Supplementary Materials: Intercomparison of Univariate and Joint Bias Correction Methods in Changing Climate from a Hydrological Perspective

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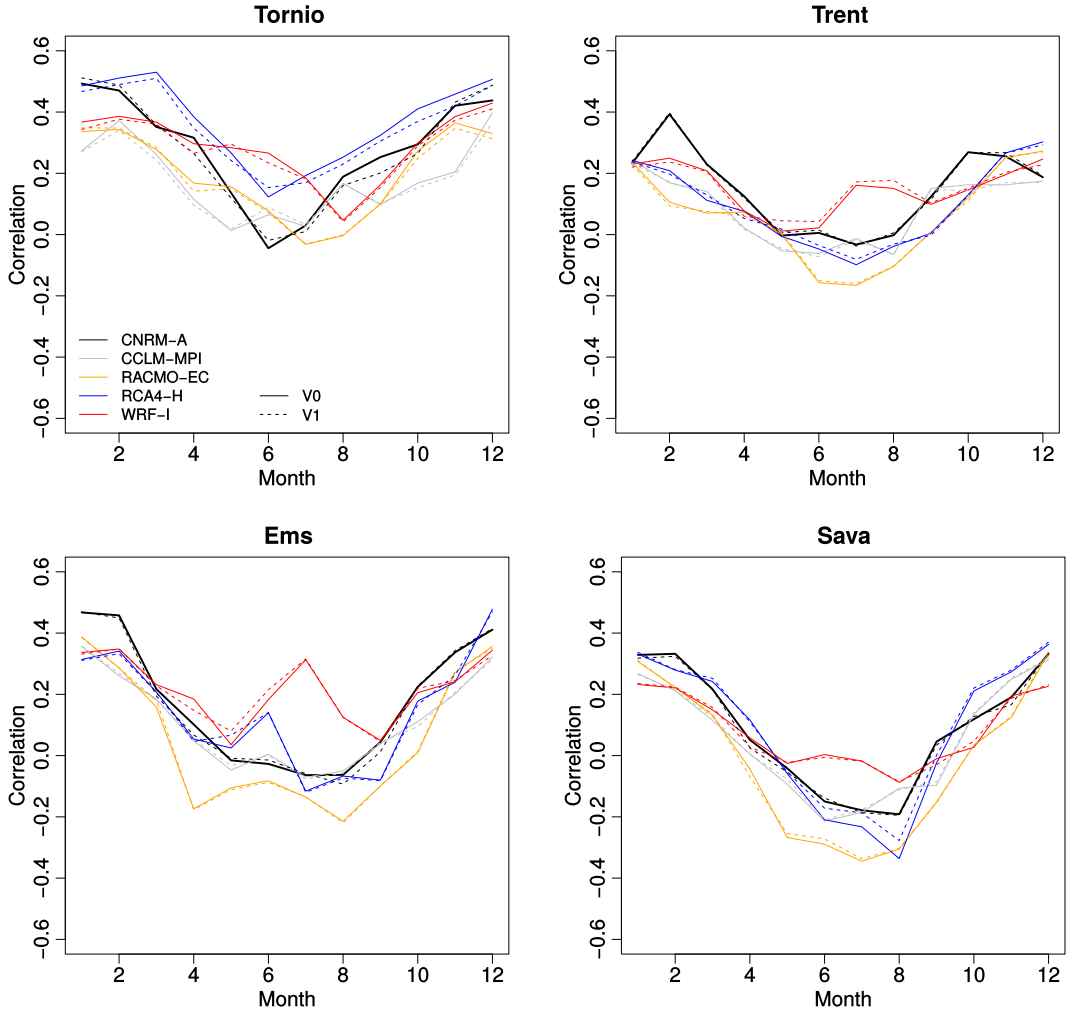

Figure S1. Sub-region-averaged monthly correlation parameter for the wet-day ($P > 0.1$ mmd^{-1}) values of daily mean temperature and daily precipitation obtained from fitting Gaussian copula to each of the five GCM-RCM simulations in the calibration period (1979–2010). The values are shown separately for both pseudo-reality versions, i.e., when applied with (dashed lines) and without (solid lines) corrections towards WFDEI.

