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Supplement of

Evaluation of bias correction methods for a multivariate drought index: case study of the Upper Jhelum Basin

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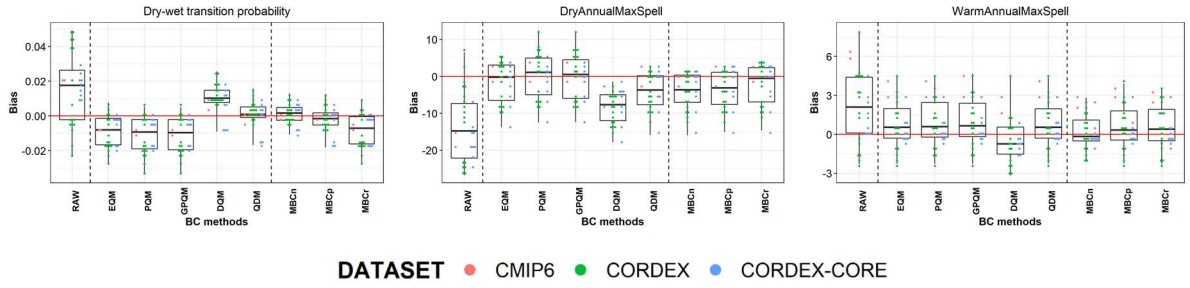

Figure S1: Spatially averaged bias (model minus reference) over the UJB in transition probability of a wet day given that the previous day was dry (left), annual longest dry spell (middle) and annual longest warm (above 90th percentile) spell (right) computed from the raw (first box in each panel) and bias corrected data (rest of boxes). Each box represents the interquartile range of biases across all models, which are depicted individually with colored dots (CMIP6 in red, CORDEX in green, CORDEX-CORE in blue), whiskers expand the full range of biases. Red horizontal lines depict perfect performance, for reference.

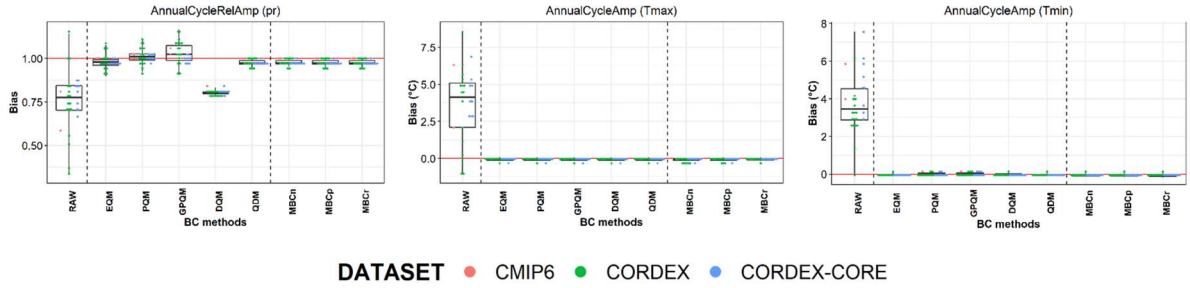

Figure S2: Spatially averaged bias (as a ratio and delta for precipitation and temperatures, respectively) over the UJB in the relative amplitude of seasonality for precipitation (left), amplitude of seasonality for maximum temperature (middle) and minimum temperature (right) computed from the raw (first box in each panel) and bias corrected data (rest of boxes). Each box represents the interquartile range of biases across all models, which are depicted individually with colored dots (CMIP6 in red, CORDEX in green, CORDEX-CORE in blue), whiskers expand the full range of biases. Red horizontal lines depict perfect performance, for reference.

