Dynamical Downscaling of MIROC5 with COSMO-CLM in the framework of ReKliEs-De

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The latest generation of climate projections for the 21st century are build on new emission scenarios based on Representative Concentration Pathways (RCPs). Within the world wide coordinated effort of the Coupled Model Intercomparison Project Phase 5 (CMIP5), their impact on climate is simulated with global models of the climate system. A sample of the global simulations is dynamically downscaled for Europe in the framework of EURO-CORDEX. Further simulations, with focus on Germany and the river catchments draining into Germany, are conducted within the framework of the project ReKliEs-De to account for the full range of model variability. Here we present preliminary results from the first COSMO-CLM simulation with boundary conditions from the global climate model MIROC5.

MIROC5 converter available

A converter (MIROC2caf) for MIROC5 data is now available for community members on the CLM-Home-page. The converter is a shell-script and uses only the Climate Data (CDO) and netCDF Operators (NCO).

Model Setup

COSMO-CLM was used in version CLM-4.8_clm18 together with INT2LM_1.10_clm14 for the dynamical downscaling of MIROC5. The model was set up for the CORDEX-EU11 domain with all settings and output intervals in accordance to the CORDEX-EU simulations. A historical run from Dec. 1949 to Dec. 2005 was conducted, followed by two runs for the scenarios RCP26 and RCP85 from Jan. 2006 to Dec. 2100.

Evaluation

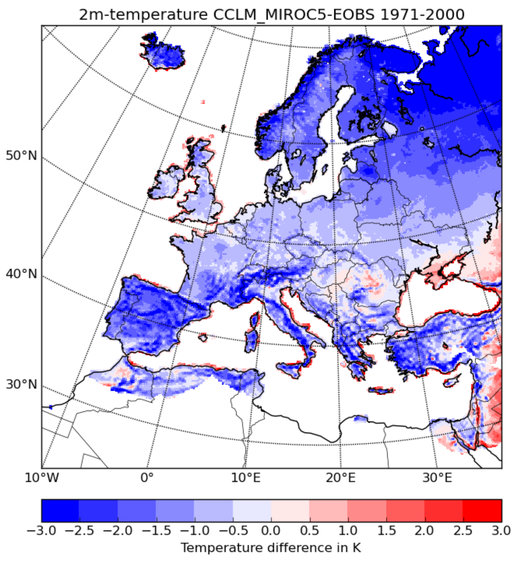

Fig. 1: Difference of the long term (1971-2000) annual mean 2m-temperature between COSMO-CLM forced with MIROC5 historical and E-OBS.

Fig. 1 shows the difference of the long term annual mean 2m-temperature between COSMO-CLM forced with MIROC5 and the gridded observational data set E-OBS for the period 1971 to 2000. COSMO-CLM is nearly everywhere in the model domain colder than E-OBS. The largest underestimations occur in the mountainous regions around the Mediterranean Sea and in the northeastern part of the model domain, where the differences reach up to 5 K. The model performs best in a broad band from Great Britain and northern France in the west to the Black Sea in the east. Within this area the differences to the observations are lower than 1 K, sometimes even lower than 0.5 K. The annual cycle of the 2m-temperature for Germany in Fig. 2 reveals, that COSMO-CLM (blue line) underestimates the temperature in winter by 2-3 K, but overestimates the temperature in summer by nearly the same amount

