

Application and Evaluation of a Regional Climate Model for Eastern Europe

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- Model setup
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Project Overview - IWAS



Project Overview – IWAS Ukraine

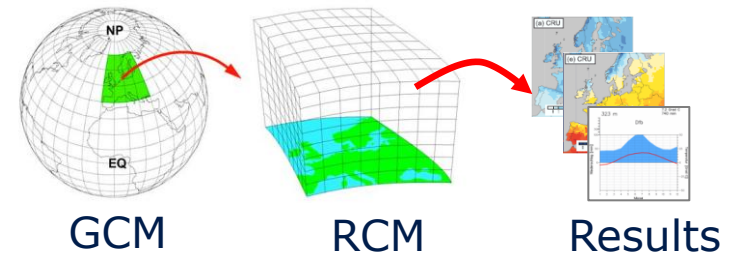
- Investigation area – Western Bug river catchment.
- Catchment area approx 40tkm², of which about 10tkm² in UA.
- 2.5 million inhabitants (connection rate ~ 50%).
- Transboundary River -> PL, BY, UA.
- Eastern border of the European Union.
- Drains indirect into the Baltic Sea (tributary of the Vistula).
- Main problem: High organic pollutant concentrations due to insufficient clarification of municipal wastewater.
- The results of the climate modelling serve as drivers for further investigations and impact studies referring to climate change in the target region.



Source: BUG Report No. 2 (2002)

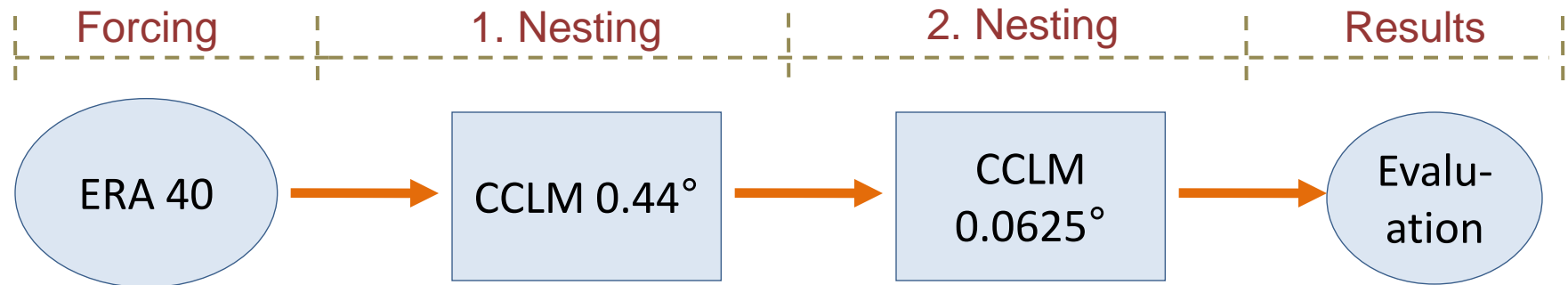
Modelling Approach

- Dynamic downscaling of global climate projections (7km horizontal resolution).
- Model: COSMO – CLM (CCLM) (DWD, CLM-Community).
- Double nesting approach (downscaling-factor)
- Control run and evaluation (1973 – 1990)
driver: reanalysis data ERA40
- Regional climate projections (IPCC SRES scenarios), driver: ECHAM 5 / MPI-OM (Max Planck Institute for Meteorology)

