

S1 Multivariate statistical feature consistency tests

This supplementary material presents figures from the multivariate statistical feature consistency tests for the case study of Hunan Province, China. These figures compare the mean, standard deviation, skewness, and kurtosis of the model data before and after bias correction using EMBCCA-UNSEEN and the other evaluated methods.

5 S1.1 Mean

Figures S1 and S2 show the mean distributions of temperature and precipitation before and after bias correction. Consistent with the fidelity assessment presented in the main manuscript, the mean is well represented following correction.

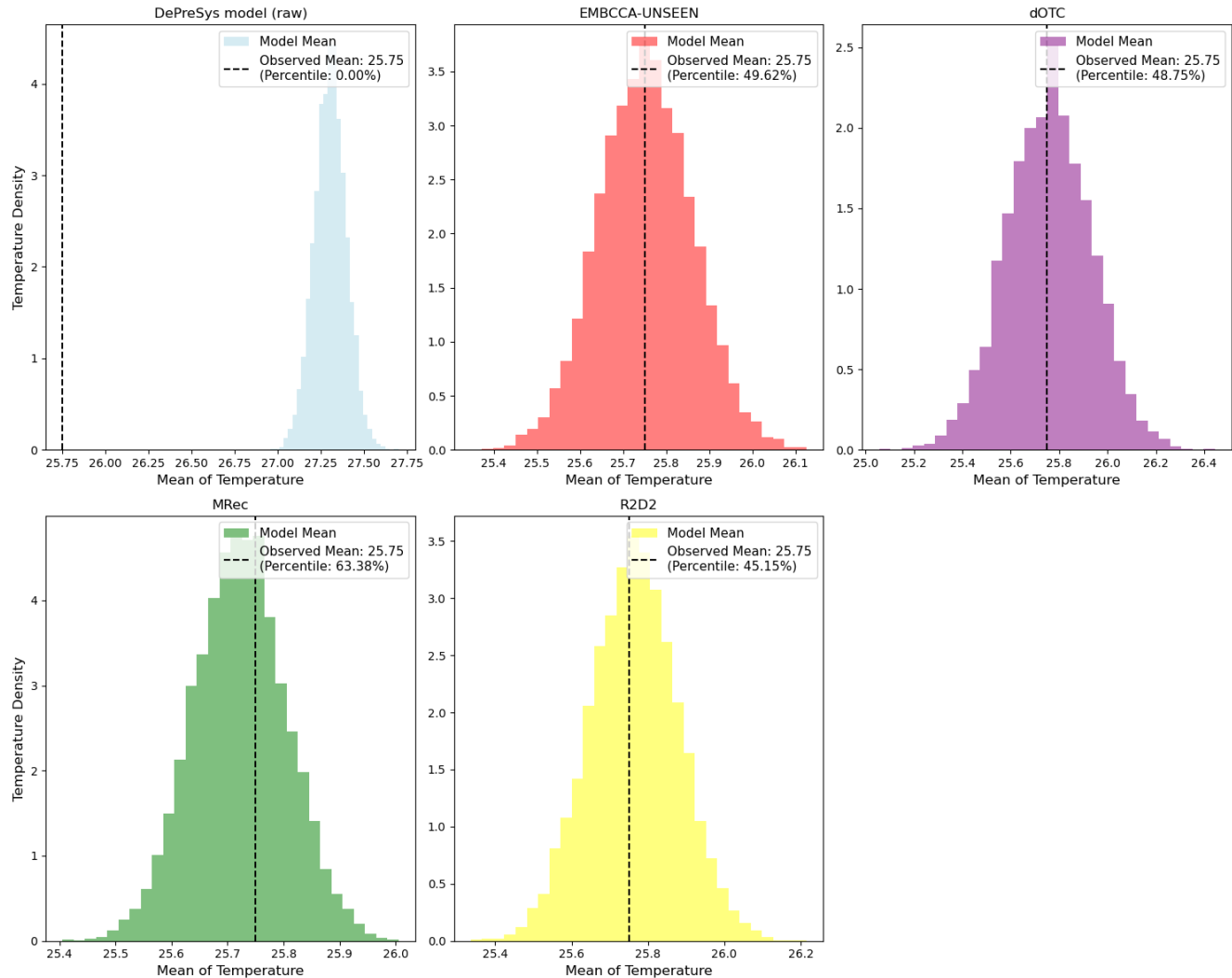


Figure S1. Temperature mean for raw DePreSys4 data and data bias-corrected using the evaluated multivariate bias-correction methods.

