Supplement of "Impact of bias adjustment strategy on ensemble projections of hydrological extremes"

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S1 Dataset

Table S1: List of the 87 catchments used in the study.

River name	Station
Birse	Soyhières, Bois du Treuil
Albula	Tiefencastel
Thur	Jonschwil, Mühlau
Kander	Hondrich
Kleine Emme	Emmen
Emme	Emmenmatt
Glatt	Rheinsfelden
Broye	Payerne, Caserne d'aviation
Areuse	Boudry
Wigger	Zofingen
Sense	Thörishaus, Sensematt
Simme	Oberwil
Töss	Neftenbach
Kleine Emme	Werthenstein, Chappelboden
Plessur	Chur

River name	Station
Lorze	Frauenthal
Ergolz	Liestal
Sitter	St. Gallen, Bruggen / Au
Dünnern	Olten, Hammermühle
Venoge	Ecublens, Les Bois
Murg	Frauenfeld
Allaine	Boncourt, Frontière
Reuss	Andermatt
Ilfis	Langnau
Birse	Moutier, La Charrue
Verzasca	Lavertezzo, Campiöi
Landwasser	Davos, Frauenkirch
Murg	Murgenthal, Walliswil
Werdenberger Binnenkanal	Salez
Rheintaler Binnenkanal	St. Margrethen
Inn	St. Moritzbad
Grande Eau	Aigle
Rom	Müstair
Suze	Sonceboz
Emme	Eggiwil, Heidbüel
Calancasca	Buseno
Promenthouse	Gland, Route Suisse
Gürbe	Belp, Mülimatt
Liechtensteiner Binnenkanal	Ruggell
Seyon	Valangin
Schächen	Bürglen, Galgenwäldli
Seez	Mels
Aubonne	Allaman, Le Coulet
Mentue	Yvonand, La Mauguettaz
Luthern	Nebikon
Areuse	St-Sulpice
Lorze	Zug, Letzi
Necker	Mogelsberg, Aachsäge
Murg	Wängi

River name	Station
Saltina	Brig
Cassarate	Pregassona
Suhre	Oberkirch
Sitter	Appenzell
Chamuerabach	La Punt-Chamues-ch
Aabach	Hitzkirch, Richensee
Scheulte	Vicques
Worble	Ittigen
Veveyse	Vevey, Copet
Langeten	Huttwil, Häberenbad
Minster	Euthal, Rüti
Ova dal Fuorn	Zernez, Punt la Drossa
Goldach	Goldach, Bleiche
Aach	Salmsach, Hungerbühl
Breggia	Chiasso, Ponte di Polenta
Alp	Einsiedeln
Orbe	Le Chenit, Frontière
Riale di Pincascia	Lavertezzo
Grosstalbach	Isenthal
Sionge	Vuippens, Château
Dischmabach	Davos, Kriegsmatte
Goneri	Oberwald
Magliasina	Magliaso, Ponte
Biber	Biberbrugg
Allenbach	Adelboden
Ova da Cluozza	Zernez
Rein da Sumvitg	Somvitg, Encardens
Chli Schliere	Alpnach, Chilch-Erli
Krummbach	Klusmatten
Glatt	Herisau, Zellersmühle
Poschiavino	La Rösa
Sellenbodenbach	Neuenkirch
Grossbach	Einsiedeln, Gross
Riale di Roggiasca	Roveredo, Bacino di compenso

River name	Station
Parimbot	Ecublens, Eschiens
Rietholzbach	Mosnang, Rietholz
Sissle	Eiken
Reppisch	Dietikon

