.

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Interactive Comment

P30095, L17-26 – It is not clear if this paragraph is just based on Fu et al. (2006) or based on this paper. The proposed transport mechanism presented by the authors in this paragraph should be supported by either their own results or previous studies.

P30096, L12 – What is the evidence of 'aerosol induced enhancement of the convection' in this work?

P30097, L1-5 – This section is very confusing and it is not clear what the authors are trying to say. Are the discussions based on Elliassen (1951) paper?

P30100, L19 – . . .thermal structure (references?)

Interactive comment on Atmos. Chem. Phys. Discuss., 12, 30081, 2012.