Sensitivity of Modelled Tropospheric Ozone to VOC Emission Inventories

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Abstract

Volatile organic compounds (VOCs) are detrimental to human health both directly and indirectly, through their role in the formation of secondary air pollutants such as tropospheric ozone (O_3). The identity and amounts of VOCs emitted into the troposphere are represented in emission inventories (EIs) for input to chemical transport models that predict air pollutant levels. These EIs are outdated but before taking on the task of providing an up-to-date and highly speciated EI, the sensitivity of models to the change in VOC input needs to be addressed. We determine the sensitivity of modelled tropospheric O_3 to VOC emission inventories by comparing the maximum potential difference in O_3 levels using various solvent sector EIs in an idealised

study using a boxmodel. We further test this sensitivity using three chemical mechanisms that describe O_3 production chemistry at different scales – point (MCM v3.2), regional (RADM2) and global (MOZART-4). Under the conditions of our study, we find a maximum difference of 17 ppbv between different EIs of the solvent sector, reproduced by each chemical mechanism. The source of the sensitivity of modelled O_3 to EIs is investigated using a "tagging" approach to allocate O_x production to the specified groups of VOC in the EIs; at the end of the model run, alkanes have the largest contribution (up to 40%) to O_x production. Moreover, we demonstrate that the O_x produced at the end of the model run by solvent sector EIs is directly related to the amount of total alkane emissions specified. These results indicate that modelled tropospheric O_3 is sensitive to the distribution of VOCs specified by emission inventories and that the maximum amount of O_x produced from an updated emission inventory depends on the amount of alkane emissions specified.