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Atmospheric Chemistry and Physics Discussions

# *Interactive comment on* "Sulfate-nitrate-ammonium aerosols over China: response to 2000–2015 emission changes of sulfur dioxide, nitrogen oxides, and ammonia" *by* Y. Wang et al.

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We thank the reviewer for his/her careful reading and thoughtful and constructive comments to improve the analysis and writing of the manuscript. The page and line numbers refer to those in the tracking-change version of the revised manuscript.

1. The model overestimate of nitrate aerosol is attributed to underestimation of wet deposition and uncertainty in the NH3 emission inventory. Both sulfate and nitrate wet deposition is underestimated by 40% yet the model performs well in simulating the



sulfate atmospheric concentrations? Please provide more detail on the likely cause of the discrepancies in the wet deposition rate for such a model that applies assimilated meteorological fields?

Response: In another paper analyzing BC to CO ratios, we made a detailed comparison of the simulated precipitation with observations and found the model's precipitation at the MY site is 40% too low and the discrepancy is particularly large for large precipitation events. We now referred to this result in the discussion of the wet deposition issue (pg 15, line 335-338). The reason why the assimilated GEOS-5 meteorology cannot reproduce large precipitations is still under investigation, but could be partly due to its coarse resolution (about 0.5 degree x 0.667 degree).

2. How does the large model overestimated of nitrate aerosol affect the policy-relevant sensitivity results presented here?

Response: The reviewer's point is well taken. The main policy-relevant sensitivity results of our study are: in order to reduce PM2.5 pollution in China, (1) there is a need for strengthening NOX emissions controls, especially over Northern China; and (2) an emphasis should be put on improving understanding of current NH3 emissions in China and controlling NH3 emissions in the future. The model's overestimation of nitrate may have offsetting effects on the two conclusions. Given the nitrate overestimation, we may have over-predicted the role of NOX emissions on SNA levels, as less nitrate means smaller sensitivity of SNA to NOx emissions. On the other hand, we may have under-estimated the role of NH3 emissions, as the overestimation of nitrate means the model's already in the NH3-abundant regime. We have added a discussion of this issue in the conclusion in the revised manuscript (pg 30, line 694-699).

3. Could satellite TES tropospheric NH3 observations be used to provide further constraint in future work?

Response: Definitely. There are already a couple of published studies on this topic. TES and IASI are two satellite instruments that retrieve NH3 column abundance (Shep-

hard et al., 2011; Clarisse et al., 2009). For example, Shephard et al. (2011) found that the GEOS-Chem simulated NH3 columns were lower than those retrieved from TES over East Asia, but Kharol et al. (2012, submitted to GRL) found that compared to the NH3 columns retrieved from IASI, the modeled NH3 columns from GEOS-Chem were 30% higher. We have added references to these studies and discussed their results in the revised manuscript (Section 3, pg 16, line 365-374).

4. For future work, it would be useful/powerful to assess the role of changing oxidants over the same period on the inorganic aerosol leading.

Response: Good point. We do plan to investigate this topic in a follow-up paper.

5. It would be interesting to quantify the sensitivity to the meteorological year, i.e. force run with another net year in order to constrain this source of uncertainty because all simulations use year 2007

Response: We agree. We have run another year of simulation using 2008 meteorology, while using the same emissions as in 2006C, which is referred to as the 2006M case (Table 1). We compared the 2008 and 2007 model results with observations in the revised Figure 8 and found generally insignificant sensitivity of the model results to meteorology. Please refer to the added discussions in Section 3 (pg 17, line 394-402).

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Interactive comment on Atmos. Chem. Phys. Discuss., 12, 24243, 2012.