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Simultaneous assimilation of satellite NO_2, O_3, CO, and HNO_3 data for the analysis of the tropospheric chemical composition

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Carbon monoxide (CO) and nitrogen oxides (NO_x) play an important role in tropospheric chemistry through their influences on the ozone and hydroxyl radical (OH). The simultaneous optimization of various chemical components is expected to improve the emission inversion through the better description of the chemical feedbacks in the NO_x- and CO-chemistry. This study aims to reproduce chemical composition distributions in the troposphere by combining information obtained from multiple satellite data sets.

The emissions of CO and NO_x, together with the 3D concentration fields of all forecasted chemical species in the global CTM CHASER have been simultaneously optimized using the ensemble Kalman filter (EnKF) data assimilation technique, and NO_2, O_3, CO, and HNO_3 data obtained from OMI, TES, MOPITT, and MLS satellite measurements. The performance is evaluated against independent data from ozone sondes, aircraft measurements, GOME-2, and SCIAMACHY satellite data. Observing System Experiments (OSEs) have been carried out. These OSEs quantify the relative importance of each data set on constraining the emissions and concentrations. We confirmed that the simultaneous data assimilation improved the agreement with these independent data sets. The combined analysis of multiple data sets by means of advanced data assimilation system can provide a useful framework for the air quality research.