S2 Snow water equivalent simulations

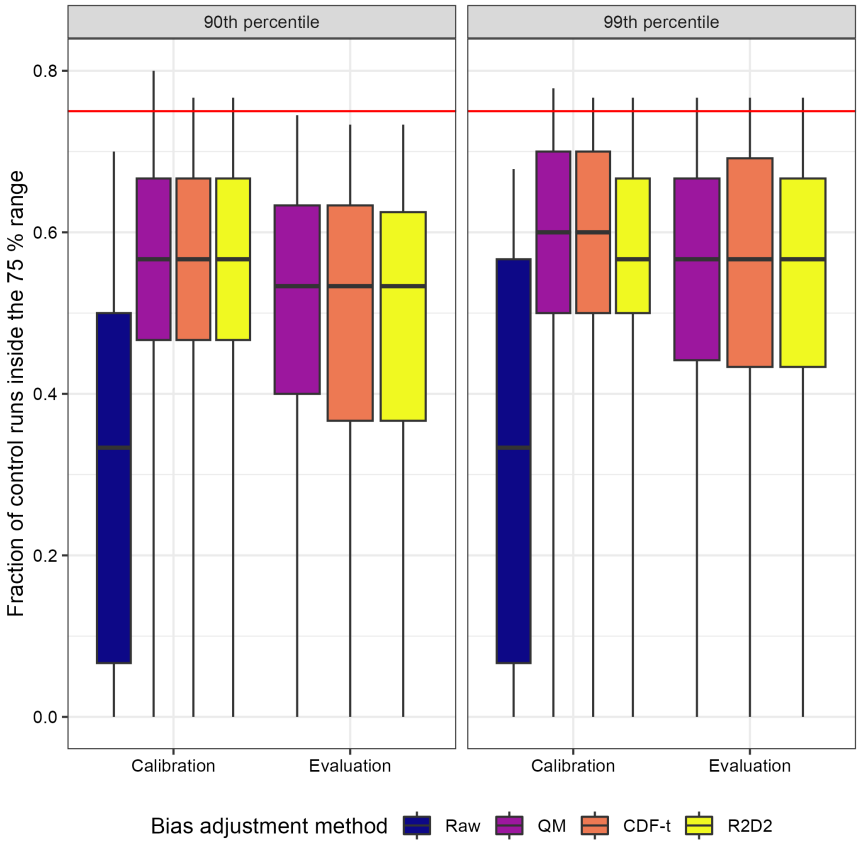

Figure S1. Efficiency of three bias adjustment methods and the unadjusted ensemble (raw) in reproducing snow water equivalent (control run) statistics for the 87 catchments. The fraction of control runs within the 75 % range was calculated for two percentiles (90^{th} and 99^{th}). The optimum value of the performance criterion is 0.75. QM is the univariate non-change-preserving method. CDF-t is the univariate change-preserving method. R2D2 is the multivariate change-preserving method. All methods were run using the ensemble adjustment approach. Calibration and evaluation combine both climatic sub-periods.