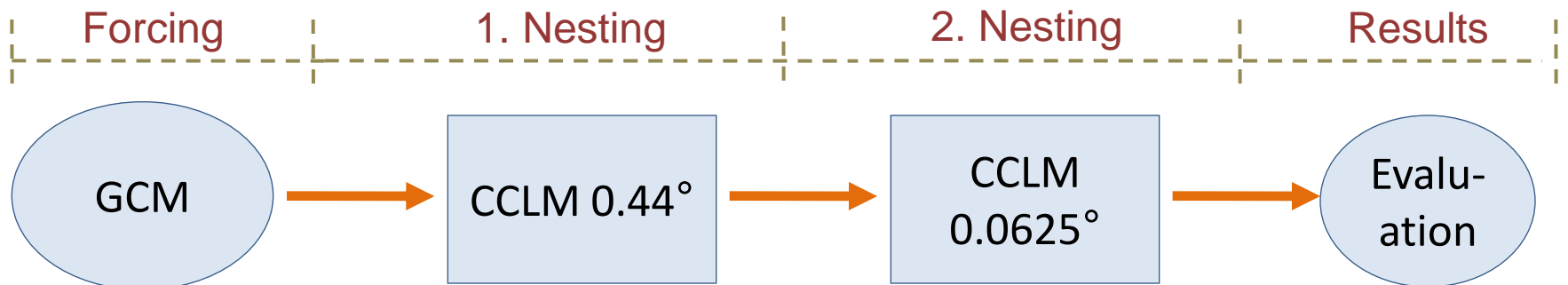


Modelling Approach

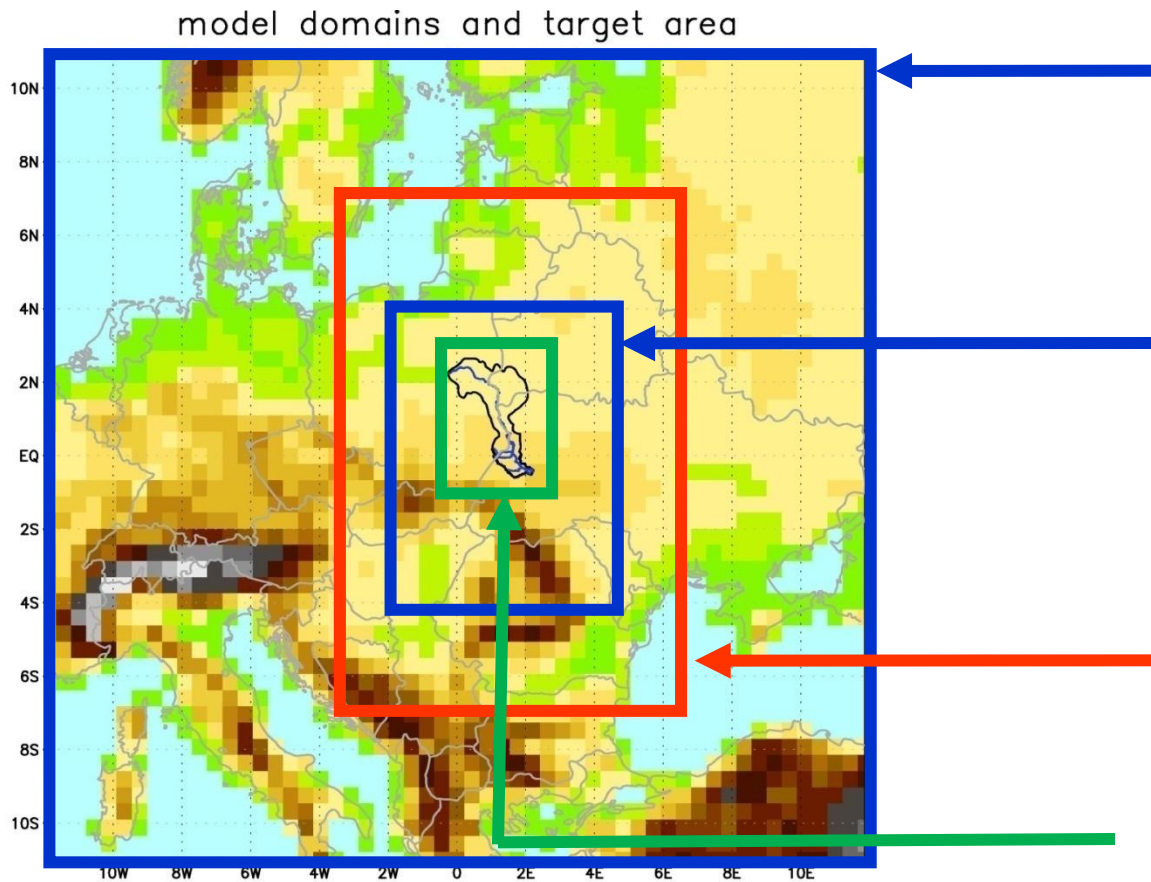
Control run



Climate projections



Model Configuration



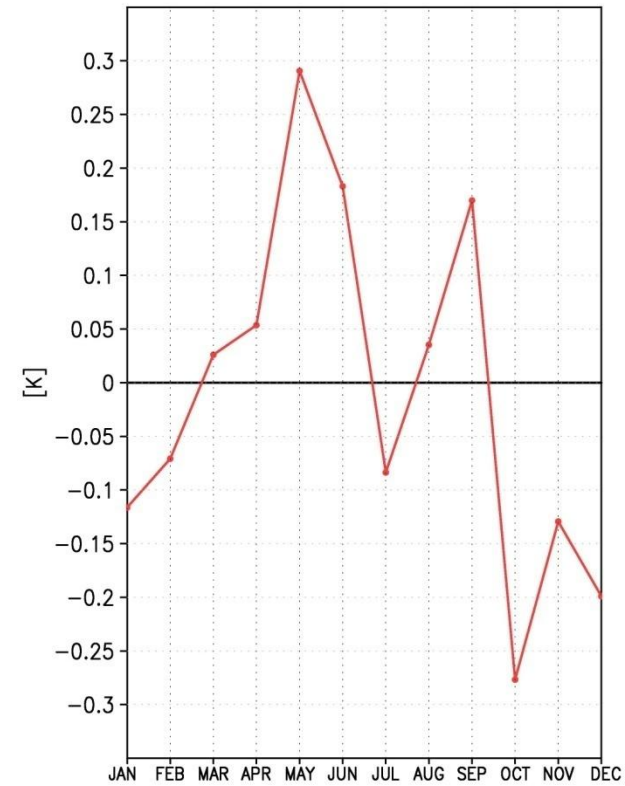
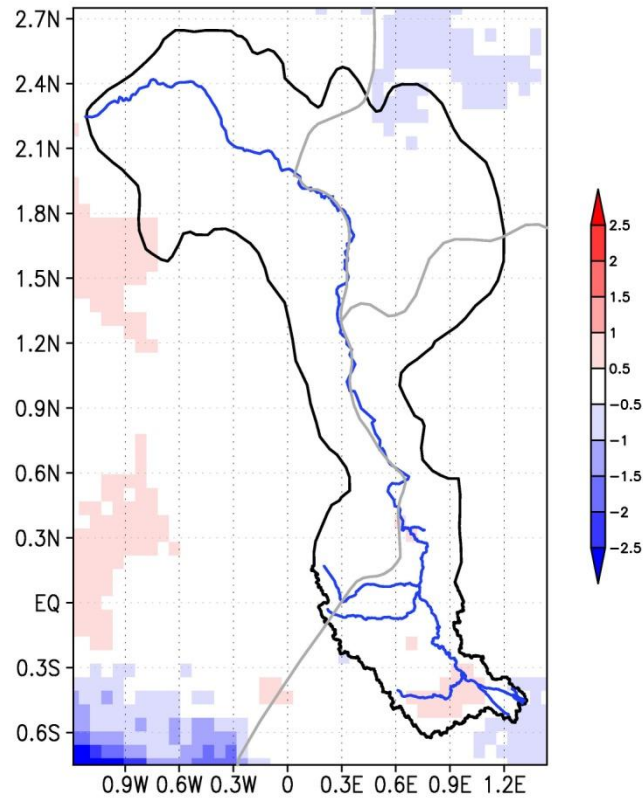
- 1. Nesting
 - domain size: 51 x 47
 - grid size: 0.44°
 - atm. layers: 32
 - soil layers: 9
- 2. Nesting
 - domain size: 135 x 107
 - grid size: 0.0625°
 - atm. layers: 32
 - soil layers: 9
- Evaluation area (0.44°)
 - domain size: 33 x 24
- Evaluation area (0.0625°)
 - domain size: 43 x 57

Evaluation 2. Nesting

- Method: comparison with interpolated station data (P, T2m)
