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Climate change of precipitation derived from an ensemble simulation over Europe with the regional climate model CLM

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Selected results of quality control of an ensemble of regional climate-change simulations over the time period 1960-2100 over Europe ($5000 \times 4500km^2$, $\Delta x = \Delta y = 0.165°$) with the non-hydrostatic model COSMO-CLM are presented. The precipitation is in the centre of consideration. The uncertainties of the simulated precipitation are estimated and the climate change of precipitation is investigated for selected regions.

The regional "COSMO model in Climate Mode" (COSMO-CLM), also known as the CLM, is a unified nonhydrostatic model for operational weather forecast (investigated by COSMO) and for regional climate simulations (investigated by the CLM-Community). The regional model has been forced with the present day climate (C20 control runs) and A1B and B1 scenario runs of the ECHAM5/MPIOM global climate model of the Max Planck Institute for Meteorology, which contributed to the fourth climate assessment report of the International Panel on Climate Change (IPCC).

The quality of the regional climate model CLM is estimated from a comparison of the evaluation run (with ERA40 as boundary conditions) with observations. The uncertainty of the climate change signal of the precipitation is derived from a systematic intercomparison of the simulation results for different ensemble members and time periods with each other, with the global model and with the evaluation run. The uncertainties are quantified by a set of statistical measures, which have been calculated for different regions covering the model domain.

The quality control allows conclusions about the internal variability of the simulated climate on different time scales and gives a quantitative estimate of the quality of regional climate change simulations on different time scales, for different regions and variables.

For example, the annual cycle of the total precipitation for Germany with its maxima in the winter- and the summertime could be reproduced by the model for the evaluation and for the reference runs. The annual precipitation of the evaluation run was overestimated by about 12 to 96 mm by different C20 reference runs considered.
The spatial patterns of the climate change signal for total precipitation have been found similar in regional and global simulations. However, the regional model simulates more precipitation than the corresponding global model mainly in the summertime. In particular, it exhibits a more realistic shape of the annual cycle of precipitation, especially for Central Europe.