Precipitation modeling in Europe and South-Asia

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INTRODUCTION

Simulations from current GCMs feature a grid resolution of about 2°. Thus, a downscaling to a grid resolution of 0.5° or less is necessary to assess regional precipitation patterns. These are for instance important for investigations on climate predictions of the water balance or of heavy precipitation changes.

APPROACH

- Dynamical downscaling of ERA40 data with the regional climate model CLM (0.44° grid spacing) in a South-Asian and a European domain (Fig. 1)
- Comparison to two statistical downscaling methods with focus on daily precipitation in the upper Brahmaputra and the upper Danube river basin (UBRB and UDRB, respectively)
- Application of two statistical bias correction methods (cf. Dobler and Ahrens, 2008)

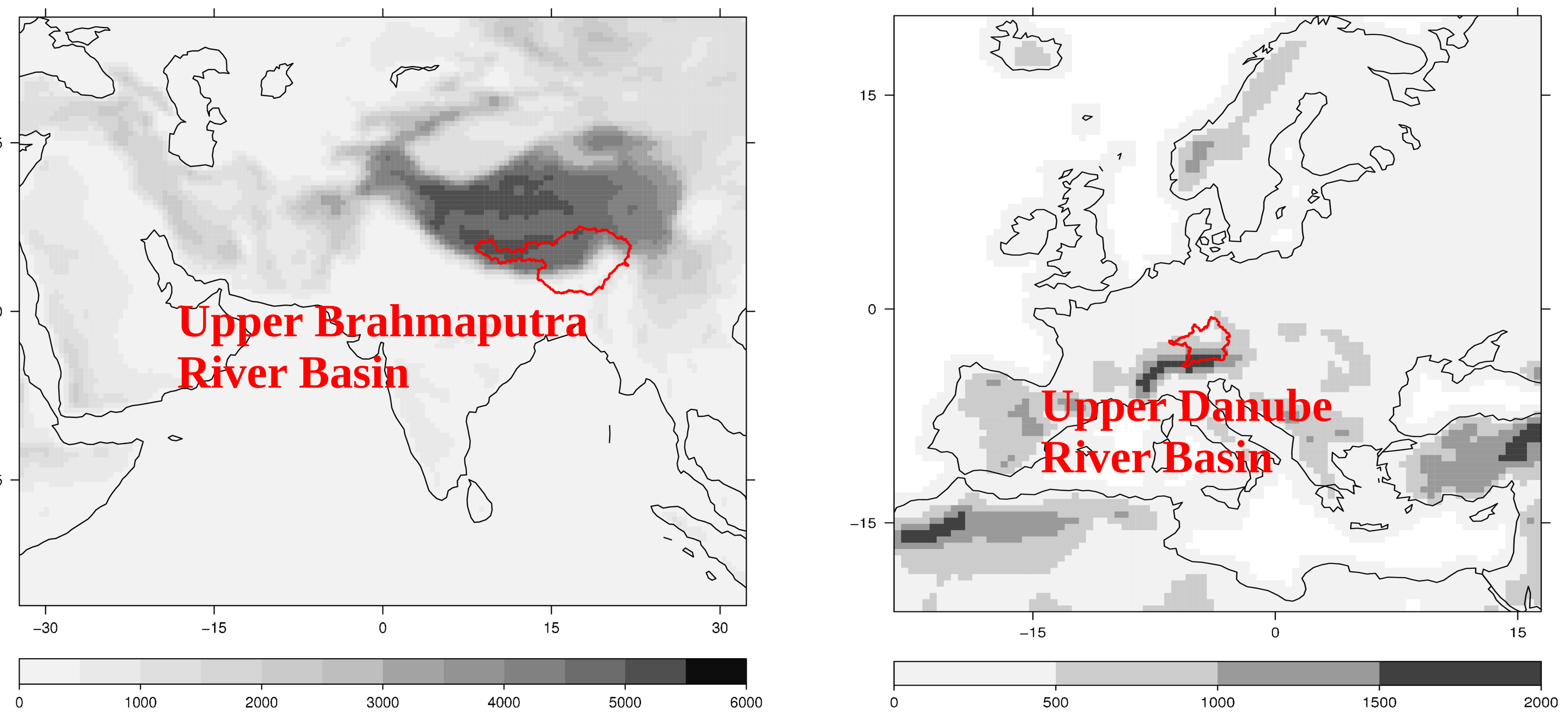

Fig. 1: Computational domains and model orography (in m).