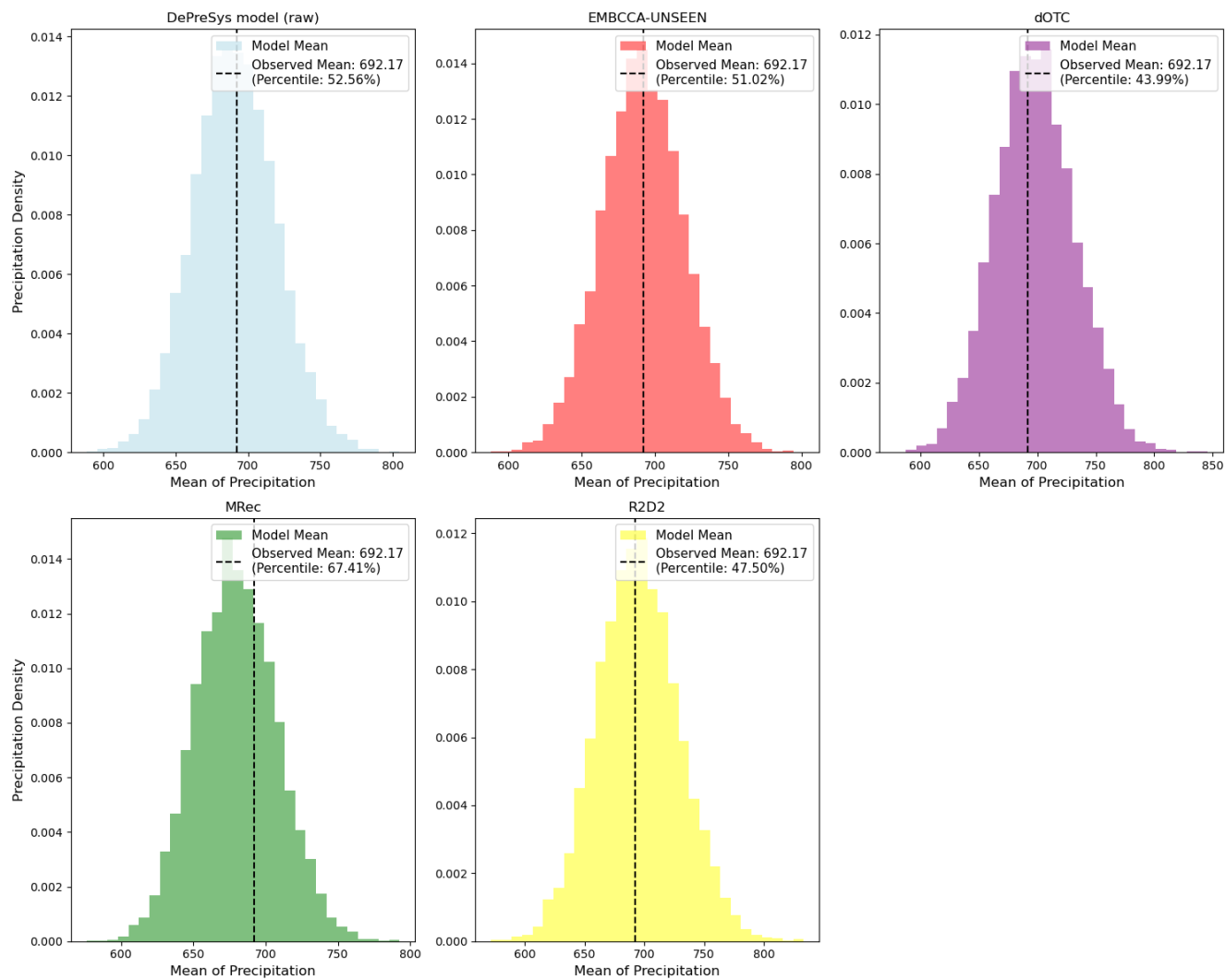


Figure S2. Precipitation mean for raw DePreSys4 data and data bias-corrected using the evaluated multivariate bias-correction methods.

