

Systematic differences between dynamical and statistical downscaling methods in the CORDEX EUR-11/ReKlies-De Ensemble

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Introduction

The latest generation of climate projections for the 21st century is built on new emission scenarios based on Representative Concentration Pathways (RCPs). Within the world wide coordinated effort of the Coupled Model Intercomparison Project Phase 5 (CMIP5), their impact on climate is simulated with global models of the climate system. A sample of the global simulations is dynamically downscaled for Europe in the framework of EURO-CORDEX. Further simulations, based on both dynamical and statistical methods, with focus on Germany and the river catchments draining into Germany, are conducted within the framework of the project ReKliEs-De (Regional Climate Projection Ensemble for Germany) to account for the full range of model variability. Here we present a comparison of climate change signals of both approaches.

Summary

- the dynamical and statistical approaches show systematic differences in the climate change signals
- the climate change signals for near surface temperature span the same range for both techniques and depend strongly on the global model which delivers the boundary conditions
- for precipitation, the statistical downscaling methods show a decrease for the period 2071-2100, while dynamical models project an increase in precipitation
- for diurnal temperature range, the statistical downscaling methods show a strong increase for the period 2071-2100, while dynamical models project only small increases and decreases

Data base

- all CORDEX EUR-11 rcp85 simulations available on 1st of May 2017 (14 simulations)
- all rcp85 simulations produced in ReKliEs-De available on 1st of May 2017 (20 simulation (8 dynamical downscaling, 12 statistical downscaling; see table below))

Tab 1: Simulations on CORDEX EUR-11 domain planned within ReKliEs-De

	finished	running	not planned		
	CCLM	REMO	WRF	STARS	WETTREG
MPI-ESM-LR RCP 2.6	BTU	EURO-CORDEX	UHOH	PIK	PIK
MPI-ESM-LR RCP 8.5	EURO-CORDEX	EURO-CORDEX	EURO-CORDEX	PIK	PIK
HadGEM2ES RCP 8.5	EURO-CORDEX	HZG	UHOH	PIK	PIK
EC-EARTH RCP 8.5	EURO-CORDEX	HZG	UHOH	PIK	PIK
CNRM-CM5 RCP 8.5	BTU	HZG	X	PIK	PIK
CanESM2 RCP8.5	DWD	HZG	X	PIK	PIK
MIROC5 RCP 8.5	DWD	HZG	UHOH	PIK	PIK

Climate change signals

- same color = same driving global model
- same form = same regional model
- ★ and • = ESDs (Empirical Statistical Downscaling)
- others = RCMs (Regional Climate Model)

● CA2_W13_R85	● MI5_CLM_R85	● IP5_WRF_R85	● MI5_ST3_R85
● CN5_W13_R85	● HG2_CLM_R85	● ECE_RAC_R85	● HG2_ST3_R85
● ECE_W13_R85	● MP1_CLM_R85	● HG2_RAC_R85	● MP1_ST3_R85
● MI5_W13_R85	● ECE_HIR_R85	● MP1_REM_R85	● CN5_RCA_R85
● HG2_W13_R85	● CA2_REM_R85	● MP2_REM_R85	● ECE_RCA_R85
● MP1_W13_R85	● CN5_REM_R85	● CA2_ST3_R85	● IP5_RCA_R85
● CA2_CLM_R85	● ECE_REM_R85	● CN5_ST3_R85	● HG2_RCA_R85
● CN5_CLM_R85	● MI5_REM_R85	● ECE_ST3_R85	● MP1_RCA_R85
● ECE_CLM_R85	● HG2_REM_R85		

