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Simulation of the impact of climate change on regional air quality

R. Forkel and R. Knoche
(renate.forkel@imk.fzk.de)

In order to investigate possible effects of global climate change on regional distributions of photochemical compounds in Europe and in particular in Southern Germany nested regional climate-chemistry simulations with a horizontal resolution of 60 km and of 20 km were performed with theonline coupled meteorology-chemistry model MCCM. MCCM is based on the NCAR/Penn State University mesoscale meteorological model MM5, which was coupled with detailed gas phase chemistry modules, a modal aerosol module, a photolysis model, and a biogenic emission module. Meteorological boundary conditions for the first nesting step were provided by a long term simulation of the global climate model ECHAM4.

For Southern Germany an increase of the mean summertime temperature by almost 2 degrees and a reduction in cloudiness by about 10 % was found between the 90ths of the previous century and the 30ths of this century which results in increased photolysis and higher emissions of biogenic hydrocarbons. Under the assumption of unchanged anthropogenic emissions the simulated increase of the mean daily ozone maximum in Southern Germany ranges between 2 and 6 ppb, which corresponds to an increase by about 10 %. As a consequence the number of days when the target value of 120 μg m^{-3} for the 8 hour average of the ozone concentration is exceeded increases by 5 to 12 days per year and the number of days with very high ozone concentrations increases by a factor of four. Due to the complex topography and due to the heterogeneous distribution of precursor emissions all parameters show pronounced regional patterns.

First results for the region of central Mexico show a similar increase in near surface ozone, although the effect of changes in cloudiness is different than in Central Europe.