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Future climate change impacts on summer surface ozone from regional climate air quality simulations over Europe

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Regional climate air quality simulations were performed over Europe for two future decades, 2041_2050 and 2091_2100 under IPCC A1B scenario and the control decade 1991_2000. The simulations serve as a theoretical experiment investigating the impact of changing climate on summer surface ozone. Our simulations suggest that changes in summer surface ozone imposed by climate change until the 2040s are below 1 ppbv and more pronounced until the 2090s. The median of summer near surface temperature for whole Europe is 2.7 K higher at the end of the 21st century than to the end of the 20th century with more intense temperature increase simulated for southern Europe. A prominent feature is the decrease of cloudiness mostly over western Europe at the end of the 21st century associated with an anticyclonic anomaly which favors more stagnant conditions and weakening of the westerly winds for the larger part Europe southern of 50°N. Biogenic emissions double in the simulation at the end of the 21st century for latitudes below 50° and together with changes in circulation patterns, temperature, and solar radiation, contribute to the enhanced average ozone concentrations at the end of the 21st century. The change is more intense over southwest Europe, where the median of ozone increases by 6.2 ppbv. Sensitivity simulations suggest that biogenic emissions, temperature and solar radiation have a comparable impact on average surface ozone in the examined range of perturbations. The maximum response of the imposed perturbations was seen over southern Europe. Our regional climate air quality system has been evaluated with respect to ozone using measurements from the EMEP network. A set of statistical metrics is used for the model evaluation, including temporal correlation coefficient, the ratio of the standard deviations and the bias of simulated versus observed values. Overall, a good agreement was found for the regional air quality simulations at the majority of the selected EMEP stations in all metrics throughout the year based either on monthly or daily ozone values. Based on these results, it is assessed that the modelling system RegCM3/CAMx is suitable to be used for present and future regional climate-air quality simulations with emphasis on near surface ozone. The EGI (European Grid Infrastructure) and HellasGrid infrastructures have provided the necessary computational resources for the realization of the air quality simulations.