5.067 A 0.56°-resolution global data assimilation of multi-constituent satellite measurements for use in tropospheric chemistry studies.

Presenting Author:
Takashi Sekiya, Japan Agency for Marine-Earth Science and Technology, tsekiya@jamstec.go.jp

Co-Authors:
Kazuyuki Miyazaki, Japan Agency for Marine-Earth Science and Technology
Koji Ogochi, Japan Agency for Marine-Earth Science and Technology
Kengo Sudo, Graduate School of Environmental Studies, Nagoya University
Masayuki Takigawa, Japan Agency for Marine-Earth Science and Technology
Henk Eskes, Royal Netherlands Meteorological Institute
Folkert Boersma, Royal Netherlands Meteorological Institute

Abstract:

Detailed information on tropospheric ozone and its precursors are important for human health, ecosystem, and climate studies. The combined use of satellite measurements of ozone and its precursors has great potential to provide comprehensive constraints on the tropospheric chemistry system from regional to global scales. Several studies have demonstrated the capability of data assimilation of multi-species satellite measurements to simultaneous optimize concentration and emission fields at relatively low resolutions (at 1°–4° resolutions; e.g., Miyazaki et al., 2015). In this study, we present results from a high-resolution global data assimilation at a 0.56°-resolution using an ensemble Kalman filter approach and a high-resolution global CTM (Sekiya et al., 2018) towards better use of satellite measurements. We assimilated multiple chemical species measurements (ozone, NO_2, CO, HNO_3, and SO_2) from multiple satellite sensors (OMI, GOME-2, SCIAMACHY, TES, MOPITT, and MLS) for simultaneous optimization of concentration and emission fields, and evaluated the analysis fields using independent measurements. The global root mean square error of tropospheric NO_2 column against OMI was smaller by 56% in the high-resolution data assimilation compared to that in a low-resolution data assimilation (at 2.8° resolution). The high-resolution data assimilation also improved agreements with world-wide surface NO_2 monitoring networks (AirBase, AQS, and Asian networks) and various ozone measurements (ozonesonde, aircraft, and surface measurements), attributing to corrections made to both concentrations and precursor's emissions. The global total surface NO_x emission was increased by 35% from the a prior emissions (HTAP_v2.2, GFED4s, and GEIA inventories), with large emission increments at megacities and biomass burning hotspots, providing substantially different emission fields from low-resolution data assimilations. These results suggest the potentials of using the high-resolution data assimilation for studying the processes controlling the atmospheric environment at various spatial scales and for making better use of future satellite measurements such as TROPOMI and geostationary satellites.