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Forecasting the weather
- ensemble techniques
in probabilistic weather prediction

Evaluation of a coupled climate – air quality model system

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A changing climate may have a significant impact on the dynamical and chemical processes in the atmosphere and thus on air quality. A common approach to investigate this effect is to couple a regional climate model to a chemistry-transport model. In this study simulations were performed with the coupled system RACMO (regional climate) – LOTOS-EUROS (air quality) over Europe.
Three sets of simulations were produced:
1) 2003-2007, LOTOS-EUROS using ECWMF analysis meteorology
2) 1989-2009, LOTOS-EUROS using RACMO meteorology with ERA-interim boundary conditions
3) 1970-2060, LOTOS-EUROS using RACMO with ECHAM5 A1B boundary conditions
For the LOTOS-EUROS simulations the anthropogenic emissions (MACC2005) were kept constant to concentrate on the effect of changing meteorological conditions.

For a good performance of the chemistry-transport model a reliable meteorological input is important. In order to quantify the differences between the three sets of input meteorology, they are compared to each other focusing on parameters important for air quality such as maximum temperature, number of warm days, wind speed and direction and precipitation. The meteorology of RACMO_ERA reproduced the ECMWF analysis well, except for rain. When RACMO is forced with ECHAM, the meteorology for the present-day climate (1989-2009) shows considerable biases, with comparable average temperature but less warm days, more rain and higher wind speeds than with ERA forcing. Differences between RACMO_ECHAM for future (2041-2060) and present-day climate are smaller than differences between RACMO_ECHAM and RACMO_ERA for the present-day climate for most of the parameters.

In order to analyse the effect of the biases on the modelled concentrations of ozone and aerosols the results for LOTOS-EUROS driven by the different sets of input meteorology are compared. Comparison of concentrations from LOTOS-EUROS with ECMWF and with RACMO_ERA forcing to EMEP observed concentrations showed mostly good correspondence. But the differences between RACMO_ERA and RACMO_ECHAM for present-day climate result in lower modelled concentrations of pollutants for the simulations with RACMO_ECHAM. Moreover for the concentrations modelled with LOTOS-EUROS driven by RACMO_ECHAM the differences for the future and present-day climate are smaller than the differences using the RACMO_ECHAM and RACMO_ERA input for the present-day climate.

For the interpretation of the simulated concentration fields of pollutants using climate models great care should be taken because of the biases and the nonlinear dependency of meteorology on air quality.