

RD2-SEMINAR

BIAS-CORRECTION IN REGIONAL CLIMATE ENSEMBLES

P. Hoffmann, A. Spekat, Ch. Menz

“Threshold-correction for Climate Extreme Assessments”

Agenda

1. **A. Spekat:**

- (a) Motivation for the ReKliEs-De project within the framework of Euro-Cordex from the decision maker point of view

2. **Ch. Menz:**

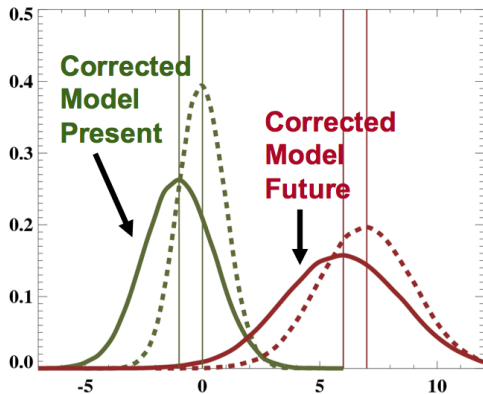
- (a) Origin of Bias in regional climate simulations seen in climatic indices

3. **P. Hoffmann:**

- (a) Bias correction of climate extremes in regional climate ensembles: An example on the national level

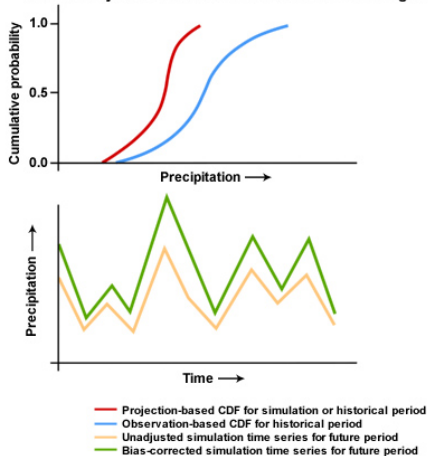
Bias in climate model simulations

Schematic

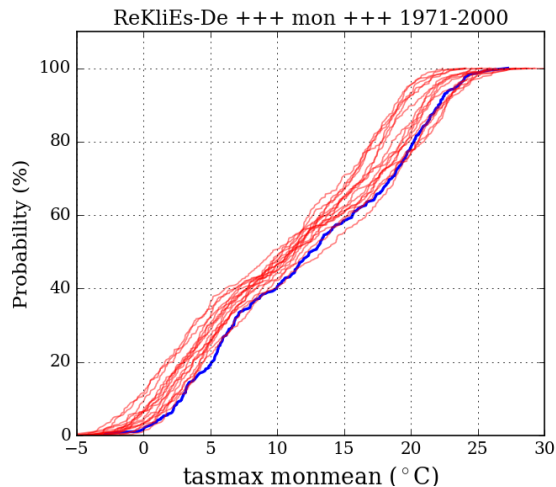
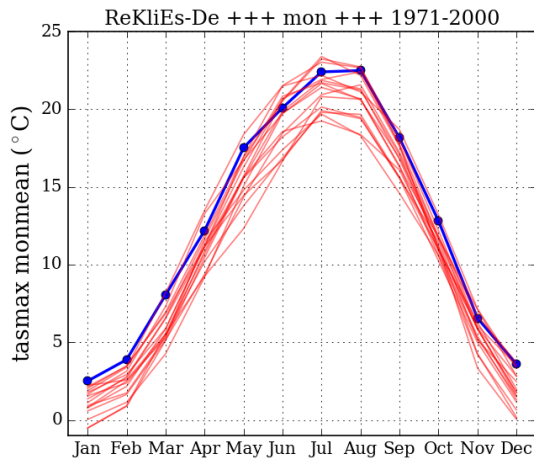


