Regional climate change impact studies in the upper Danube and upper Brahmaputra river basin using CLM projections*

B. Ahrens and A. Dobler, Institute for Atmospheric and Environmental Sciences, Goethe-University, Frankfurt am Main, Germany

CLM

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GOETHE UNIVERSITÄT FRANKFURT AM MAIN

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Contact: bodo.ahrens@iau.uni-frankfurt.de

INTRODUCTION

For regional climate change impact studies in two alpine regions, different ECHAM5 IPCC SRES scenarios have been dynamically downscaled from 1.875° to 0.44° in the upper Danube and the upper Brahmaputra river basin (UDRB and UBRB resp., Fig.1). The downscaling has been carried out with the regional climate model COSMO-CLM (www.clm-community.eu) for the SRES scenarios A1B, A2, B1 and commitment and the time period 1960-2100.

METHODS

Different seasonal precipitation and temperature indices (Table 1) are calculated for the time period 1960-2100 and evaluated for linear trends. Inside the two major river basins (RBs), five sub-basins of interest are considered: Lech RB, Salzach RB, Assam, Lhasa RB, and Wang-Chu RB (Fig.1). A normalization using the 1971-2000 mean has been carried out to remove constant model biases.

Name	*Description*	*Unit*
precip	Precipitation amount	mm/season
FRE	Wet day frequency	1
INT	Wet day intensity	mm/d
PX5D	Max. 5-day precip.	mm
CDD	Longest period of consec. dry days	d
T2M	Mean 2m temperature	°C
T2MIN	Mean daily min. temp.	°C
T2MAX	Mean daily max. temp.	°C

Table 1: List of precipitation and temperature indices.

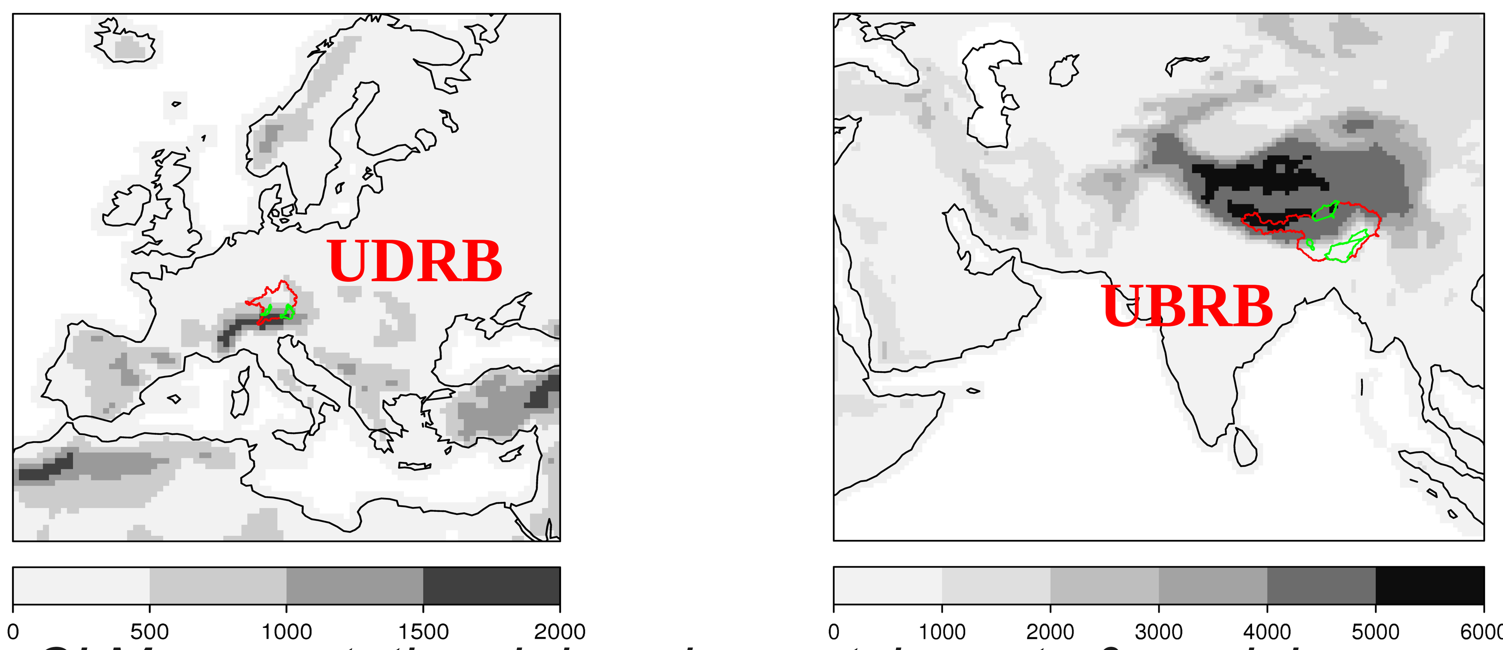

Fig. 1: CLM computational domains, catchments & model orography.

