1   *Hydrology and Earth System Sciences*

2   Supplementary Material for

3   **Towards the Development of a Pan-European Stochastic**
4   **Precipitation Dataset**

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10 **0. Contents of this file**

15 **1. Evaluation of bias correction methods in a climatological perspective**

16 Tables S1, S2, S3, and S4 contain the results of the evaluation of the tested bias correction methods
17 for the Elbe, Oder, Rhine, and Vistula catchments. The results are already discussed in Sect. 4 of the
18 main paper.

19 **2. Added value of bias correction for extreme precipitation events**

20 Figure S1 shows the time evolution of the Rhine flood in May 1983. Figures S2 and S3 show the
21 precipitation pattern for the 1997 and 2002 flooding events. The results are already discussed in
22 Sect. 5 of the main paper. Table S5 shows the added value of bias correction for the top ten river
23 floods between 1979 and 2010 for ERA20C-CCLM.

Table S1. Root mean square error (RMSE), Pearson's correlation coefficients (R) and Taylor's skill scores (S) for the raw model runs plus for the model runs with different bias corrections just for the Elbe catchment: linear scaling (LS), local intensity scaling (LOCI), power transformation (PT), empirical quantile mapping (EQM), and quantile mapping with gamma distribution (GQM). Results of ERAI-CCLM based on RPI and of ERA20C-CCLM on RPII. Best values of each measure are print in bold.

	ERAI-CCLM			ERA20C-CCLM		
	RMSE	R	S	RMSE	R	S
raw	2.178	0.641	0.950	2.454	0.509	0.952
$LS_{monthly}$	2.224	0.640	0.948	2.551	0.506	0.947
$LS_{seasonal}$	2.220	0.641	0.948	2.549	0.505	0.946
$LS_{half-yearly}$	2.225	0.637	0.946	2.542	0.503	0.946
$LOCI_{monthly}$	2.268	0.640	0.944	2.605	0.505	0.941
$LOCI_{seasonal}$	2.265	0.640	0.945	2.603	0.504	0.941
$LOCI_{half-yearly}$	2.269	0.637	0.943	2.596	0.502	0.941
$PT_{monthly}$	2.105	0.659	0.960	2.406	0.528	0.965
$PT_{seasonal}$	2.108	0.657	0.959	2.409	0.527	0.964
$PT_{half-yearly}$	2.110	0.656	0.958	2.409	0.526	0.963
$EQM_{monthly}$	2.154	**0.662**	**0.961**	2.466	**0.531**	**0.965**
$EQM_{seasonal}$	2.164	0.659	0.959	2.476	0.528	0.962
$EQM_{half-yearly}$	2.177	0.655	0.957	2.482	0.525	0.961
$GQM_{monthly}$	**2.101**	0.657	0.958	**2.401**	0.527	0.964
$GQM_{seasonal}$	2.108	0.655	0.957	2.410	0.524	0.962
$GQM_{half-yearly}$	2.116	0.652	0.955	2.413	0.521	0.959

Table S2. As in Tab. S1, but for the Oder catchment.

	ERAI-CCLM			ERA20C-CCLM		
	RMSE	R	S	RMSE	R	S
raw	2.546	0.538	0.947	2.997	0.320	0.879
$LS_{monthly}$	2.642	0.547	0.953	2.976	0.429	0.949
$LS_{seasonal}$	2.650	0.542	0.950	2.963	0.425	0.948
$LS_{half-yearly}$	2.655	0.538	0.948	2.954	0.424	0.948
$LOCI_{monthly}$	2.445	0.548	0.932	2.767	0.429	0.952
$LOCI_{seasonal}$	2.457	0.543	0.928	2.764	0.425	0.948
$LOCI_{half-yearly}$	2.462	0.539	0.925	2.759	0.423	0.946
$PT_{monthly}$	2.455	**0.564**	**0.961**	2.726	**0.449**	**0.968**
$PT_{seasonal}$	2.462	0.562	0.959	2.727	0.448	0.967
$PT_{half-yearly}$	2.468	0.560	0.958	2.728	0.447	0.966
$EQM_{monthly}$	**2.430**	0.564	0.956	**2.726**	0.448	0.967
$EQM_{seasonal}$	2.460	0.555	0.951	2.739	0.443	0.963
$EQM_{half-yearly}$	2.469	0.551	0.949	2.747	0.440	0.961
$GQM_{monthly}$	2.465	0.561	0.959	2.737	0.447	0.967
$GQM_{seasonal}$	2.490	0.554	0.955	2.748	0.442	0.963
$GQM_{half-yearly}$	2.498	0.550	0.953	2.748	0.439	0.961

31 **Table S3.** As in Tab. S1, but for the Rhine catchment.

