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Evaluation of regional climate models ALARO-0 and REMO2015 at 0.22° resolution over the CORDEX Central Asia domain

Sara Top et al.

Correspondence to: Sara Top (sara.top@ugent.be)

Table S1: Overview of the model specifications for the ALARO-0 and REMO RCM experiments used for this study.

	ALARO-0	REMO
projection resolution	Lambert conical projection 0.22°	rotated pole 0.22°
horizontal spatial discretisation	spectral on collocated grid	2nd order finite differences on staggered C-grid
vertical coordinate levels	46 hybrid levels	27 hybrid levels
temporal discretisation	semi-implicit semi-Lagrangian	leap-frog with semi-implicit correction and Asselin filter, semi-Lagrangian advection
time step	450 s	120 s
convective scheme	3MT scheme	Tiedtke with modifications after Nordeng and Pfeifer (Pfeifer, 2006)
radiation scheme	The Action de Recherche Petite Echelle Grande Echell (ARPEGE) Calcul Radiatif avec Nebulosité (ACRANEB) scheme for radiation	Morcrette et al. (1986) and Giorgetta and Wild (1995)
turbulence vertical diffusion	A pseudoprognostic turbulent kinetic energy (pTKE) scheme (i.e., a Louis-type scheme for stability dependencies, but with memory, advection, and autodiffusion of the overall intensity of turbulence)	Louis-type with a higher order closure scheme for the transfer coefficients of momentum, heat, moisture and cloud water within and above the planetary boundary layer. Eddy diffusion coefficients are calculated as functions of the turbulent kinetic energy.
cloud microphysics scheme	A statistical sedimentation scheme for precipitation within a prognostic-type scheme for microphysics.	The cloud microphysical scheme by Lohmann and Roeckner (1996).
land surface scheme	The Interaction Sol-Biosphère-Atmosphère (ISBA) scheme	Based on the surface runoff scheme (Hagemann, 2002), inland glaciers (Kotlarski, 2007), and vegetation phenology (Rechid, 2009)
institute	RMIB-UGent	HZG-GERICS (https://remo-rcm.de/)