RESULTS

- The CLM underestimates the monthly precipitation from July to September in the UDRB (Fig. 2) as well as in the UBRB (Fig. 3)
- In the UBRB, this especially applies to the subregion Assam (Fig. 4), but not to the subregion Tibet (Fig. 5)

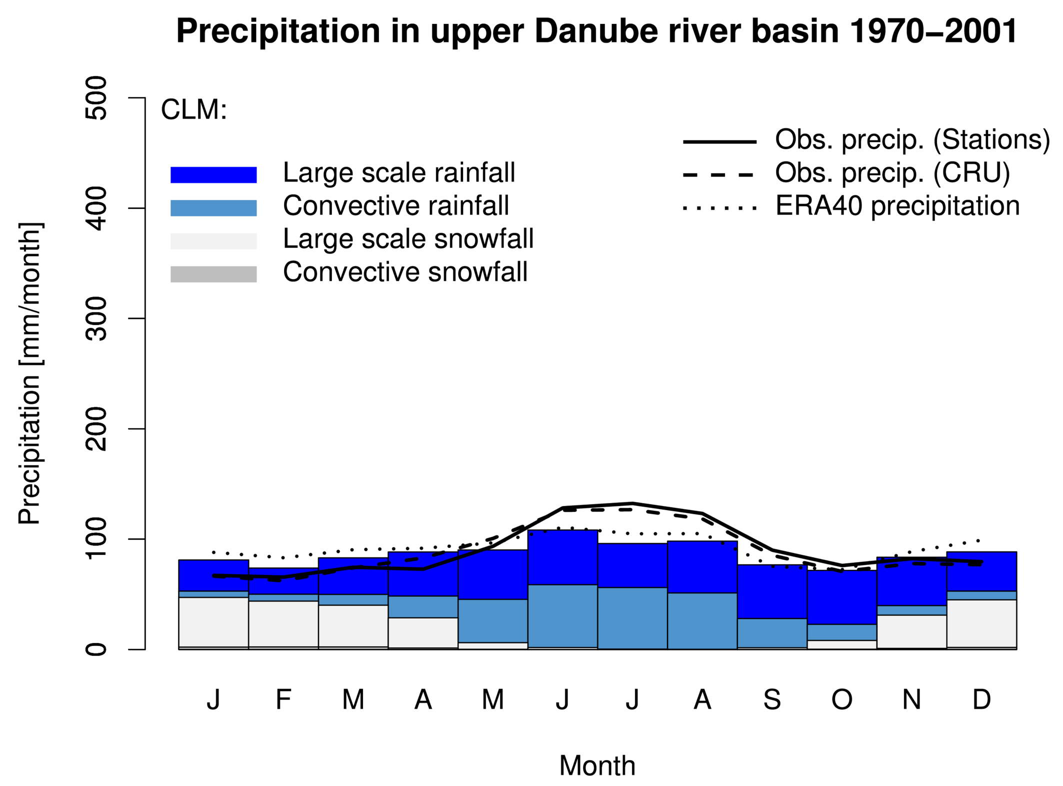

Fig. 2: Simulated and observed precipitation in the UDRB.

