Supplement of Hydrol. Earth Syst. Sci., 28, 4263–4274, 2024
https://doi.org/10.5194/hess-28-4263-2024-supplement

Hydrology and Earth System Sciences
Open Access

Supplement of

Changes in mean evapotranspiration dominate groundwater recharge in semi-arid regions

Tuvia Turkeltaub and Golan Bel

Correspondence to: Tuvia Turkeltaub (tuviat@bgu.ac.il)

Supplement

Contents of this file

1. Figures S1 to S6
2. A flowchart describing the process of modifying the climate statistics.
3. The data used in this research is available at the following link:
   http://www.hydroshare.org/resource/5a28b74c55c74a7e9ad2b59a0a5d9ab3

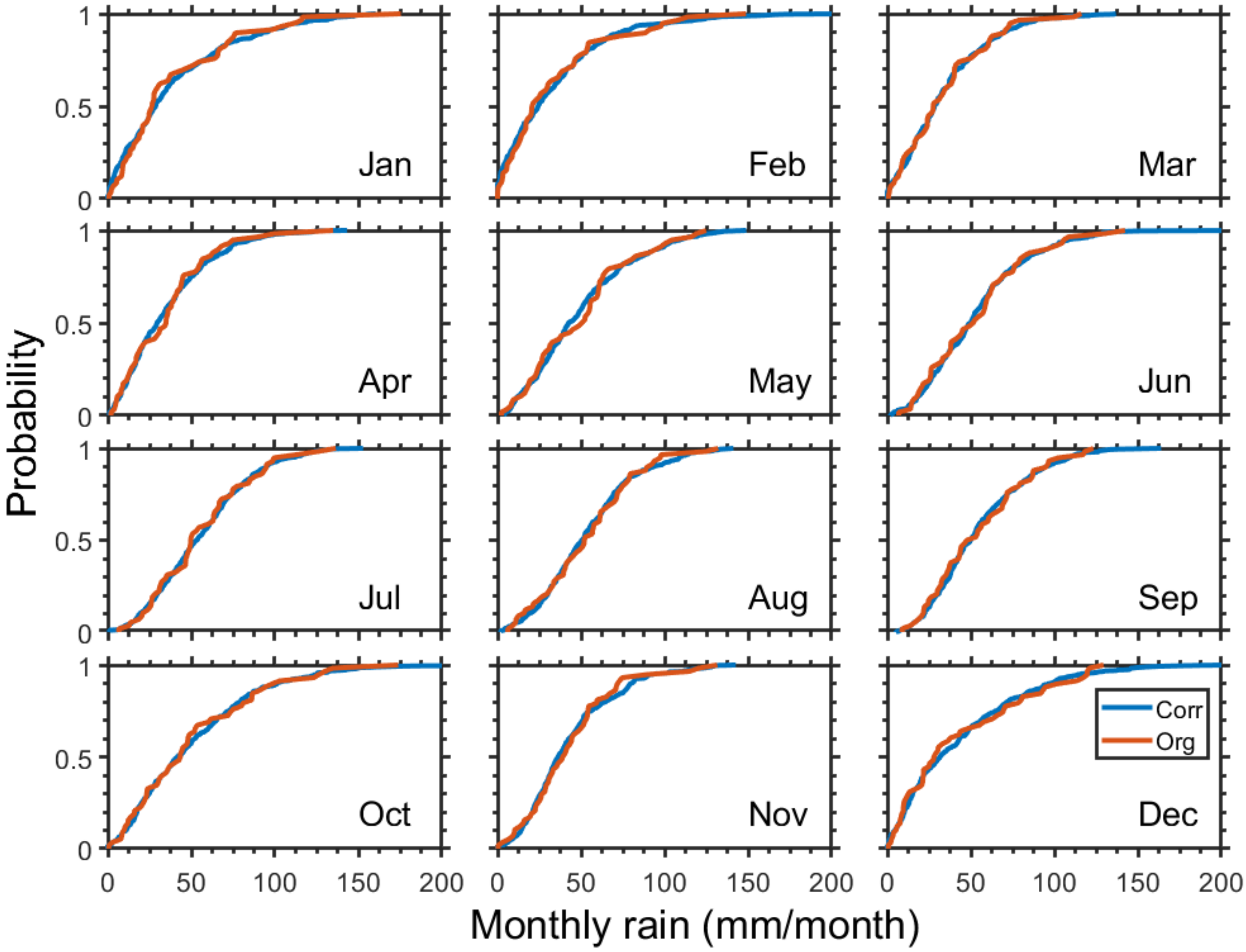


Figure S1: The effect of the monthly mean and STD correction on the monthly rain cumulative distribution function. See the Methods section of the main paper. For this demonstration, we used the rain data for a specific location ([-36.4469, 145.711]; Crosbie et al. (2010)).