- Interpolation method: Kriging (Ordinary Kriging, Kriging with Trend)
- Period: 1973 – 1990
- Horizontal resolution of the reference data 1 x 1 km
- Time step: monthly sums, monthly means
- Data sources: 1.) NOAA (<http://www.ncdc.noaa.gov/>)
2.) ECA (<http://eca.knmi.nl/>)
3.) data of the project partners (UA)
- Work steps: acquisition, data check, correction, spatial interpolation, assessment
- Problems: insufficient data availability, sparse network density, missing meta data

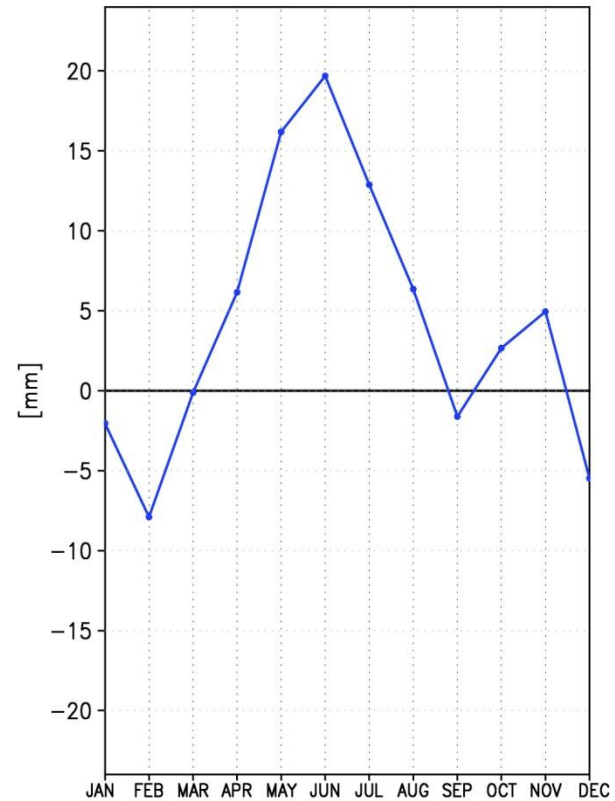
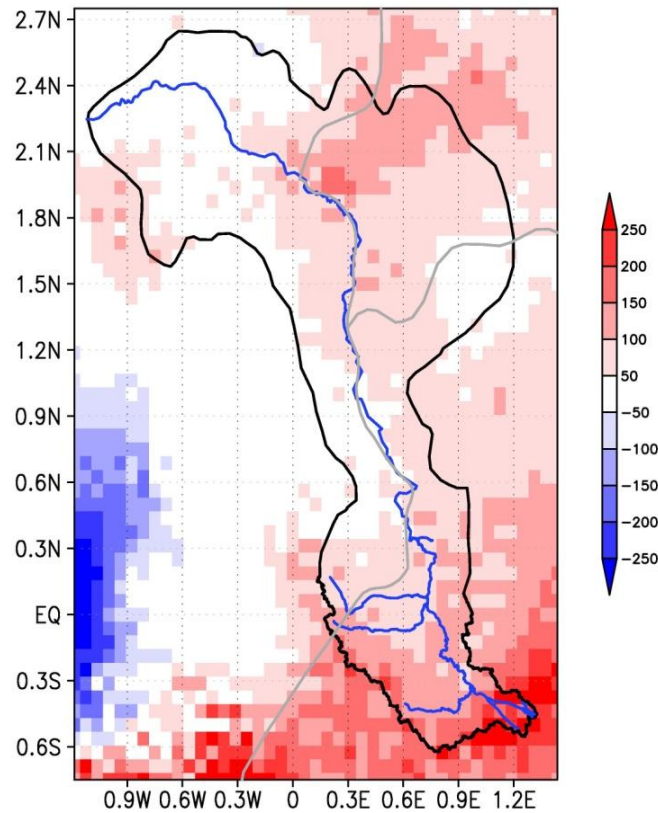
Evaluation 2. Nesting

