1.159 Sensitivity of tropospheric ozone formation in urban areas under changing climate, emissions and vegetation modeled with the city-scale chemical transport model CityChem-EPISODE..

Early Career Scientist

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Abstract:

Tropospheric ozone is a major threat for human health but still 90% of Europe’s urban citizens are exposed to ozone concentrations above air quality guidelines. Policy support by Air Quality Management (AQM) requires a deeper understanding of ground-level ozone formation in cities. Within AQM, the potential of biogenic volatile organic compound (BVOC) emissions from urban vegetation in combination with anthropogenic emissions to produce ground-level ozone has long been recognized. Higher temperatures in a future climate will increase chemical reactivity. Emission abatement regulations leading to less emissions of nitrogen oxides (NOx) and higher BVOC emissions from vegetation in urban agglomerations might interact to generate enhanced ozone concentrations in densely populated areas. Only few regional chemical transport model (CTM) studies have investigated the role of biogenic emissions in future climate states and have shown that these can contribute significantly to ground level ozone production in urban regions. In this study, city-scale CTM simulations resolving the near-field dispersion of pollutants are used to investigate the sensitivity of ground-level ozone formation in a changed climate and urban environment. Specifically we study the sensitivity towards elevated temperatures, increased BVOC emissions due to urban vegetation, and reduced NOx traffic emissions. We use the CityChem-EPISODE model which includes detailed VOC-chemistry and a street-canyon module with a resolution of 100m for the urban agglomeration of Duisburg, Germany (1.000.000 inhabitants). Scenarios are performed to identify the influence of higher temperatures on photochemical ozone-cycle and the influence of changing the VOC/NOx-ratio to more NOx-sensitive regimes, by systematically raising BVOC emissions of vegetation and reducing NOx traffic emissions. Based on these findings insights about the formation of ground-level ozone under future climate and urban development conditions as well as shortcomings of the CTM mechanisms are gathered, and will improve the capabilities of urban AQM systems to serve for policy support.