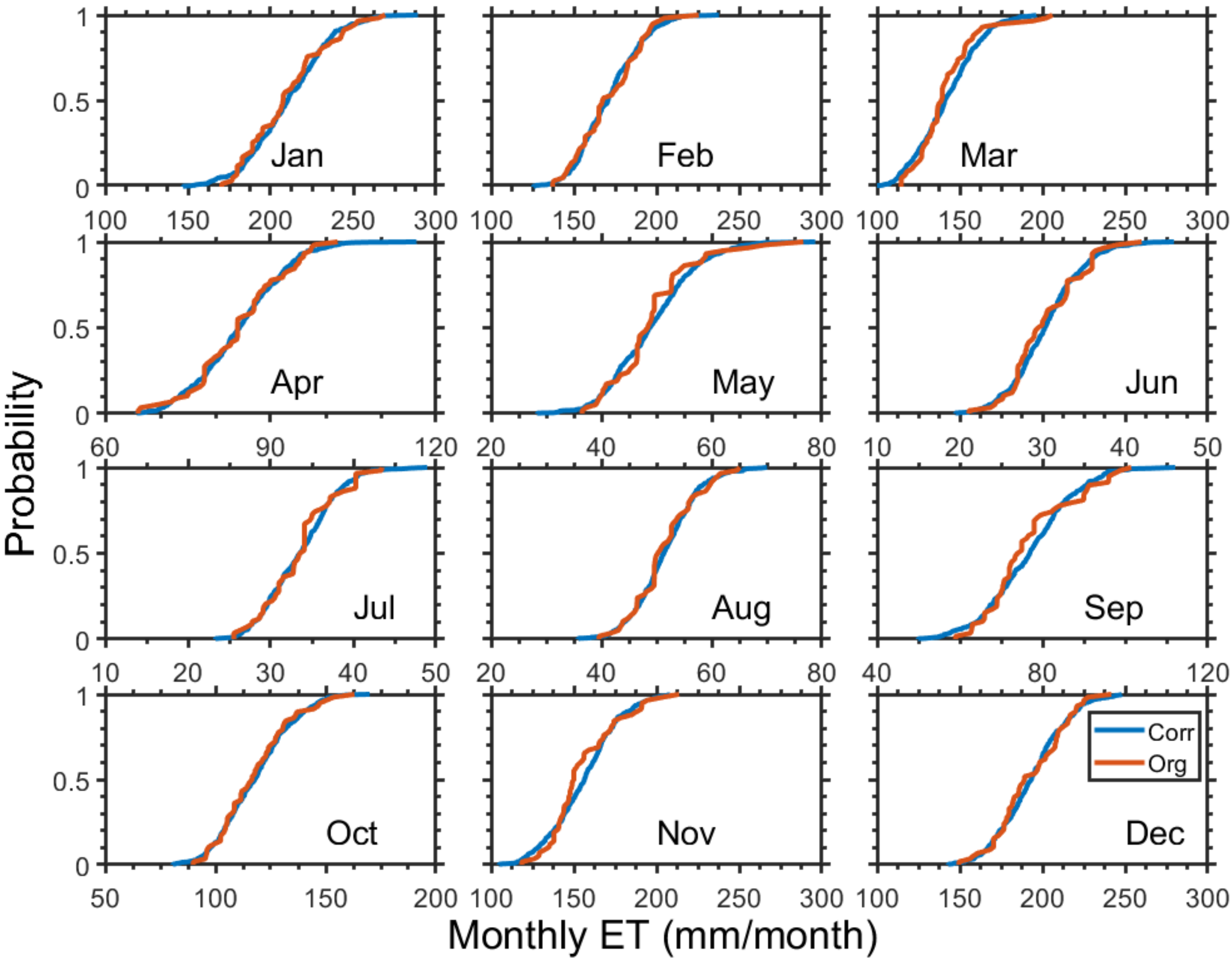


Figure S2: The effect of the monthly mean and STD correction on the monthly cumulative E_p distribution function. See the Methods section of the main paper. For this demonstration, we used the E_p data for a specific location ([-36.4469, 145.711]; Crosbie et al. (2010)).

