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One decade of space-based isoprene emission estimates: Interannual variations and emission trends between 2005 and 2014

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Isoprene is one of the most largely emitted hydrocarbons in the atmosphere, with global annual emissions estimated at about 500 Tg, but with large uncertainties (Arneth et al., 2011). Here we use the source inversion approach to derive top-down biogenic isoprene emission estimates for the period between 2005 and 2014 constrained by formaldehyde observations, a high-yield intermediate in the oxidation of isoprene in the atmosphere. Formaldehyde columns retrieved from the Ozone Monitoring Instrument (OMI) are used to constrain the IMAGESv2 global chemistry-transport model and its adjoint code (Stavrakou et al., 2009). The MEGAN-MOHYCAN isoprene emissions (Stavrakou et al., 2014) are used as bottom-up inventory in the model. The inversions are performed separately for each year of the study period, and monthly emissions are derived for every model grid cell. The inversion results are compared to independent isoprene emissions from GUESS-ES (Arneth et al., 2007) and MEGAN-MACC (Sinderalova et al., 2014) and to top-down fluxes based on GOME-2 formaldehyde columns (Bauwens et al., 2014; Stavrakou et al., 2015).
The mean global annual OMI-based isoprene flux for the period 2005-2014 is estimated to be 270 Tg, with small interannual variation. This estimate is by 20% lower with regard to the a priori inventory on average, but on the regional scale strong emission updates are inferred. The OMI-based emissions are substantially lower than the MEGAN-MACC and the GUESS-ES inventory, but agree well with the isoprene fluxes constrained by GOME-2 formaldehyde columns. Strong emission reductions are derived over tropical regions. The seasonal pattern of isoprene emissions is generally well preserved after inversion and relatively consistent with other inventories, lending confidence to the MEGAN parameterization of the a priori inventory. In boreal regions the isoprene emission trend is positive and reinforced after inversion, whereas the inversion suggests negative trends in the rainforests of Equatorial Africa and South America. The top-down isoprene fluxes are available at a resolution of 0.5°x0.5° between 2005 and 2014 at the GlobEmission website (http://www.globemission.eu).

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