S3 Streamflow simulations with another hydrological model

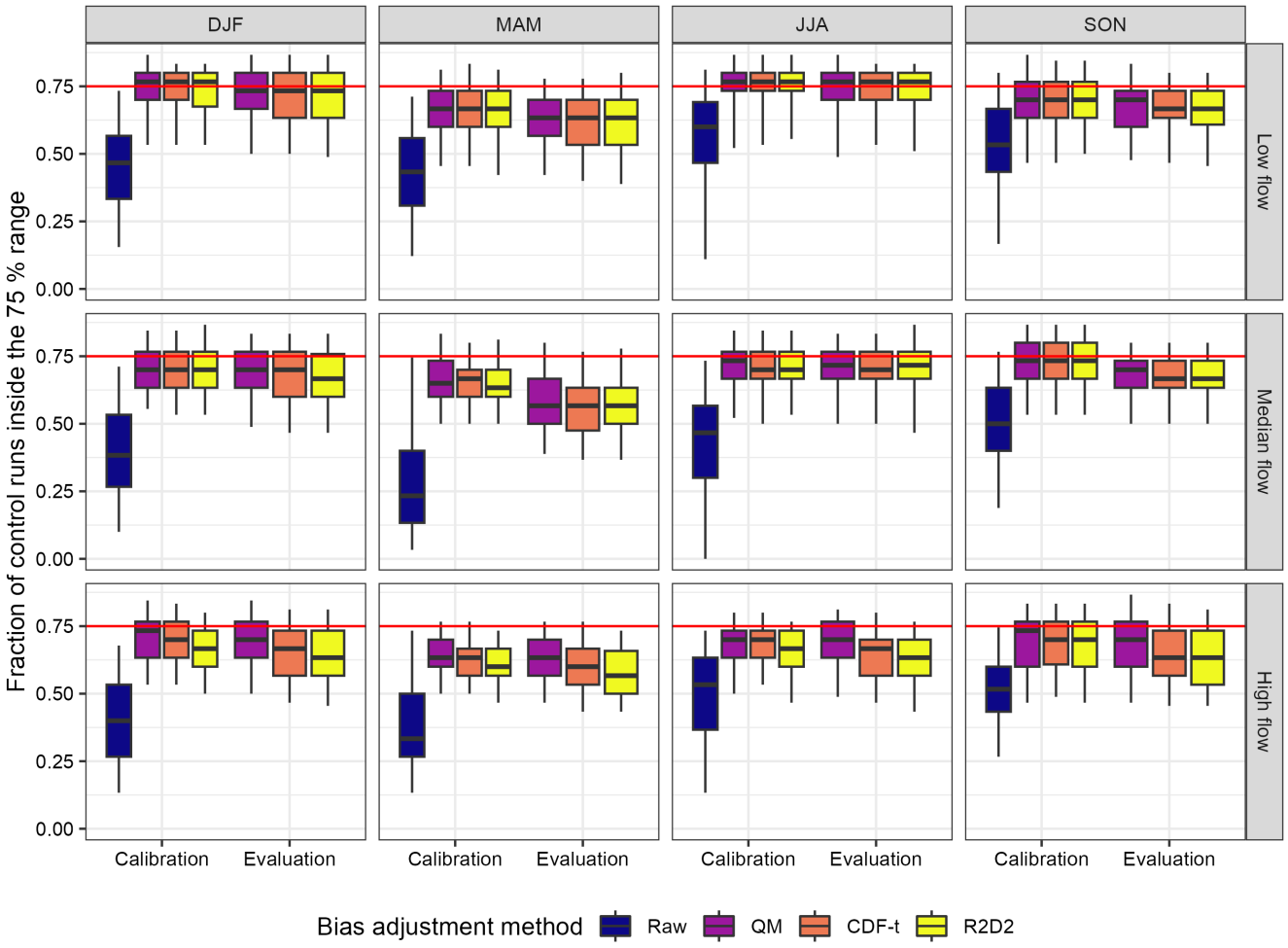

Figure S2. Efficiency of three bias adjustment methods and the unadjusted ensemble (raw) in reproducing streamflow statistics of the control runs for the 87 catchments. Streamflow was simulated with the Cemaneige-GR5J model (Le Moine, 2008; Valéry et al., 2014; Coron et al., 2020). The fraction of control runs within the 75 % range was calculated for four seasons (December/January/February, March/April/May, June/July/August, September/October/November) and three streamflow percentiles (1^{st}, 50^{th} and 99^{th}). The optimum value of the performance criterion is 0.75. QM is the univariate non-change-preserving method. CDF-t is the univariate change-preserving method. R2D2 is the multivariate change-preserving method. All methods were run using the ensemble adjustment approach. Calibration and evaluation combine both climatic sub-periods.

S4 Relationship between temperature performance and the raw signal between sub-periods