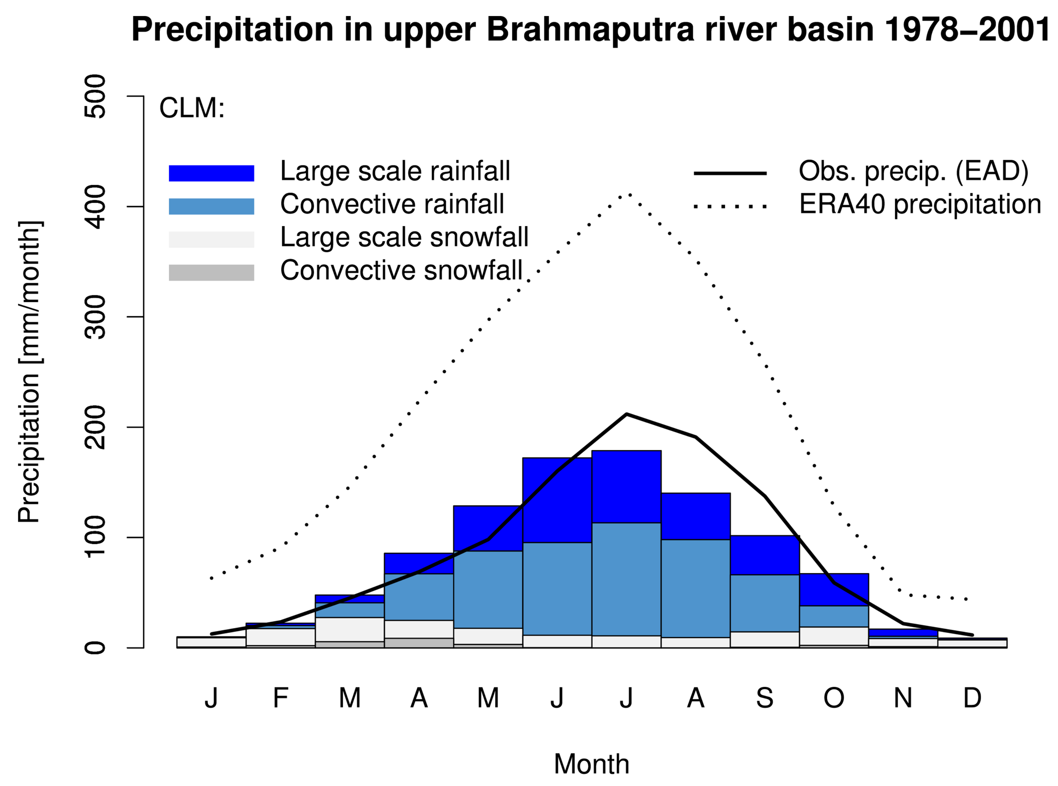

Fig. 3: Simulated and observed precipitation in the UBRB.

RESULTS (continued)

- The East Asia daily precipitation data set (EAD, cf. Xie et al. 2007) and station data in Assam show major differences (Fig. 4)
- Good agreement of the EAD and station data in Tibet (Fig. 5) as well as of the CRU data set (Mitchell and Jones, 2005) and station data in the UDRB (Fig. 2)