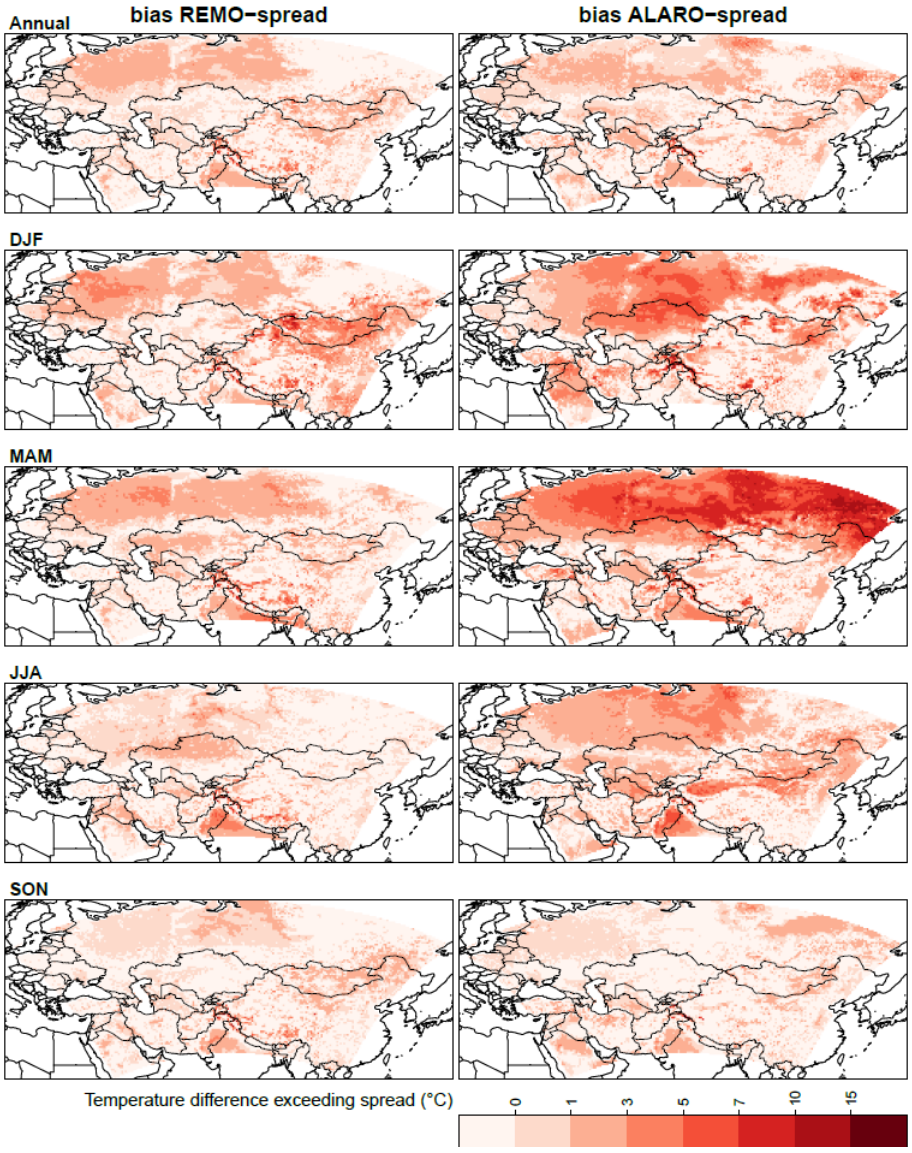

Figure S1: Difference between absolute value of bias and observational spread for the variable mean temperature (°C) of RCMs REMO and ALARO-0.

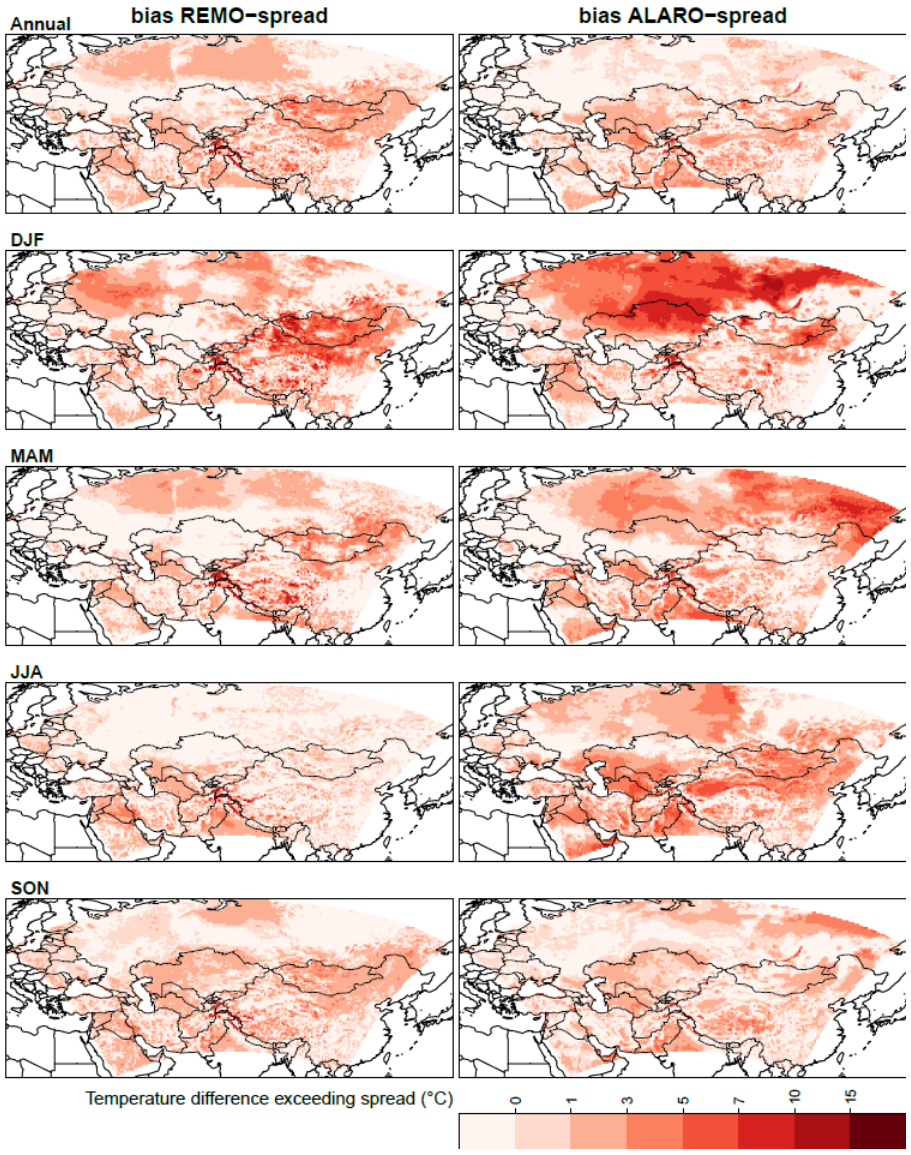

Figure S2: Difference between absolute value of bias and observational spread for the variable minimum temperature (°C) of RCMs REMO and ALARO-0.

