

Regional Climate Scenarios for IWRM

A dynamical downscaling approach for the Western Bug River Catchment in Ukraine

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1 Objectives

The main objective of this study is the downscaling of climate projections from the global scale to the regional scale. Within the framework of the IWRM-Project International Water Alliance Saxony (IWAS) the projected climate data are needed as input for impact studies referring to the water cycle like water balance and water quality modelling.

2 Methods and Data

- Dynamical downscaling with the regional climate model **CCLM 4.8** (Rockel et al. 2008).
- Control-runs: ERA40 → CCLM 1961 – 1990
ECHAM5 → CCLM 1961 – 1990
- Reference data: Interpolated station data 1973 – 1990
- Projections: ECHAM5 / A2 → CCLM 2011 – 2100
ECHAM5 / B1 → CCLM 2011 – 2100

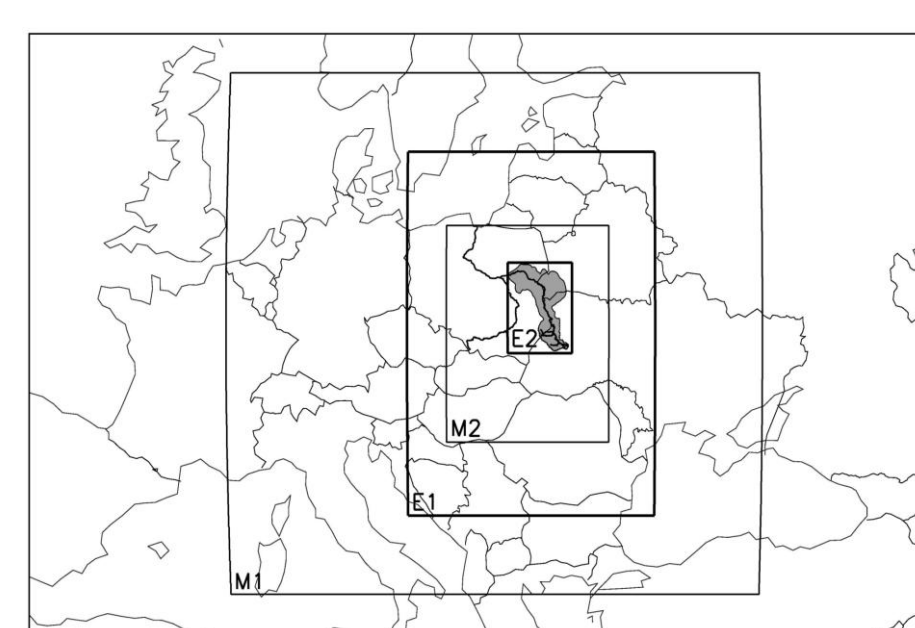


Fig. 1: The Western Bug Catchment (shaded area) within the two model domains (M1) and (M2) and their corresponding evaluation areas (E1) and (E2)

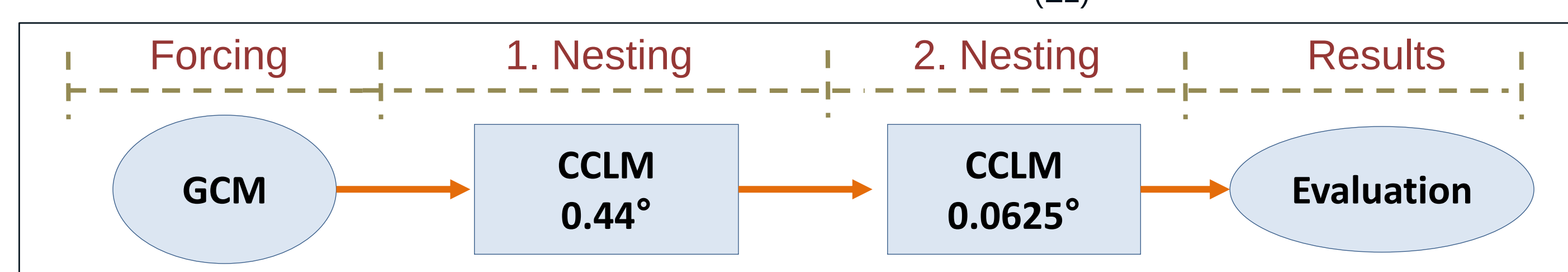


Fig. 2: Model chain

3 Results

3.1 Model Performance (1973 – 1990)

The model control runs driven by ERA40 and ECHAM 5 were evaluated by comparison with interpolated station data. Deviations and errors were quantified with statistical measures (Pavlik et al. 2011). Table 1 shows the results for the control runs. Temperature will properly reproduced by the model with a slight cold bias for the ECHAM 5 driven simulations (Fig. 3-4). Precipitation is slightly overestimated for ERA40 driven and strongly overestimated for ECHAM 5 driven runs (Fig. 5-6).