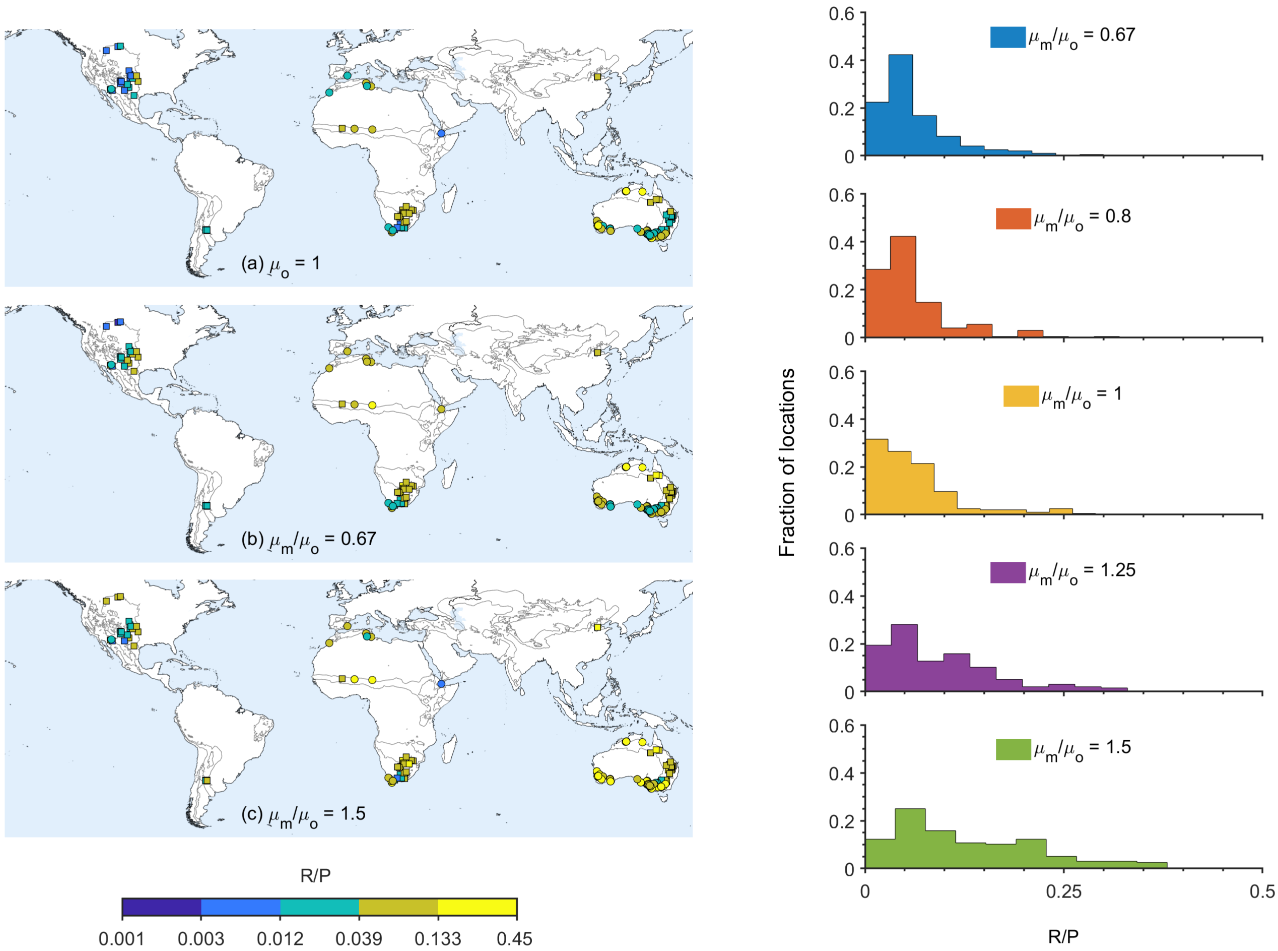


Figure S3: The effect of rain yearly mean modification on the R/P ratio. The left panels depict the modified ratio in different locations. The right panels depict the histograms of the fraction of locations with different R/P ratios under different mean rain modifications.