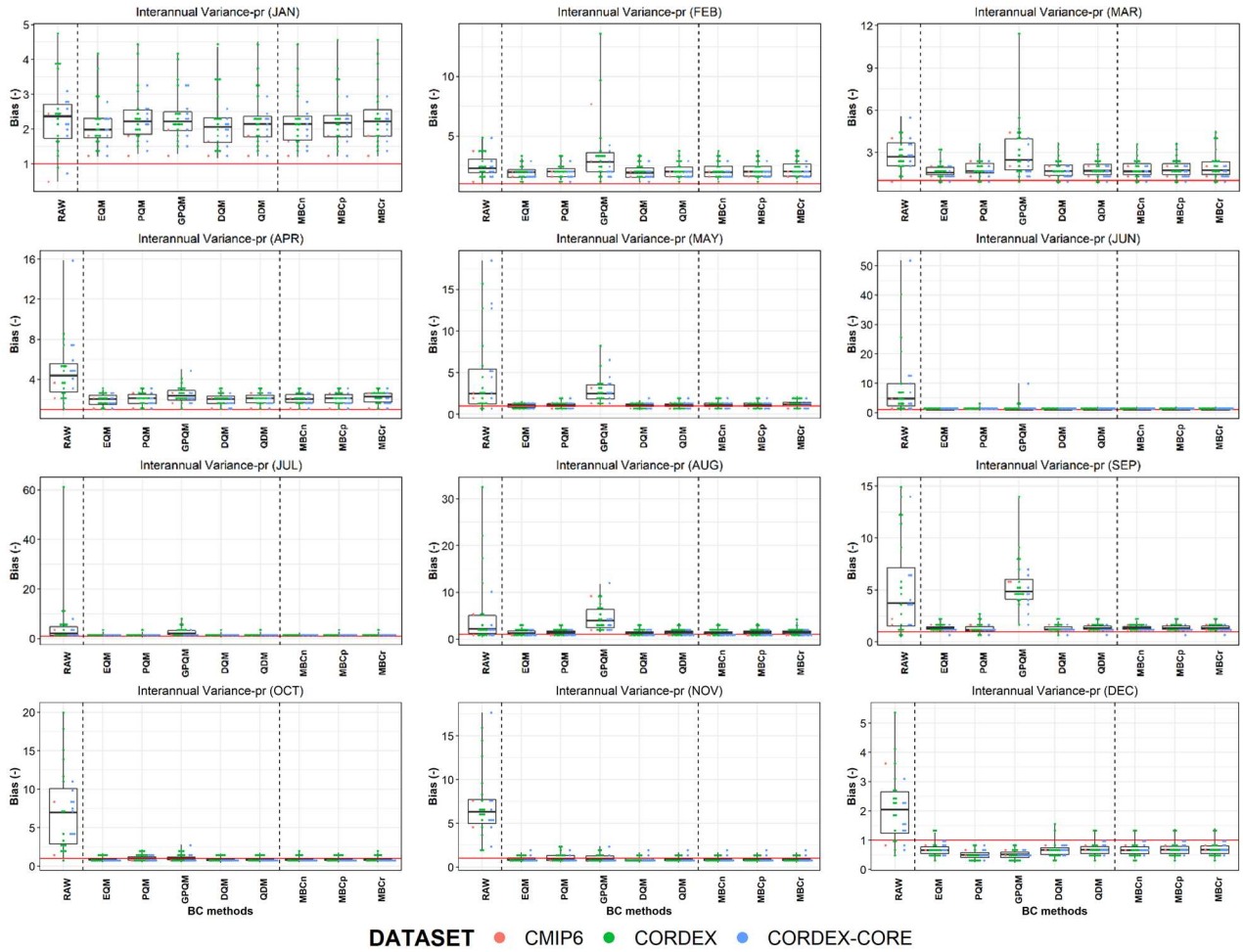

Figure S3: Spatially averaged bias (as a ratio of model to reference) over the UJB in interannual variance of precipitation for each month, computed from the raw (first box in each panel) and bias corrected data (rest of boxes). Each box represents the interquartile range of biases across all models, which are depicted individually with colored dots (CMIP6 in red, CORDEX in green, CORDEX-CORE in blue), whiskers expand the full range of biases. Red horizontal lines depict perfect performance, for reference.

