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A simple modeling approach to study the regional impact of a Mediterranean forest isoprene emission on anthropogenic plumes

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Abstract. Research during the past decades has outlined the importance of biogenic isoprene emission in tropospheric chemistry and regional ozone photo-oxidant pollution. The first part of this article focuses on the development and validation of a simple biogenic emission scheme designed for regional studies. Experimental data sets relative to Boreal, Tropical, Temperate and Mediterranean ecosystems are used to estimate the robustness of the scheme at the canopy scale, and over contrasted climatic and ecological conditions. A good agreement is generally found when comparing field measurements and simulated emission fluxes, encouraging us to consider the model suitable for regional application. Limitations of the scheme are nevertheless outlined as well as further on-going improvements. In the second part of the article, the emission scheme is used on line in the broader context of a meso-scale atmospheric chemistry model. Dynamically idealized simulations are carried out to study the chemical interactions of pollutant plumes with realistic isoprene emissions coming from a Mediterranean oak forest. Two types of anthropogenic sources, respectively representative of the Marseille (urban) and Martigues (industrial) French Mediterranean sites, and both characterized by different VOC/NOx are considered. For the Marseille scenario, the impact of biogenic emission on ozone production is larger when the forest is situated in a sub-urban configuration (i.e. downwind distance TOWN-FOREST <30km, considering an advection velocity of 4.2 $m.s^{-1}$). In this case the enhancement of ozone production due to isoprene can reach +37% in term of maximum surface concentrations and +11% in term of total ozone production. The impact of biogenic emission decreases quite rapidly when the TOWN-FOREST distance increases. For the Martigues scenario, the biogenic impact on the plume is significant up to TOWN-FOREST distance of 90km where the ozone maximum surface concentration enhancement can still reach +30%. For both cases, the importance of the VOC/NO_x ratio in the anthropogenic plume and its evolution when interacting with the forest emission are outlined. In complement to real case studies, this idealized approach can be particularly useful for process and sensitivity studies and constitutes a valuable tool to build regional ozone control strategies.

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