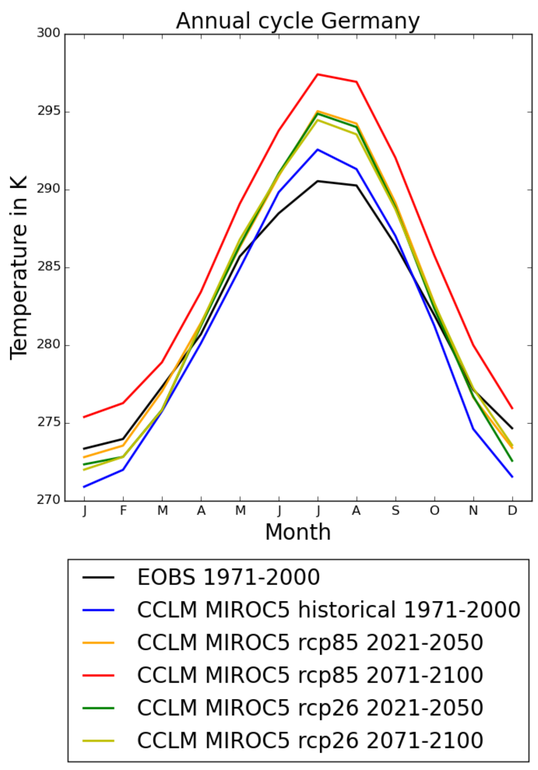

Fig. 2: Annual cycle of the 2m-temperature averaged over Germany.

compared to E-OBS (black line). In spring and fall the agreement of the model data with the observations is much better.

Scenarios

The comparison of the time series of the annual mean 2m-temperature for Germany in Fig. 3 shows, that the development in the high emission scenario RCP85 and the low emission scenario RCP26 is very similar until 2040. Afterwards the values diverge and difference between the scenarios reaches 5.5 K until the end of the century. This development becomes also apparent by the spatial patterns in Fig. 4. The differences between both scenarios are small until mid of the century and the temperature increase for central Europe is between 1-2 K compared to the period 1971-2000 (Fig. 4a and 4c). But whereas the temperature in RCP26 (Fig. 4b) does not increase further in most parts of the domain until 2100, a strong increase takes place in RCP85 (Fig. 4d). For central Europe the temperature increases by 3.5 to 4.5 K. The largest increase occurs in the northern and northeastern part of the model domain with up to 10 K. The annual cycle (Fig 2.) reveals, that the temperature increase is larger than 3 K in all month with maximum values of more than 5 K in summer.

Summary

- **COSMO-CLM forced with MIROC5 shows a small cold bias in the long term annual mean 2m-temperature over central Europe compared to E-OBS**
- **the model overestimates the 2m-temperature in summer and underestimates the 2m-temperature in winter**
- **the difference in the 2m-temperature between RCP26 and RCP85 is small until the mid of the century**
- **towards the end of the century the differences between RCP26 and RCP85 reach more than 5 K for single years and about 3 K in the long term mean**

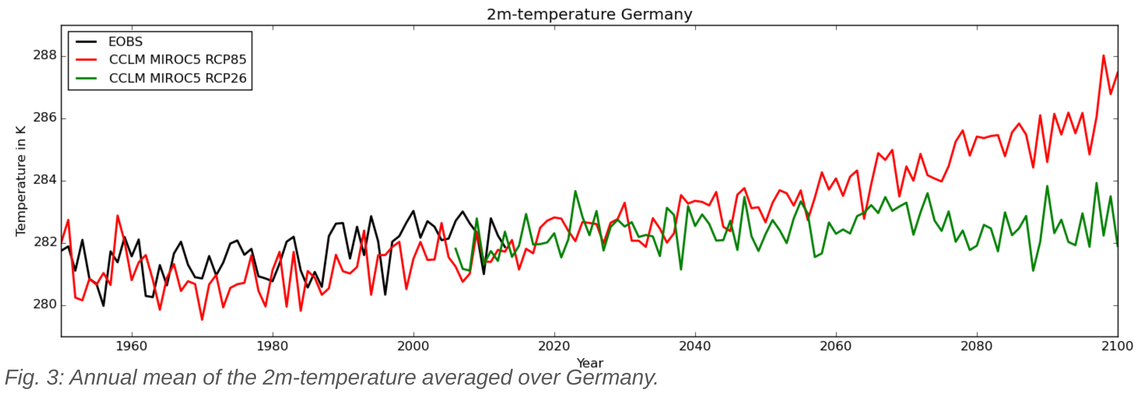

Fig. 3: Annual mean of the 2m-temperature averaged over Germany.