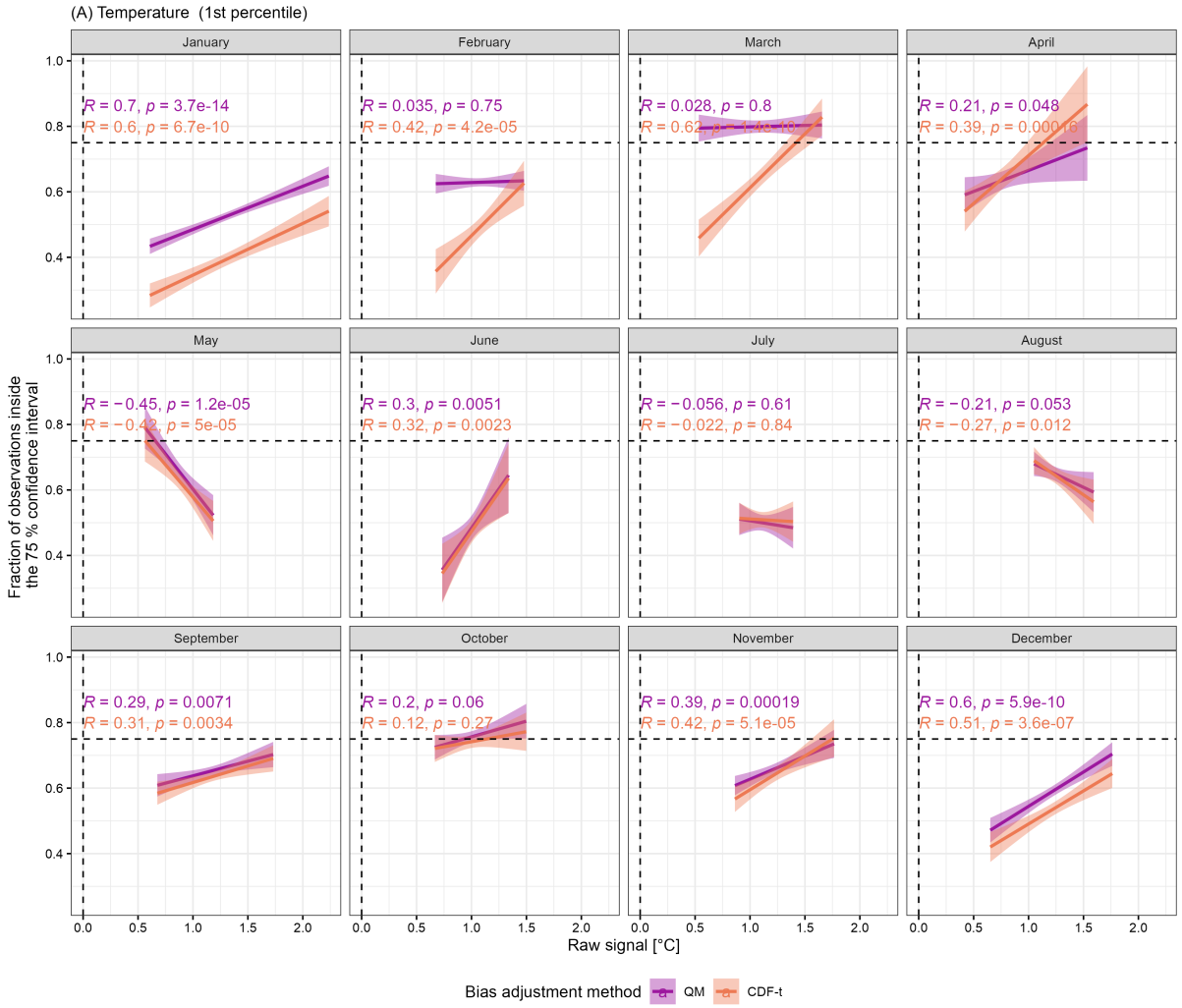

Figure S3. Relationship between temperature (1st percentile) performance (evaluation sub-period P1) and the raw signal between sub-periods, for 87 catchments.. Performance is assessed with the fraction of observations falling inside the simulated 75 % confidence interval. The signal is the difference (absolute) between the percentile value of the sub-period P2 and the percentile value of the sub-period P1. The results are shown with a linear regression (line) with the 95% confidence interval (bandwidth). QM is the non change-preserving bias adjustment method and CDF-t is the change-preserving bias adjustment method. The results are shown for the ensemble adjustment option.