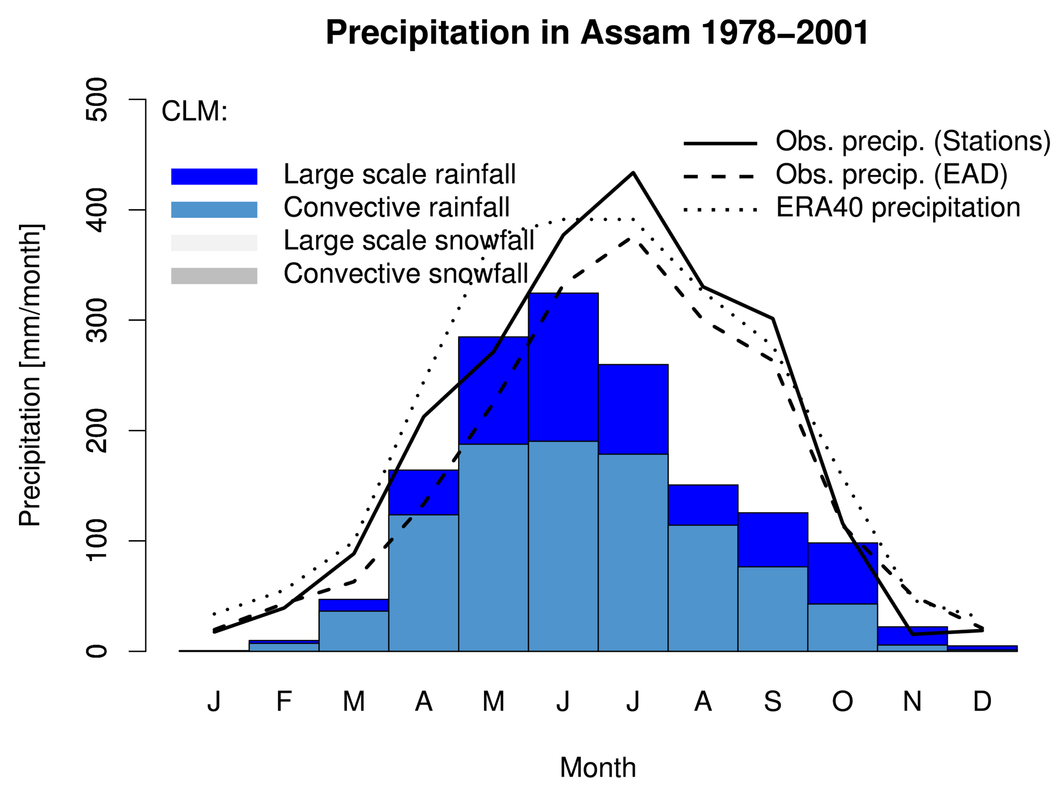

Fig. 4: Same as Fig. 2 but only for the subregion Assam.

- The CLM performance is comparable to ERA40 and statistically downscaled ERA40 precipitation in the UDRB (Dobler and Ahrens, 2008)
- The ERA40 reanalysis highly overestimates the precipitation in the UBRB (Fig. 3) and especially in the subregion Tibet (Fig. 5) where the CLM performs much better

- Bias correction methods based on rain day frequency and rain day intensity calibration work well in the UDRB but the CLM has difficulties in representing rain day climatologies in the UBRB (Fig. 6)
- A small number of rain days in November to January yields big uncertainties in the CLM model bias in the UBRB (Dobler and Ahrens, 2008)

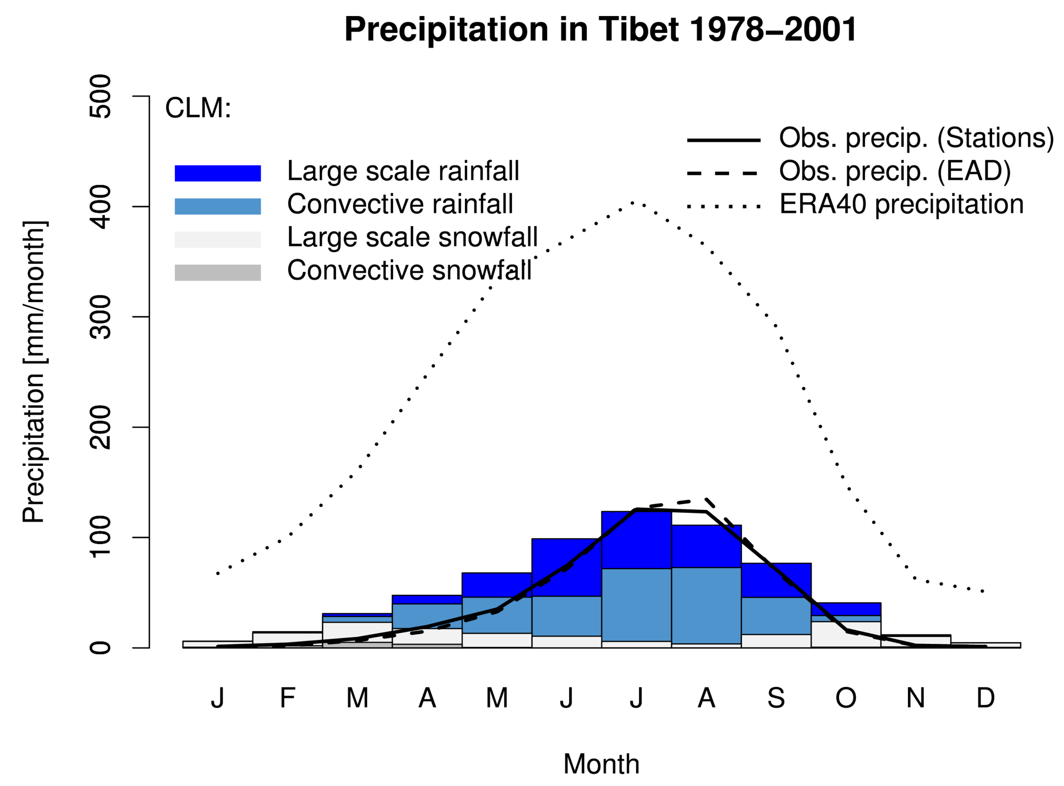

Fig. 5: Same as Fig. 2 but for the subregion Tibet.