2m temperature [K], long-term means 1973-1990 (CCLM - reference data)



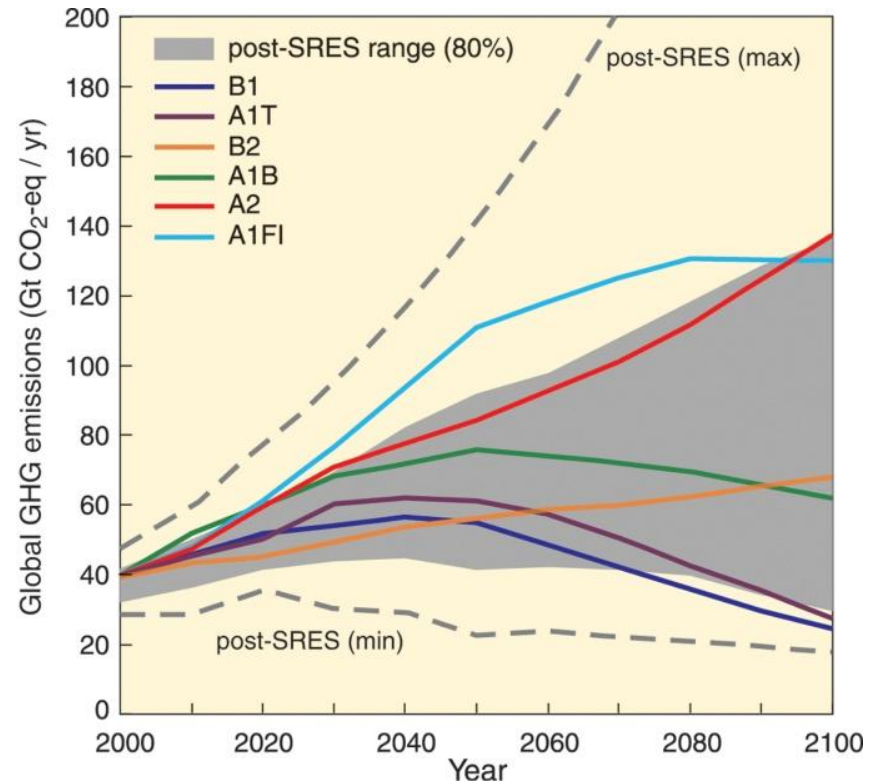
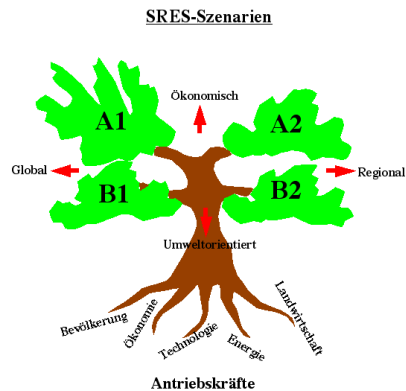
Evaluation 2. Nesting

precipitation [mm], long-term means 1973-1990 (CCLM - reference data)