Tab. 1: Statistical error measures of the evaluation procedure, BIAS = bias, SRMSE = spatial root mean square error, PCOR = pattern correlation, RSV = ratio of spatial variance

Forcing	Temperature				Precipitation			
	BIAS	SRMSE	PCOR	RSV	BIAS	SRMSE	PCOR	RSV
ERA 40	0.00 K	0.40 K	0.43	1.63	52 mm	99 mm	0.28	0.62
ECHAM 5	-0.19 K	0.44 K	0.45	1.99	264 mm	278 mm	0.37	1.13

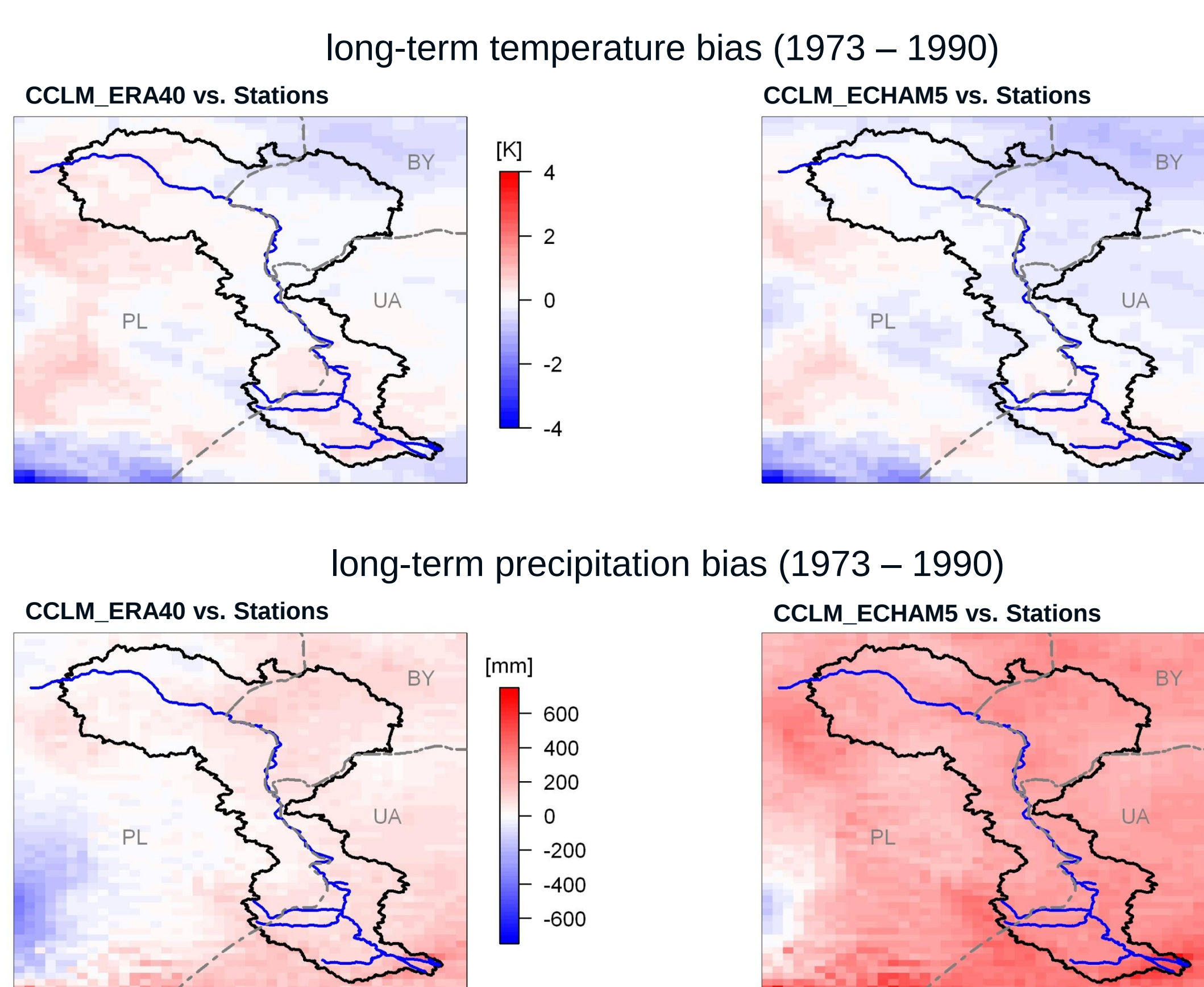


Fig. 3 – 6: Spatial characteristics of long-term temperature bias and precipitation bias for the ERA40 and ECHAM 5 driven control runs.

