An improved statistical downscaling method for seasonal climate projections

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Highlights

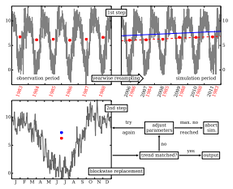
- the **STatistical Analogue Resampling Scheme** (STARS) has been applied for seasonal climate projection in **Germany**
- independent STARS ensemble simulations for **summer** and **winter**
- reordering of two different driving data:
  - **obs:** climate station network of the German Weather Service
  - **rcm:** RCA4 driven by ERAint provided by SMHI for Euro-Cordex (0.11)
- **1981-2010**: T-trend from OBS $\mapsto$ STARS (obs) & STARS (rcm):
  - weak T-Bias after resampling, prcp-pattern in rcm more heterogeneous
- **2041-2070:** T-trend from GCM $\mapsto$ STARS (obs) & STARS (rcm):
  - **stronger warming in summer** than in winter
- **T-Bias correction** of RCM simulations

Data and Model

Stations

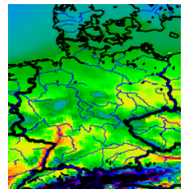
DWD
1981-2010

STARS Concept



MPI-M-MPI-ESM-LR (rcp 8.5)
20 realisations

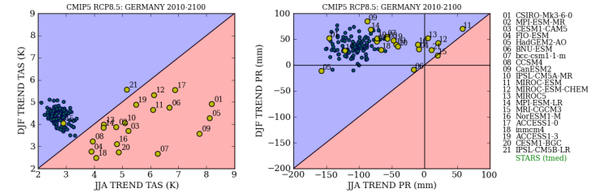
RCM-ERAint



SMHI-RCA4
1981-2010

- **basic idea:** past weather situations will recur in a similar way in near future
- **first approximation:** the annual means of the simulated time series have to match the given linear trend for the simulation time period
- **result:** generating a mapping from dates of an observation period to dates of the simulation period

Improvement

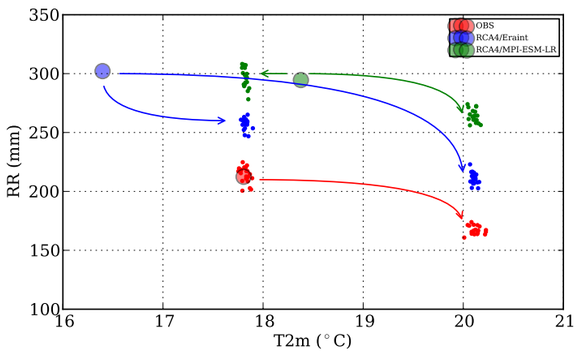


- reordering by annual mean T-trends generates a stronger warming in winter than in summer (green circles) in comparison to GCMs (yellow circles)

STARS	Trends	Reference	Projection	Data	Summer Temp
old:	annual	1951-2010	2011-2100	obs	colder than GCM
new:	seasonal	1981-2010	2041-2070	obs+rcm	STARS $\sim$ GCM

- reordering by seasonal mean T-trends generates a stronger warming in summer than in winter, which is consistent with GCMs

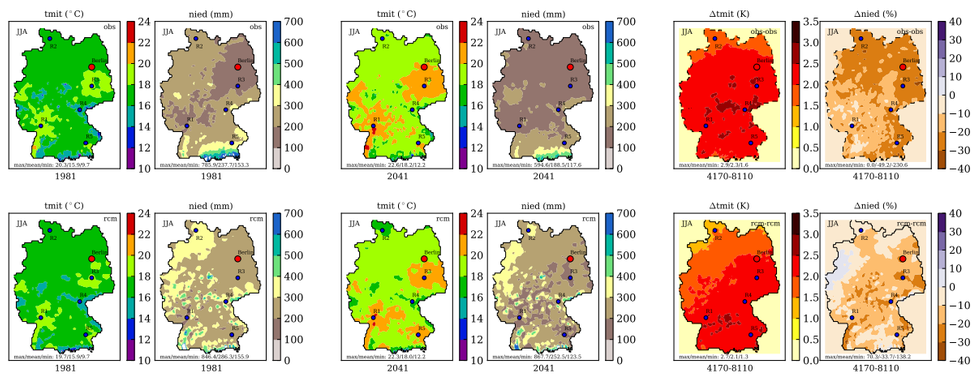
Summer (JJA)



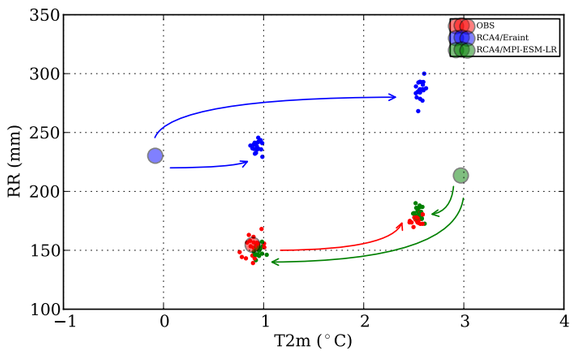
1981-2010:

Correlation: $\rho(T,R)$	-0.12	
Bias: tmit (rcm-obs)	-1.4K	
Bias: nied (rcm-obs)	+98mm	
obs/rcm	**tmit (°C)**	**nied (mm)**
1981-2010:	15.9/15.9	237.7/286.3
2041-2070:	18.2/18.0	188.5/252.5
Δ 4170-8110:	**2.3/2.1**	**-49.2/-33.7**

Median | **1981-2010** | **2041-2070** | **$\triangle$ 4170-8110**



Winter (DJF)



1981-2010:

Correlation: $\rho(T,R)$	+0.26	
Bias: tmit (rcm-obs)	-1.0K	
Bias: nied (rcm-obs)	+84mm	
obs/rcm	**tmit (°C)**	**nied (mm)**
1981-2010:	-0.2/-0.2	189.5/288.0
2041-2070:	1.3/1.3	214.9/345.9
Δ 4170-8110:	**1.5/1.6**	**24.6/57.9**

Median | **1981-2010** | **2041-2070** | **$\triangle$ 4170-8110**