S1.2 Standard deviation

Figures S3 and S4 show the standard deviation distributions of temperature and precipitation before and after bias correction. Consistent with the fidelity assessment presented in the main manuscript, the standard deviation is largely preserved following correction and thus retains the DePreSys model’s representation of extreme events.

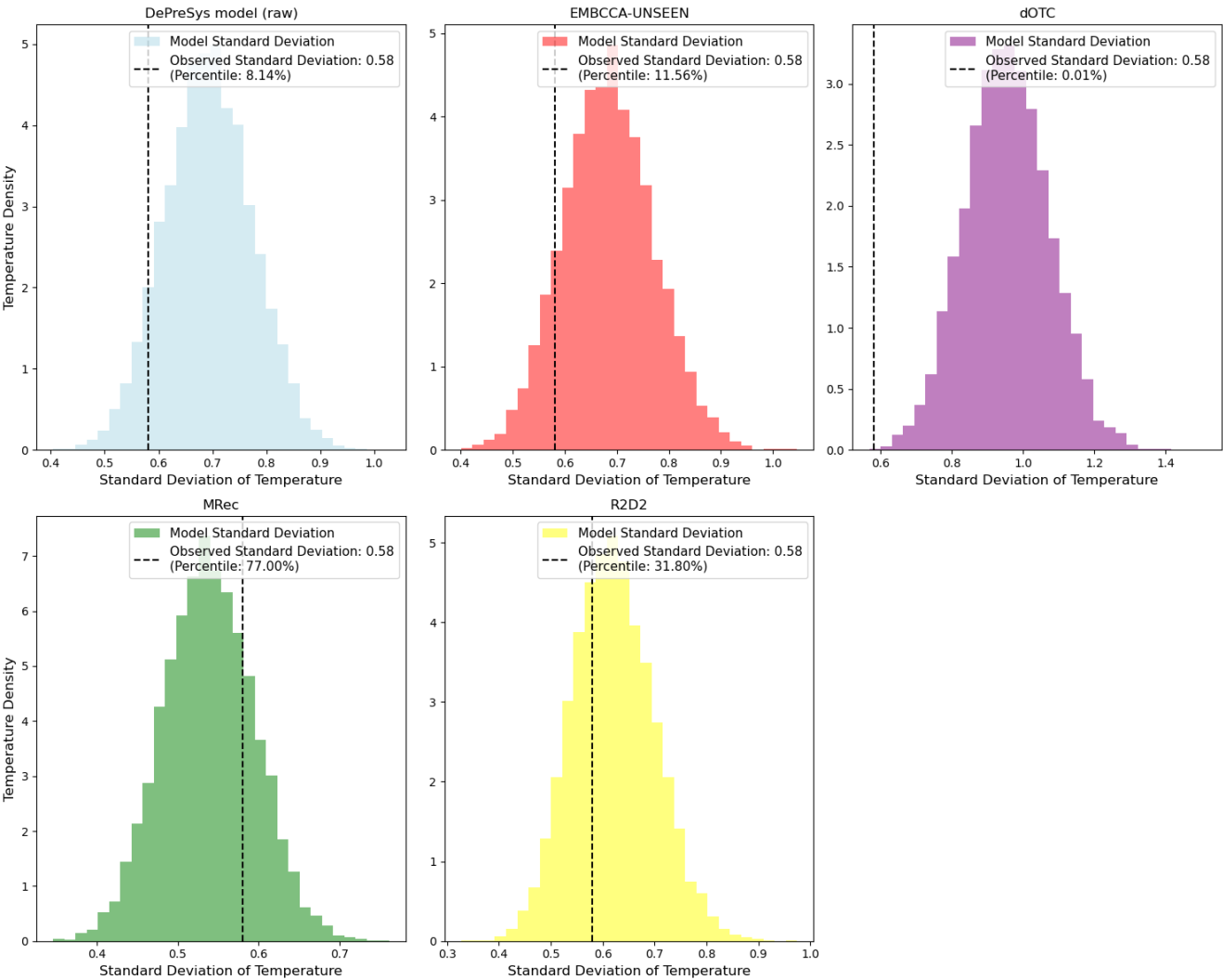


Figure S3. Temperature standard deviation for raw DePreSys4 data and data bias-corrected using the evaluated multivariate bias-correction methods.