	ERAI-CCLM			ERA20C-CCLM		
	RMSE	R	S	RMSE	R	S
raw	2.693	0.745	0.945	2.992	0.647	0.951
$LS_{monthly}$	2.638	0.743	0.947	3.032	0.643	0.949
$LS_{seasonal}$	2.635	0.743	0.948	3.035	0.642	0.948
$LS_{half-yearly}$	2.630	0.743	0.948	3.026	0.642	0.948
$LOCI_{monthly}$	2.691	0.743	0.945	3.094	0.643	0.946
$LOCI_{seasonal}$	2.688	0.743	0.945	3.096	0.642	0.946
$LOCI_{half-yearly}$	2.683	0.743	0.945	3.087	0.641	0.946
$PT_{monthly}$	2.526	0.761	**0.957**	2.916	0.663	**0.960**
$PT_{seasonal}$	2.534	0.759	0.956	2.919	0.662	0.960
$PT_{half-yearly}$	2.536	0.759	0.956	2.921	0.661	0.960
$EQM_{monthly}$	2.616	**0.763**	0.955	3.008	**0.665**	0.959
$EQM_{seasonal}$	2.627	0.761	0.954	3.016	0.663	0.958
$EQM_{half-yearly}$	2.635	0.759	0.953	3.025	0.660	0.957
$GQM_{monthly}$	**2.523**	0.759	0.956	**2.910**	0.661	0.959
$GQM_{seasonal}$	2.536	0.757	0.955	2.919	0.659	0.958
$GQM_{half-yearly}$	2.542	0.756	0.955	2.915	0.659	0.958