Probability Density Functions

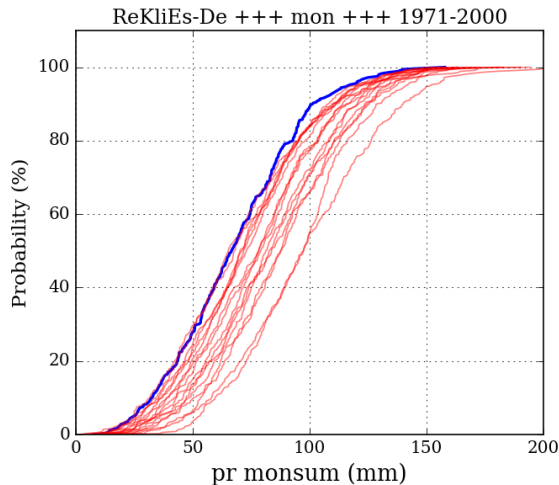
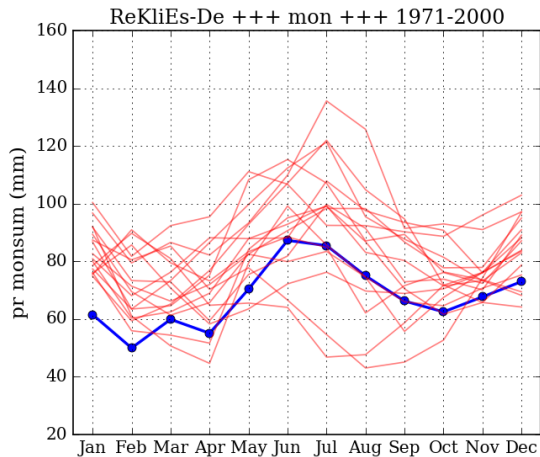
Model Projection Bias: Values Too Low and Range Too Narrow



Simulation vs. Observation: Tasmax



Simulation vs. Observation: Precipitation



simulations wetter than observations

Bias-correction across scales

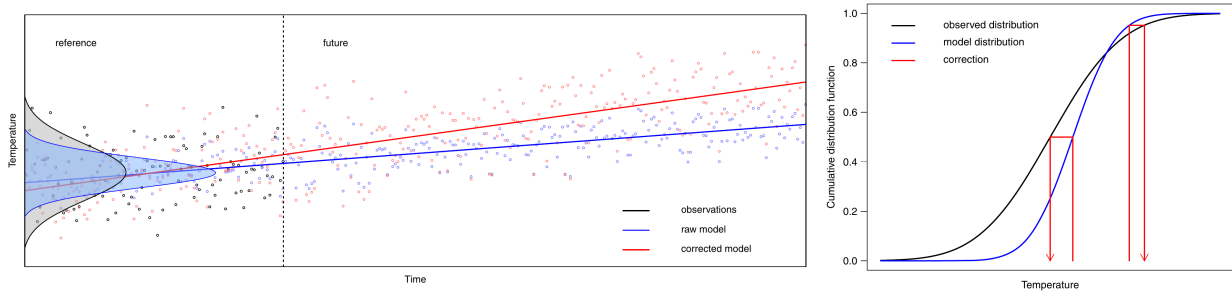
	global	regional	national
Domain	Continents	Euro-Cordex	Germany
Models	GCMs	GCM/RCM	GCM/RCM
Resolution	$100 \times 100km$	$12 \times 12km$	$12 \times 12km$
Observations	WATCH	E-OBS	PIK-BEOGRID
remap	$50 \times 50km$	$25 \times 25km$	$12 \times 12km$
bias-correction	ISIMIP	Impact2C	ReKliEs-De
Reference	Hempel et al. (2013)	Gobiet et al. (2015)	N.N.

Bias-correction for climate impact assessments!

... and for climate extreme assessments?

Critical Review: Bias Correcting Climate Change Simulations (Maraun, 2016)

standard QM



1. transient climate simulations are not in synchrony with observations
2. biases are time dependent due to the presence of circulation biases
3. local bias-correction should not modify the trend
4. ~~bias-correction should not be used to correct the wrong global climate sensitivity~~

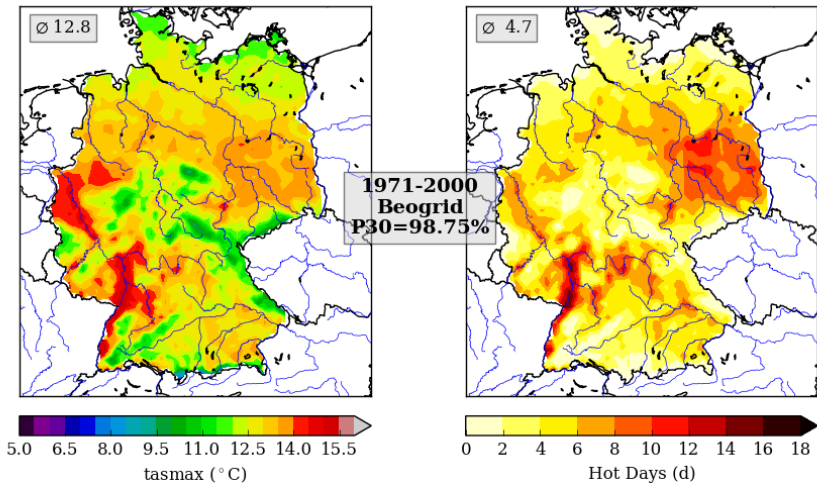
Threshold Correction (ReKliEs-De) for climate extreme assessment

