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Attribution of projected changes in summertime US ozone and $PM_{2.5}$ concentrations to global changes

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Abstract. The impact that changes in future climate, anthropogenic US emissions, background tropospheric composition, and land-use have on summertime regional US ozone and $PM_{2.5}$ concentrations is examined through a matrix of downscaled regional air quality simulations, where each set of simulations was conducted for five months of July climatology, using the Community Multi-scale Air Quality (CMAQ) model. Projected regional scale changes in meteorology due to climate change under the Intergovernmental Panel on Climate Change (IPCC) A2 scenario are derived through the downscaling of Parallel Climate Model (PCM) output with the MM5 meteorological model. Future chemical boundary conditions are obtained through downscaling of MOZART-2 (Model for Ozone and Related Chemical Tracers, version 2.4) global chemical model simulations based on the IPCC Special Report on Emissions Scenarios (SRES) A2 emissions scenario. Projected changes in US anthropogenic emissions are estimated using the EPA Economic Growth Analysis System (EGAS), and changes in land-use are projected using data from the Community Land Model (CLM) and the Spatially Explicit Regional Growth Model (SERGOM). For July conditions, changes in chemical boundary conditions are found to have the largest impact (+5 ppbv) on average daily maximum 8-h (DM8H) ozone. Changes in US anthropogenic emissions are projected to increase average DM8H ozone by +3 ppbv. Land-use changes are projected to have a significant influence on regional air quality due to the impact these changes have on biogenic hydrocarbon emissions. When climate changes and land-use changes are considered simultaneously, the average DM8H ozone decreases due to a reduction in biogenic VOC emissions (−2.6 ppbv). Changes in average 24-h (A24-h) $PM_{2.5}$ concentrations are dominated by projected changes in anthropogenic emissions (+3 μg m^{-3}), while changes in chemical boundary conditions have a negligible effect. On average, climate change reduces A24-h $PM_{2.5}$ concentrations by −0.9 μg m^{-3}, but this reduction is more than tripled in the Southeastern US due to increased precipitation and wet deposition.

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