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Evaluation of regional climate – air quality simulations over Europe for the period 1996-2006 with emphasis on tropospheric ozone: The impact of chemical boundary conditions

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A modeling system based on the air quality model CAMx driven off-line by the regional climate model RegCM3 is used for assessing the impact of lateral boundary conditions on tropospheric ozone over Europe for the period 1996-2006. The RegCM3 and CAMx simulations were performed on a 50 km x 50 km grid over Europe with RegCM3 driven by NCEP reanalysis fields. Average monthly concentration values obtained from the global chemistry climate model ECHAM5-MOZ were used as chemical boundary conditions for the CAMx simulations. The present period (1996-2006) was simulated two times. The first run (clean) was forced from constant lateral chemical boundary conditions and constant emissions based on the EMEP emissions of the year 1996. The second simulation (run1) was based on ECHAM5-MOZ chemical boundary conditions and emissions fixed for the year 1996. In order to evaluate the ability of the RegCM3/CAMx modeling system, simulated ozone concentrations are compared against near surface ozone measurements from the EMEP network. Since many of the stations of the EMEP network were not operating continuously during the time period of our study (1996-2006), we have used in the evaluation analysis only those stations that fulfill the criteria of 75% data availability for near surface ozone, choosing 87 stations from 23 European countries. Various statistical metrics are used for the model evaluation, including correlation coefficient (R), normalized standard deviation (NSD) and modified normalized mean bias (MNMB). The different lateral boundary conditions forcing resulted in changes of near surface ozone concentrations and variability. Using lateral boundary conditions obtained from the global chemistry climate model ECHAM5-MOZ (run1), the RegCM3/CAMx modeling system is capturing in a much better way the ozone monthly variability than using constant lateral boundary conditions (clean), especially for stations of northern and northwestern Europe. Concerning the correlation between simulated and observed monthly ozone values, the run1 simulation exhibit R values greater than the clean simulation for 95% of the stations. Furthermore, both clean and run1 simulations show a tendency of model overestimation concerning near surface ozone concentrations, as the MNMB median is 5.15% for clean and 4.67% for run1 respectively.