area	climatic index	period
Germany	$T_{max} \geq 30^{\circ}\text{C}$	1971-2000

- calculate the space-time percentile in observations that corresponds to this threshold
 - `TXobs = TXobs(d,y,x)` raw data
 - `TXobsS30 = 30.` threshold
 - `TXobs = numpy.ravel(TXobs[:, :, :])` space-time merging
 - `TXobsP30 = scipy.stats.percentileofscore(TXobs, score=TXobsS30, kind="rank")` percentile
- calculate the threshold in RCM TX_{rcm} that corresponds to the space-time percentile TX_{obsP30}
 - `TXrcmS30 = numpy.percentile(TXrcm, TXobsP30)` threshold
- results: spatial frequency distribution of hot days

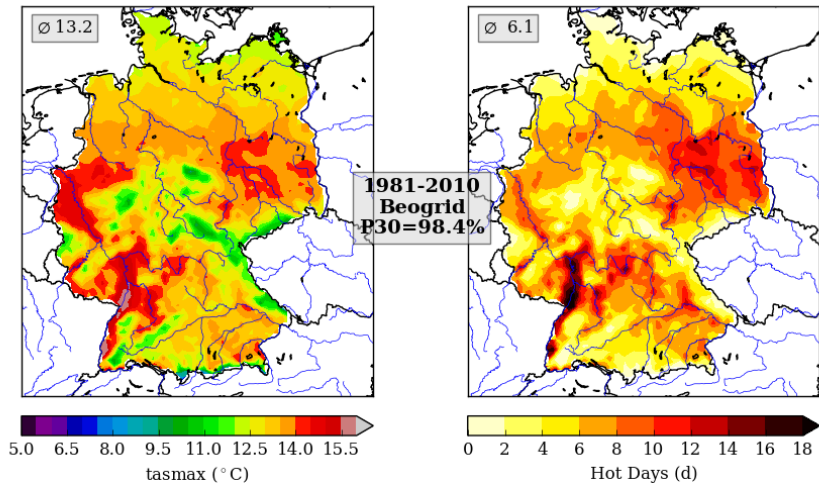
$T_{max} \geq 30^{\circ}\text{C}$ (1971-2000) $s=30.0^{\circ}\text{C}$ $p=98.75\%$ $n=4.7\text{d}$ uncorrected

observation

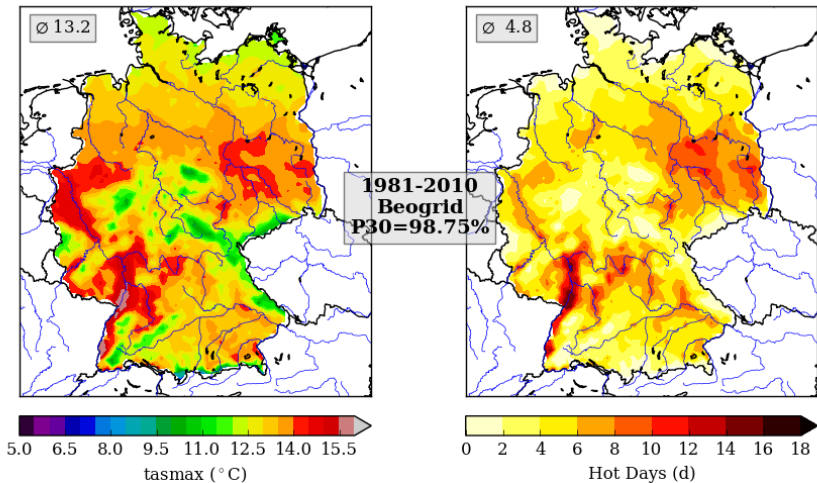


$T_{max} \geq 30^{\circ}\text{C}$ (1981-2010) $s=30.0^{\circ}\text{C}$ $p=98.40\%$ $n=6.1\text{d}$ uncorrected

