5.042 An updated global multi-constituent chemical reanalysis data set for 2005-2017 and its applications in atmospheric chemistry studies.

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Abstract:

An updated global chemical reanalysis data set of multi-constituent concentration and emission fields (TCR-2) was produced from an assimilation of the updated multiple satellite retrievals of ozone, CO, NO_2, HNO_3, and SO_2 from OMI, SCIAMACHY, GOME-2, TES, MLS, and MOPITT, for the years 2005-2017 at a 1.1-degree spatial resolution. Surface emissions of NOx, CO, and SO_2, lightning NOx sources, and the concentrations of various species were simultaneously optimized. The consistent concentration and emission data products provide unique information on decadal changes in the atmospheric environment that can be used for various applications in air-quality and climate research. We used the DC-8 aircraft measurements in East Asia during the KORUS-AQ campaign to evaluate the performance and efficiency of the data assimilation in East Asia. The evaluation of the data assimilation fields showed improved agreements in ozone, CO, NO_2, SO_2, PAN, and OH profiles. Significant improvements in the free tropospheric OH profile confirm the usefulness of multiple-species assimilation in tropospheric chemistry analysis and to improve emission inversions. Our results suggest that combining precursors' emission optimization and direct concentration assimilation is an effective method for obtaining sufficient correction of the entire tropospheric ozone profile, and to adjust various tracers chemically linked to the species assimilated. The reanalysis fields have also been used to investigate detailed distributions of emissions for all major regions, their diurnal and seasonal variability, and their evolution over the 13-

year period, such as strong positive trends over India and negative trends over China, with substantial differences between the variations in NOx, CO, and SO_2 emissions, and to evaluate bottom-up emission inventories and chemistry-climate simulations.