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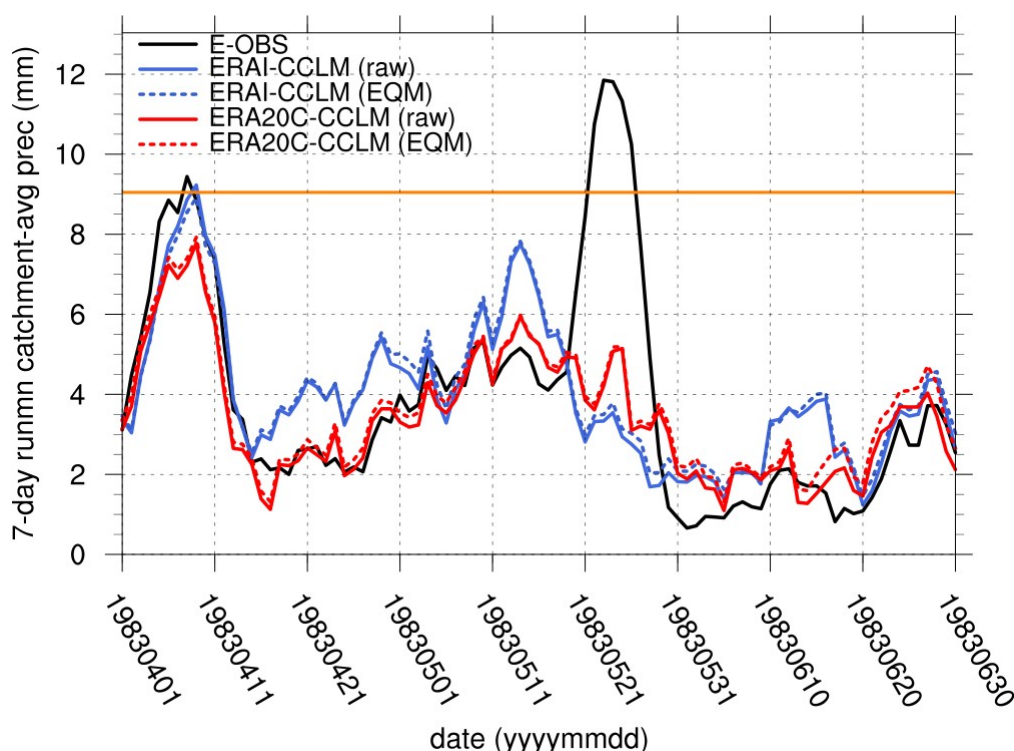
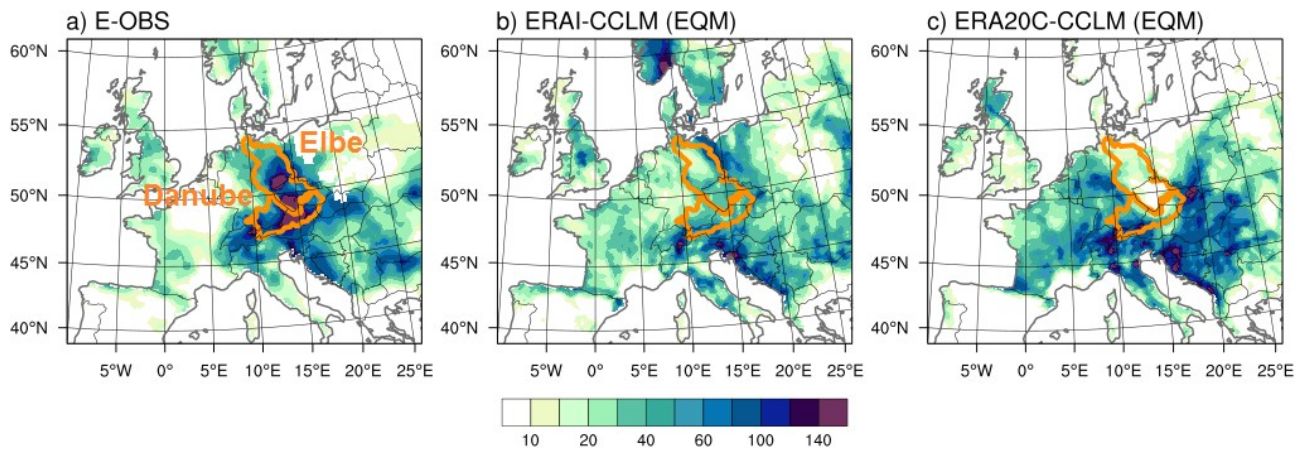
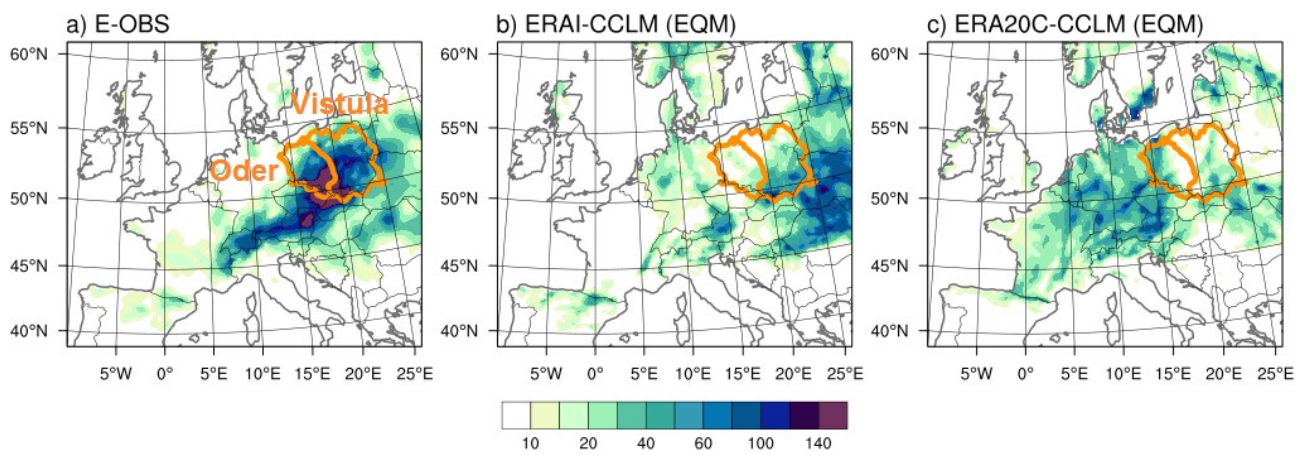
33 **Table S4.** As in Tab. S1, but for the Vistula catchment.