3.2 Climate Change

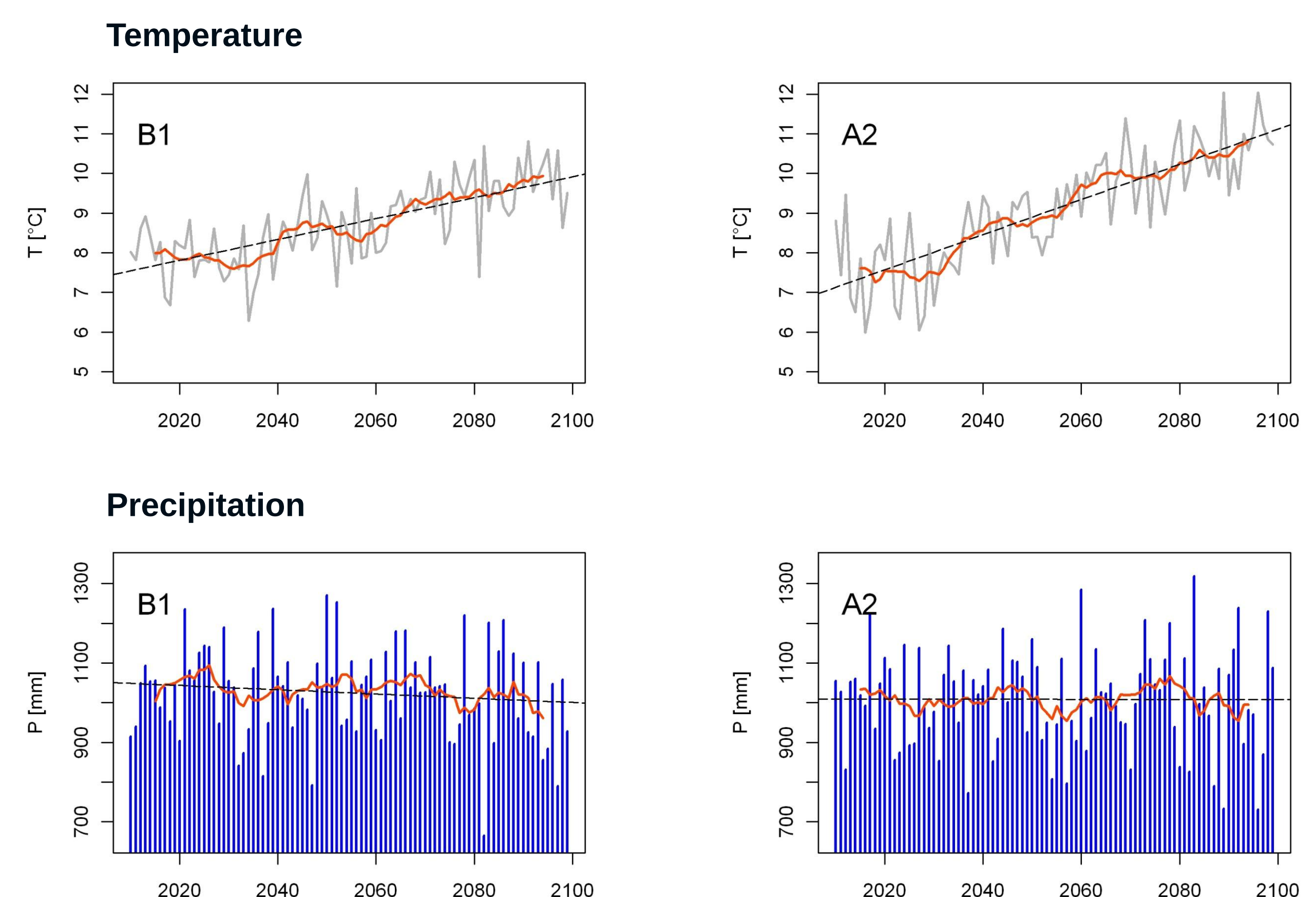


Fig. 7-10: Downscaled yearly temperature means and precipitation sums of the Western Bug River catchment for the IPCC SRES B1 and A2 (grey lines, blue bars), 11-year moving average (red lines), linear trends (black dashed lines).