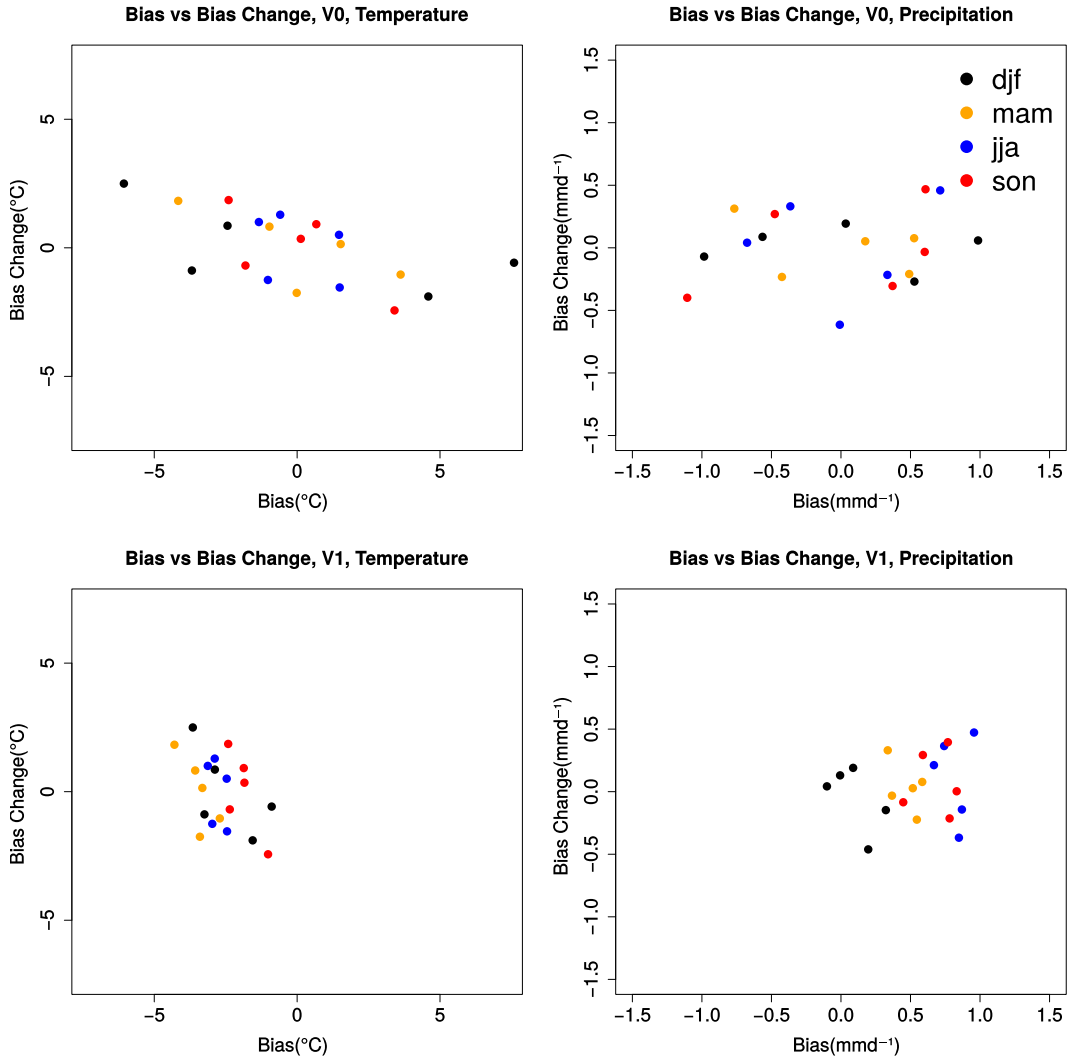

Figure S2. Scatter plots of bias in the ensemble mean of the four predicting models calculated against each of the five pseudo-realities (i.e., verifying model) and the change in this bias from the baseline period (1981–2010) to the projection period (2061–2090) in Tornio sub-model. The results are shown separately for (**left**) daily mean temperature and (**right**) daily precipitation when applying the pseudo-reality approach (**bottom**) with and (**top**) without the adjustment towards WFDEI (different colors) at each season.

