Challenges in precipitation modeling in South-Asia*

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Application:

Downscaling ERA40 data with CLM 3.2.11 in a South-Asian and a European domain (Fig. 1) with the same configuration as consortial runs, except number of vertical layers (20 instead of 32) and horizontal grid resolution (0.44° instead of 0.165°). Our focus lies on precipitation modeling in upper Brahmaputra river basin (UBRB). Two bias correction methods (cf. Dobler and Ahrens, 2008) are applied in UBRB and three smaller evaluation domains (Fig. 1). Evaluation with the East Asia Daily Precipitation dataset (Xie et al. 2007).

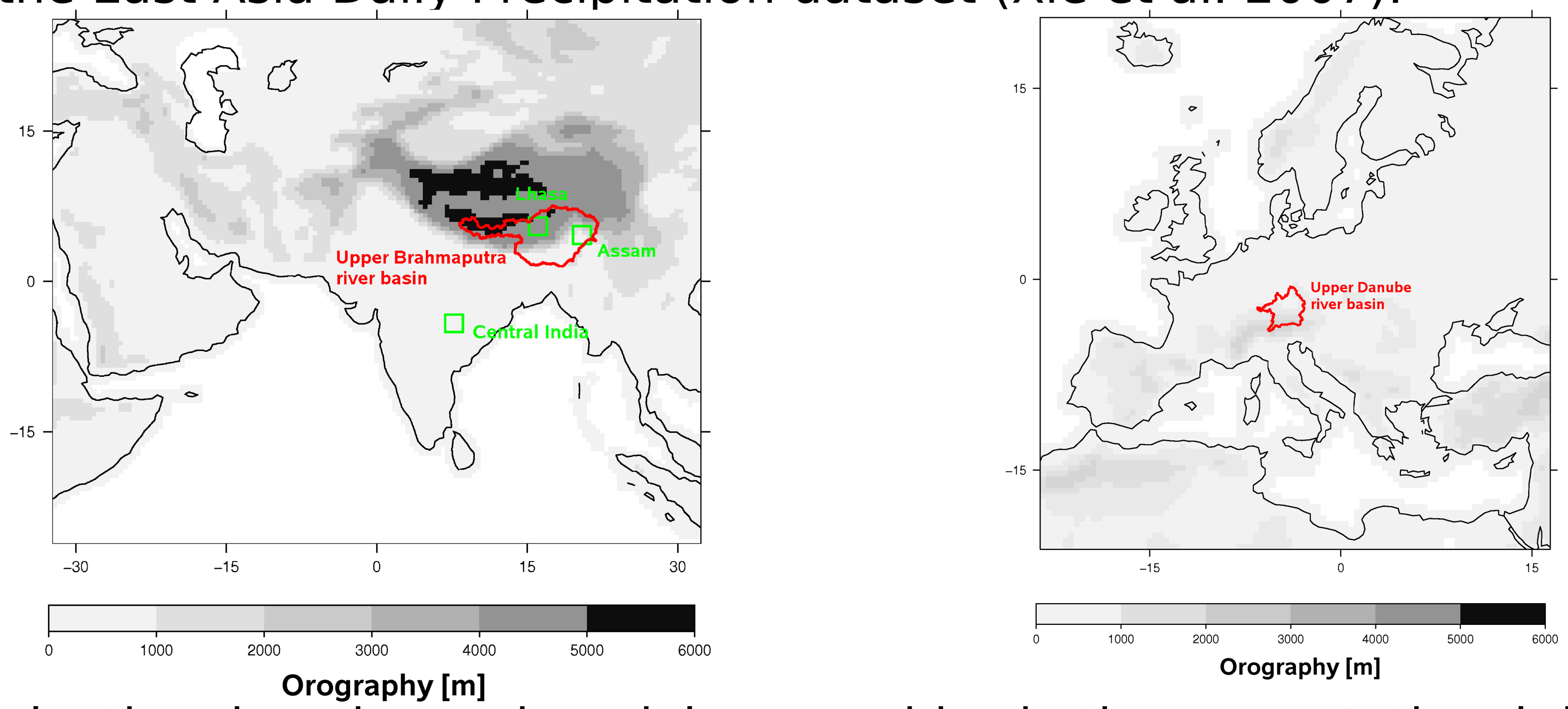

Fig. 1: Evaluation domains and model orographies in the computational domains.

