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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.**

Anonymous Referee #1

Received and published: 6 November 2012

The authors present modeling results for changes in sulfate, nitrate, and ammonium aerosol components over China for the 2000–2015 time period. GOES-Chem simulations were conducted for years 2000, 2006 and 2015 to reflect increases in precursor emissions between 2000 and 2006 as well as projected emissions changes between 2006 and 2015. Recommendations based on these model simulations are then made concerning emission controls strategies. In particular, the authors conclude that there is a need for strengthening NO_x emissions controls over Northern China and placing an emphasis on reducing NH₃ emissions. This strategy aims to avoid offsetting future

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decreases in sulfate aerosol with increases in nitrate. The study also makes clear that there is a need for improvements in emissions inventories and development of observational networks in China. Overall, this is a very nice study that is presented clearly. I would recommend publication of this manuscript in ACP after the comments below are addressed.

General Comments:

1. The model evaluation is based on very limited data, and it is hard to determine the validity of the conclusion that model performance is good. The model evaluation is generally presented by comparing observed and modeled data averaged over long time periods which can obscure model performance issues. I understand that limited data exist to evaluate the model, but the evaluation is based on seasonal or monthly average comparisons even in situations where weekly average observations are available.

2. The conclusion that ammonia emissions are over-estimated seems to draw heavily on the finding that model performance for nitrate can be improved by adjusting NH₃ emissions. While ammonia emissions may be over-estimated as the authors indicate, I do not see how a clear understanding of model performance issues for nitrate can be developed based on the limited ambient data and to what degree these issues might be attributed to errors in ammonia emissions.

3. The discussion of inorganic aerosol thermodynamics is highly simplified in this study. The authors almost exclusively refer to solid phase ammonium salts and do not mention the temperature or relative humidity conditions in the study areas. For many atmospheric conditions, the inorganic particle components will exist as separate ions in an aqueous solution rather than as crystalline salts. I understand that a detailed discussion of the actual processes at play could complicate and potentially distract from the discussion. However, improvements could be made in certain areas (e.g., where the authors indicate that decreases in sulfate can “make additional nitrate”).

Specific comments:

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p. 24245, lines 10-12: Transition-metal catalyzed oxidation of sulfur oxides in clouds should also be mentioned

p. 24245, line 13: “NO_x” should be “NO₂”

p. 24247, line 19: The aerosol thermodynamics module used is quite old and does not consider the impact of crustal elements that could be important when dust storms impact aerosol concentrations. Why not use a more recent version of GEOS-Chem with ISORROPIA II?

p. 24249, line 14, “poor NH₃ conditions”: I know what you are trying to say here, but please rephrase this for clarity.

p. 24250, line 4: Please provide more details on the measurement methods. Later in the manuscript, there is mention of the challenges in measuring nitrate, so it would be helpful to mention the measurement techniques that were used.

p. 24251, line 6: Based on the limited data and disagreements between observations and predictions in Figure 4, one should not conclude that the model has “excellent ability” in representing the spatial heterogeneity.

p. 24251, line 15: What filter material was used to collect aerosols for the nitrate measurements? The degree of volatilization of nitrate from filters is highly dependent on filter material.

p. 24251 and p. 24252, Figure 5 and 6: The observations at MY and BB are based on weekly averages, right? Why not evaluate model predictions at this time resolution rather than averaging to the seasonal and monthly time scales?

p. 24256, lines 7-9: Why would the presence of dust be expected to lower nitrate? Nitric acid can react with calcium carbonate in dust to form calcium nitrate, and so the presence of dust could increase nitrate. This pathway could be particularly important in an ammonia-limited environment.

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