	ERAI-CCLM			ERA20C-CCLM		
	RMSE	R	S	RMSE	R	S
raw	2.545	0.533	0.952	2.986	0.283	0.849
$LS_{monthly}$	2.648	0.534	0.956	2.833	0.438	0.940
$LS_{seasonal}$	2.632	0.535	**0.956**	2.816	0.437	0.942
$LS_{half-yearly}$	2.635	0.533	0.956	2.806	0.435	0.942
$LOCI_{monthly}$	2.421	0.531	0.853	2.590	0.433	0.939
$LOCI_{seasonal}$	2.419	0.531	0.849	2.583	0.432	0.937
$LOCI_{half-yearly}$	2.421	0.530	0.848	2.579	0.429	0.933
$PT_{monthly}$	2.425	**0.550**	0.944	2.524	**0.465**	**0.965**
$PT_{seasonal}$	2.428	0.548	0.943	2.526	0.463	0.964
$PT_{half-yearly}$	2.426	0.549	0.943	2.529	0.461	0.962
$EQM_{monthly}$	**2.405**	0.546	0.926	**2.518**	0.462	0.962
$EQM_{seasonal}$	2.414	0.543	0.924	2.529	0.458	0.959
$EQM_{half-yearly}$	2.409	0.544	0.924	2.539	0.453	0.956
$GQM_{monthly}$	2.442	0.547	0.946	2.541	0.461	0.963
$GQM_{seasonal}$	2.447	0.545	0.945	2.547	0.458	0.961
$GQM_{half-yearly}$	2.442	0.546	0.944	2.555	0.453	0.957

34 **Table S5.** Top 10 events of the five investigated river catchments for the time period from 1979 to
2010. The events are identified as the ten highest catchment-averaged 7-day running means of
precipitation from E-OBS. The indicated dates (YYYY-MM-DD) address the timing of the peak
value. Events where bias correction (EQM monthly) do not have an added value and the ERA20C-
CCLM shows large differences towards observations are printed in italic (-) Events which are
already captured well in ERA20C-CCLM, so that bias correction cannot lead to a further
improvement, are printed standard (0). Events where bias correction has an added value are in bold
print (+). The underlined events are very well captured.

Top 10	Rhine		Danube		Elbe		Oder		Vistula	
1	**1991-12-19**	(+)	*2002-08-09*	(-)	*2002-08-09*	(-)	*1997-07-06*	(-)	*2010-09-03*	(-)
2	1998-10-26	(0)	**1979-06-16**	(+)	*1983-08-04*	(-)	**1981-07-21**	(+)	*2006-08-09*	(-)
3	1986-10-22	(0)	**1981-07-18**	(+)	*1986-12-30*	(-)	**1996-07-09**	(+)	*1992-09-04*	(-)
4	1995-01-25	(0)	**2009-06-22**	(+)	*1997-07-18*	(-)	*1995-08-31*	(-)	*2009-06-22*	(-)
5	1990-02-13	(0)	**1985-08-04**	(+)	**1981-07-21**	(+)	**2001-07-18**	(+)	*1997-07-06*	(-)
6	1993-12-22	(0)	**1995-08-29**	(+)	**1998-10-29**	(+)	*2010-07-20*	(-)	2007-07-07	(0)
7	*1983-05-23*	(-)	**2002-03-21**	(+)	*2010-09-26*	(-)	*2002-08-13*	(-)	*1995-09-01*	(-)
8	2004-01-11	(0)	*2006-08-04*	(-)	**1995-08-29**	(+)	*2006-08-05*	(-)	*2001-07-23*	(-)
9	**1984-09-07**	(+)	**2003-10-06**	(+)	**1996-07-08**	(+)	1986-06-02	(0)	*2010-05-15*	(-)
10	1983-11-27	(0)	**1991-07-30**	(+)	2001-09-10	(0)	1980-07-06	(0)	*1980-10-11*	(-)

42 **Figure S1.** Time series of the 7-day running mean (in mm) averaged over the Rhine catchment. The
orange line marks the 99th percentile of the daily precipitation sum from E-OBS based on the time
period between 1979 and 2010.

45 **Figure S2.** 7-day precipitation sum (in mm) for 7 to 13 August 2002 in a) E-OBS, b) ERAI-CCLM,
46 and c) ERA20C-CCLM. Orange lines mark the relevant river catchments.

47 **Figure S3.** 7-day precipitation sum (in mm) for 3 to 8 July 1997 in a) E-OBS, b) ERAI-CCLM, and
48 c) ERA20C-CCLM. Orange lines mark the relevant river catchments.