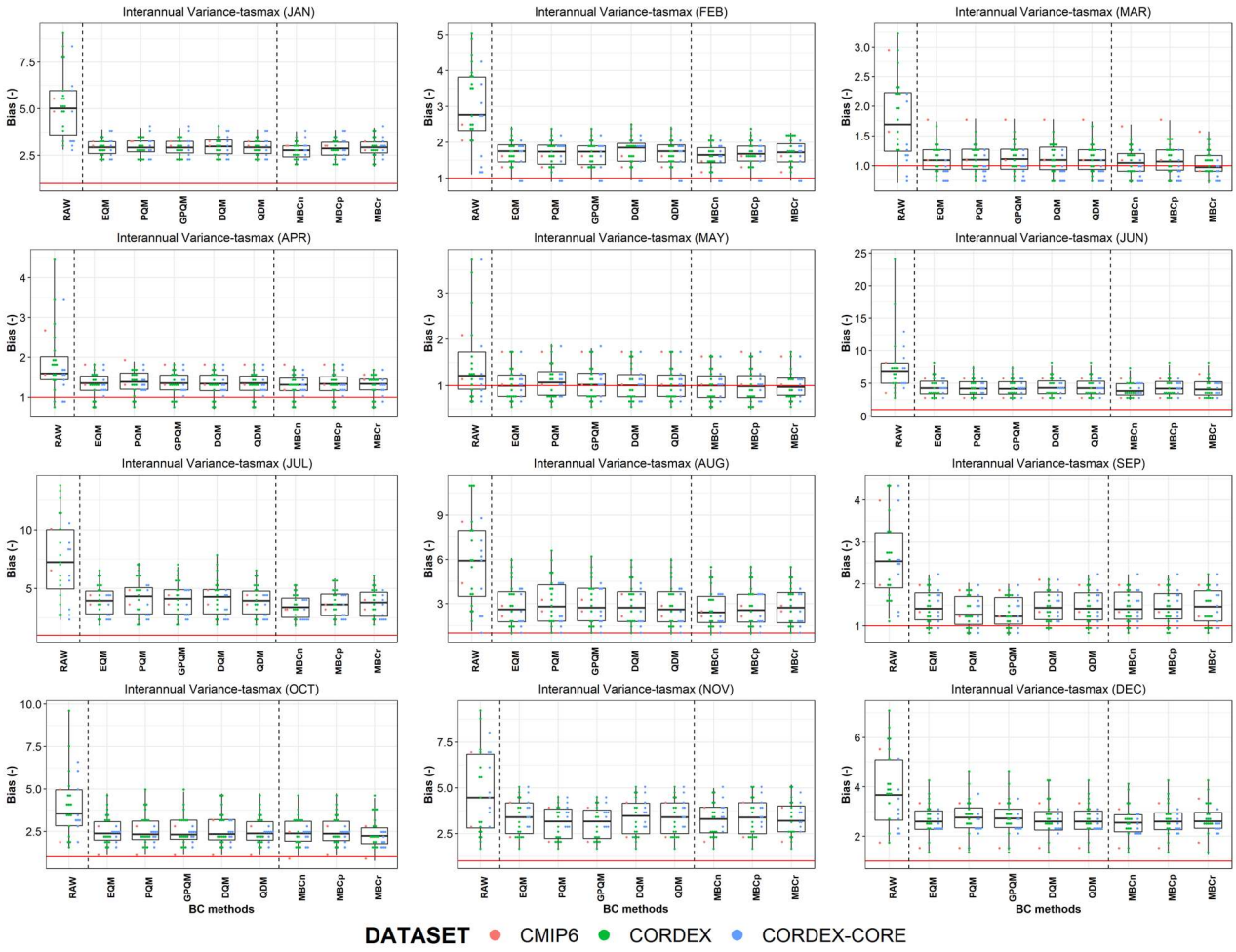

Figure S4: Same as figure S3, but for maximum temperature.

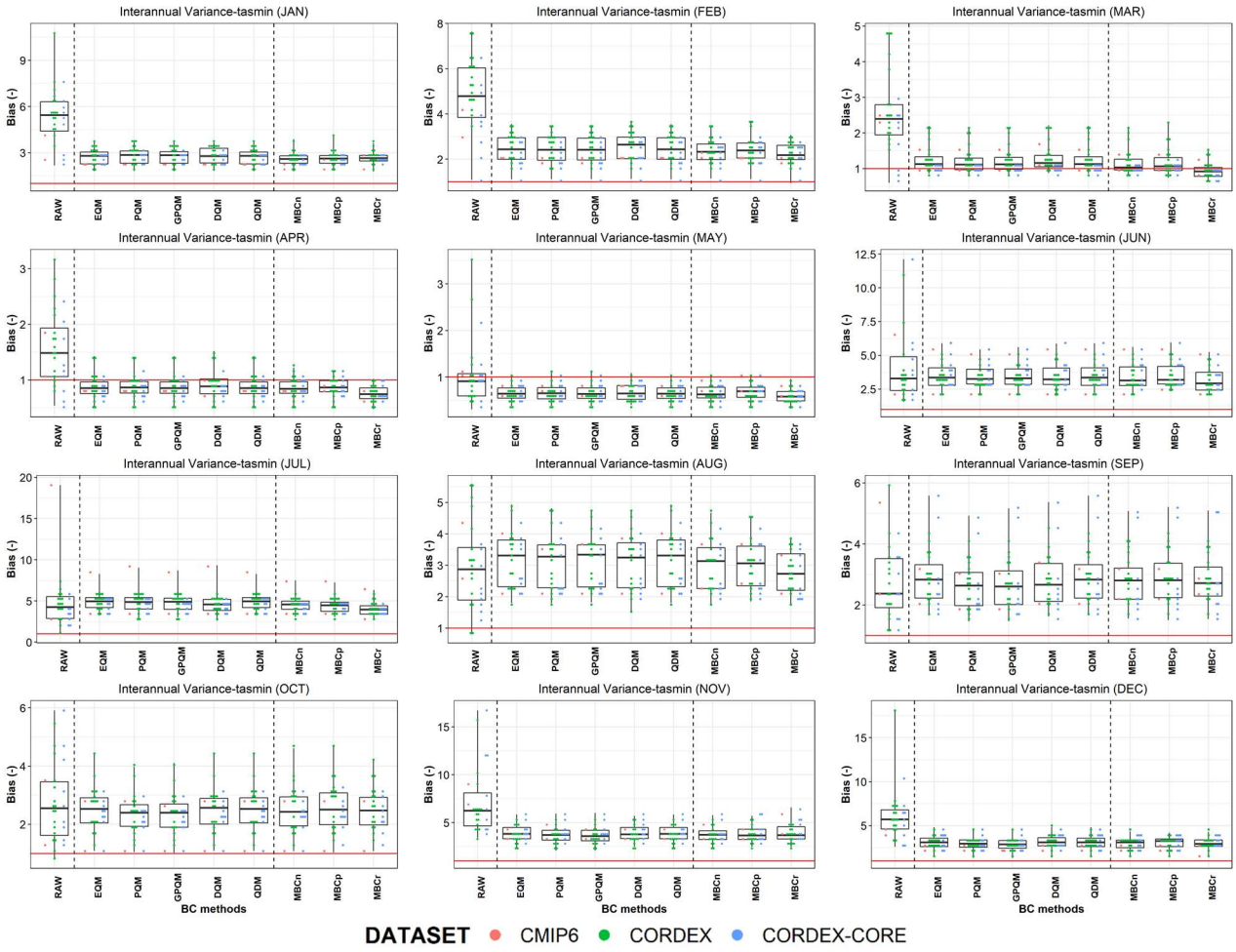

Figure S5: Same as figure S3, but for minimum temperature.