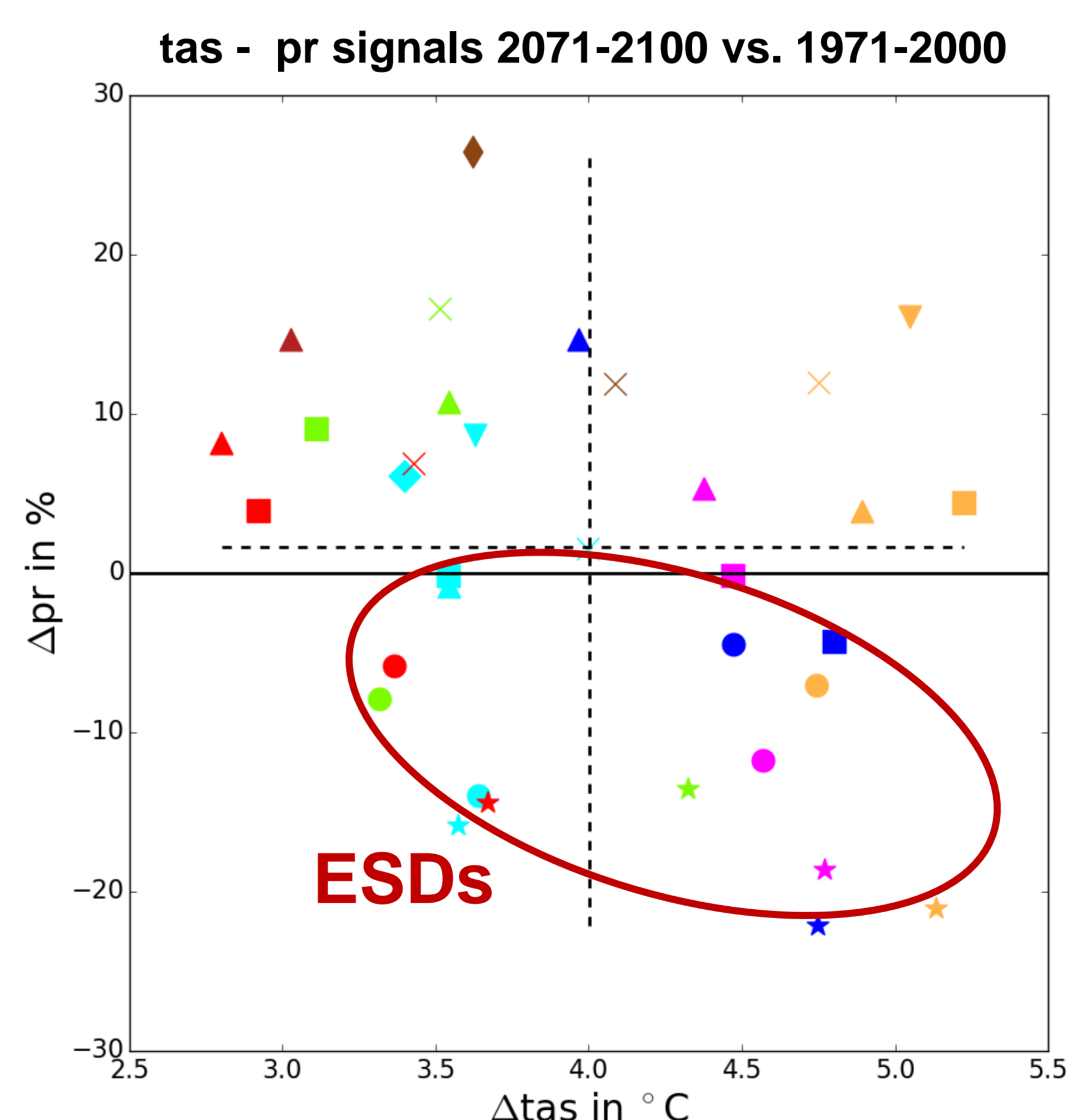


Fig. 1: tas (near-surface air temperature) and pr (precipitation) signals (spatial means) for 2071-2100 relative to 1971-2000

