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Performance of the JULES land surface model for UK Biogenic VOC emissions

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Emissions of biogenic non-methane volatile organic compounds (NMVOCs) are important for air quality and tropospheric composition. Through their contribution to the production of tropospheric ozone and secondary organic aerosol (SOA), biogenic VOCs indirectly contribute to climate forcing and climate feedbacks [1]. Biogenic VOCs encompass a wide range of compounds and are produced by plants for growth, development, reproduction, defence and communication [2]. There are both biological and physico-chemical controls on emissions [3]. Only a few of the many biogenic VOCs are of wider interest and only two or three (isoprene and the monoterpenes, α- and β-pinene) are represented in chemical transport models.

We use the Joint UK Land Environment Simulator (JULES), the UK community land surface model, to estimate biogenic VOC emission fluxes. JULES is a process-based model that describes the water, energy and carbon balances and includes temperature, moisture and carbon stores [4, 5]. JULES currently provides emission fluxes of the 4 largest groups of biogenic VOCs: isoprene, terpenes, methanol and acetone. The JULES isoprene scheme uses gross primary productivity (GPP), leaf internal carbon and the leaf temperature as a proxy for the electron requirement for isoprene synthesis [6].

In this study, we compare JULES biogenic VOC emission estimates of isoprene and terepenes with (a) flux measurements made at selected sites in the UK and Europe and (b) gridded estimates for the UK from the EMEP/EMEP4UK atmospheric chemical transport model [7, 8], using site-specific or EMEP4UK driving meteorological data, respectively. We compare the UK-scale emission estimates with literature estimates. We generally find good agreement in the comparisons but the estimates are sensitive to the choice of the base or reference emission potentials.

References

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