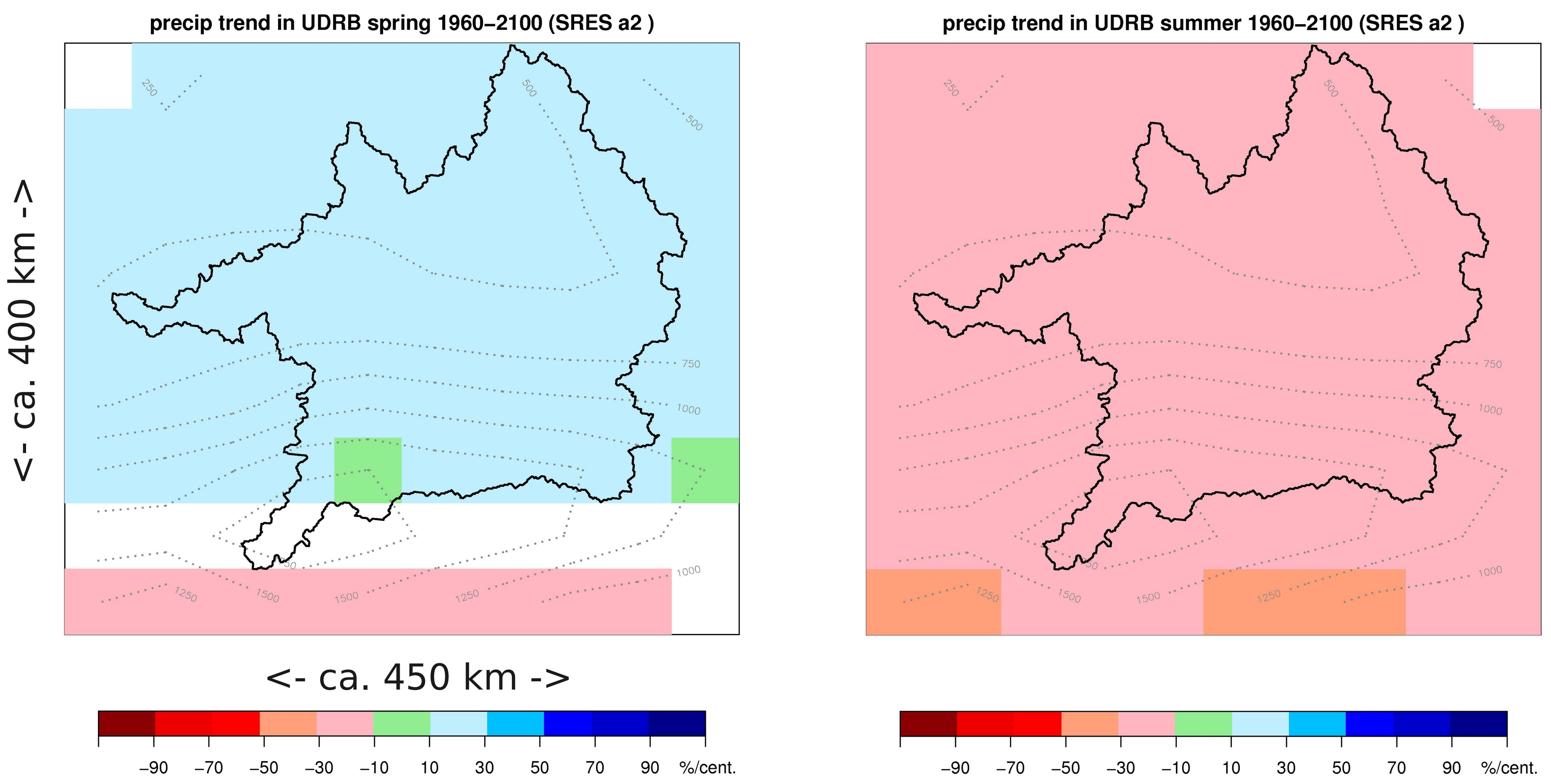

Fig. 2: Projected linear trends (sign. at 0.05 level) of spring and summer precipitation in the UDRB for the A2 scenario.