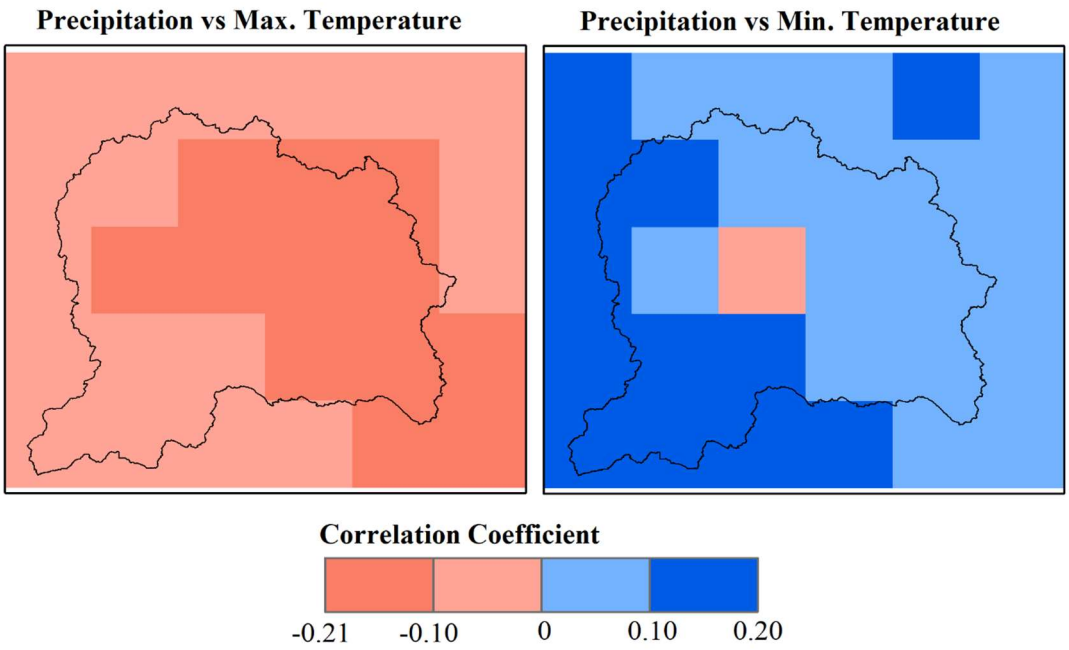

Figure S6: Spearman correlation coefficient between daily precipitation and maximum temperature (left panel) and between daily precipitation and minimum temperature (right panel) for the reference data.

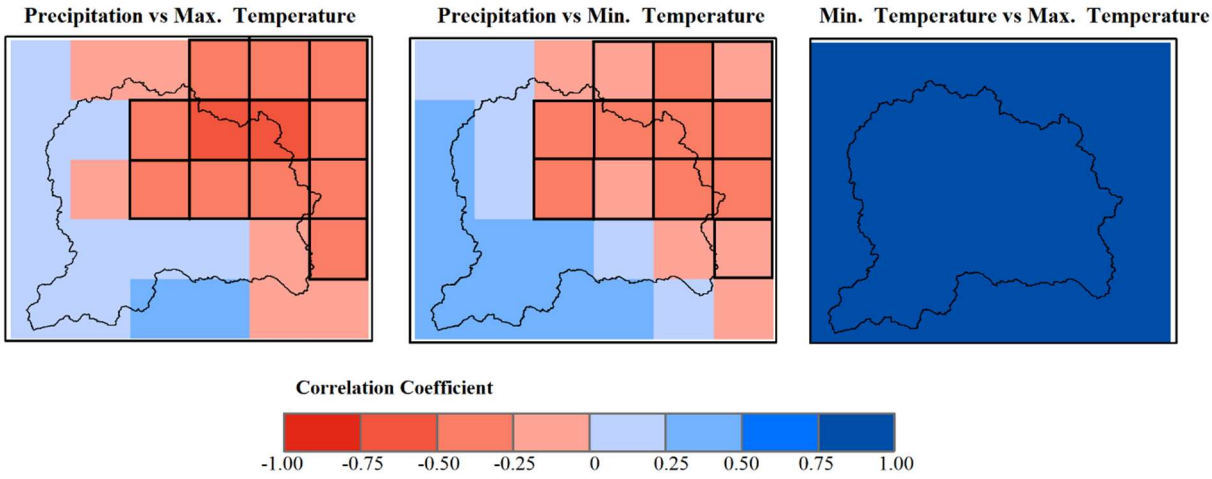

Figure S7: Spearman correlation coefficient between monthly timeseries of precipitation and maximum temperature (left), precipitation and minimum temperature (center) and Pearson correlation coefficient between minimum temperature and maximum temperature (right) for the reference data. The marked/highlighted grid boxes are used for further analyses in Fig. S8.

