

An estimation of the accuracy of NO_x emissions over Japan via comparison analysis between CMAQ-simulated and OMI-retrieved tropospheric NO₂ columns

¹Sojin Lee, ¹K. M. Han, ¹C. H. Song

¹Gwangju Institute of Science and Technology

Abstract

With an intention of estimating the accuracy of NO_x emissions over Japan, we compared model-simulated and satellite-observed tropospheric NO₂ columns. The model-retrieved tropospheric NO₂ columns were obtained from the US Environmental Protection Agency Community Multi-scale Air Quality (US EPA CMAQ) model v4.5.1 simulations using REAS (Regional Emission Inventory in Asia), INTEX-B (Intercontinental Chemical Transport Experiment-Phase B) and CAPSS (Clean Air Policy Support System) emission inventories over Japan, China, and Korea, respectively, with a high grid-resolution of 30 km × 30 km. The satellite-derived tropospheric NO₂ columns were retrieved from the Dutch KNMI (DOMINO) retrieval algorithm from Ozone Monitoring Instrument (OMI). The comparison analyses were performed over Japan, and also over two major metropolitan areas, such as Greater Tokyo Area (hereafter, GTA) and Greater Osaka Area (hereafter, GOA), during four months: March, June, September and December in 2006. The analysis showed that the CMAQ-simulated tropospheric NO₂ columns were overestimated compared to the OMI-retrieved tropospheric NO₂ columns over Japan by factors between 1.15 and 2.16 except for June. Over GTA, the CMAQ-simulated tropospheric NO₂ columns were slightly overestimated during all seasonal episodes by factors between 1.12 and 1.24, compared to the OMI-retrieved tropospheric NO₂ columns. On the other hand, over the GOA, the CMAQ-simulated tropospheric NO₂ columns were overestimated in September and December by factors of 1.15 and 1.36, respectively, and were underestimated in June by factor of 0.72 compared to the OMI-retrieved tropospheric NO₂ columns. These results indicated that the bottom-up NO_x emissions from the REAS inventories would be relatively accurate over Japan, particularly with the approximate uncertainties of ±30% over the large megacity areas like GTA and GOA. The relatively large discrepancies in June may be due to the inaccuracies in both the NO_x emissions and the biogenic emissions, since both NO_x and biogenic VOC chemistries are closely coupled to each other. In addition, possible overestimations of the Dutch KNMI tropospheric NO₂ column products during summer were discussed further in this study.