Estimating global budget of formaldehyde and BVOCs emission using satellite observations and global chemistry transport model

*Kengo Sudo[1,2], Yuki Isono[1], Akihiko Ito[3,2], Kazuyuki Miyazaki[2]

1.Graduate School of Environmental Studies, Nagoya University, 2.Japan Marine-Earth Science and Technology, 3.National Institute of Environmental Studies

This study evaluates global distribution and budget of atmospheric formaldehyde using satellite measurements and global chemistry-transport model simulations, particularly focusing on the roles of global emission of biogenic VOCs (BVOCs) and methane oxidation. Formaldehyde (HCHO) is chemically produced by oxidation of methane (CH_4) and volatile organic compounds (VOCs) in the atmosphere, and hence its global budget can be used for deriving methane concentrations and VOCs emissions. For simulating global HCHO, this study uses a global chemistry-transport model CHASER (MIROC-ESM version) which considers detailed chemistry in the troposphere and stratosphere with an on-line aerosol simulation including production of particulate nitrate and SOA. We use the NCEP reanalysis data (FNL) for constraining the model's meteorology. Anthropogenic and biomass burning emissions are specified using the EDGAR-HTAP2 and MAC inventories, respectively. For a base emission of BVOCs, we employ calculation by the land ecosystem/trace gas emission model VISIT (Ito et al., 2008) and MEGAN (Guenther et al., 2006) for 2000-2012. In this study, global emission of BVOCs is first estimated employing a series of emission sensitivity simulations by CHASER in combination with the global and regional HCHO distributions derived from the OMI satellite observation. As a result, the global emission amount of isoprene (a major component of BVOCs) is estimated at 300 - 400 TgC yr^{-1}, suggesting that the current estimates as by the VISIT and MEGAN land-ecosystem models (> 500 TgC yr^{-1} for isoprene) are probably overestimated. For the global budget of HCHO, the model with global isoprene emission of 400 TgC yr^{-1} estimates a major contributions from the CH_4 oxidation (ca. 66%) to the global production of HCHO, which is followed by oxidation of BVOCs (ca. 21%) and anthropogenic and biomass burning related VOCs (ca. 13%). The CH_4 contribution to the global HCHO production, inferred from the OMI HCHO observation, is about 71%, significantly larger than the above-estimated value, suggesting that global isoprene emission may be less than 300 TgC yr^{-1} or that anthropogenic VOCs emissions in the current inventories may be overestimated.

Keywords: BVOCs, Isoprene, Formaldehyde, OMI satellite observation, Chemistry-transport model

