

Comparison of two gridded climatological observation-based datasets for use in climate projections development

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Why is it important?

Future climate projections are based on future climate simulations by numerical climate models. Model performance is evaluated by comparing historical model simulations against observations. As model simulations are gridded, gridded observation-based datasets are widely used as the evaluation reference. These datasets can be created either by interpolation of station observations, or by using station observations as input into numerical weather prediction models producing reanalyses (simulated gridded 'observations').

Specifics of the method used to create a gridded observation-based dataset (e.g. interpolation method, NWP model) cause individual datasets to differ, leading to uncertainty in climate model evaluation. For credible model evaluation and therefore credible future climate projections, it is important to assess this uncertainty. Additionally, this uncertainty can be reduced by avoiding the use of gridded datasets which show large inconsistencies with station observations.

The datasets

two gridded datasets

- CARPATCLIM (CCLIM)
gridded observations, 1961-2005
- ERA5-Land (ERA5)
high-resolution reanalysis, 1951-2005

station observations - 10 stations, 1951-2005

compared climatological variables:

- daily precipitation (PR)
- daily temperature averages (TAS)
- daily temperature maxima (TASMAX)
- daily temperature minima (TASMIN)

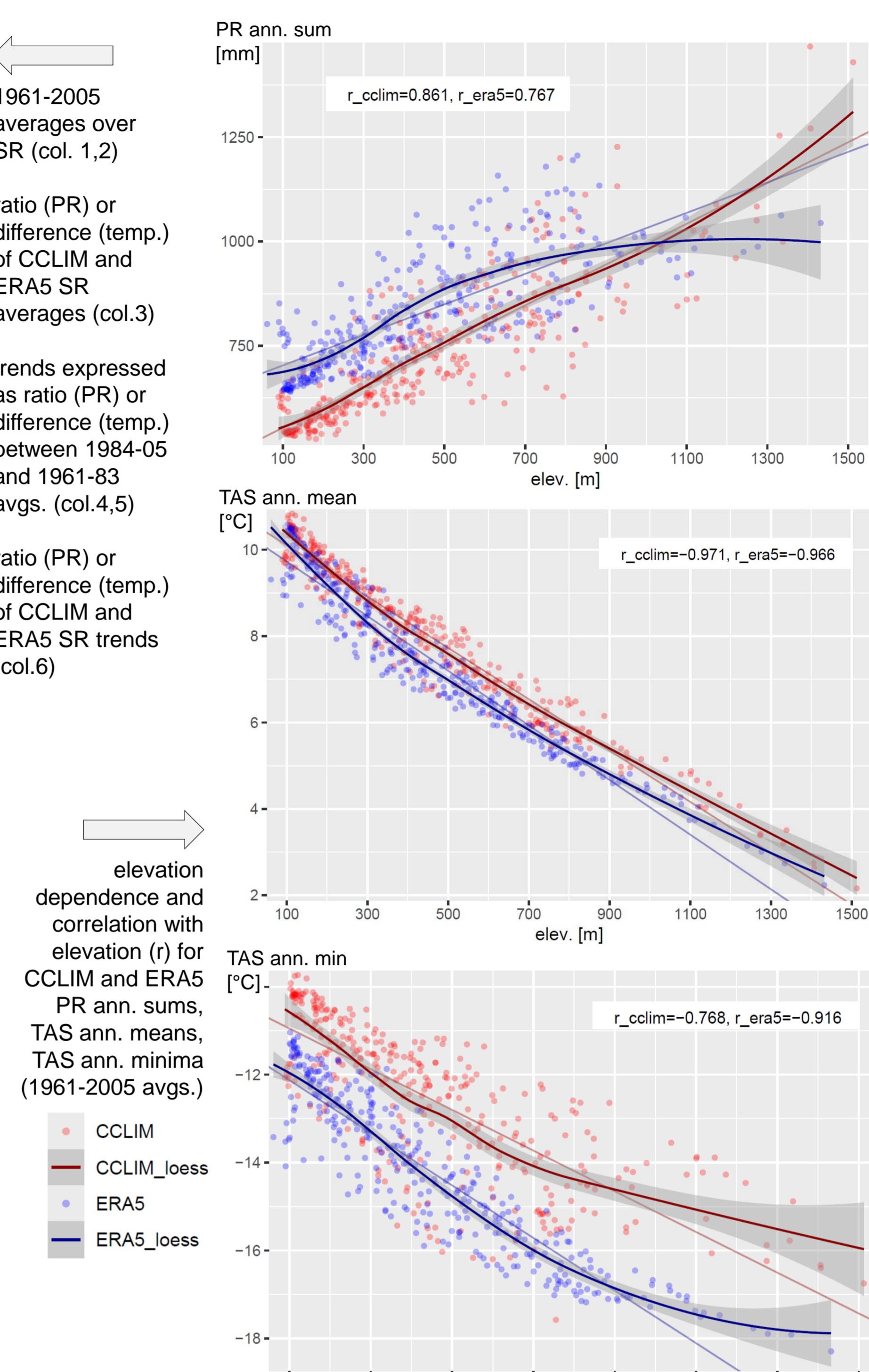
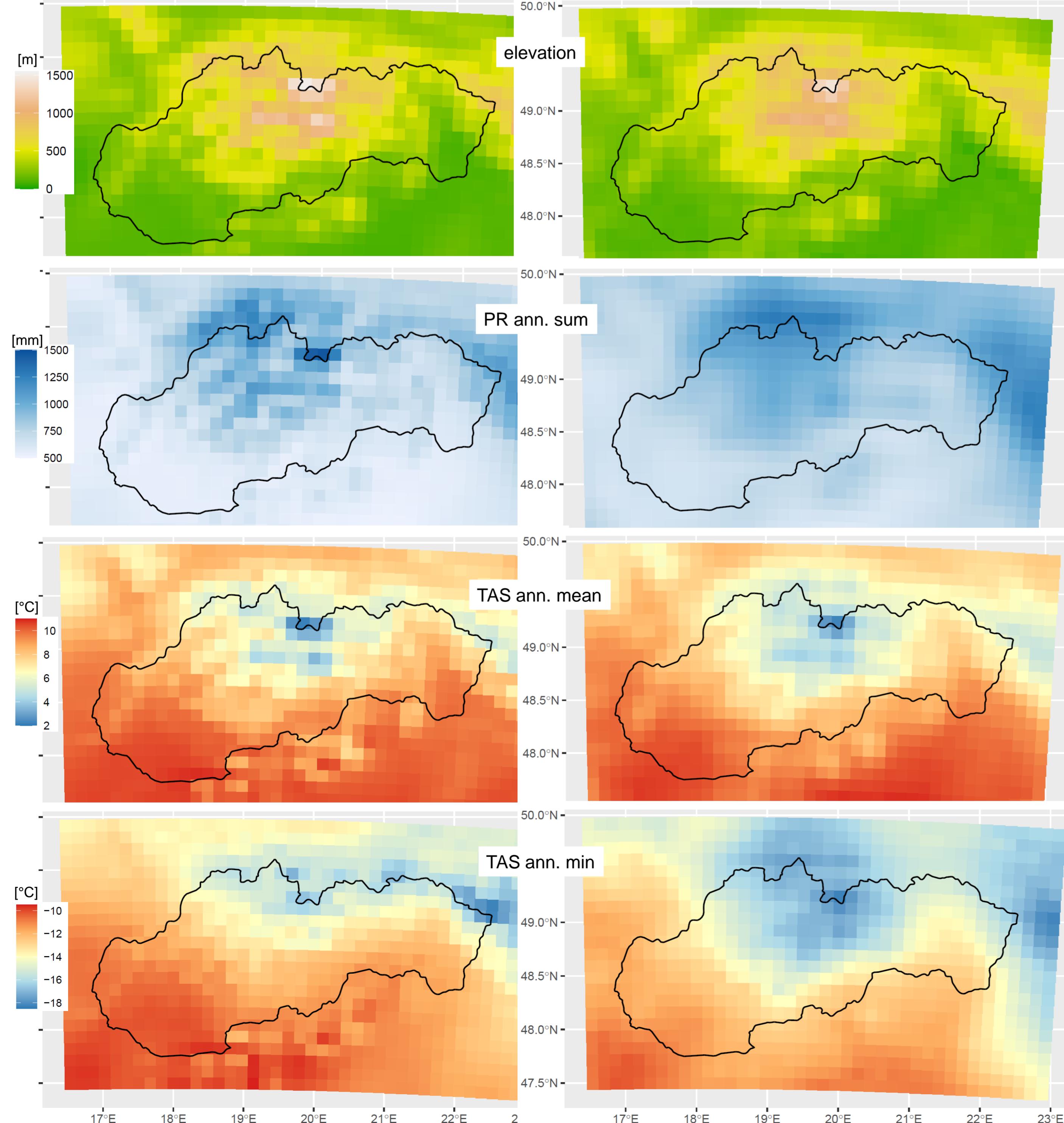
Key findings

There are significant differences between the two compared gridded observation-based datasets.