observation

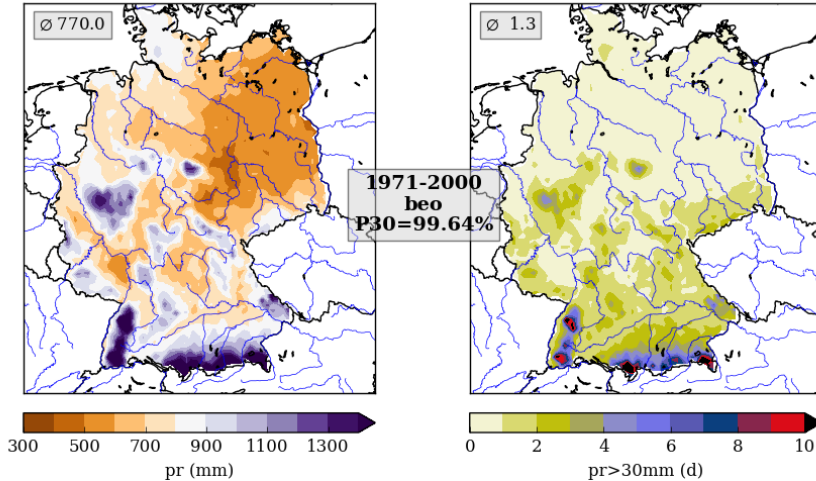


$T_{max} \geq 30^{\circ}\text{C}$ (1981-2010)	$s=30.0^{\circ}\text{C}$	$p=98.40\%$	$n=6.1\text{d}$	uncorrected
observation	$S=30.5^{\circ}\text{C}$	$P=98.75\%$	$N=4.7\text{d}$	bias-corrected

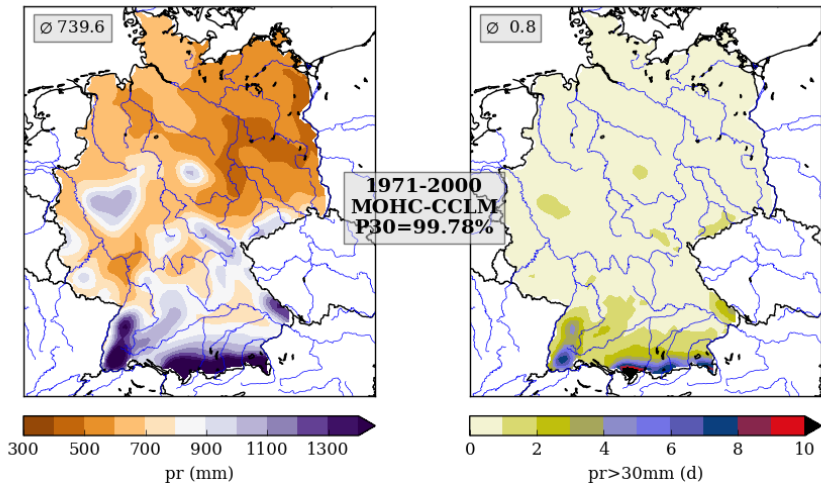


$pr > 30\text{mm}$ (1971-2000) $s=30.0\text{mm}$ $p=99.64\%$ $n=1.3d$ uncorrected

