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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Simulation of the interannual variations of aerosols in China: role of variations in meteorological parameters" *by* Q. Mu and H. Liao

Anonymous Referee #3

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This manuscript presents modeling analysis to quantify the interannual variations (IAVs) of aerosol species over China during the period 2004 to 2012 driven by meteorological parameters. Three sets of simulations were conducted, all with varying meteorology but differ in treatment of emissions: fixed anthropogenic emissions at 2006 levels (ANNmet), turning off natural emissions that are coupled with meteorology, varying anthropogenic emissions. Through comparing the IAVs of the three sets of simulations, the authors conclude that the IAVs of aerosols in China are mainly caused by meteorology, rather than by natural emissions or by anthropogenic emissions. IAVs of different processes are diagnosed from the model simulations (with fixed anthro-

pogenic emissions) and the processes with largest IAVs are selected as the key processes that drive the IAVs of different aerosols. Gas-phase formation of sulfate is found to drive the IAVs of sulfate over NC, while the gas-to-aerosol partitioning of nitrate is the major factor leading to large IAVs of nitrate in China.

Overall the paper presents interesting new analysis of the driving factors of aerosols variations in China. The paper is well organized and thoroughly written. It is suitable for publication in ACP once several revisions have been made, as described below.

Major comments:

1. Section 3.3 comparison of simulations with MODIS AOD: this section evaluates the simulated IAVs of aerosols with AODs retrieved by MODIS. The evaluation was based on the ANNmet simulation (i.e., simulations with fixed anthropogenic emissions), but the MODIS AOD should reflect both changes in meteorology and emissions. Therefore, the ANNall simulation (i.e., simulations with changing anthropogenic emissions) should be better suited for comparison with MODIS AOD.

2. Although this manuscript is focused on IAVs of aerosol in China, some of the conclusions can be strengthened by expanding the analysis to the changes in absolution concentrations of aerosols by different factors/processes, or at least discussing this aspect in Section 4 or 5. The impact of the large increases of anthropogenic emissions in China on aerosols is completely neglected in the manuscript, although the authors have conducted simulations with increasing anthropogenic emissions. I understand that the authors based their analysis on the IAVs, since the IAVs of increasing anthropogenic emissions are comparable to the IAVs of fixed anthropogenic emissions. Still, to discuss the different role of meteorology factors and anthropogenic emissions on aerosols in China will strength the analysis of the paper and have a bigger impact.

Minor comments:

1. pg 11180, line 5-7: check the spelling of MODIS and MISR.

2. pg 11181, line 21: should be regional-scale GEOS-Chem model since the manuscript uses the nested-grid capability of GEOS-Chem.

3. pg 11187, line 1: what's the faction of nitrate in PM2.5? How does this compare with observations?

4. pg 11182, line 17-20: not sure how dusts and sea salts are treated in the simulations. Are they allowed to vary with meteorology in all the three simulations? Are their natural emissions turned off in the ANNmet_ATM simulation? Do the PM2.5 results presented in the paper include dust or sea salt? This needs to be clarified.

Interactive comment on Atmos. Chem. Phys. Discuss., 14, 11177, 2014.