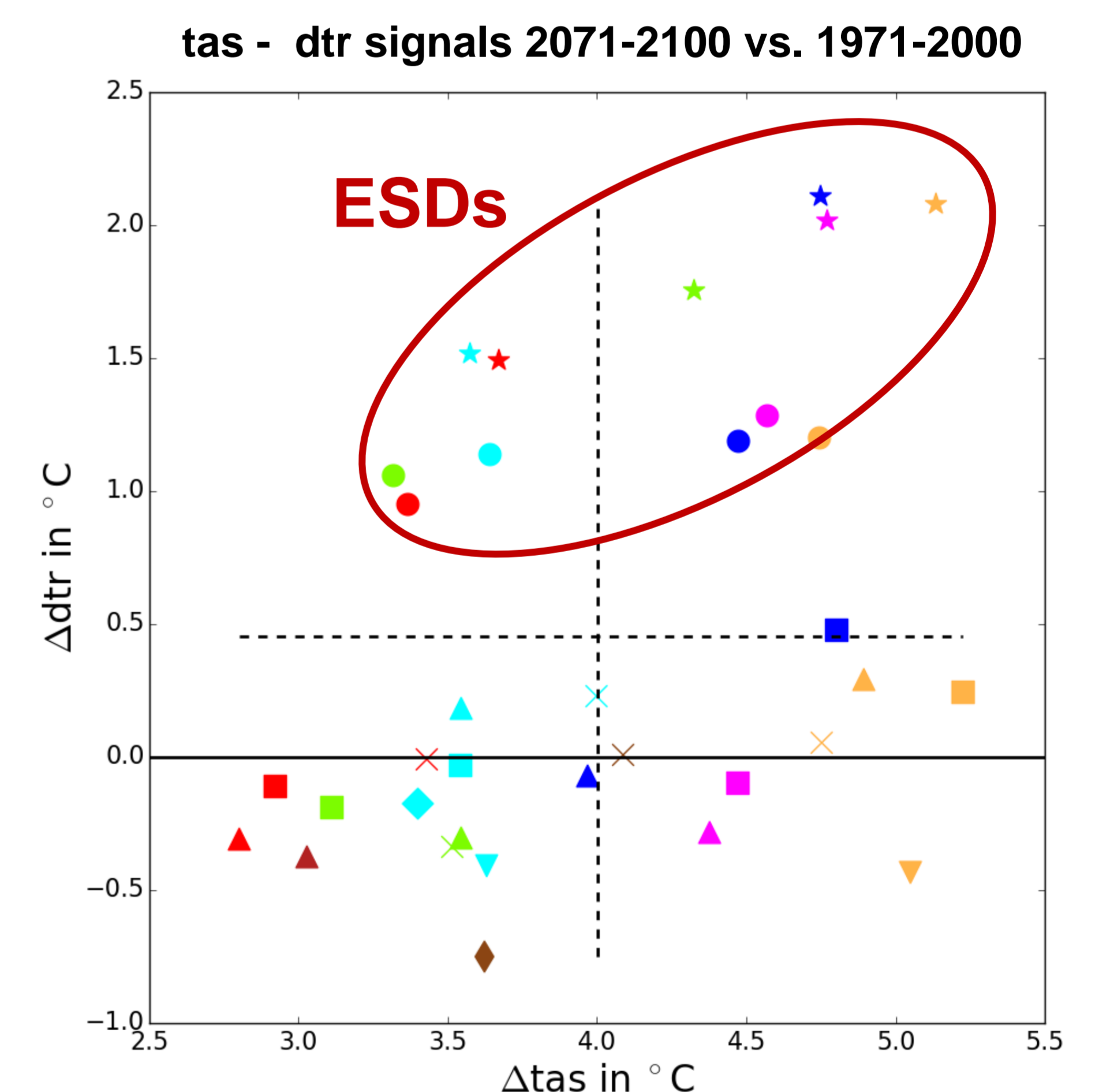


Fig. 2: tas (near-surface air temperature) and dtr (diurnal temperature range) signals (spatial means) for 2071-2100 relative to 1971-2000

Method

- calculation of long-term annual mean values for all variables for the periods 1971-2000 (reference period) and 2071-2100
- calculation of spatial means for the ReKliEs-De domain (Germany and river catchments draining into Germany)
- calculation of climate change signal for all variables (difference between values for 2071-2100 and 1971-2000)
- dtr (diurnal temperature range) is the difference between daily maximum and minimum temperature

- tas signals are mainly determined by the driving global model
- tas signals of ESDs and RCMs cover almost the same range
- pr signals are stronger influenced by the regional model
- the pr signals derived from ESDs show a decrease in precipitation
- the pr signals derived from RCMs show usually an increase in precipitation
- the pr signals derived from the two different downscaling techniques differ in sign

- tas signals are mainly determined by the driving global model
- tas signals of ESDs and RCMs cover nearly the same range
- dtr signals are influenced by the regional model
- the dtr signals derived from ESDs show an increase of 1°C to more than 2°C
- the dtr signals derived from RCMs are in the range of ± 0.5°C
- the dtr signals derived from the two different downscaling techniques are systematically different

