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Investigation of NO_x emissions and NO_x -related chemistry in East Asia using CMAQ-predicted and GOME-derived NO_2 columns

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Abstract. In this study, NO₂ columns from the US EPA Models-3/CMAQ model simulations carried out using the 2001 ACE-ASIA (Asia Pacific Regional Aerosol Characterization Experiment) emission inventory over East Asia were compared with the GOME-derived NO₂ columns. There were large discrepancies between the CMAQ-predicted and GOME-derived NO₂ columns in the fall and winter seasons. In particular, while the CMAQpredicted NO₂ columns produced larger values than the GOME-derived NO₂ columns over South Korea for all four seasons, the CMAQ-predicted NO2 columns produced smaller values than the GOME-derived NO₂ columns over North China for all seasons with the exception of summer (summer anomaly). It is believed that there might be some error in the NO_x emission estimates as well as uncertainty in the NO_x chemical loss rates over North China and South Korea. Regarding the latter, this study further focused on the biogenic VOC (BVOC) emissions that were strongly coupled with NO, chemistry during summer in East Asia. This study also investigated whether the CMAQ-modeled $\mathrm{NO}_2/\mathrm{NO}_{\mathrm{x}}$ ratios with the possibly overestimated isoprene emissions were higher than those with reduced isoprene emissions. Although changes in both the NO_x chemical loss rates and NO₂/NO_x ratios from CMAQ-modeling with the different isoprene emissions affected the CMAQ-modeled NO₂ levels, the effects were found to be limited, mainly due to the low absolute levels of NO₂ in summer. Seasonal variations of the NO_x emission fluxes over East Asia were further investigated by a set of sensitivity runs of the CMAQ model. Although the results still exhibited the summer anomaly possibly due to the uncertainties in both NO_x-related chemistry in the CMAQ model and the GOME measurements, it is believed that consideration of both the seasonal variations in NO_{X} emissions and the correct BVOC emissions in East Asia are critical. Overall, it is estimated that the NO_x emissions are underestimated by ~57.3% in North China and overestimated by ~46.1%

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03 | ACP, 12 Mar 2009: Comparison of tropospheric gas-phase chemistry schemes for use within global models in South Korea over an entire year. In order to confirm the uncertainty in NO_x emissions, the NO_x emissions over South Korea and China were further investigated using the ACE-ASIA, REAS (Regional Emission inventory in ASia), and CAPSS (Clean Air Policy Support System) emission inventories. The comparison between the CMAQ-calculated and GOME-derived NO₂ columns indicated that both the ACE-ASIA and REAS inventories have some uncertainty in NO_x emissions over North China and South Korea, which can also lead to some errors in modeling the formation of ozone and secondary aerosols in South Korea and North China.

■ <u>Final Revised Paper</u> (PDF, 4185 KB) ■ <u>Discussion Paper</u> (ACPD)

Citation: Han, K. M., Song, C. H., Ahn, H. J., Park, R. S., Woo, J. H., Lee, C. K., Richter, A., Burrows, J. P., Kim, J. Y., and Hong, J. H.: Investigation of NO_x emissions and NO_x -related chemistry in East Asia using CMAQ-predicted and GOME-derived NO_2 columns, Atmos. Chem. Phys., 9, 1017-1036, 2009. Bibtex EndNote Reference Manager