Atmos. Chem. Phys. Discuss., 10, C2528–C2531, 2010
www.atmos-chem-phys-discuss.net/10/C2528/2010/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "How can aerosols affect the Asian summer monsoon? Assessment during three consecutive pre-monsoon seasons from CALIPSO satellite data" *by* J. Kuhlmann and J. Quaas

J. Kuhlmann and J. Quaas

julian.kuhlmann@zmaw.de

Received and published: 10 May 2010

1. Pre-monsoon season: the authors used March-April-May as the pre-monsoon season in their analysis and this is quite different than the April-May duration in most other studies. The authors might want to switch the analysis duration for comparability.

– We agree that comparability certainly is an important issue, since this study is meant to provide an observational grounding for purely model-based studies of the topic. However, investigations show that our results are qualitatively insensitive to a particu-

lar choice of a pre-monsoon season (e.g. April-May instead of March-April-May). We attached three figures containing data from April-May only to this answer. Because of the sparse spatial sampling of CALIPSO data, we prefer however to use all the data for the figures in the paper in order to improve the statistics.

2. Statistics of CALIPSO: the CALIPSO data advances in providing high-resolution vertical profiles of aerosols and clouds. On the other hand, because the thin slice path it suffers in statistical representation of aerosol distribution outside its track. How to assess such representation is still challenging. The authors might want to provide at least the statistics over selected regions, i.e., the variability of ensemble of all track data within these regions. This could be done, e.g., by adding variability measures above Figure 2 among others.

– Indeed, the CALIPSO data is available along thin paths only. In order to conduct a study over a larger region, we had to average over all measurements falling into a $2^\circ \times 2^\circ$ gridbox. The underlying assumption is that the data along the thin path is representative for a broader region, especially when seasonal means are considered. It is a good idea to add variability measures to Figures 2 and 11, and we thank the reviewer for suggesting this. We now divided each subregion into four equal-sized parts and used errorbars to indicate the value of the lowest and highest quarter. These errorbars cannot account for various other error sources, such as instrument errors, cloud and molecular scattering, or noise from solar illumination, but they provide an idea of the geographical variability within the subregion. Since we consider the subregions to be roughly homogeneous, this is an important point. For legibility, we drew the errorbars at two altitudes of each plot only. Due to the inhomogeneity of the ROI, we omitted the errorbars in the respective (a) plots.

3.1 Recent studies including Wang et al. (2009; GRL, v.36, L21704) and Levermann et al (2009; PNAS, v. 106, p.20572) suggested alternative views on the aerosol-monsoon influence. The authors might want to compare their findings to these works. Specifically, the quantity and location of aerosol heating estimated in this paper seems quite

consistent with Wangś results. This type of analysis might be also useful to address the statistics issue in 2.

– Thank you for pointing out these two interesting studies. The results from Wang et al. (2009) indeed compare quite well to our results, especially considering that they accounted for anthropogenic aerosols only. We now mention their paper in the Introduction and compare the results in the Conclusion. A comparison to the study bei Levermann et al. (2009) is more problematic since their main focus is not aerosols and since their model simulates month-to-month variations only, thereby not capturing the interannual variability that the EHP hypothesis is aiming at.

3.2 Reanalysis wind: the authors perhaps noticed that these wind data might not correctly reflect the aerosol forced flow because of a lack of aerosol forcing in the reanalysis model.

– Aerosol forcing on wind in the reanalysis model might indeed be imperfect. However, we use NCEP/NCAR wind data only to roughly determine possible source regions of aerosols that might be advected to the Tibetan Plateau. Our focus lies on the CALIPSO aerosol data. For our use, the probably rather small modifications that wind direction and speed might obtain from aerosol forcing is very unlikely to alter our conclusions qualitatively.

4. Certain discussions of the paper suffer from a domain being put too north that does not cover many of the Indian land region and arguments being weighted too heavily on the EHP hypothesis itself. For instance, p.4895, line 15-18, the authors argued that smoking aerosols are less important to the monsoon system, perhaps what they really meant was that this would be the case should the EHP was the only mechanism of smoke aerosol to affect monsoon system?

– Certainly, it is beyond the scope of this paper to describe accurately aerosol distributions in the entire region of the Indian Summer Monsoon or to rule out any connection between aerosols and the monsoon. Our aim is to investigate certain proposed influ-

ence pathways in the light of new measurements, especially the role of the Tibetan Plateau in aerosol-monsoon influence and the EHP hypothesis. Most other conclusions on aerosol-monsoon influence cannot be drawn from CALIPSO data and radiative transfer modelling alone – GCM studies, and new ideas how to constrain these from observations, would be needed. This was what motivated our choice of the region of interest. We added a paragraph explaining this choice at the end of Section 1.

5. In section 5, the discussions of downward or upward radiative fluxes did not always come with corresponding locations (e.g., TOA or surface). In addition, the authors should indicate the limitation in using clear-sky radiative budget to discuss TOA and surface forcing (particularly when dealing with absorbing aerosols) although it is understood that this is perhaps the best usage of satellite retrievals.

– Thank you for pointing out the inaccuracies in Section 5. We have added indications of the vertical locations at a couple of places in our discussions. The omission of clouds is certainly a limitation. Clearly, including clouds into our simulations would be more realistic, though it would also introduce new uncertainties due to imperfect estimation of cloud optical properties. Since we are concerned with aerosol-induced anomalies only, the simulation of aerosols in clear-sky conditions seems justified. We have added a corresponding comment at the end of Section 2.3.

Interactive comment on Atmos. Chem. Phys. Discuss., 10, 4887, 2010.