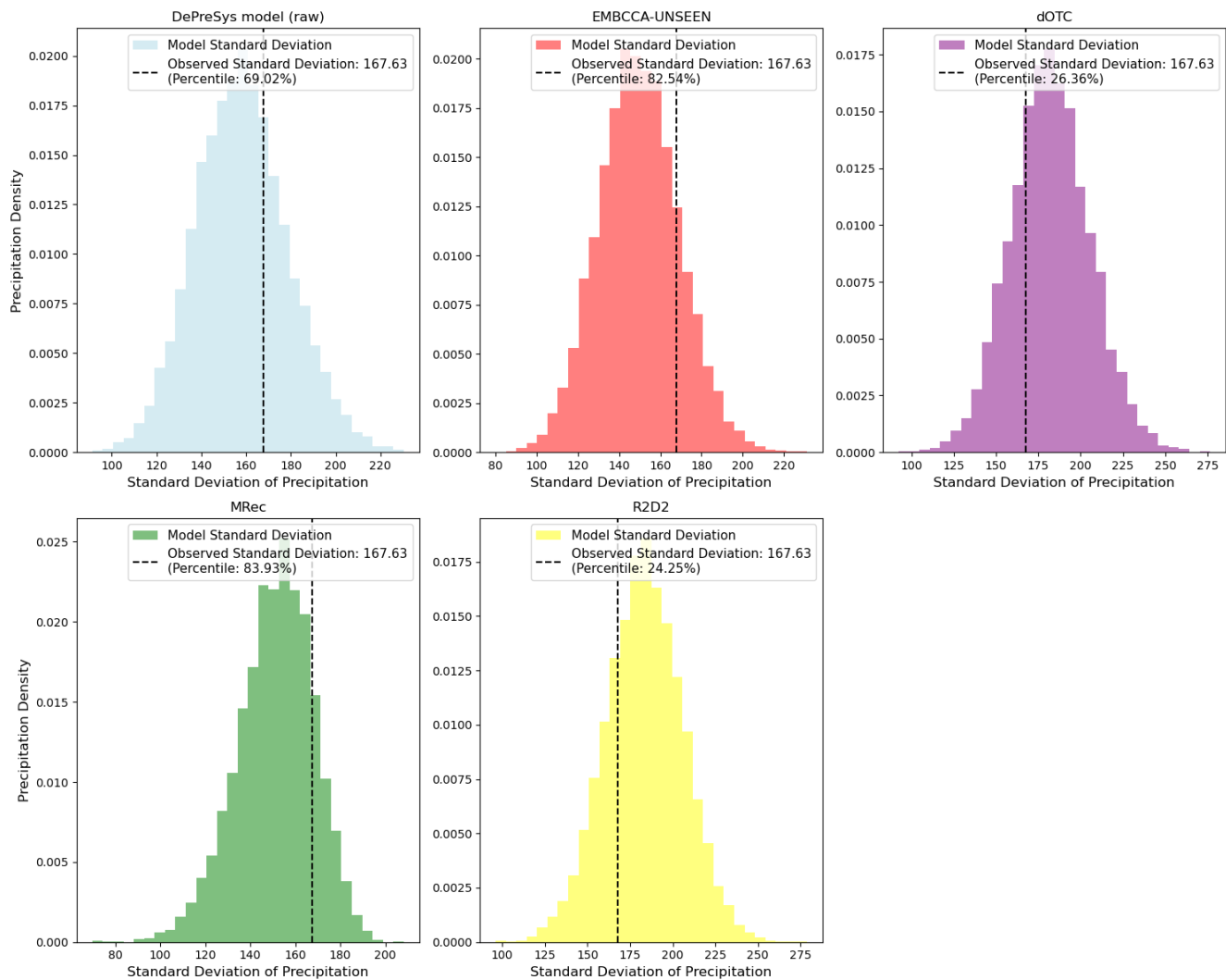


Figure S4. Precipitation standard deviation for raw DePreSys4 data and data bias-corrected using the evaluated multivariate bias-correction methods.