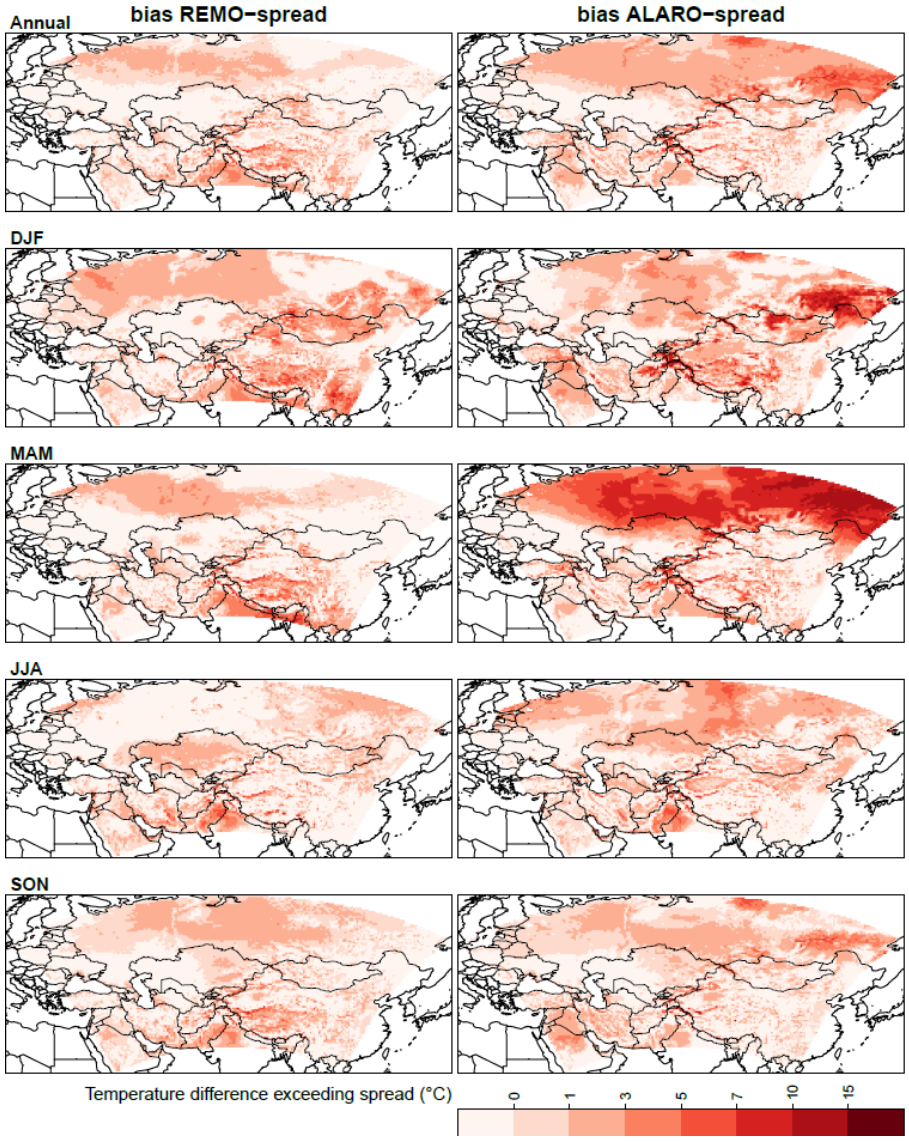

Figure S3: Difference between absolute value of bias and observational spread for the variable maximum temperature (°C) of RCMs REMO and ALARO-0.