Regional climate projections

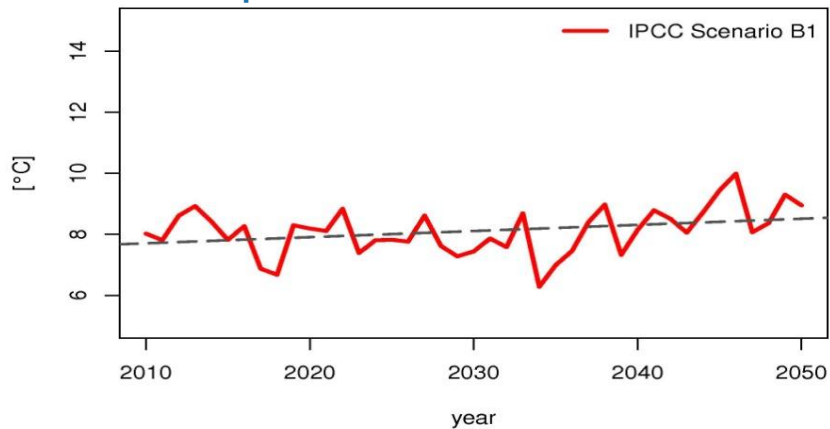
- GCM (ECHAM 5/MPI-OM) as driver for CCLM
- IPCC SRES-scenarios:
 - A2 (extreme)
 - B1 (moderate)
- period: 2010 - 2100