CARPATCLIM corresponds to station observations to a considerably greater degree than ERA5-Land.

PR [mm]	CCLIM	ERA5	CCLIM /ERA5	CCLIM trend	ERA5 trend	CCLIMtr /ERA5tr
sum	726	831	0.87	1	0.97	1.03
sumSpr	170	208	0.82	1.08	1.02	1.06
sumSumm	252	280	0.9	0.97	0.97	1
sumFall	169	186	0.91	1.02	0.99	1.03
sumWint	131	154	0.85	0.88	0.86	1.03
meanDwp	3.2	2.7	1.17	1.02	0.99	1.03
q90Dwp	8.9	7.8	1.15	1.02	0.99	1.03
max	34.4	30.5	1.13	1.07	1.04	1.03
iqrDwp	3.8	3.3	1.16	1.02	0.97	1.05
DWOP [n.]	138	61	2.25	1.04	1.12	0.92
TAS [°C]	CCLIM	ERA5	CCLIM - ERA5	CCLIM trend	ERA5 trend	CCLIMtr -ERA5tr
mean	8.0	7.5	0.5	0.5	0.6	-0.1
meanSpr	8.1	7.5	0.6	0.5	0.7	-0.2
meanSumm	17.2	17.1	0.1	0.8	0.8	0.1
meanFall	8.5	8.1	0.4	0.1	0.1	0.0
meanWint	-2.0	-2.8	0.8	0.6	1.0	-0.4
min	-12.6	-14.2	1.7	0.2	0.6	-0.4
q10	-3.3	-3.9	0.6	0.3	0.9	-0.6
q90	18.4	18.2	0.2	0.7	0.7	0.0
max	23.6	23.7	-0.1	1.3	1.2	0.1
iqr	13.8	14.2	-0.4	0.1	-0.2	0.3
TASMAX [°C]	CCLIM	ERA5	CCLIM - ERA5	CCLIM trend	ERA5 trend	CCLIMtr -ERA5tr
mean	12.7	11.4	1.3	0.6	0.8	-0.2
q90	24.9	23.1	1.8	0.9	0.8	0.0
max	31.0	29.4	1.7	1.5	1.3	0.2
iqr	16.3	15.5	0.8	0.1	-0.3	0.4
TASMIN [°C]	CCLIM	ERA5	CCLIM - ERA5	CCLIM trend	ERA5 trend	CCLIMtr -ERA5tr
mean	3.4	3.4	0.0	0.4	0.6	-0.2
q90	-6.8	-7.3	0.5	0.4	1.1	-0.8
max	-18.2	-19.7	1.5	0.3	1.0	-0.7
iqr	11.5	12.5	-1.0	0.3	-0.1	0.4

spatial fields for elevation and 1961-2005 averaged statistics:
PR annual sum, TAS annual mean, TAS annual minima;
CCLIM on the left, ERA5 on the right



Comparison to station data

CARPATCLIM aside from a few exceptions corresponds well to station data for both trends and averages (with a suitable choice of reference grid point). Exceptions: different trends for ann. and wint. PR sums for Oravská Lesná, higher TASMIN averages for Oravská Lesná and Bratislava-Koliba. These differences could be caused by local effects specific to station. There is also a difference in PR distribution (less DWOP, smaller mean, q10,max), and lower temperature maxima and higher minima compared to stations, all of which are a likely consequence of the gridding process.

ERA5-land is less consistent with stations compared to CARPATCLIM. Trends between 1951-60 do not agree with stations. Similar to CCLIM, some of the trends for Oravská Lesná are different. In addition, for multiple stations ERA5 shows different trends for multiple TAS and TASMIN statistics, and moderate differences in annual cycles. Compared to multiple stations ERA5 also shows larger PR sums, lower values of TASMAX statistics and different values for some TAS and TASMIN statistics. As for CCLIM, there is an expected difference in PR distribution, however for ERA5 this is much more pronounced, with DWOP being largely underestimated compared to station data (possible numerical model 'drizzle effect').