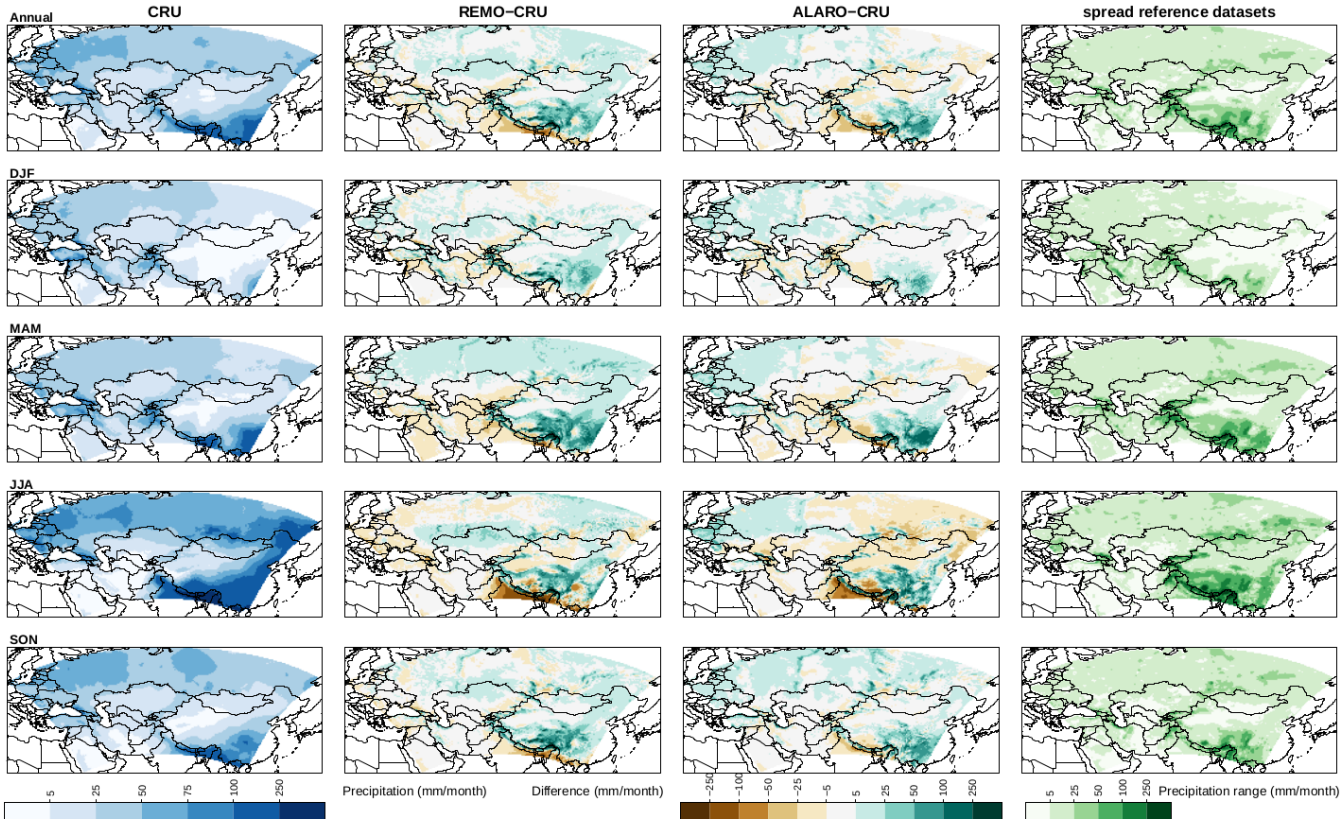

Figure S4: Absolute difference between the average seasonal and annual CRU precipitation (mm month^{-1}) and the precipitation simulated by REMO and ALARO-0 over the 1980-2017 period.

Table S2: Climatological mean CRU precipitation (mm month^{-1}) for the 1980-2017 period over the CAS-CORDEX domain and subdomains, and absolute biases (mm month^{-1}) and MAE (mm month^{-1}) against CRU for the RCMs (REMO and ALARO-0), and the other reference datasets (ERA-Interim, MW and GPCC).