S1.3 Skewness and kurtosis

Figures S5 and S6 show the skewness and kurtosis evaluated using the measures for multivariate data introduced in (Mardia and Zemroch, 1975). Consistent with the fidelity assessment presented in the main manuscript, these higher-order statistics are largely preserved following correction.

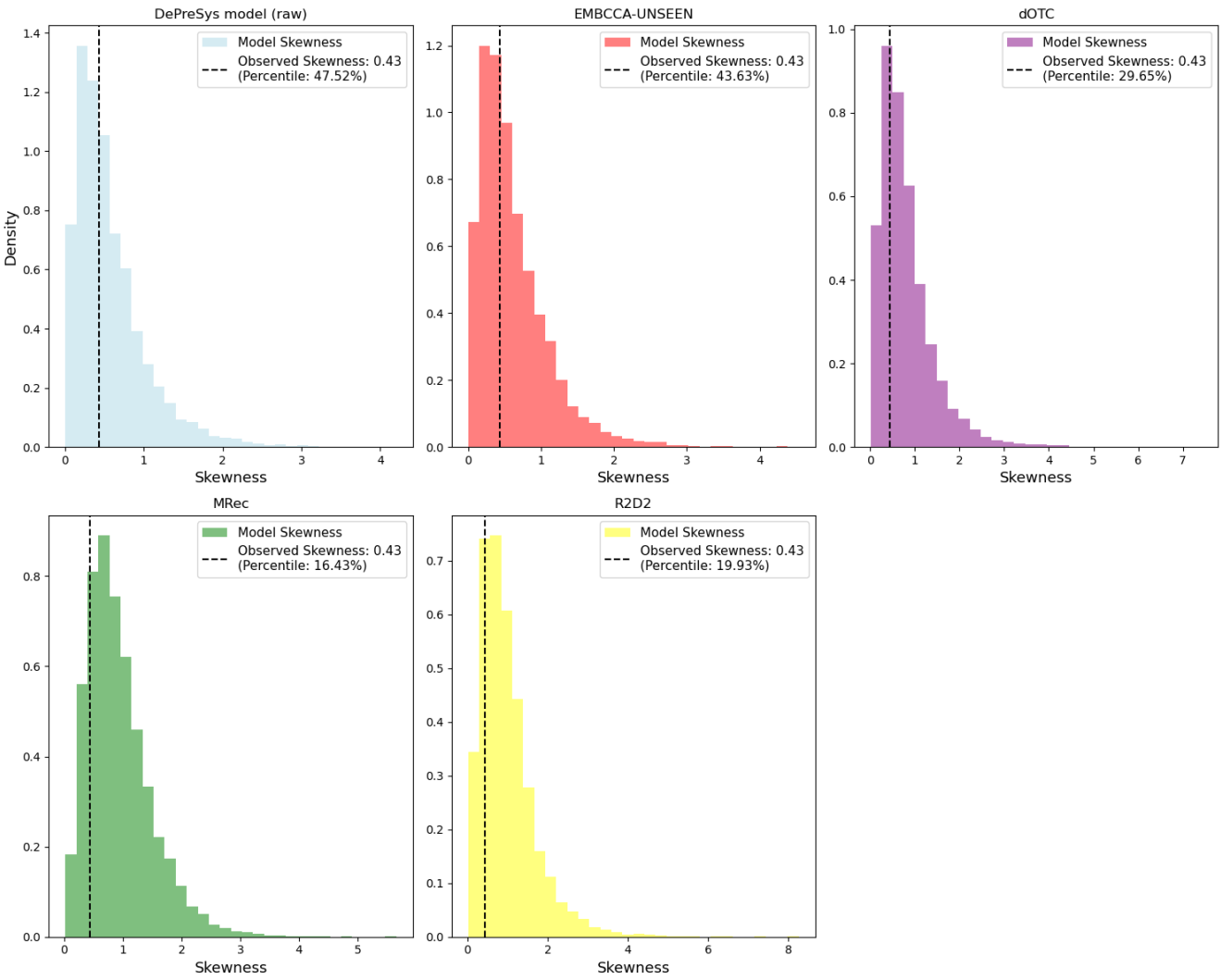


Figure S5. Mardia multivariate skewness of the joint temperature–precipitation distribution for raw DePreSys4 data and data bias-corrected using the evaluated multivariate bias-correction methods.