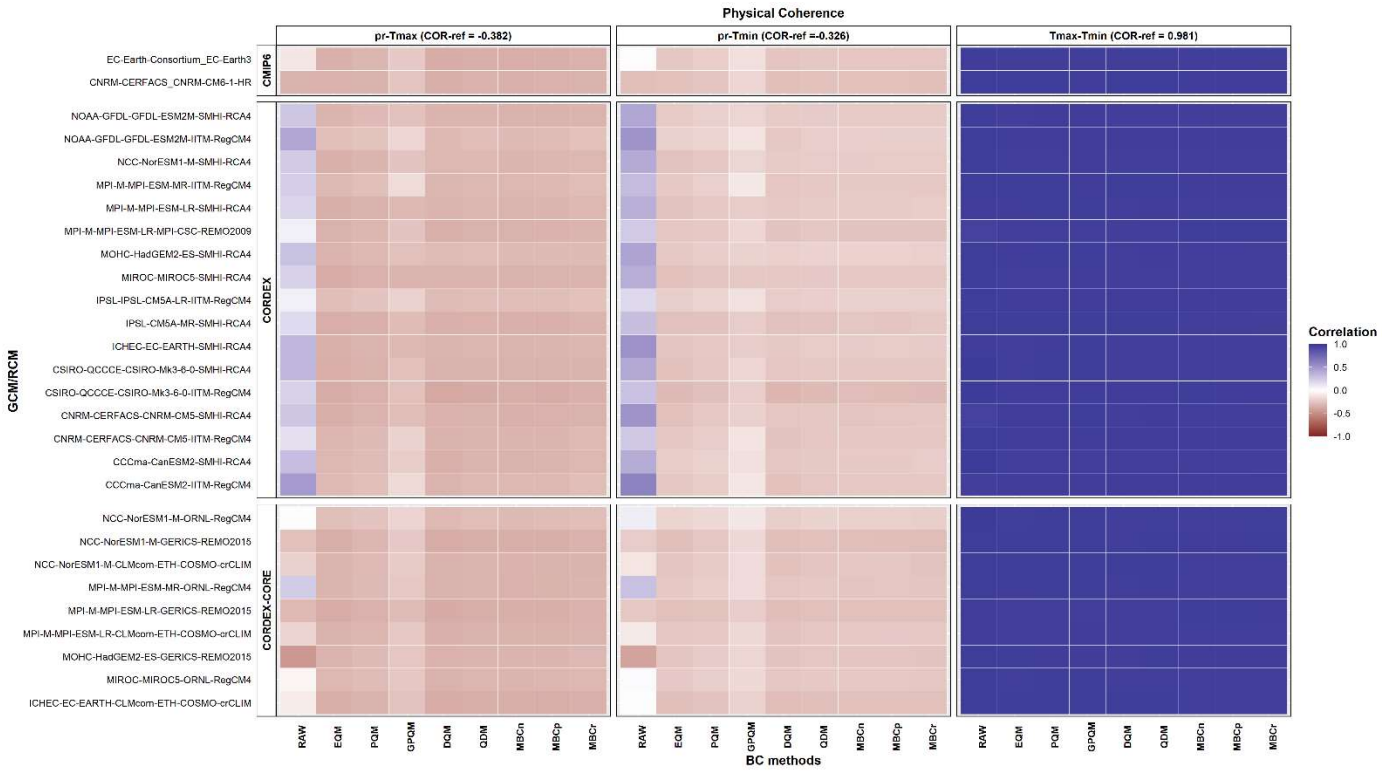

Figure S8: Spearman correlation coefficient between monthly timeseries of precipitation and maximum temperature (left), precipitation and minimum temperature (middle) and Pearson correlation coefficient between minimum temperature and maximum temperature (right) for the raw and bias corrected climate model data (only component-wise approach). Correlation for the reference data is shown on top of each panel. Correlation values between precipitation and temperature (left and middle panels) are spatially averaged over few grid boxes in the northeast part of the domain with negative correlation in the reference data (marked grid boxes in Fig. S7). Correlation between max. and min. temperature is spatially averaged over the whole domain.

