Global emissions of non-methane hydrocarbons deduced from SCIAMACHY formaldehyde columns through 2003– 2006
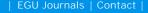
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Abstract. Formaldehyde columns retrieved from the Scanning Imaging Absorption Spectrometer for Atmospheric Chartography/Chemistry (SCIAMACHY) instrument onboard ENVISAT satellite through 2003 to 2006 are used as top-down constraints to derive updated global biogenic and biomass burning flux estimates for the non-methane volatile organic compounds (NMVOCs) precursors of formaldehyde. Our interest is centered over regions experiencing strong emissions, and hence exhibiting a high signal-to-noise ratio and lower measurement uncertainties. The formaldehyde dataset used in this study has been recently made available to the community and complements the long record of formaldehyde measurements from the Global Ozone Monitoring Experiment (GOME). We use the IMAGESv2 global chemistry-transport model driven by the Global Fire Emissions Database (GFED) version 1 or 2 for biomass burning, and from the newly developed MEGAN-ECMWF isoprene emission database. The adjoint of the model is implemented in a grid-based framework within which emission fluxes are derived at the model resolution, together with a differentiation of the sources in a grid cell. Two inversion studies are conducted using either the GFEDv1 or GFEDv2 as a priori for the pyrogenic fluxes. Although on the global scale the inferred emissions from the two categories exhibit only weak deviations from the corresponding a priori estimates, the regional updates often present large departures from their a priori values. The posterior isoprene emissions over North America, amounting to about 34 Tg C/yr, are estimated to be on average by 25% lower than the a priori over 2003– 2006, whereas a strong increase (55%) is deduced over the south African continent, the optimized emission being estimated at 57 Tg C/yr. Over Indonesia the biogenic emissions appear to be overestimated by 20– 30%, whereas over Indochina and the Amazon basin during the wet season the a priori inventory captures both the seasonality and the magnitude of the observed columns. Although neither biomass burning inventory seems to be consistent with the data over all regions, pyrogenic estimates inferred from the two inversions are reasonably similar, despite their a priori deviations. A number of sensitivity experiments are conducted in order to assess the impact of uncertainties

related to the inversion setup and the chemical mechanism. Whereas changes in the background error covariance matrix have only a limited impact on the posterior fluxes, the use of an alternative isoprene mechanism characterized by lower HCHO yields (the GEOS-Chem mechanism) increases the posterior isoprene source estimate by 11% over northern America, and by up to 40% in tropical regions.

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