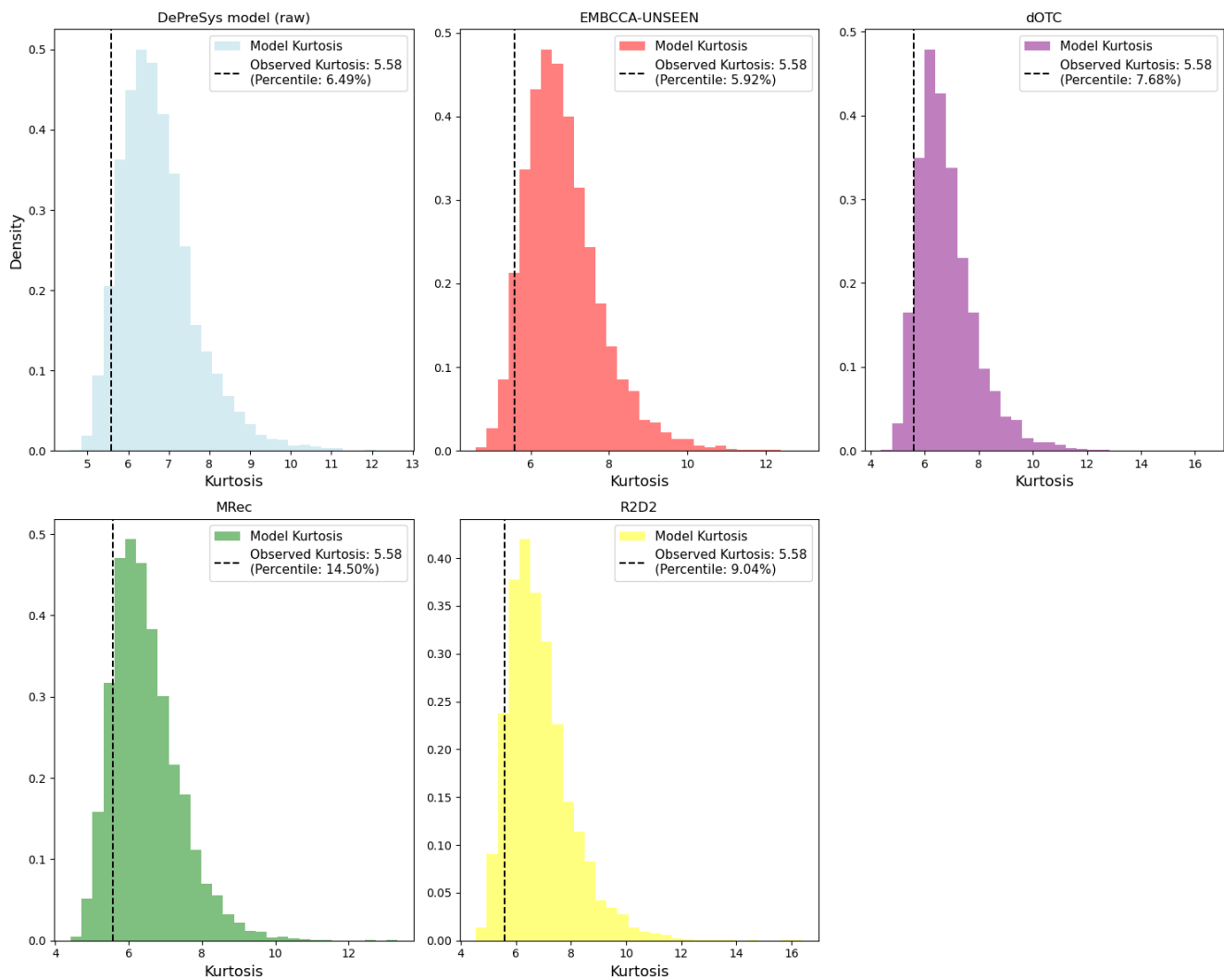


Figure S6. Mardia multivariate kurtosis of the joint temperature–precipitation distribution for raw DePreSys4 data and data bias-corrected using the evaluated multivariate bias-correction methods.

References

Mardia, K. and Zemroch, P.: Measures of multivariate skewness and kurtosis, *Journal of the Royal Statistical Society: Series C (Applied Statistics)*, 24, 262–265, 1975.