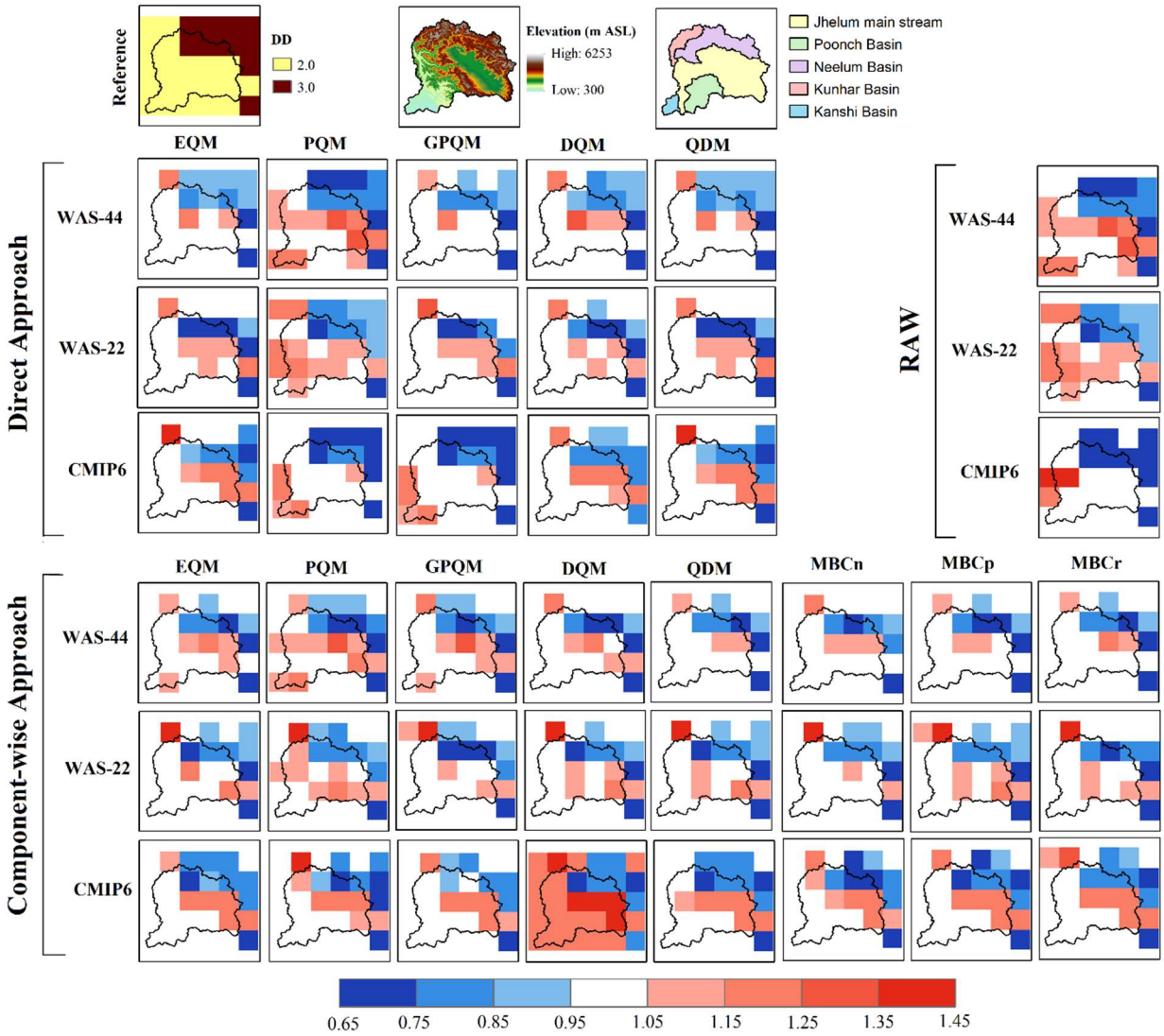

Figure S9: Median dry duration (DD) expressed in months in the reference dataset (first row, left), digital elevation model in meter above sea level (first row, center and location of sub-basins (first row, right), and biases (as a ratio of model to reference) for the multi-model raw ensembles and bias-corrected ensembles, for the two bias correction approaches and all methods (columns).