S5 Relationship between precipitation performance and the raw signal between sub-periods

S6 Relationship between temperature performance and the raw and observed signals between sub-periods

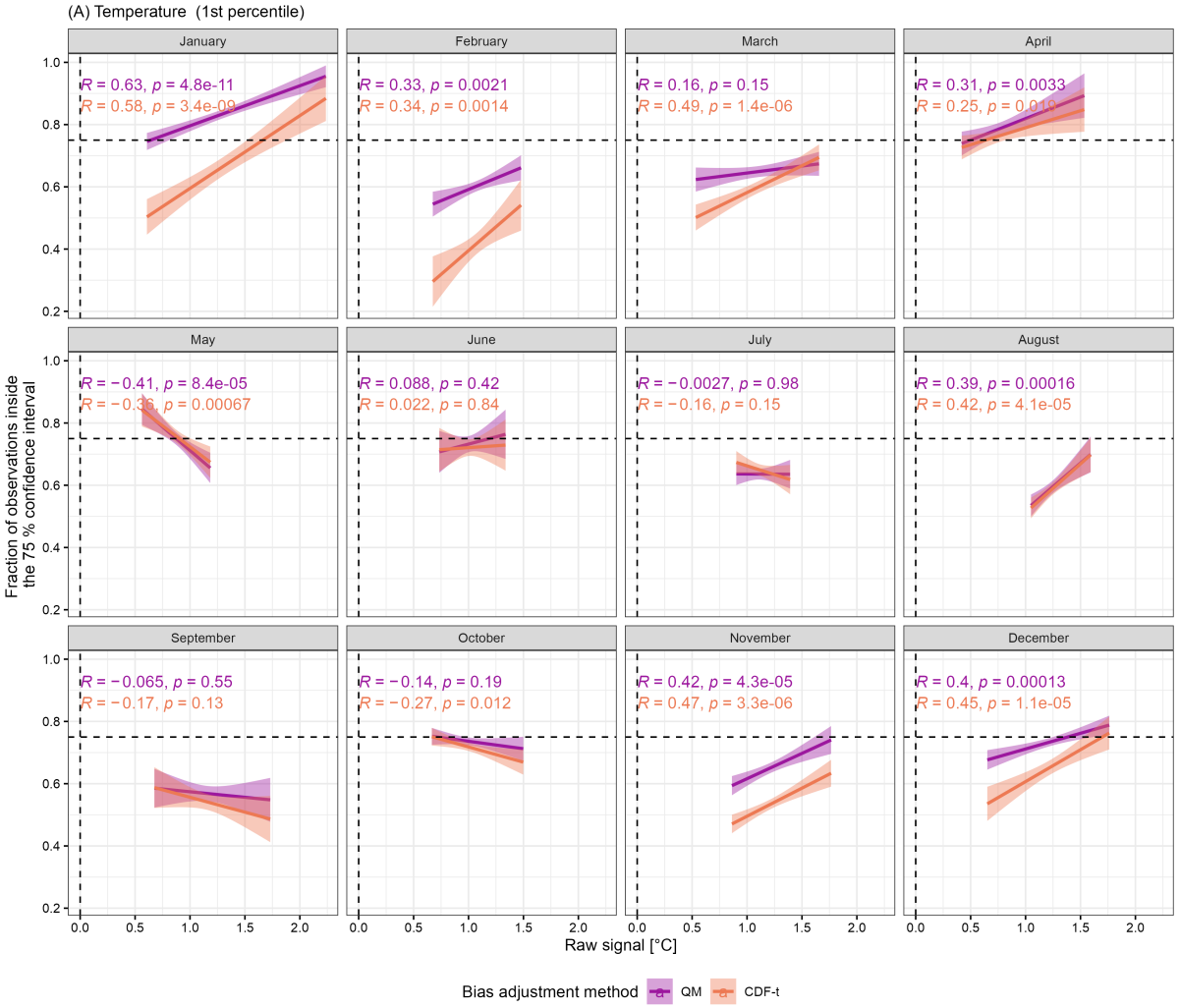

Figure S4. Relationship between temperature (1st percentile) performance (evaluation sub-period P2) and the raw signal between sub-periods, for 87 catchments.. Performance is assessed with the fraction of observations falling inside the simulated 75 % confidence interval. The signal is the difference (absolute) between the percentile value of the sub-period P2 and the percentile value of the sub-period P1. The results are shown with a linear regression (line) with the 95% confidence interval (bandwidth). QM is the non change-preserving bias adjustment method and CDF-t is the change-preserving bias adjustment method. The results are shown for the ensemble adjustment option.