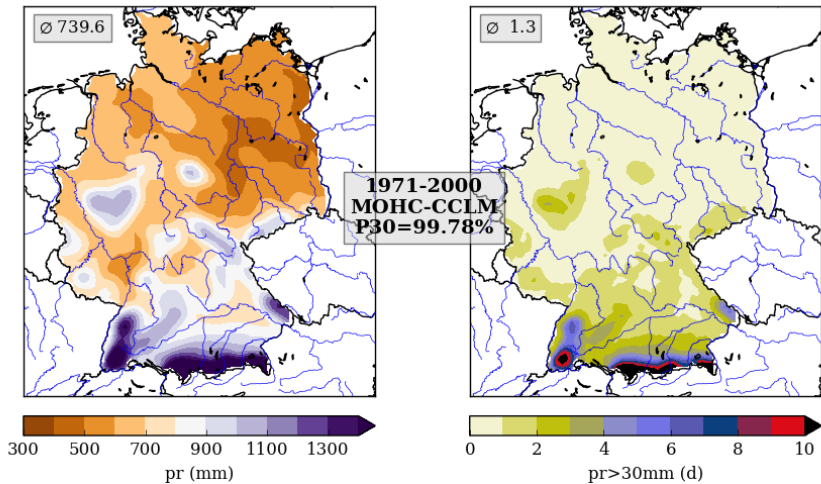
observation



$pr > 30mm$ (1971-2000) $s=30.0mm$ $p=99.78\%$ $n=0.8d$ uncorrected
simulation



$pr > 30mm$ (1971-2000)	$s=30.0mm$	$p=99.78\%$	$n=0.8d$	uncorrected
simulation	$S=26.1mm$	$P=99.64\%$	$N=1.3d$	bias-corrected



Threshold matrix: $T_{max} \geq 30^{\circ}\text{C}$ (1971-2000)

$T_{max} \geq 30^{\circ}\text{C}$	CLM	REM	RAC	HIR	WRF	RCA	W13	ST3
CA2	30.33	28.29	–	–	–	–	31.50	30.10
CN5	28.32	28.20	–	–	–	28.75	31.10	29.90
ECE	27.30	28.06	26.91	25.55	–	27.09	31.30	30.20
HG2	30.87	–	29.99	–	–	31.07	31.20	30.20
IP5	–	–	–	–	29.31	28.21	–	–
MI5	29.98	29.80	–	–	–	–	31.20	30.20
MPI	26.45	29.60	–	–	–	28.08	31.80	30.40



thresholds lower than 30°C in most of the simulations

Threshold matrix: $pr > 30mm$ (1971-2000)

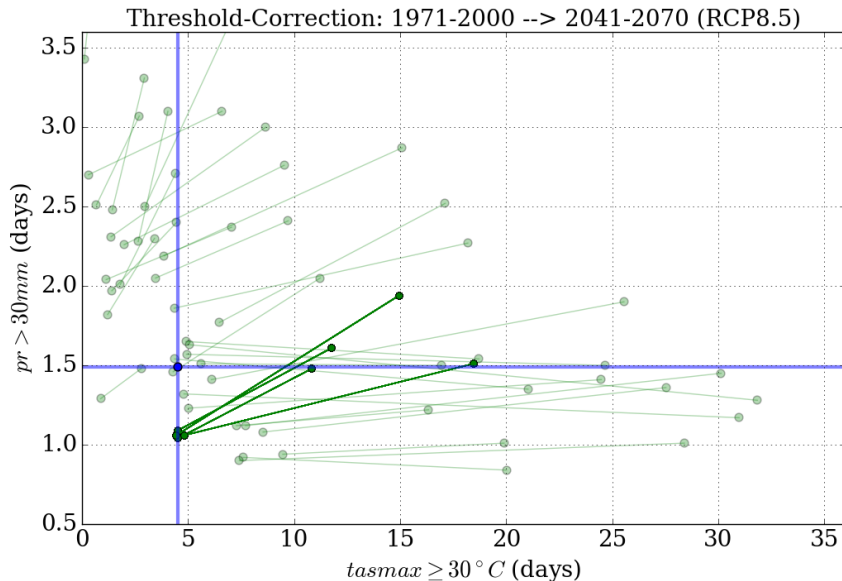
$pr > 30mm$	CLM	REM	RAC	HIR	WRF	RCA	W13	ST3
CA2	28.27	35.21	–	–	–	–	27.50	28.90
CN5	32.77	36.09	–	–	–	34.52	27.77	30.20
ECE	31.83	33.04	28.58	42.23	–	33.21	26.33	30.90
HG2	29.58	–	29.90	–	–	31.97	27.69	30.80
IP5	–	–	–	–	35.05	34.40	–	–
MI5	32.21	34.43	–	–	–	–	26.15	30.40
MPI	34.93	33.59	–	–	–	36.54	26.50	30.10