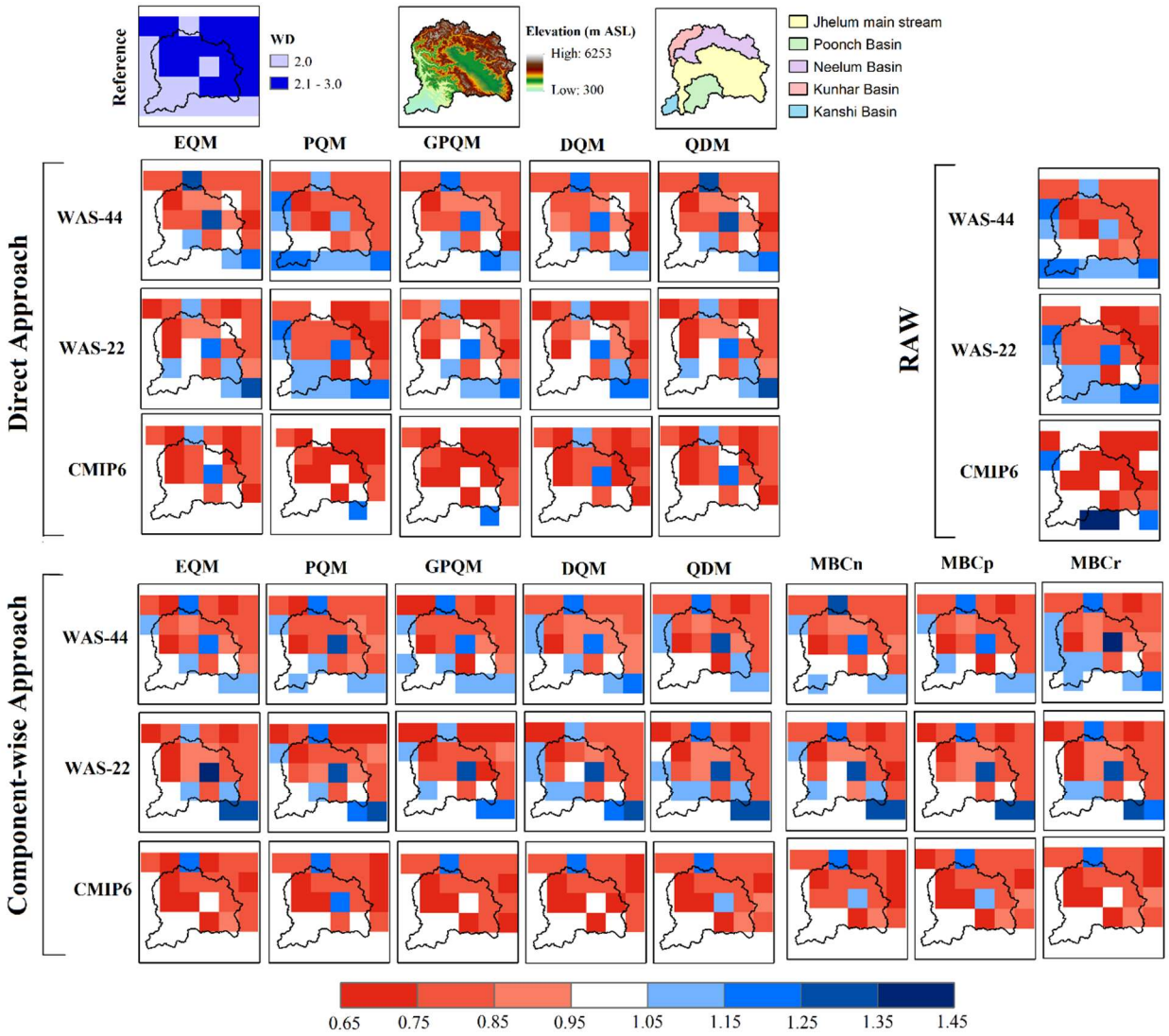

Figure S10: Same as figure S9, but for median wet duration (WD) expressed in months.