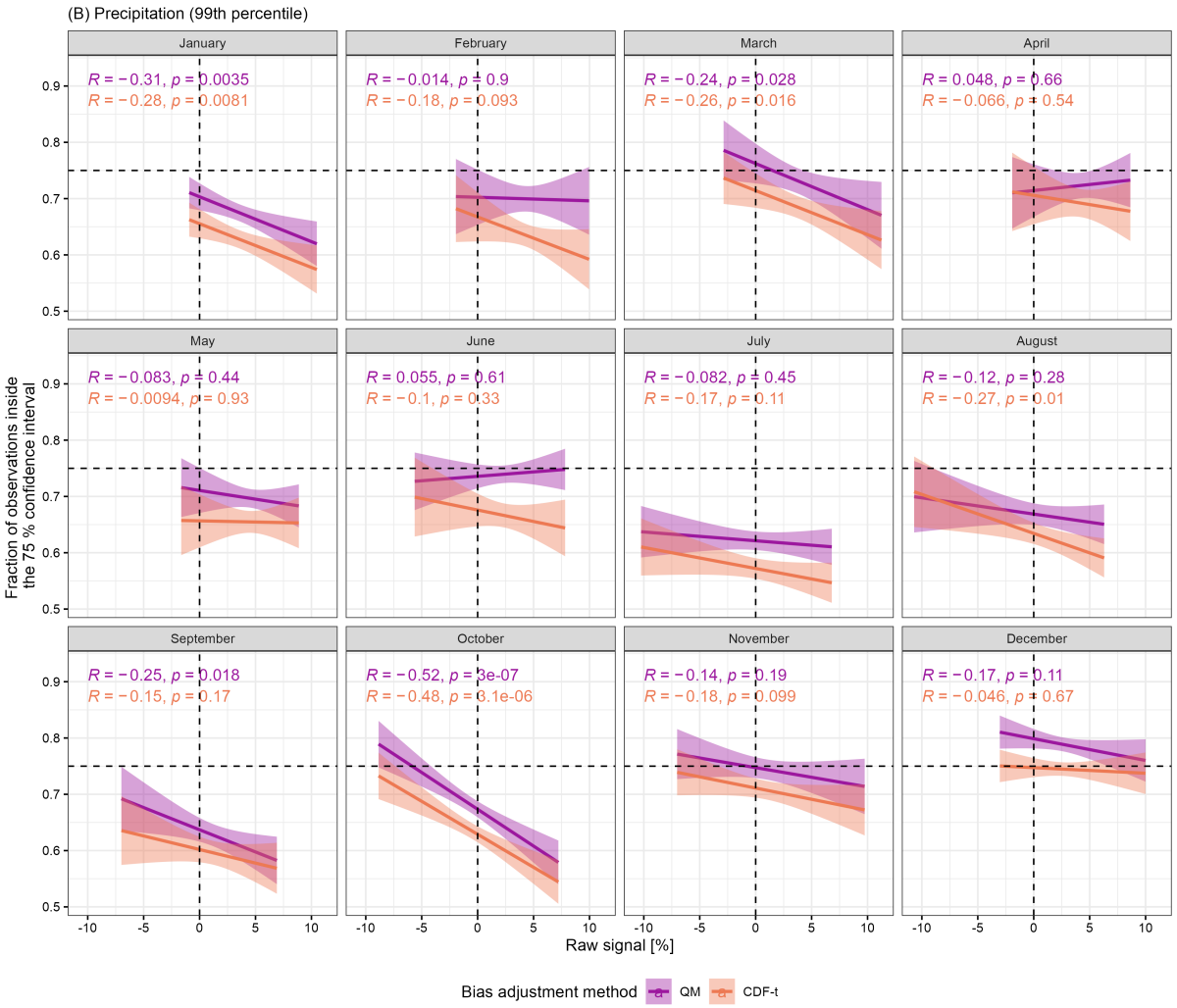

Figure S5. Relationship between precipitation (99th percentile) performance (evaluation sub-period P1) and the raw signal between sub-periods, for 87 catchments.. Performance is assessed with the fraction of observations falling inside the simulated 75 % confidence interval. The signal is the difference (relative) between the percentile value of the sub-period P2 and the percentile value of the sub-period P1. The results are shown with a linear regression (line) with the 95% confidence interval (bandwidth). QM is the non change-preserving bias adjustment method and CDF-t is the change-preserving bias adjustment method. The results are shown for the ensemble adjustment option.