thresholds larger than 30mm in most of the simulations

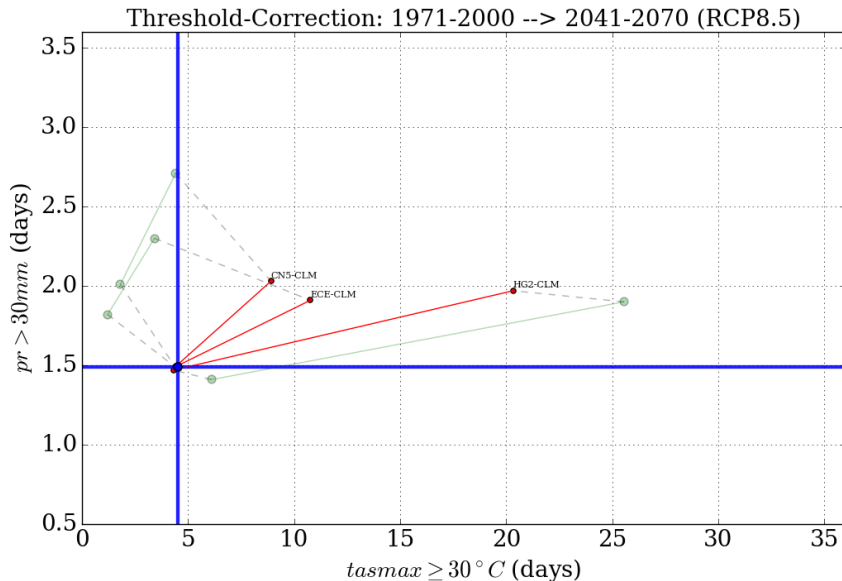
ReKliEs-De Ensemble: Projection of $T_{max} \geq 30^{\circ}\text{C}$ and $pr > 30\text{mm}$

RCMs + I2Cs



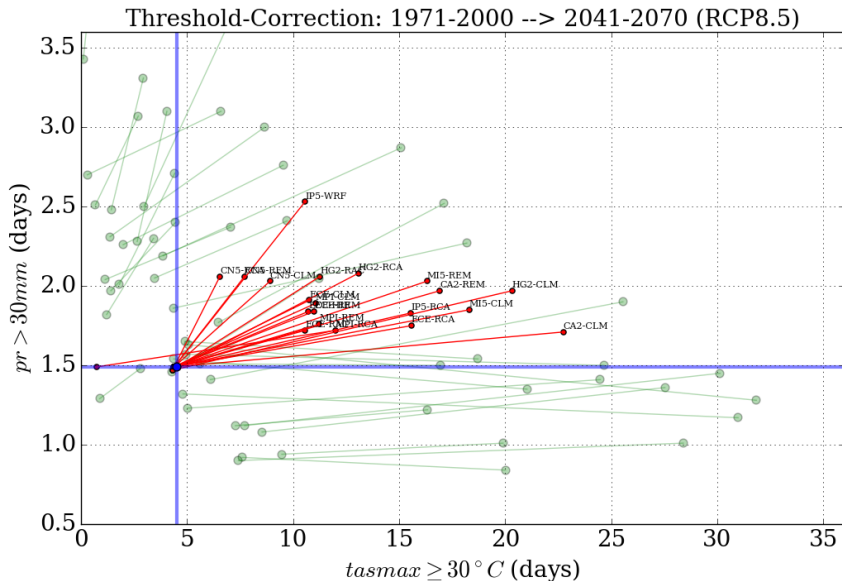
ReKliEs-De Ensemble: Projection of $T_{max} \geq 30^{\circ}\text{C}$ and $pr > 30\text{mm}$

RCMs + BCMs

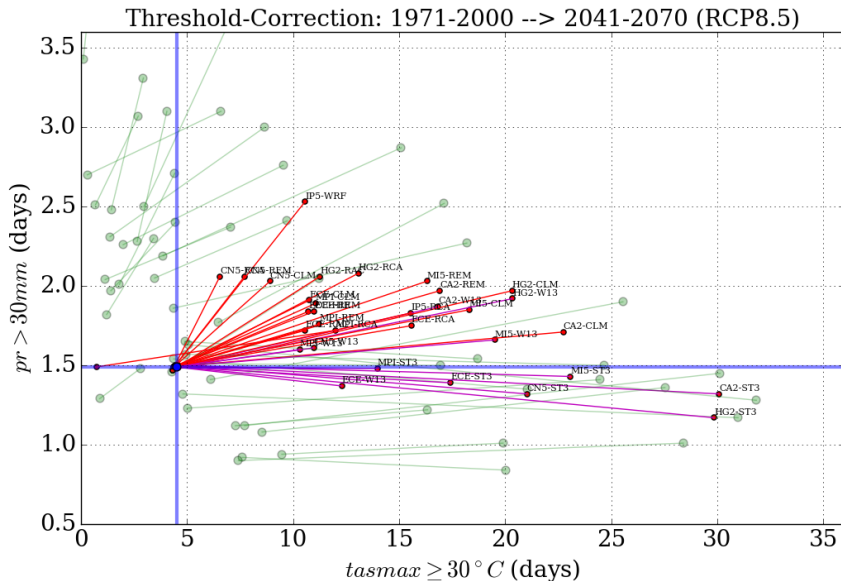


ReKliEs-De Ensemble: Projection of $T_{max} \geq 30^{\circ}\text{C}$ and $pr > 30\text{mm}$