RESULTS

- Generally (not shown):
  - Largest trends: A1B & A2, followed by, B1 & COM
  - A1B leads up to 2080 (e.g., for CDD see Tables 2 and 3)
  - Higher increase in T2MAX than T2M, smaller in T2MIN
  - Trends in precip. indices less clear than in temp. indices
  - Trends in precip. indices less clear in UBRB than in UDRB
  - Largest trends in Lhasa RB, smallest in Assam & Wang-Chu
- Large regional and seasonal differences (Figs. 2 and 3)
- T2M: +1.5°C to +4.5°C per century in UDRB, +2.5°C to +5.5°C per century in UBRB (A1B, A2 & B1)
- precip: +15% per century in spring, -20% per century in summer (A1B, A2 & B1) in UDRB (Fig. 2). Approx. same trends for PX5D and CDD, resp.
- Tibetan Plateau (Fig. 3).
  - Positive X5D trend in Monsoon (A1B, A2 & B1)
  - Positive CDD trend in Monsoon (A1B, A2, B1 & COM)

Summer (JJA)	*A2*	*A1B*	*B1*	*COM*
UDRB	**26**	**31**	8	18
Lech RB	**22**	**29**	8	7
Salzach RB	**21**	**30**	10	7
Monsoon (JJAS)				
UBRB	**16**	**21**	**12**	12
Assam	**20**	**26**	9	8
Wang-Chu RB	13	**16**	5	0
Lhasa RB	**36**	**52**	**25**	**23**

Table 2: CDD trends (% per century) for the time period 1960-2080.Bold values are statistically significant (at the 0.05 level).

Summer (JJA)	*A2*	*A1B*	*B1*	*COM*
UDRB	**38**	**34**	**22**	13
Lech RB	**37**	**35**	**22**	8
Salzach RB	**31**	**32**	**21**	7
Monsoon (JJAS)				
UBRB	**22**	**24**	**16**	9
Assam	**18**	**20**	10	2
Wang-Chu RB	**15**	**16**	6	0
Lhasa RB	**42**	**53**	**31**	**19**

Table 3: As for Table 2, but for the time period 1960-2100.

CONCLUSIONS

- Projections indicate:
  - Increase in temperature variability
  - Increasing flood risk in the UDRB in spring
  - Increasing drought risk in the UDRB in summer
  - Tibetan Plateau highly sensitive to climate changes
  - Trends depend on altitude and SRES scenario

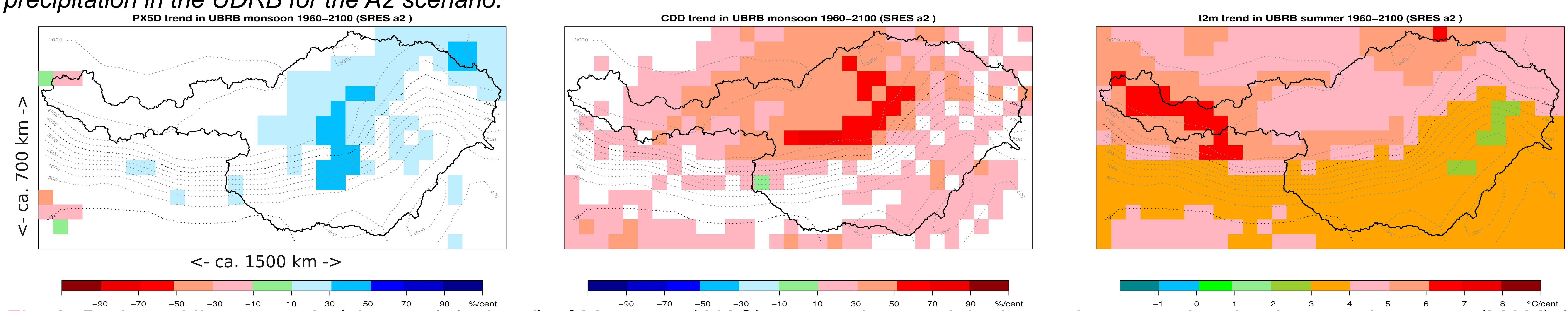

Fig. 3: Projected linear trends (sign. at 0.05 level) of Monsoon (JJAS) max. 5-day precipitation and consecutive dry days, and summer (MAM) 2m temperature (from left to right) in the UBRB for the A2 scenario.

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