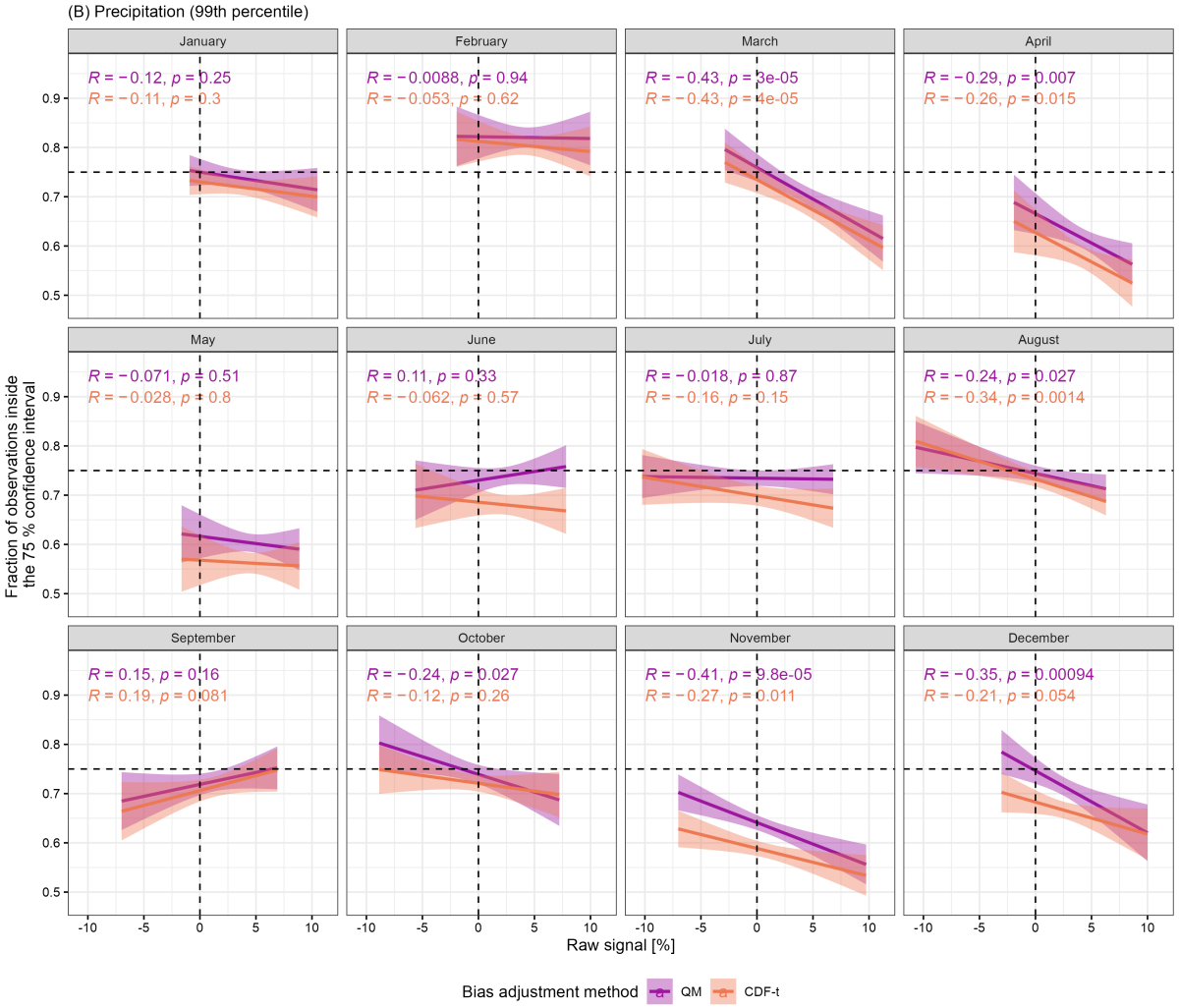

Figure S6. Relationship between precipitation (99th percentile) performance (evaluation sub-period P2) and the raw signal between sub-periods, for 87 catchments. Performance is assessed with the fraction of observations falling inside the simulated 75 % confidence interval. The signal is the difference (relative) between the percentile value of the sub-period P2 and the percentile value of the sub-period P1. The results are shown with a linear regression (line) with the 95% confidence interval (bandwidth). QM is the non change-preserving bias adjustment method and CDF-t is the change-preserving bias adjustment method. The results are shown for the ensemble adjustment option.