	EEU					WSB					ESB				
	DJF	MAM	JJA	SON	Annual	DJF	MAM	JJA	SON	Annual	DJF	MAM	JJA	SON	Annual
CRU	34.91	34.16	55.26	45.62	42.51	22.74	27.99	51.53	35.94	34.60	11.13	22.10	72.28	29.62	33.90
REMO - CRU	4.18	6.83	4.02	4.31	4.84	3.73	7.10	6.72	4.96	5.64	3.33	14.01	5.73	6.35	7.38
MAE REMO CRU	5.62	7.86	8.64	5.61	5.62	6.23	9.83	10.73	7.69	7.31	5.18	15.00	11.37	9.09	8.88
ALARO - CRU	7.45	3.95	5.50	8.33	6.29	4.55	0.90	-2.21	6.05	2.30	3.91	-0.26	-13.52	6.08	-0.99
MAE ALARO CRU	8.04	5.72	10.58	8.73	7.18	5.93	4.66	8.11	7.59	4.85	5.24	5.14	18.38	8.65	5.96
ERA-Interim - CRU	4.49	6.53	5.75	3.98	5.19	3.99	7.46	8.35	5.50	6.34	3.26	12.61	8.19	9.07	8.30
MAE ERA-Interim CRU	5.18	6.59	6.62	4.46	5.33	4.80	8.47	9.41	6.10	6.97	4.08	12.88	11.21	9.71	8.84
MW - CRU	-3.69	-2.33	-3.69	-2.89	-3.14	-1.75	-1.47	-4.13	-2.00	-2.34	-0.42	-3.42	-9.59	-2.72	-4.05
MAE MW CRU	4.49	3.07	4.44	4.49	4.49	3.48	3.69	6.10	3.48	3.48	2.09	4.42	11.04	2.09	2.09
GPCC - CRU	-8.21	-5.23	-4.05	-5.19	-5.65	-2.70	-3.19	-1.81	-2.81	-2.63	-0.81	-4.59	-6.57	-3.72	-3.94
MAE GPCC CRU	8.82	5.68	5.85	8.82	8.82	4.88	5.02	4.70	4.88	4.88	2.38	5.15	8.24	2.38	2.38
	WCA					TIB					CAS-CORDEX				
	DJF	MAM	JJA	SON	Annual	DJF	MAM	JJA	SON	Annual	DJF	MAM	JJA	SON	Annual
CRU	33.18	37.52	16.74	18.45	26.46	8.12	17.73	48.56	15.02	22.45	22.60	32.34	64.75	35.50	38.88
REMO - CRU	5.77	-3.59	-3.20	3.24	0.53	21.07	34.40	15.23	28.07	24.70	6.55	12.45	2.47	6.98	7.12
MAE REMO CRU	17.57	16.96	7.87	8.51	11.32	24.04	39.38	32.92	30.72	30.47	10.85	18.88	18.13	12.80	13.56
ALARO - CRU	-0.71	-1.75	-3.00	1.61	-0.96	2.15	6.37	6.85	5.64	5.26	5.04	6.14	0.74	7.82	4.93
MAE ALARO CRU	11.24	11.63	11.06	8.09	9.13	7.83	16.36	32.96	12.83	16.29	8.31	12.75	19.82	11.69	11.41
ERA-Interim - CRU	6.90	10.79	12.85	7.02	9.41	4.76	20.81	30.60	10.98	16.86	4.88	12.37	12.50	7.61	9.37
MAE ERA-Interim CRU	10.46	14.20	15.02	8.85	11.13	7.88	23.20	39.94	13.36	19.98	6.85	14.00	17.27	9.50	11.08
MW - CRU	-1.22	-2.98	-0.33	1.20	-0.83	1.11	0.53	4.14	3.07	2.21	-1.28	-1.25	-1.75	-0.84	-1.28
MAE MW CRU	9.75	9.57	5.00	9.75	9.75	6.13	9.50	20.30	6.13	6.13	4.56	6.08	11.10	4.56	4.56
GPCC - CRU	0.08	-2.50	-1.21	-0.38	-1.01	-0.74	-3.08	-2.11	-0.30	-1.57	-1.65	-2.65	-0.92	-1.89	-1.77
MAE GPCC CRU	10.44	8.73	5.03	10.44	10.44	5.88	9.81	20.44	5.88	5.88	5.82	6.52	10.64	5.82	5.82