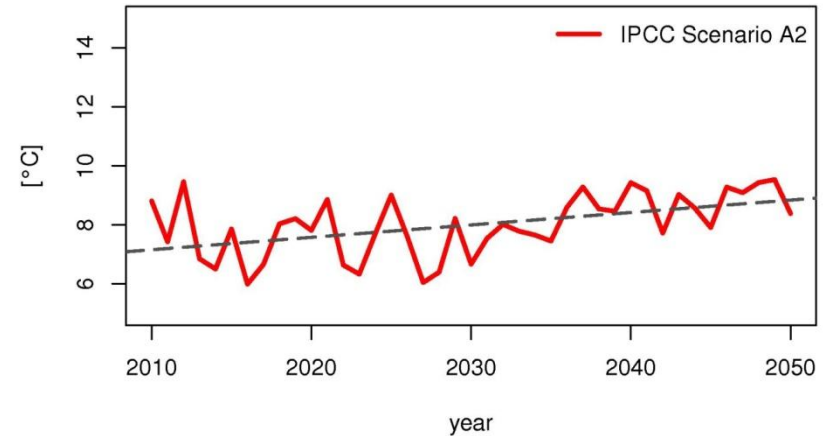
Regional climate projections - Trends

Temperature

B1

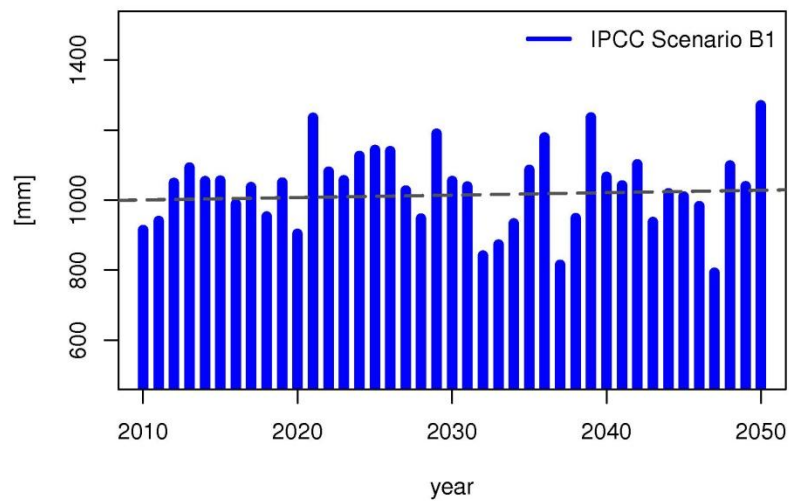


A2

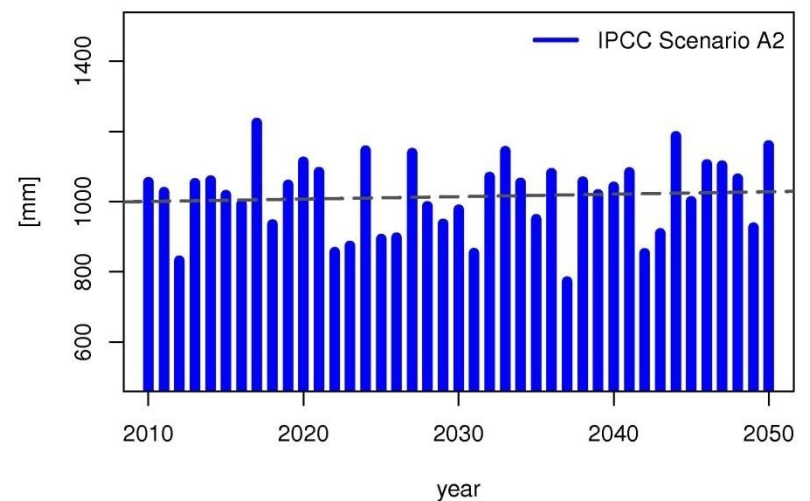


Precipitation

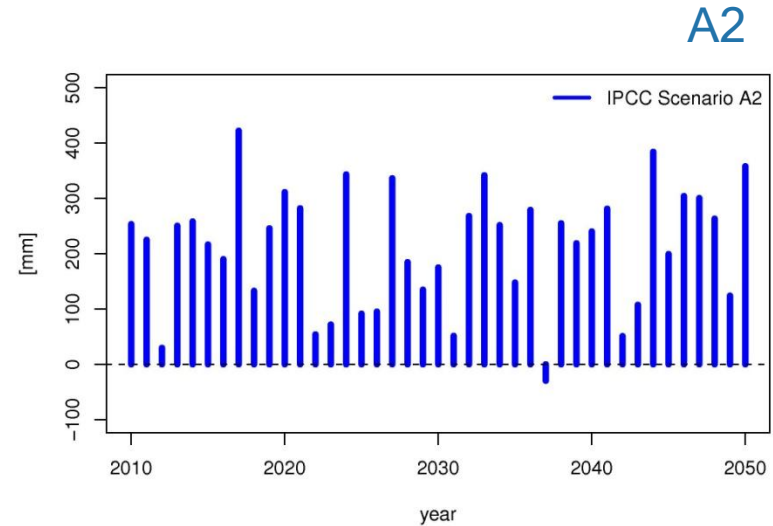
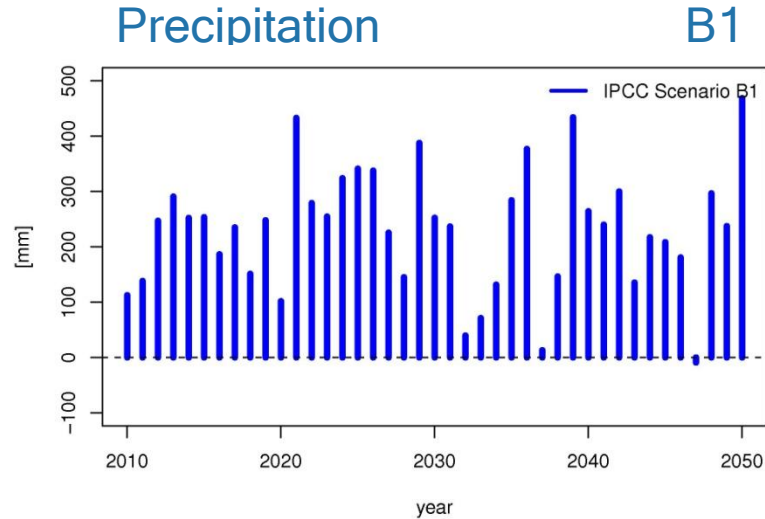
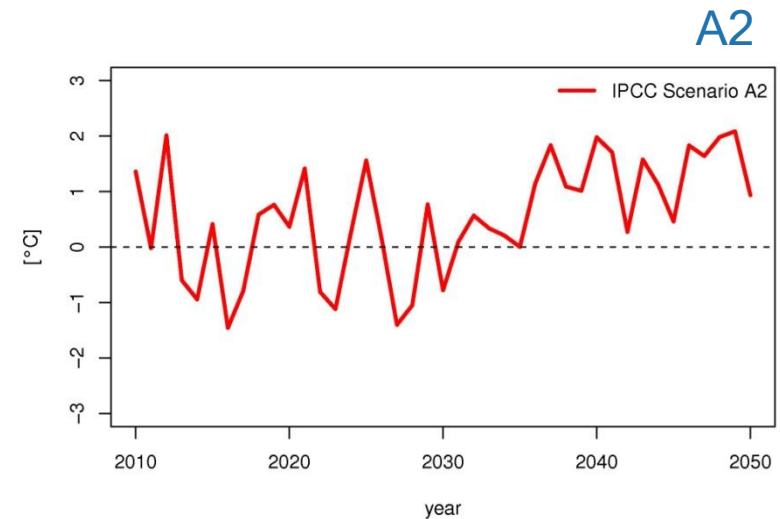
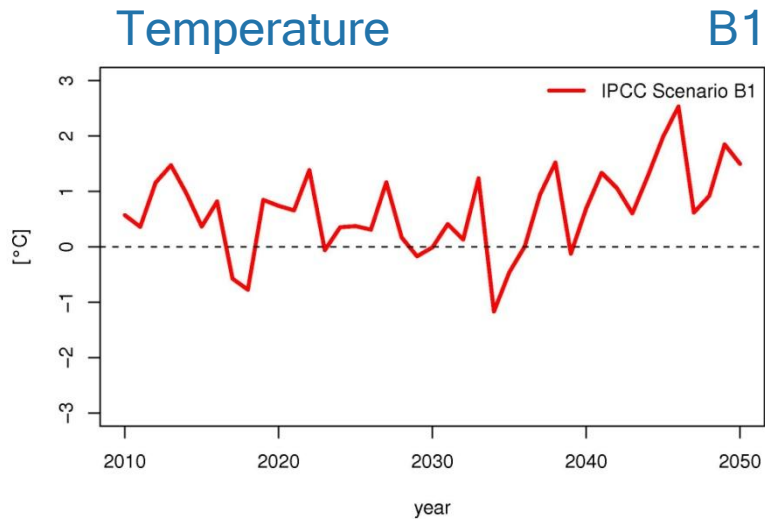
B1



