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Evaluating the performance of pyrogenic and biogenic emission inventories against one decade of space-based formaldehyde columns

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Abstract. A new one-decade (1997–2006) dataset of formaldehyde (HCHO) columns retrieved from GOME and SCIAMACHY is compared with HCHO columns simulated by an updated version of the IMAGES global chemical transport model. This model version includes an optimized chemical scheme with respect to HCHO production, where the short-term and final HCHO yields from pyrogenically emitted non-methane volatile organic compounds (NMVOCs) are estimated from the Master Chemical Mechanism (MCM) and an explicit speciation profile of pyrogenic emissions. The model is driven by the Global Fire Emissions Database (GFED) version 1 or 2 for biomass burning, whereas biogenic emissions are provided either by the Global Emissions Inventory Activity (GEIA), or by a newly developed inventory based on the Model of Emissions of Gases and Aerosols from Nature (MEGAN) algorithms driven by meteorological fields from the European Centre for Medium-Range Weather Forecasts (ECMWF). The comparisons focus on tropical ecosystems, North America and China, which experience strong biogenic and biomass burning NMVOC emissions reflected in the enhanced measured HCHO columns. These comparisons aim at testing the ability of the model to reproduce the observed features of the HCHO distribution on the global scale and at providing a first assessment of the performance of the current emission inventories. The high correlation coefficients (r>0.7) between the observed and simulated columns over most regions indicate a good consistency between the model, the implemented inventories and the HCHO dataset. The use of the MEGAN-ECMWF inventory improves the model/data agreement in almost all regions, but biases persist over parts of Africa and Australia. Although neither GFED version is consistent with the data over all regions, a better agreement is achieved over Indonesia and Southern Africa when GFEDv2 is used, but GFEDv1 succeeds better in getting the correct seasonal patterns and intensities of the fire episodes over the Amazon basin, as reflected in the significantly higher correlations calculated in this region. Although the uncertainties in the HCHO retrievals, especially over fire scenes, can be quite large, this study provides a first assessment about whether the improved methodologies and input data implemented in GFEDv2 and

MEGAN-ECMWF lead to better results in the comparisons of modelled with observed HCHO column measurements.

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