Influence of the monsoon climate:

In the South-Asia domain, the tropical monsoon climate generates a high seasonal variability with the major part of precipitation simulated by the Tiedtke (1989) convection scheme during the monsoon season (Fig. 2). The CLM underestimates total observed precipitation from July to September in the UBRB as well as in the upper Danube river basin (UDRB).

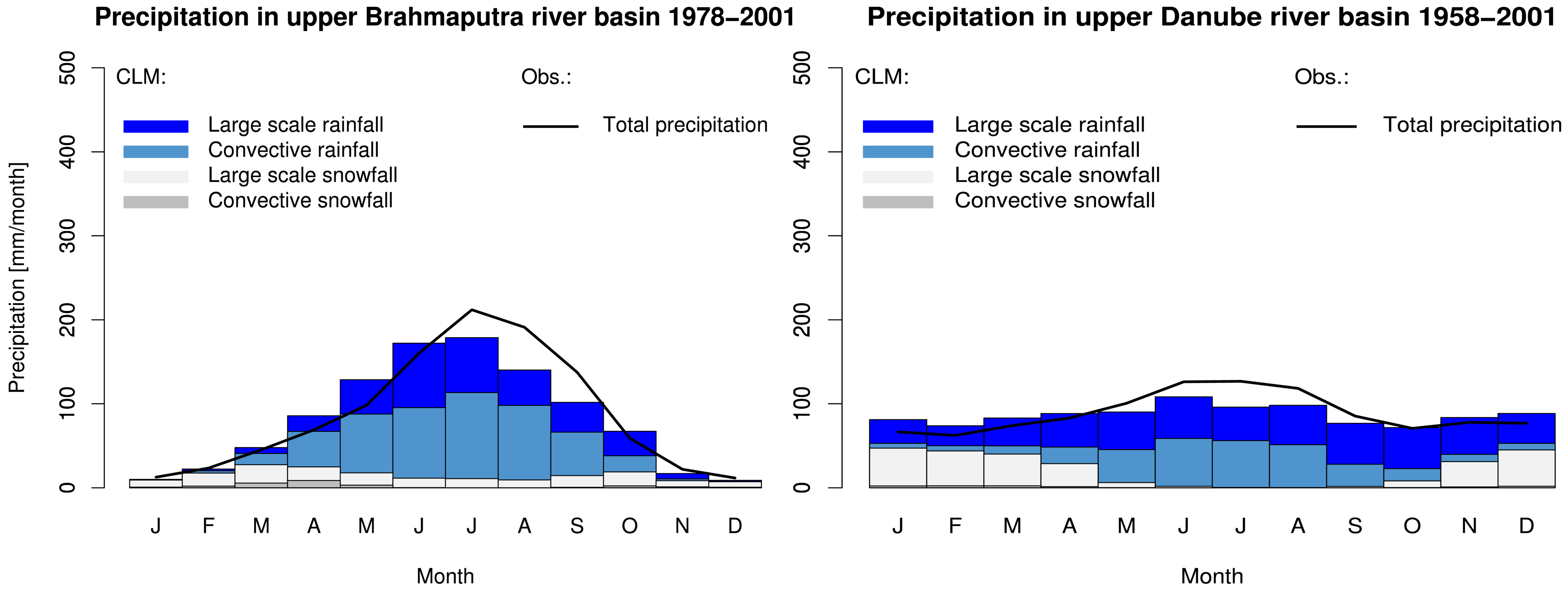

Fig. 2: Simulated and observed precipitation in UDRB and UBRB.

Precipitation characteristics in UBRB (Fig. 3):

- Overestimation of rain day frequency throughout the whole year
- Good match of rain day intensity from February to June
- Underestimation of rain day intensity from July to January with biggest differences in August and November

