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Climate-chemistry interactions: Future air quality simulations with a global chemistry-climate model

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In order to account for the feedbacks between global and regional air pollution and changes in the (physical) climate system, general circulation models of the atmosphere must be coupled on-line with detailed tropospheric chemistry schemes. We present the simulation results for three different future climate and air quality scenarios produced with the recently developed MOZECH model, which comprises of a one-way coupling between the MOZART-2 chemistry scheme and the general circulation model ECHAM 5. The emission scenarios for the years 2000 and 2030 were developed at the International Institute for Applied Systems Analysis (IIASA), and are those employed in the ongoing ACCENT/IPCC-AQ2030 study. MOZECH was run for scenarios S1, S2, and S5, thus investigating the impacts of emission changes as well as changes in the global climate. Sea surface temperatures, sea ice cover, and greenhouse gas concentrations were taken from the recent IPCC simulations performed with ECHAM 5. Compared to earlier studies, which were based on the unrealistic SRES A2 scenario and typically focusing on the year 2100, the changes in tropospheric ozone and other air pollutants simulated with MOZECH are modest: Summertime surface ozone concentrations over Europe change between -10% and 10% if only emission changes are considered. Under year 2030 climate conditions they generally increase by about 10 to 20%. The year 2000 simulations give a good agreement with surface measurements in Europe (EMEP) except for the mediterranean region in summer. CO concentrations compare very well with CMDL surface data in the southern hemisphere, but are underestimated in the wintertime northern hemisphere. This may be caused by the absence of a seasonal cycle in the emissions data.