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Scale interactions in ozone photochemistry: Impacts of urban scale variability on regional and global scales

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Distributions and changes in tropospheric ozone on a global scale are normally calculated with rather coarse resolution Chemistry-Transport Models (CTM). E.g. the T42 resolution (2.8 deg x 2.8 deg) is now frequently used for this purpose. However, a substantial part of the chemistry affecting production of ozone takes place in polluted regions on scales well below the resolution of global CTMs. This introduces errors as the formation of ozone from ozone precursors is non-linear. In order to quantify such inaccuracies, which are due not only to inhomogenities in emissions but also to small scale meteorological effects (e.g. convection), we have used the WRF (Weather Research and Forecasting) model. The version we use is the WRF-Chem with the RADM2 chemistry scheme. The model is run for a three week period in 2003 in Europe, starting with a square grid resolution of 81 km, zooming in on the UK and the London metropolitan area in four successive nesting levels, namely 27 km, 9 km, 3 km, and 1 km. Assimilated meteorology from the ECMWF is used as initial and boundary conditions. Emissions of ozone precursors (VOC, NOx and CO) are from the UK National Emissions inventory and from RETRO for the rest of Europe. Impacts of processes on sub-grid scales are quantified in terms of effective emissions for the scales resolved by regional or global models, taking into account e.g. transformation of NOx to other NOy species and formation of ozone that take place on smaller scales before diluted and transported to larger scales.