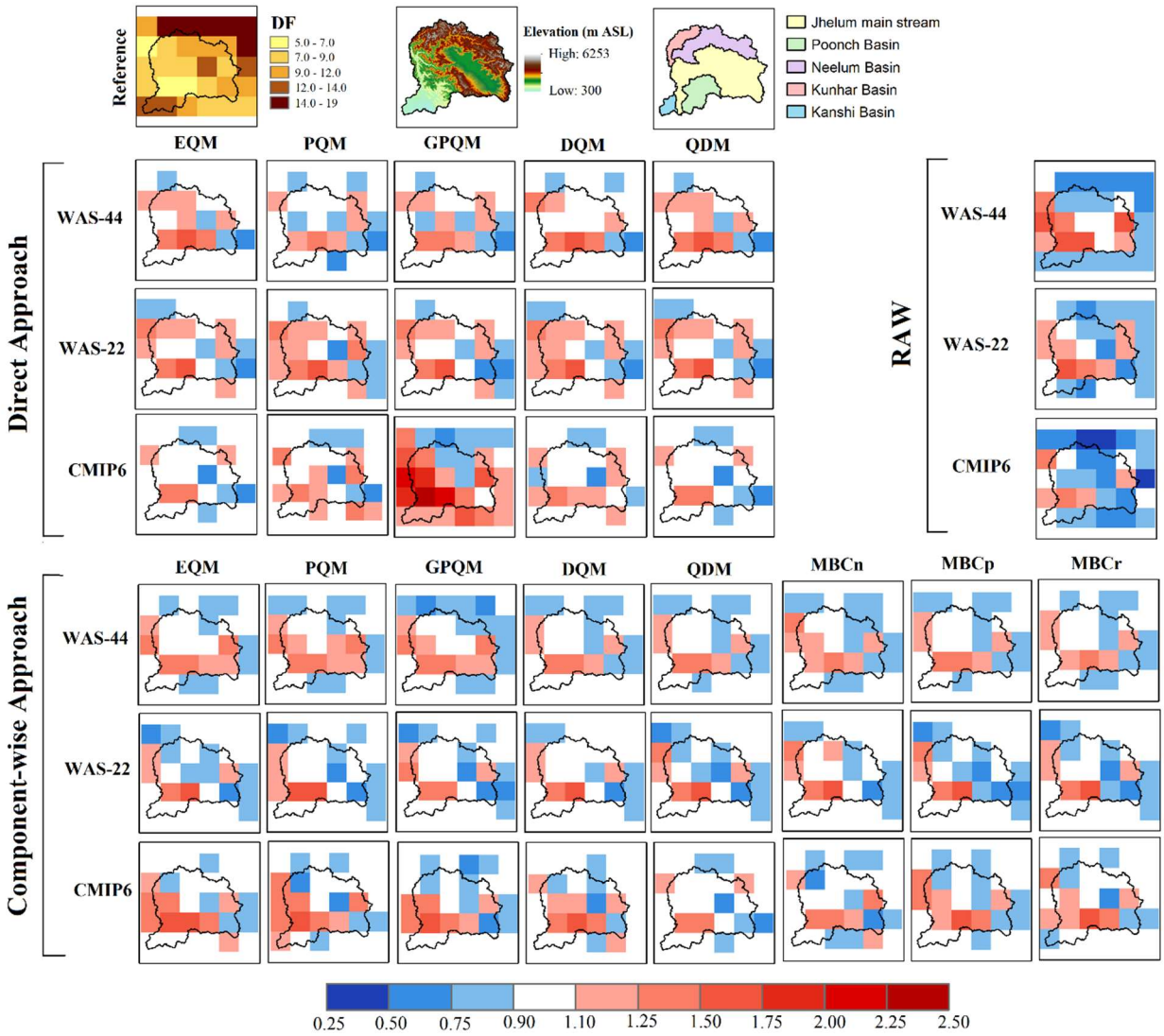

Figure S11: Same as figure S9, but for absolute dry frequency (DF) expressed as total number of dry events.

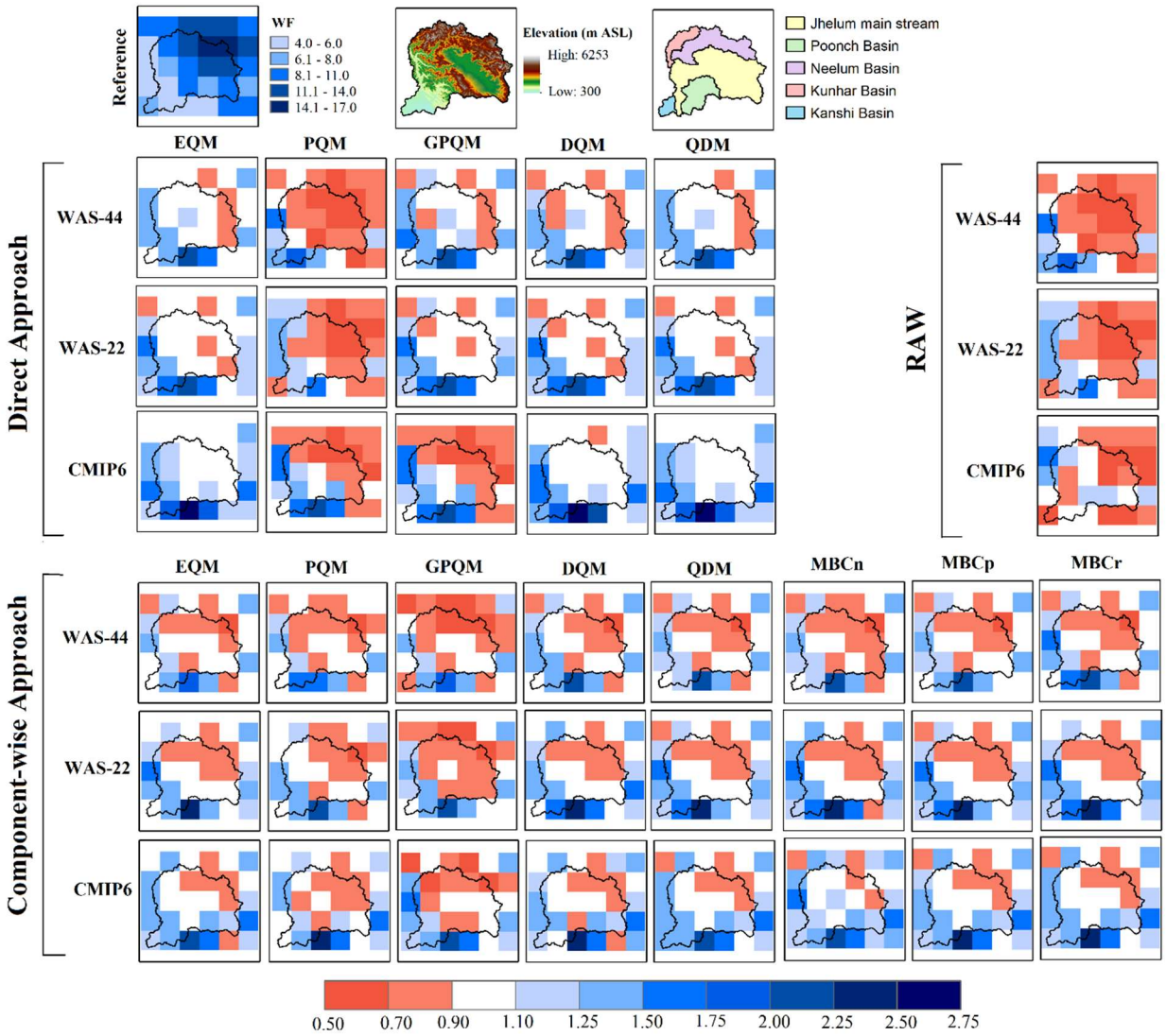

Figure S12: Same as figure S9, but for absolute wet frequency (WF) expressed as total number of wet events.