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Temperature as a driver of ground-level ozone concentration in Europe

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The link between high temperature and extreme concentrations of ozone is generally well established. In this work, we employ a suite of statistical modelling techniques to systematically examine the importance of temperature along with a number of other local meteorological parameters such as humidity, solar radiation intensity, as well as wind speed and direction for predicting observed ozone concentrations in Europe. Moreover, the influence of large-scale circulation is also investigated through a set of airflow indices. We show that temperature is a significant driver of summertime ozone concentration over much of the western-to-central European mainland, however this relationship does not apply for much of the rest of Europe, where a simple persistence relationship has more skill, and parameters other than temperature are often ranked higher as predictors. The extreme components of the ozone concentration frequency distribution show similar patterns to the full distribution. We employ the same suite of statistical modelling techniques as employed in our analysis of the observations to examine the driving parameters in regional chemistry-climate model simulations. Using our regional chemistry-climate model and a detailed chemical box model, we investigate this ozone-temperature relationship using several commonly-used chemical mechanisms. We show that the temperature dependence of the ozone production rate can be broken down into a component due to the temperature dependence of isoprene emissions, and a component due to temperature dependent reaction rates. Geographically, the temperature dependence of ozone production rate is related to the chemical regime (NO_x vs. VOC sensitive chemistry).