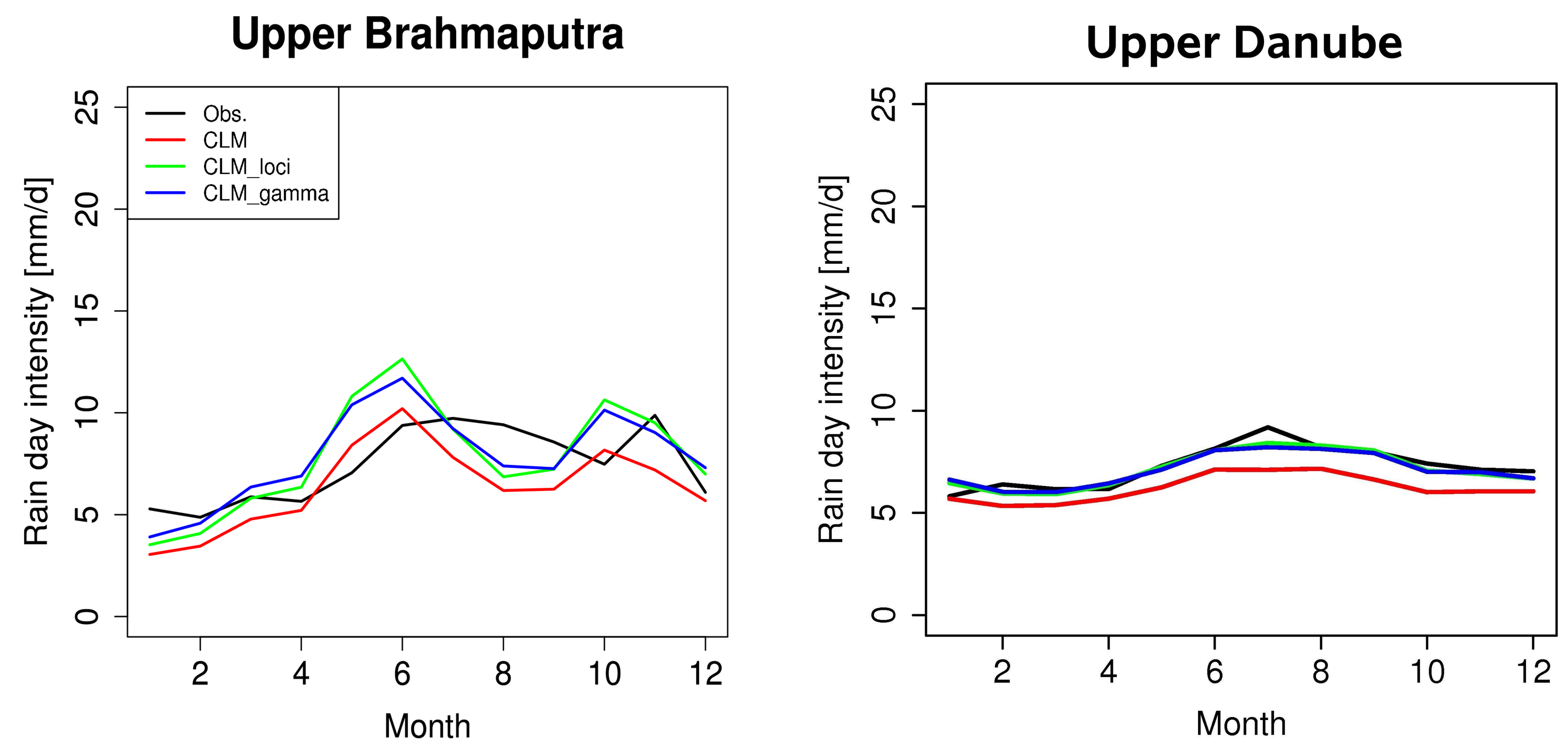

Fig.6: Rain day intensity before and after bias correction in the UBRB and the UDRB for the evaluation period 1990-2001.

CONCLUSIONS

While the CLM and the bias correction methods work well in Europe, there are some challenges in South-Asia:

- A high seasonal variability of the CLM bias deteriorates the bias correction methods in the UBRB
- The CLM bias uncertainties in the UBRB from November to January are relatively large due to a small number of rain days (Dobler and Ahrens, 2008)
- Bad performance of the CLM especially in a region facing large Monsoon driven precipitation events (i.e., Assam) where the major part of precipitation is simulated by the Tiedtke (1989) convection scheme

REFERENCES AND ACKNOWLEDGMENT

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