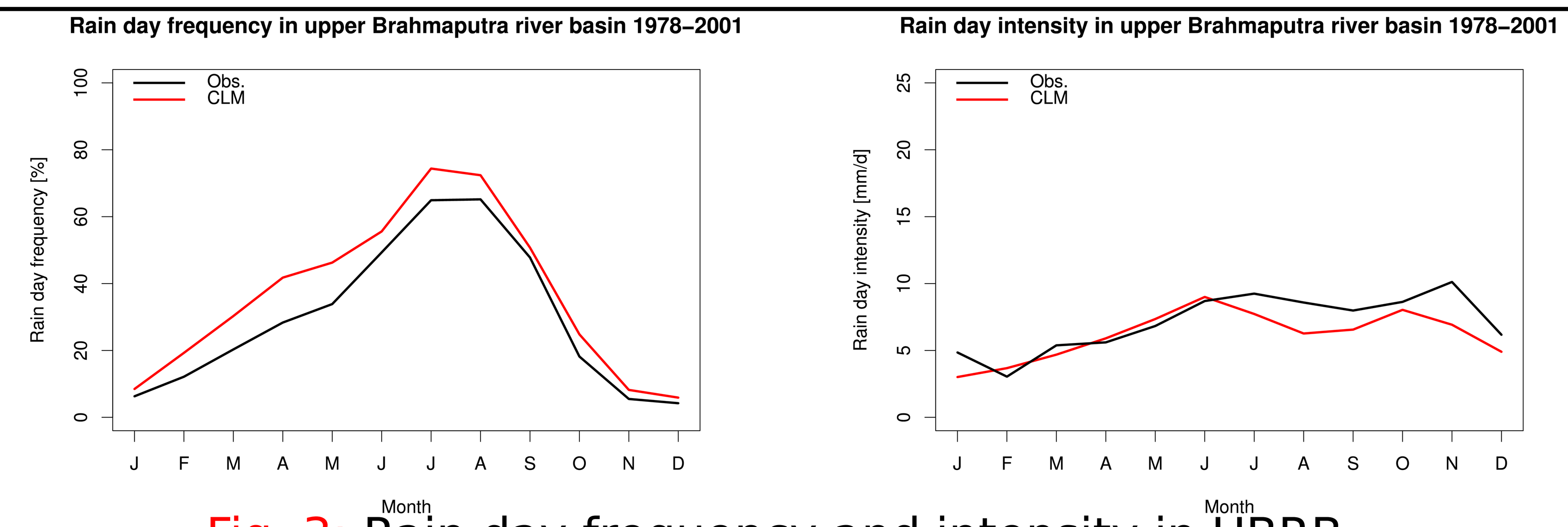

Fig. 3: Rain day frequency and intensity in UBRB.

Bias correction:

- CLM performance comparable to ERA40 and statistically downscaled ERA40 precipitation (Dobler and Ahrens, 2008)
- Bias correction methods based on rain day frequency and intensity (during calibration period) work well in UDRB (Fig. 4)
- Difficulties in representing rain day climatologies in South-Asia
- High seasonal variability of CLM bias deteriorates the methods in UBRB (Fig. 4)
- The small number of rain days in November to January (Fig. 3) yields big uncertainties in the model bias