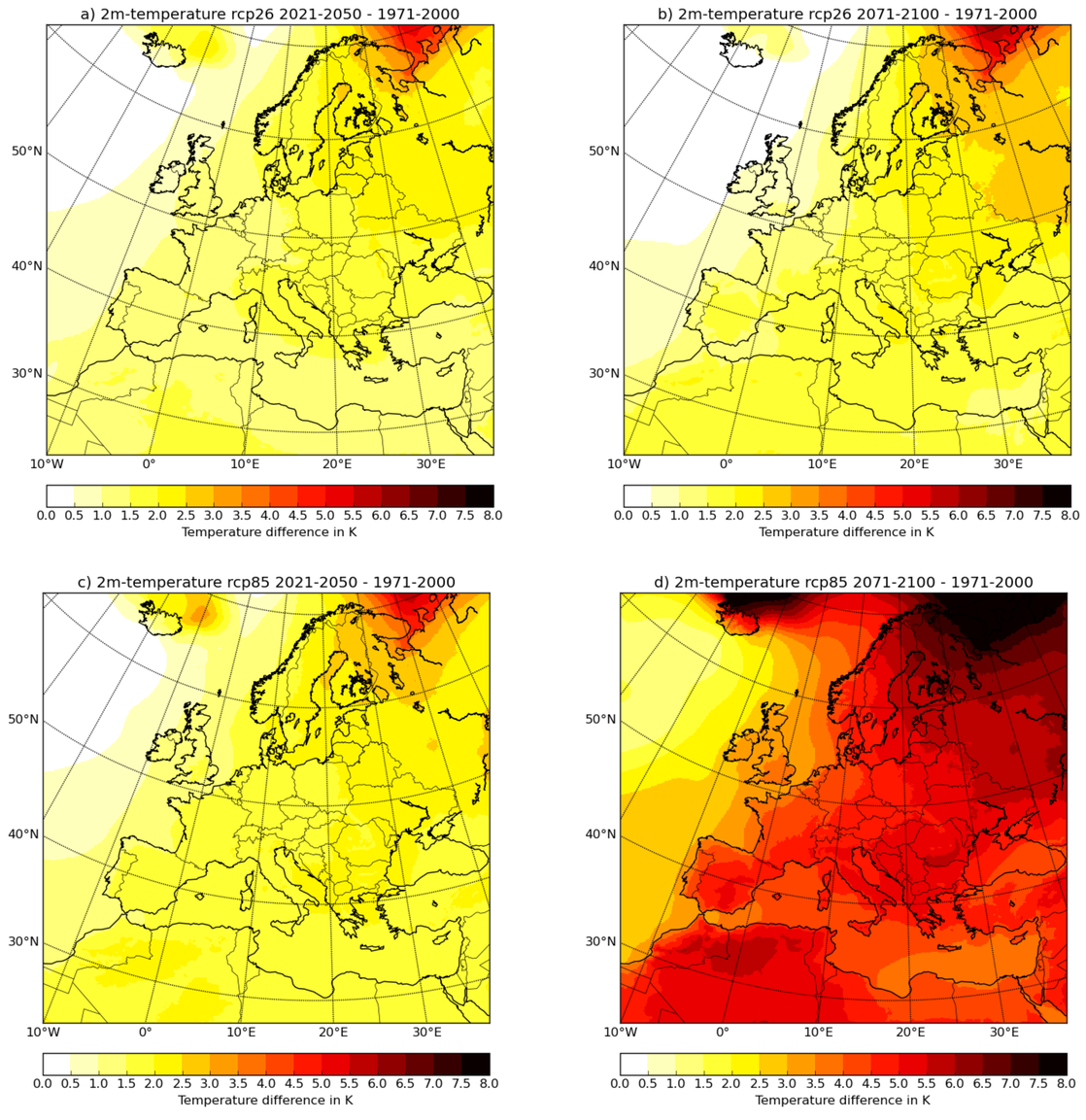

Fig. 4: Temperature signal for a) RCP26 2021-2050, b) RCP26 2071-2100, c) RCP85 2021-2050 and d) RCP85 2071-2100 relative to the period 1971-2000.

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