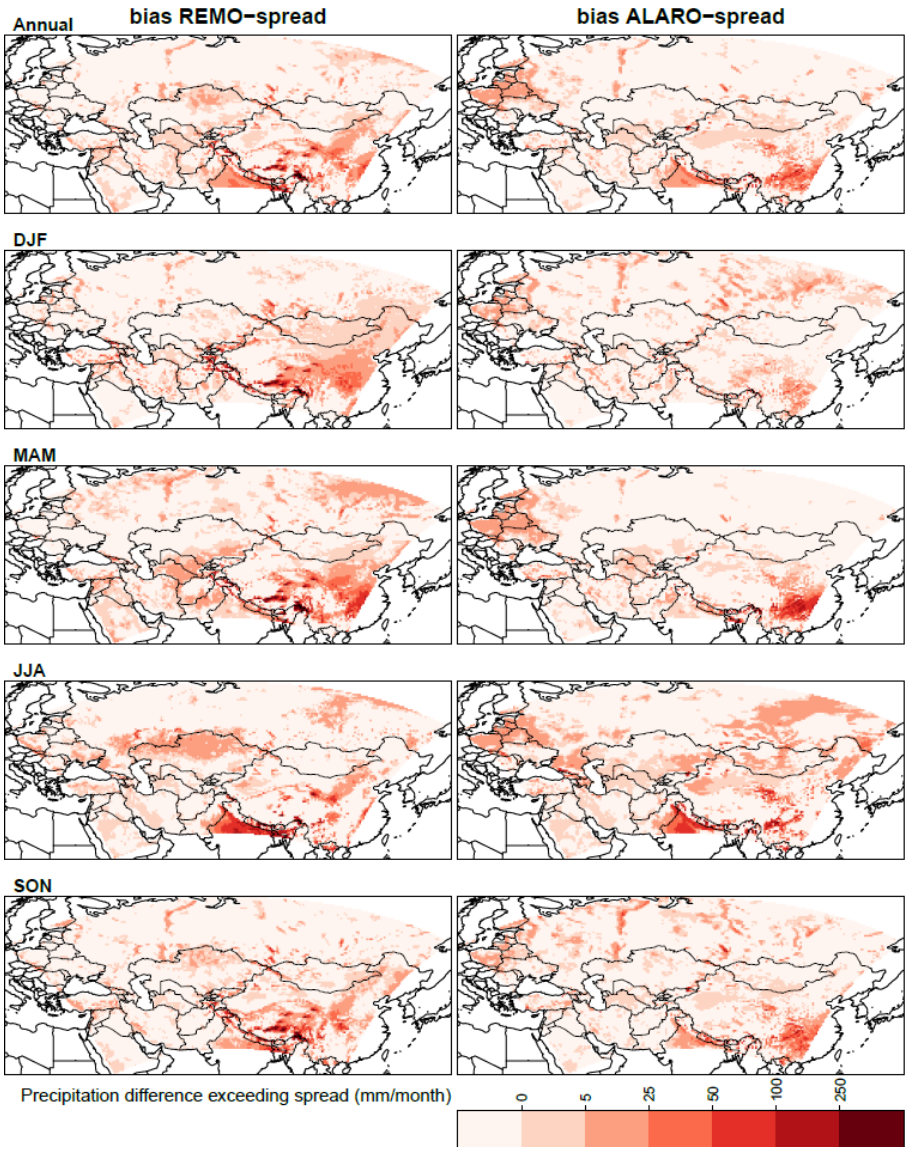

Figure S5: Difference between absolute bias and observational spread for the variable precipitation of RCMs REMO and ALARO-0.