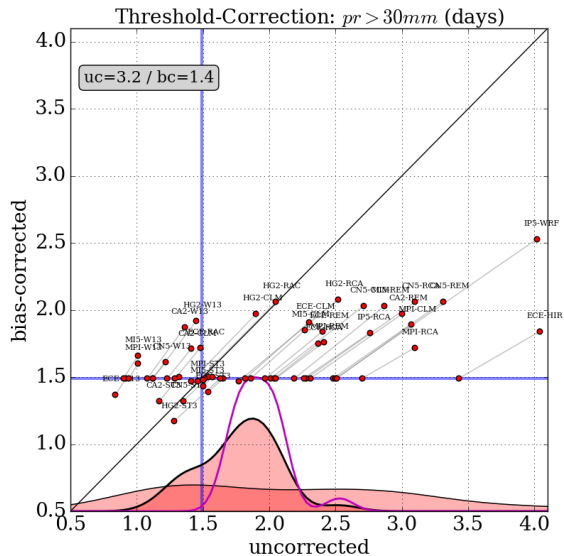
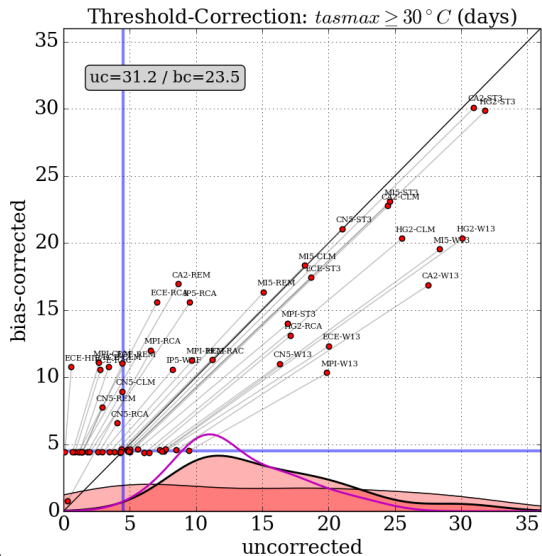
RCMs + BCMs



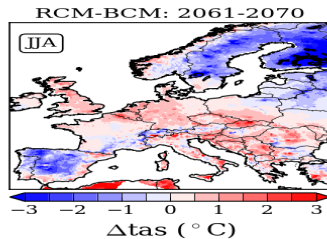
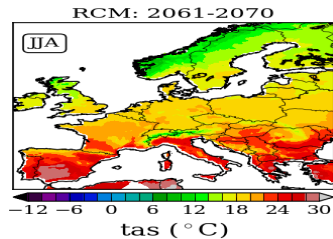
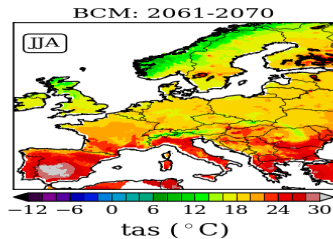
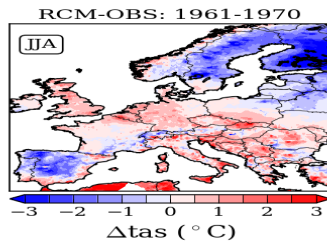
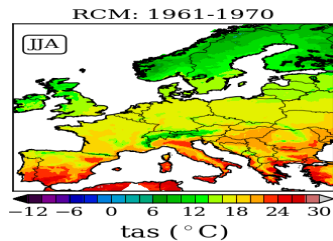
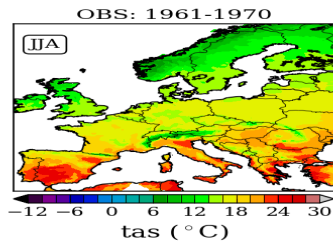
RCMs + BCMs + ESDs



