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Evaluation of simulated VOCs during the KORUS-AQ campaign and their effect on ozone production in Korea

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Volatile Organic Compounds (VOCs) play an important role as a precursor of ozone, which is a key secondary air pollutant that affects human health and the ecosystem. However, the magnitude of VOCs emission and their role in atmospheric chemistry has been less examined in Korea, which is compounded by lack of in-situ observations and theoretical modeling of VOCs. We here use a 3-D global chemistry transport model (CTM), GEOS-Chem, and extensive observations of VOCs during the Korea-US Air Quality (KORUS-AQ) campaign, which occurred in May-June, 2016. During the KORUS-AQ campaign, aircraft observations of VOCs were conducted onboard the NASA DC-8 aircraft, using the Whole Air Sampler (WAS), which provides high frequency measurements of biogenic and anthropogenic VOCs. The observed aromatic species, especially toluene, shows high concentration of up to 10 ppbv in Korea compared to the observations in other global regions. To examine the role of VOCs in atmospheric chemistry and ozone production, we implement a detailed aromatic chemistry scheme in the model, which reduces the normalized mean bias of simulated ozone concentration from -24% to -15%. The observed and model-derived ozone production efficiencies (OPE=ΔOx/ΔNO_z) are found to be in overall good agreement throughout the Korean peninsula, with a bias within 10% and values ranging from 4-6. However, the model-derived OPE shows less pronounced non-linear dependency as a function of NO_x and is too high compared to the observation in the low-NO_x regime ([NO_x]<0.5 ppbv). This discrepancy in the model is associated with the overestimation of heavy alkanes and alkenes with high reactivity especially in rural regions with low NO_x levels.