A2

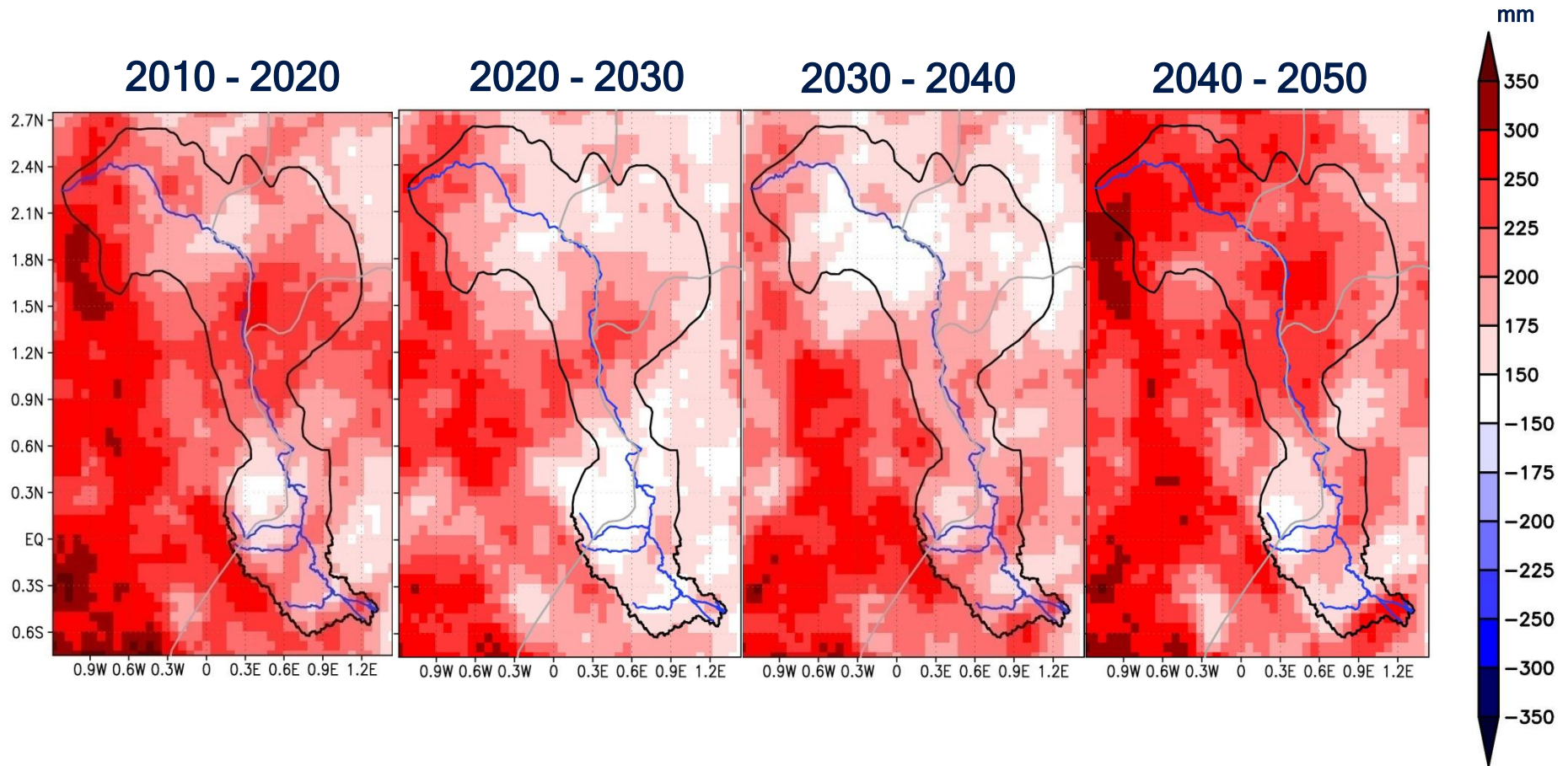


Regional climate projections - Climate Change Signal



Problem:

Strong positive precipitation signal because of biased driving data of the GCM !