ReKliEs-De Ensemble: Projection uncorrected vs. bias-corrected

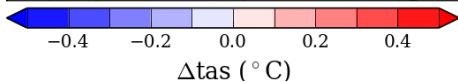
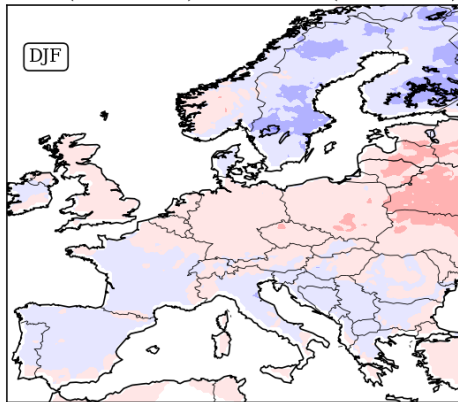


Outlook: ISIMIP Bias-correction regional/national: tas (JJA)

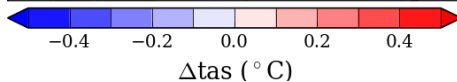
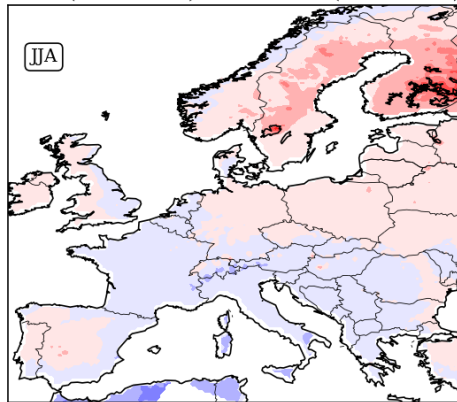


ISIMIP Bias-correction regional/national: tas (DJF) & tas (JJA)

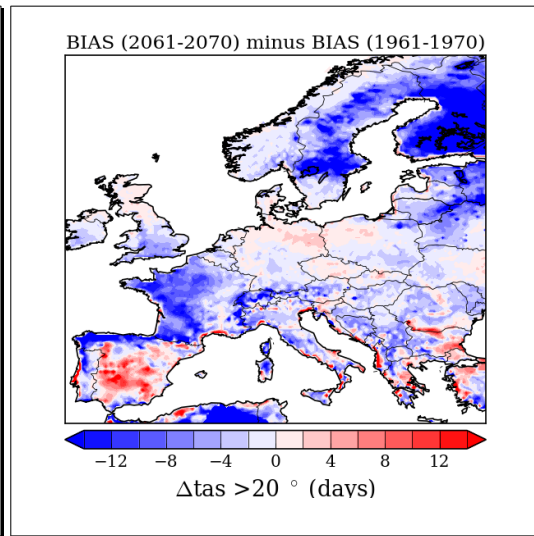
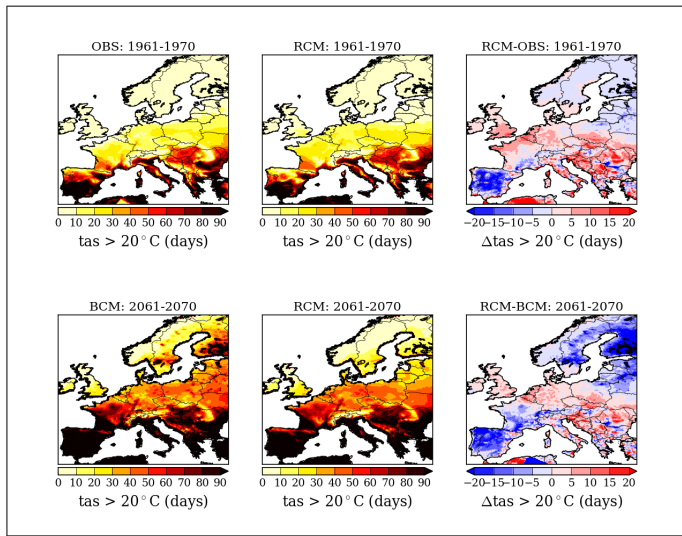
BIAS (2061-2070) minus BIAS (1961-1970)



BIAS (2061-2070) minus BIAS (1961-1970)



ISIMIP Bias-correction regional/national: $tas > 20^{\circ}\text{C}$



THANK YOU FOR YOUR ATTENTION!