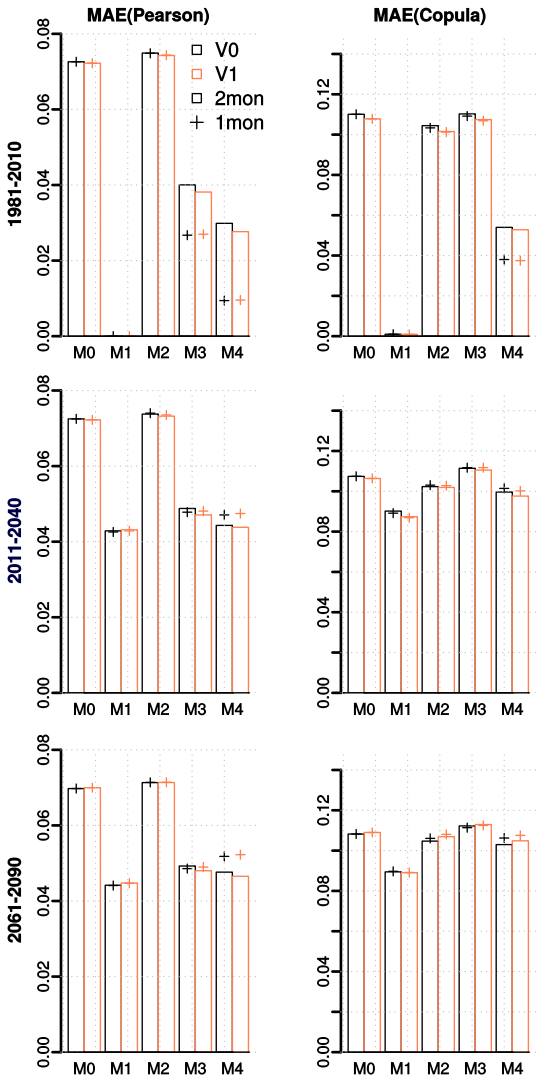

Figure S3. Cross-validated MAE in (**left**) the Pearson correlation coefficient and (**right**) the empirical copula density of temperature and precipitation in years (**top**) 1981–2010, (**middle**) 2011–2040 and (**bottom**) 2061–2090, when calculated for the wet-day part ($P > 0.1\text{mmd}^{-1}$) of the joint distribution. Black bars show the results for the pseudo-reality approach without additional adjustments towards WFDEI (V0), while the red bars denote the results for the approach, where pseudo-realities have been adjusted to biases in relation to WFDEI (V1). The cross-validation statistics are plotted for both one-month (crosses) and two-month (bars) time windows, used to estimate the simulated changes or model biases.

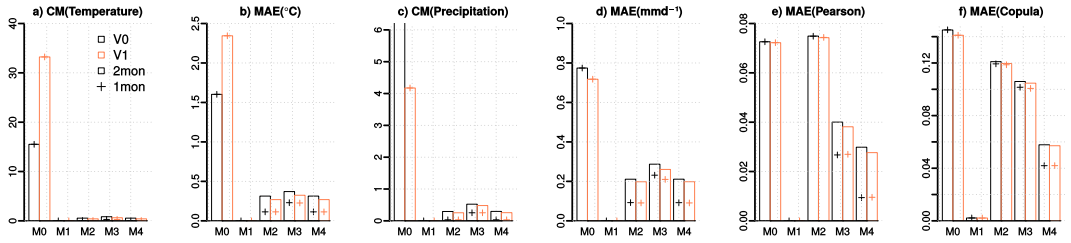

Figure S4. Cross-validated CM and MAE for (**a,b**) daily mean temperature and (**c,d**) daily precipitation distribution in years 1981–2010. Also shown are the MAE in (**e**) the Pearson correlation coefficient and (**f**) the empirical copula density. Black bars denote the results for the pseudo-reality approach without additional adjustments towards WFDEI (V0), while the results for the approach where pseudo-realities have been adjusted to biases in relation to WFDEI are shown in red (V1). The results are shown for cases where one-month (crosses) and two-month (bars) time windows have been used when estimating simulated changes or model biases.

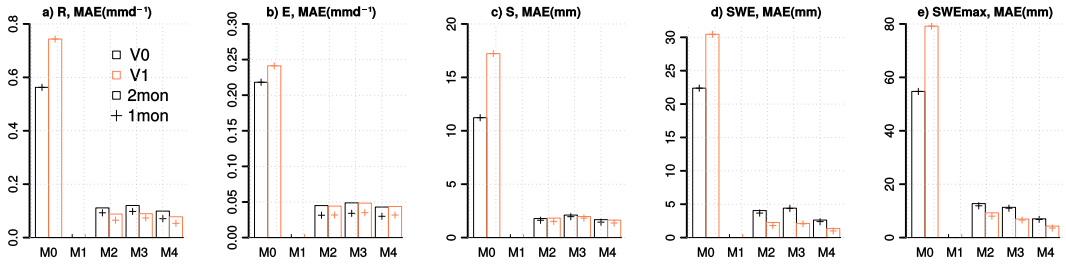

Figure S5. Similar to Figure S4 but shown for the MAE in the monthly means of (**a**) total runoff, (**b**) evapotranspiration, (**c**) soil moisture, (**d**) snow water equivalent and (**e**) the mean annual maximum snow water equivalent in years 1981–2010.