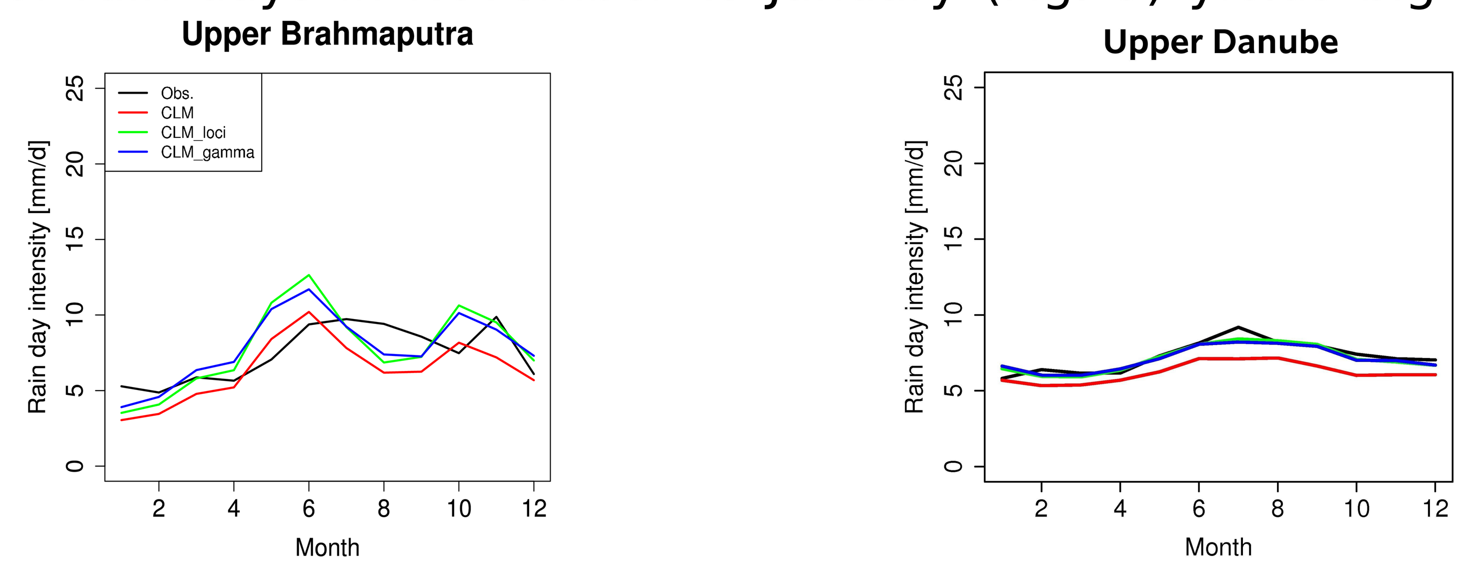

Fig.4: Rain day intensity before and after bias correction in UBRB and UDRB for evaluation period (1990-2001)

- Regionally highly variable performance (Fig.5), e.g., increase in rain day intensity bias in Central India for several months.

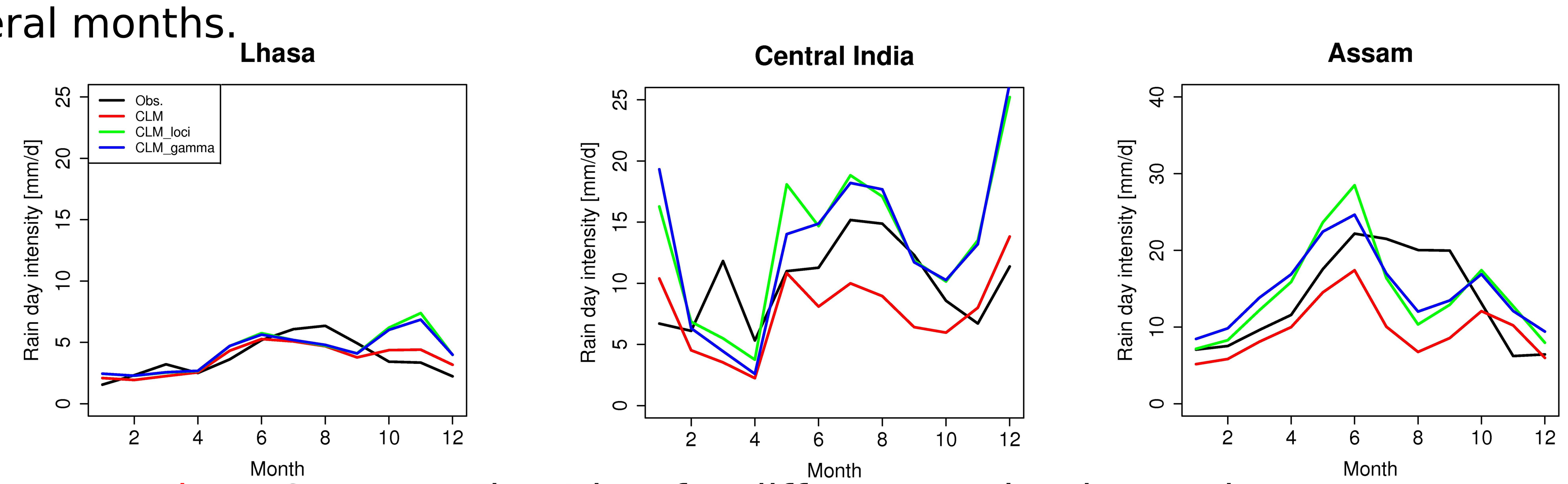

Fig.5: Same as Fig. 4 but for different evaluation regions.

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

References:
Dobler, A. and B. Ahrens (2008): Precipitation by a regional climate model and bias correction in Europe and South-Asia, Meteorolog. Z, in revision.
Tiedtke, M. (1989): A comprehensive mass flux scheme for cumulus parameterization in large-scale models. Mon. Wea. Rev., 117, 1779-1800.
Xie et al. (2007): A gauge-based analysis of daily precipitation over East Asia. J. Hydrometeor., 8, 607-627.

AD was funded by the EC project BRAHMATWINN (Contract No. 036592 (GOCE)). Support of the CLM model by the COSMO consortium and the CLM community. *) Poster presented at the 3rd CLM-Community Assembly, 5.3.08, Langen