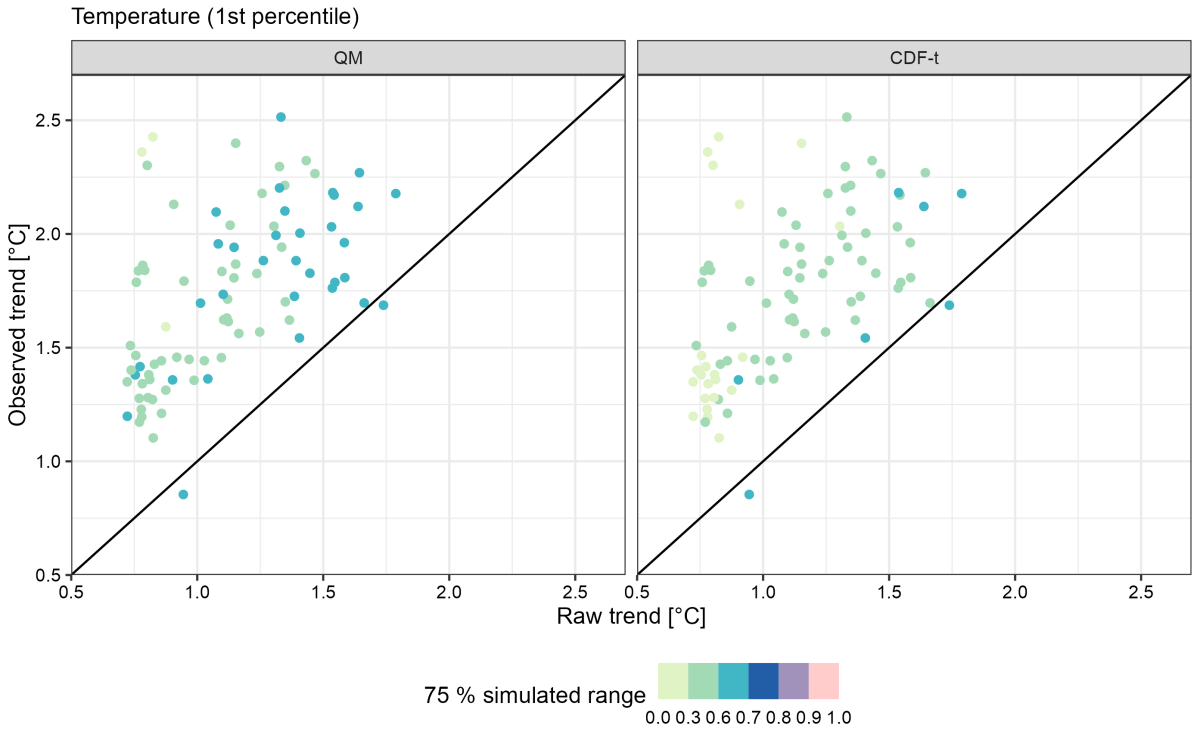

Figure S7. Comparison between observed and raw temperature signals (1st percentile) with regards to performance (evaluation sub-period P1) for 87 catchments. Performance is assessed with the fraction of observations falling inside the simulated 75 % confidence interval. The signal is the difference (absolute) between the percentile value of the sub-period P2 and the percentile value of the sub-period P1. QM is the non change-preserving bias adjustment method and CDF-t is the change-preserving bias adjustment method. The results are shown for the ensemble adjustment option.

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