Updated atmospheric composition chemica reanalysis and emission estimates

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This study presents the results from the Tropospheric Chemistry Reanalysis version 2 (TCR-2) for the period 2005–2018 at 1.1 horizontal resolution obtained from the assimilation of multiple updated satellite measurements of ozone, CO, NO_2, HNO_3, and SO_2 from the OMI, SCIAMACHY, GOME-2, TES, MLS, and MOPITT satellite instruments. The reanalysis calculation was conducted using a global chemical transport model MIROC-CHASER and an ensemble Kalman filter technique that optimizes both chemical concentrations of various species and emissions of several precursors, which was efficient for the correction of the entire tropospheric profile of various species and its year-to-year variations. Comparisons against independent aircraft, satellite, and ozonesonde observations demonstrate the quality of the reanalysis fields for numerous key species on regional and global scales, as well as for seasonal, yearly, and decadal scales, from the surface to the lower stratosphere. The multi-constituent data assimilation brought the model vertical profiles and interhemispheric gradient of OH closer to observational estimates, which was important in improving the description of the oxidation capacity of the atmosphere and thus vertical profiles of various species. The evaluation results demonstrate the capability of the chemical reanalysis to improve understanding of the processes controlling variations in atmospheric composition, including long-term changes in near-surface air quality and emissions. The estimated emissions can be employed for the elucidation of detailed distributions of the anthropogenic and biomass burning emissions of co-emitted species (NO_x, CO, SO_2) in all major regions, as well as their seasonal and decadal variabilities.

Keywords: Atmospheric composition, Satellite observation, Data assimilation

