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SCIAMACHY formaldehyde observations: constraint for isoprene emission estimates over Europe?

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Abstract. Formaldehyde (HCHO) is an important intermediate compound in the degradation of volatile organic compounds (VOCs) in the troposphere. Sources of HCHO are largely dominated by its secondary production from VOC oxidation, methane and isoprene being the main precursors in unpolluted areas. As a result of the moderate lifetime of HCHO, its spatial distribution is determined by reactive hydrocarbon emissions. We focus here on Europe and investigate the influence of the different emissions on HCHO tropospheric columns with the CHIMERE chemical transport model in order to interpret the comparisons between SCIAMACHY and simulated HCHO columns. Europe was never specifically studied before for these purposes using satellite observations. The bias between measurements and model is less than 20% on average. The differences are discussed according to the errors on the model and the observations and remaining discrepancies are attributed to a misrepresentation of biogenic emissions. This study requires the characterisation of: (1) the model errors and performances concerning formaldehyde. The errors on the HCHO columns, mainly related to chemistry and mixed emission types, are evaluated to 2×10^{15} molecule/cm² and the model performances evaluated using surface measurements are satisfactory (~13%); (2) the observation errors that define the needs in spatial and temporal averaging for meaningful comparisons. Using SCIAMACHY observations as constraint for biogenic isoprene emissions in an inverse modelling scheme reduces their uncertainties by about a factor of two in region of intense emissions. The retrieved correction factors for the isoprene emissions range from a factor of 0.15 (North Africa) to a factor of 2 (Poland, the United Kingdom) depending on the regions.

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