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Sensitivities of isoprene emissions to soil moisture and impacts on surface ozone levels as simulated over the Euro-Mediterranean region by the regional climate model RegCM4.7chem-CLM4.5-MEGAN2.1

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In response to changes in environmental conditions (e.g., temperature, radiation, soil moisture), plants emit biogenic volatile organic compounds (BVOCs). In the large family of BVOCs, isoprene dominates and plays an important role in atmospheric chemistry. Once released in the atmosphere, isoprene influences levels of ozone, thus affecting both climate and air quality. In turn, climate change may alter isoprene emissions by increasing the occurrence and intensity of severe thermal and water stresses that alter plant functioning. To better constrain the evolution of isoprene emissions under future climates, it is critical to reduce the uncertainties in global and regional estimates of isoprene under present climate. Part of these uncertainties is related to the impact of water stress on isoprene. Recently, the BVOC emission model MEGAN has adopted a more sophisticated soil moisture activity factor γ_{sm} which does not only account, as previously, for soil moisture available to plants but also links isoprene emissions to photosynthesis and plant water stress.

To assess the effects of soil moisture on isoprene emissions and, lastly, on ozone levels in the Euro-Mediterranean region, we use the regional climate model RegCM4.7, coupled to the land surface model CLM4.5, MEGAN2.1 and a chemistry module (RegCM4.7chem-CLM4.5-MEGAN2.1). We have performed a control experiment over 1987-2016 (with a 5-yr spin-up) at a horizontal resolution of 0.22°. Model output from the control experiment is used to initialize RegCM4.7chem-CLM4.5-MEGAN2.1 for the 10 most dry/wet summers (May-August) selected referring to the 1970-2016 precipitation climatology. Each May-August experiment is run with the old and with the new MEGAN soil moisture activity factor γ_{sm}. The results are then compared with a simulation whit no soil moisture activity factor. Both activity factors γ_{sm} reduce isoprene emissions under water deficit.

During dry summers, the old soil moisture activity factor reduces isoprene emissions homogeneously over the model domain by nearly 100%, while ozone levels decrease by around

10%. When the new γ^{sm} is used,isoprene emissions are reduced with a patchy pattern by 10-20%, while ground-surface ozone levels diminish homogeneously by few percent over the southern part of the model domain.