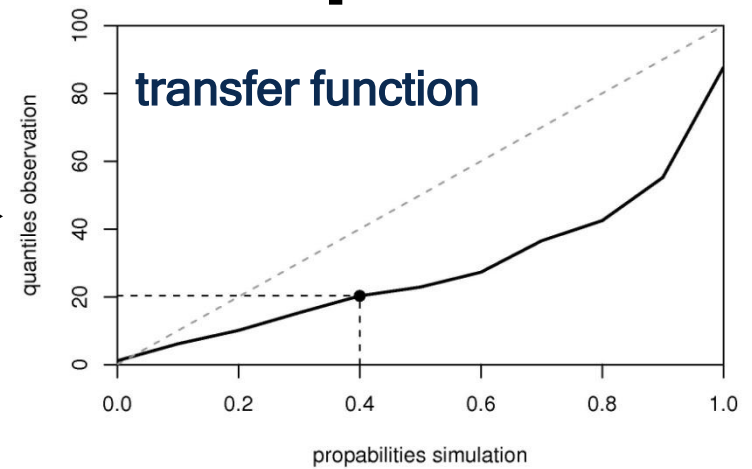
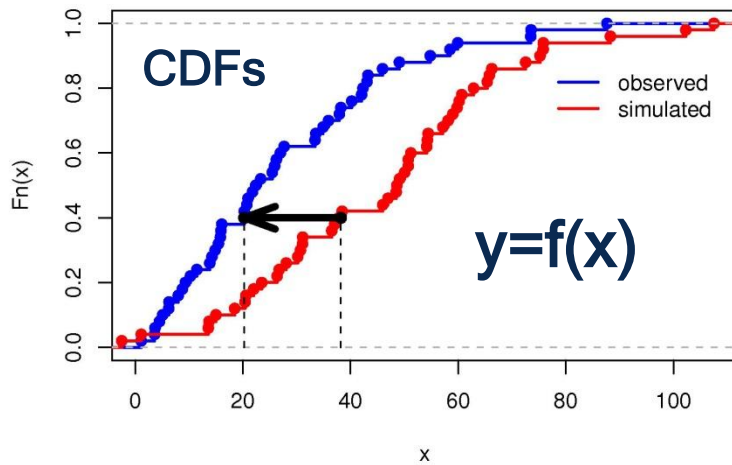
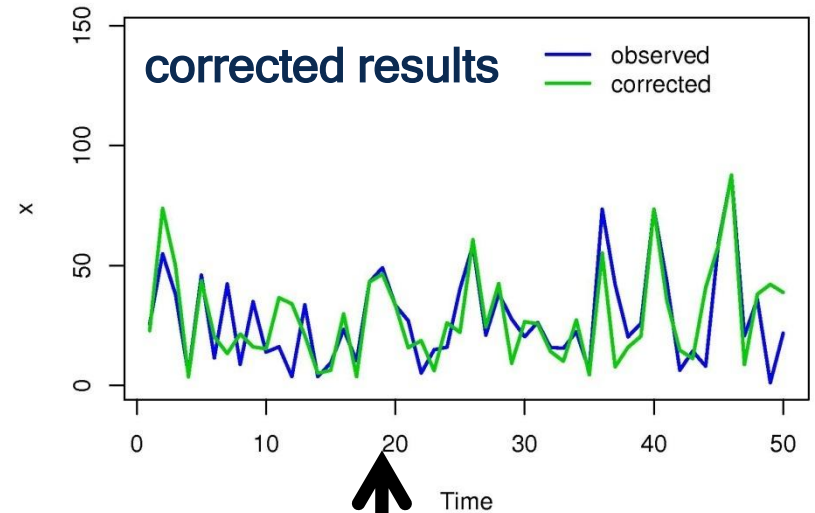
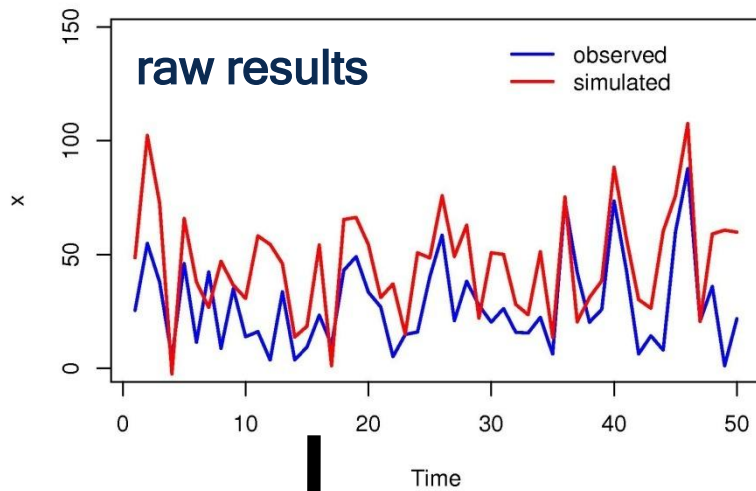
Problem:

Strong positive precipitation signal because of biased driving data of the GCM !

Solution:

**Application of a statistical bias correction approach.
Method: „quantile mapping“**

Bias-correction with "quantile mapping"



Conclusions and Outlook

Conclusions

- The regional climate model CCLM was successful configured and evaluated for the Bug River Catchment.
- The long-term mean of the precipitation is overestimated by the model in spring, summer and fall and underestimated in winter.
- 2m temperatures are well reproduced by the model and are promising.
- Climate projections show a clear positive trend for temperatures up to 2050.
- Projected precipitation has a strong positive bias due to biased forcing by the GCM.

Outlook

- Development and application of a bias correction for precipitation.
- Continuation of the climate projections up to 2100.
- Preparation of the results for hydrological model applications.

Thank you for your attention!

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The CCLM is provided and developed by the CLM-Community.



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