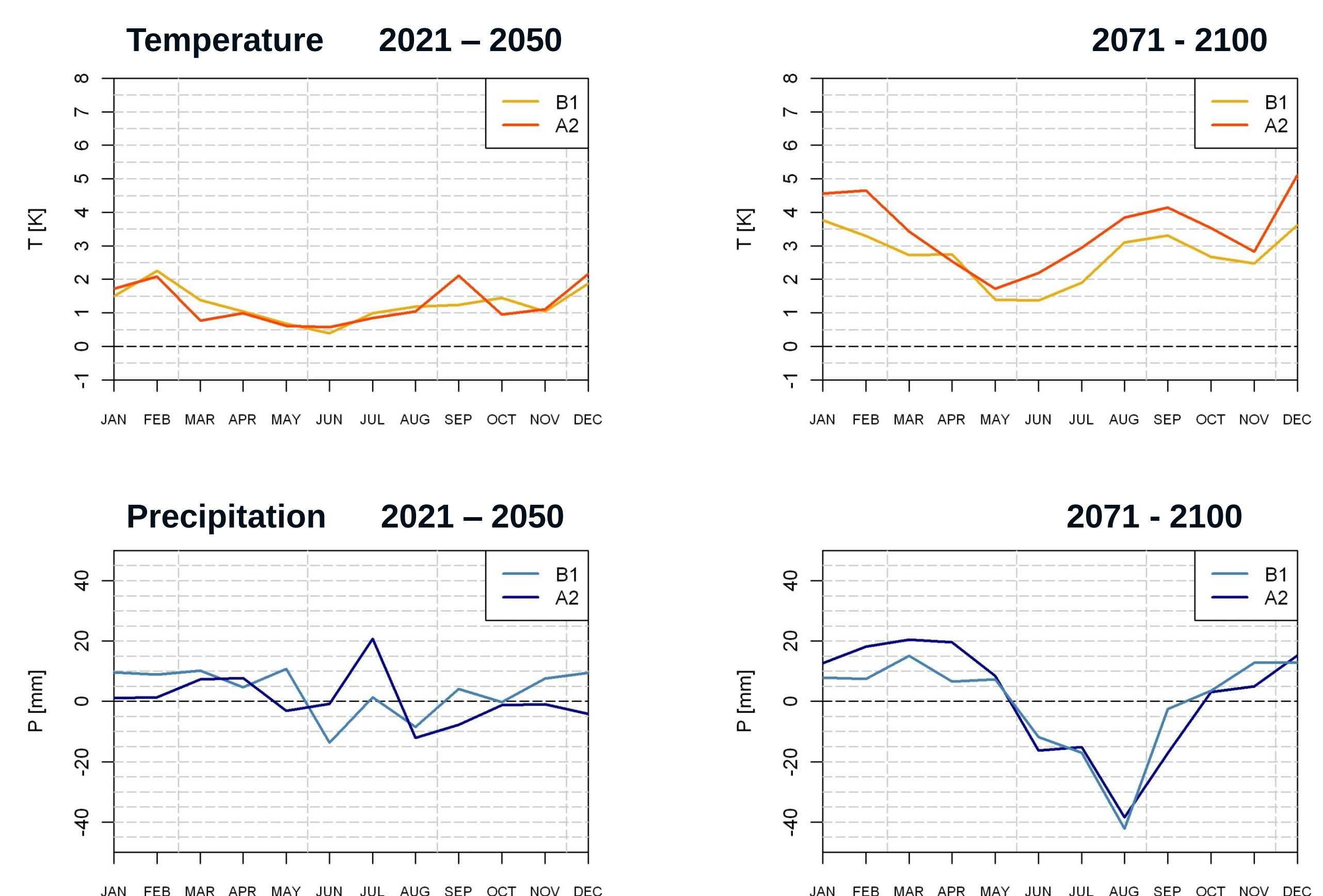


Fig. 11-14: Mean monthly temperature and precipitation changes, calculated by the difference of the respective Projection (CCLM_ECHAM_B1, CCLM_ECHAM_A2) and the control run (CCLM_ECHAM_Ctrl.).

4 Summary and Conclusion

Dynamic downscaling of global climate projections is a promising method for estimating future climate conditions. The model performance shows a good representation of the mean temperatures and an overestimation of precipitation for the Western Bug River catchment. The results of the downscaled future climate scenarios A2 and B1 indicate a significant increase of mean temperatures and no significant trends for yearly precipitation sums (Fig. 7-10). A shift to more precipitation in winter and spring and a strong decline in summer months is noticeable within the annual cycle (Fig. 11-14). This will increase evaporation and vegetation water demand in the investigation area until the end of 21st century. To use the model results as input for hydrological applications a bias correction is necessary especially for precipitation. Within the IWRM framework, the presented climate downscaling results build the basis for subsequent investigations on climate change effects on the water cycle.

References:

Pavlik D, Söhl D, Pluntke T, Mykhnovych A, Bernhofer C (2011) *Dynamic downscaling of global climate projections for Eastern Europe with a horizontal resolution of 7km*. Environ. Earth. Sci. doi: 10.1007/s12665-011-1081-1
Rockel B, Will A, Hense A (2008) *The Regional Climate Model COSMO-CLM (CCLM)*. Meteorol. Z. 17:347-348

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