

Interactive comment on “Investigation of NO_x emissions and NO_x-related chemistry in East Asia using CMAQ-predicted and GOME-derived NO₂ columns” by K. M. Han et al.

K. M. Han et al.

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First of all, thank you for your valuable comments and suggestions. In the revised manuscript we tried to clarify this manuscript by eliminating, modifying, and adding several parts from/into the original text (the added or modified parts are painted in a red color in the revised manuscript). Also, following the suggestions from both reviewers, we improved the clarification of figures (Figs. 3, 4, and 7) and added new figures (Figs. 9, 10, 11, and 13) into the revised manuscript. Below are our replies to your specific comments:

1. I want to stress that their conclusions are all based on assumptions. I would like to strongly suggest that the authors must make a sensitivity study by adjusting the

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biogenic VOC emission (say half), and China anthropogenic NO_x emission (original and twice condition cases) for summer time simulation, and examine how the results are changed by this modification. This is a kind of key issue in order to accept the publication.

Reply) The sensitivity runs of CMAQ model were performed, using 100%, 50%, 30%, and 0% GEIA isoprene emissions for the summer episode. We also considered seasonal variations in anthropogenic NO_x emissions over East Asia for four seasonal episodes. Corresponding discussions can be found at p.19:9-22:22 and in newly-added Figs. 9, 10, and 11 (also in Table 2 and 3). From the newly-added discussions, we tried to investigate all the uncertainties that could occur in the comparison studies between CTM-modeled and satellite-derived NO₂ columns (also, refer to p.22:23-23:22).

2. The authors must refer the model intercomparison study by van Noije et al (2006; Atmos. Chem. Phys., 6, 2943-2979). They compared a lot of global chemical transport models and also found that the China emission is under-estimated very much. I would like to suggest checking the biogenic VOC emission inventory used in that model inter-comparison.

Reply) We included van Noije et al. (2006) in the revised manuscript, and also set a stage for discussing the possible implications of our study to van Noije et al's work. As you pointed out, their results also showed similar discrepancy between two NO₂ columns over North China. However, they did not consider the possible importance of the BVOC emissions and its coupled-chemistry in the comparison studies between CTM-modeled and satellite-derived NO₂ columns (the same thing can also be applied to the works of Kunhikrishnan et al. (2004), Ma et al. (2005), and Uno et al. (2007). We would therefore think that our work could be a good complementary study to the works previously done. Please, refer to p.20:3-21:2.

Minors

3. p. 17309 line 17; North (A) must be North China (A)

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Reply) Thank you for this correction. We changed it (see p.14:11).

4. p. 17313 line 17-23; CMAQ model is flexible for the choice of gas-chemistry and aerosol formation modules. The statement of MONO-TERP species in the version of CMAQ 4.3 seems miss-understanding to the reader, this depend on the choice of CMAQ option by user.

Reply) While isoprene chemistry is included explicitly in the CBM4 of the CMAQ model, mono-terpenes (such as pinenes, limonenes, carenes etc) chemistries are not yet included in any mechanism we can select from the list of the CMAQ model. This could further influence the NO₂ levels from the CMAQ model simulations. Reactions including TERP in CBM4 are only for secondary organic formation, not for gas-phase chemistry. However, as reviewer pointed out, it could mislead (or confuse) readers. So, we decided to remove the parts.

5. p. 17318 lines 15-18; It would be very useful to include reason (or contribution of which sectors) of under-estimation of ACE-Asia and REAS inventory.

Reply) As mentioned above, we considered the seasonal variations in anthropogenic NO_x emission over East Asia in this revised manuscript that could be important in this type of comparison study between CTM-derived and satellite-retrieved NO₂ columns. According to Zhang et al.(2007), the under-estimation could be due to not considering small-scale combustion sources of NO_x. Please, refer to p. 26:1-26:17.

Interactive comment on Atmos. Chem. Phys. Discuss., 8, 17297, 2008.

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