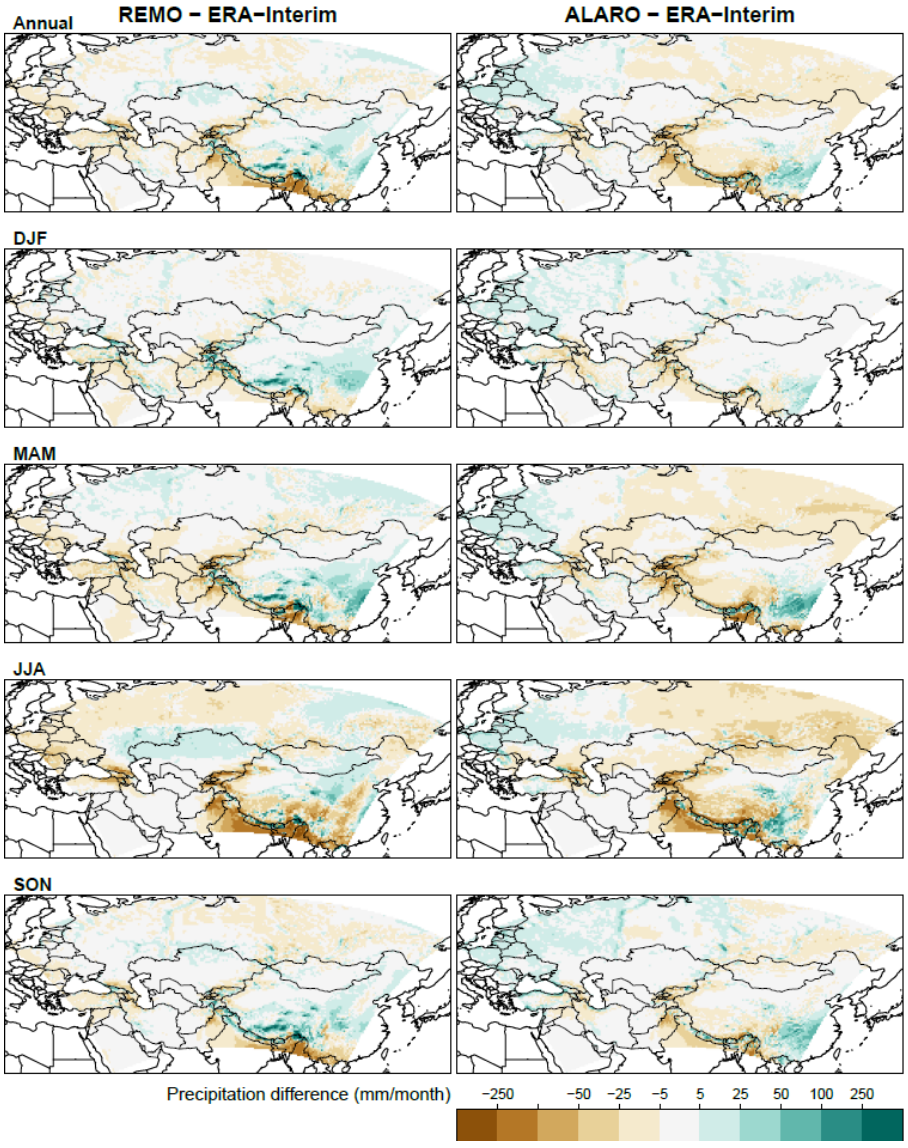

Figure S6: Absolute difference between the average seasonal and annual ERA-Interim precipitation (mm month^{-1}) and the precipitation simulated by REMO and ALARO-0 over the 1980-2017 period.

Table S3: Overview of the identifiers on the ESGF data platform (data node: esgf1.dkrz.de) of the used ALARO-0 and REMO RCM climate data.

Data	Identifier	PID
ALARO-0		
precipitation	cordex.output.CAS-22.RMIB-UGent.ECMWF-ERAINT.evaluation.r1i1p1.ALARO-0.v1.mon.pr	/
temperature	cordex.output.CAS-22.RMIB-UGent.ECMWF-ERAINT.evaluation.r1i1p1.ALARO-0.v1.mon.tas	/
minimum temperature	cordex.output.CAS-22.RMIB-UGent.ECMWF-ERAINT.evaluation.r1i1p1.ALARO-0.v1.mon.tasmin	/
maximum temperature	cordex.output.CAS-22.RMIB-UGent.ECMWF-ERAINT.evaluation.r1i1p1.ALARO-0.v1.mon.tasmax	/
REMO		
precipitation	cordex.output.CAS-22.GERICS.ECMWF-ERAINT.evaluation.r1i1p1.REMO2015.v1.day.pr	hdl:21.14103/2ecffe86-b5e4-359c-8c34-e7152de17a43
temperature	cordex.output.CAS-22.GERICS.ECMWF-ERAINT.evaluation.r1i1p1.REMO2015.v1.day.tas	hdl:21.14103/bf8468cf-b15c-3a20-ae42-4c42b14e749c
minimum temperature	cordex.output.CAS-22.GERICS.ECMWF-ERAINT.evaluation.r1i1p1.REMO2015.v1.day.tasmin	hdl:21.14103/74aa90a5-c99b-35f9-888e-acc0115dfc4d
maximum temperature	cordex.output.CAS-22.GERICS.ECMWF-ERAINT.evaluation.r1i1p1.REMO2015.v1.sem.tasmax	hdl:21.14103/a72e5ea1-533d-3685-b04d-5e4ab162e065