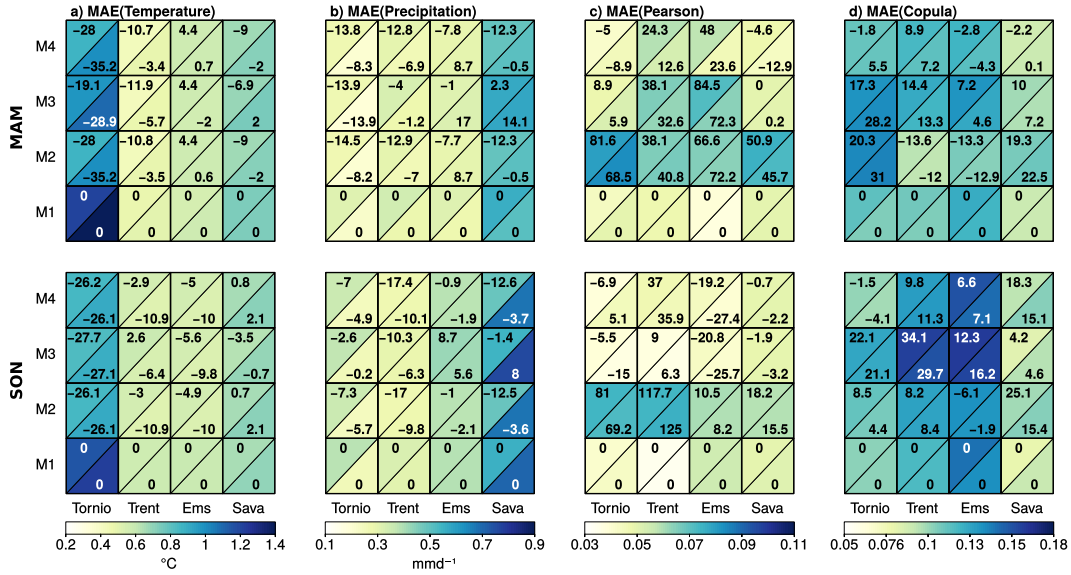

Figure S6. Cross-validated MAE (colors) of (**a**) daily mean temperature, (**b**) daily precipitation, (**c**) Pearson correlation coefficient and (**d**) empirical copula density shown separately for each method (panel rows) at each hydrological sub-domain (panel columns) in years 2061–2090, when two-month time window has been used to estimate simulated changes or model biases. Values for the pseudo-reality approach V0 (V1) are plotted in the upper (lower) triangle of each cell and are shown separately for (top) spring and (bottom) autumn seasons. In addition, percentage differences to M1 are shown as numeric values in each triangle.

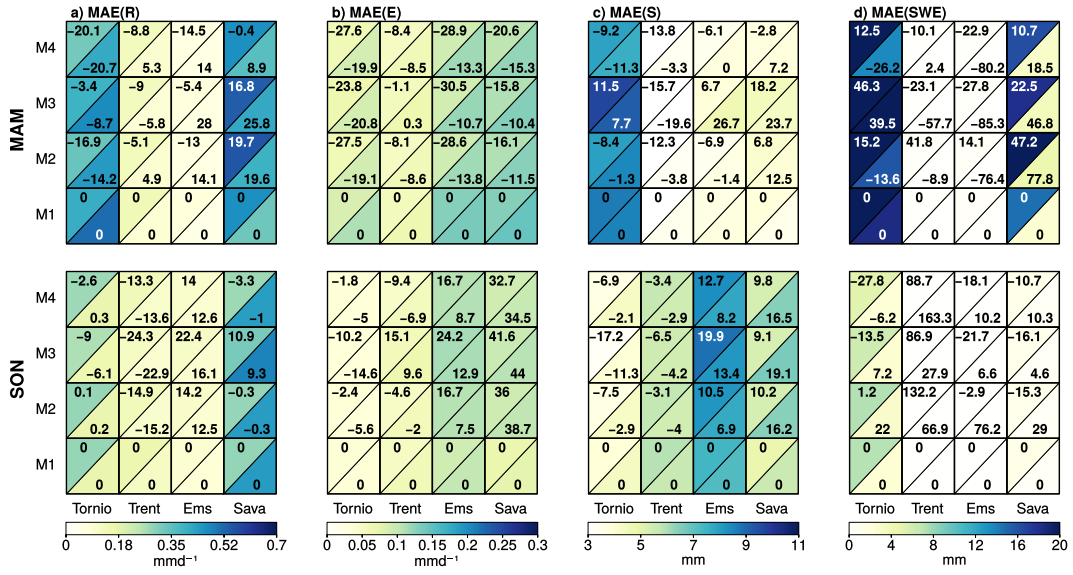

Figure S7. Similar to Figure S6 but shown for monthly mean (**a**) total runoff, (**b**) evapotranspiration, (**c**) soil moisture and (**d**) snow water equivalent.