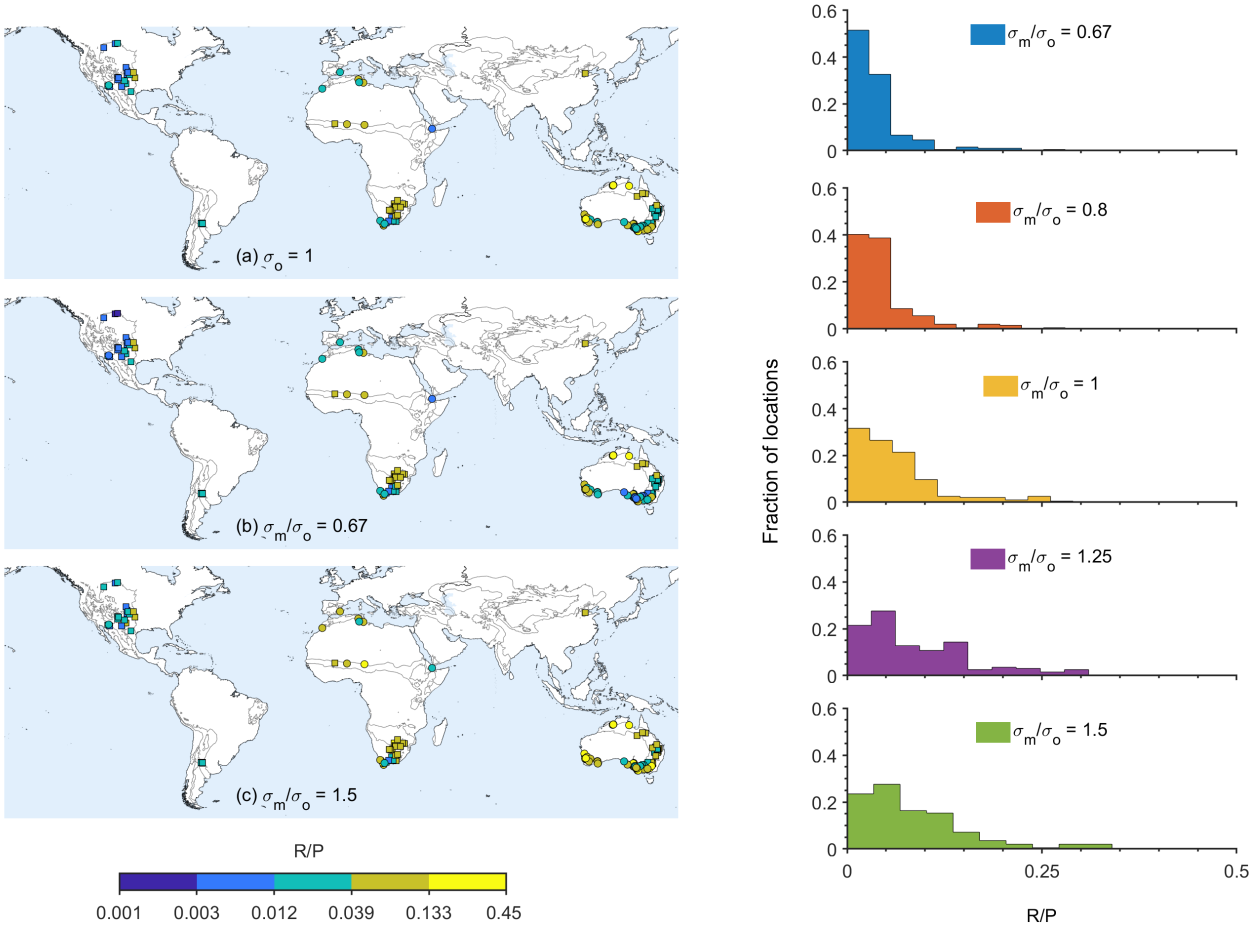


Figure S4: The effect of E_p yearly STD modifications on the R/P ratio. The left panels depict the modified ratio in different locations. The right panels depict the histograms of the fraction of locations with different R/P ratios under different mean rain modifications.

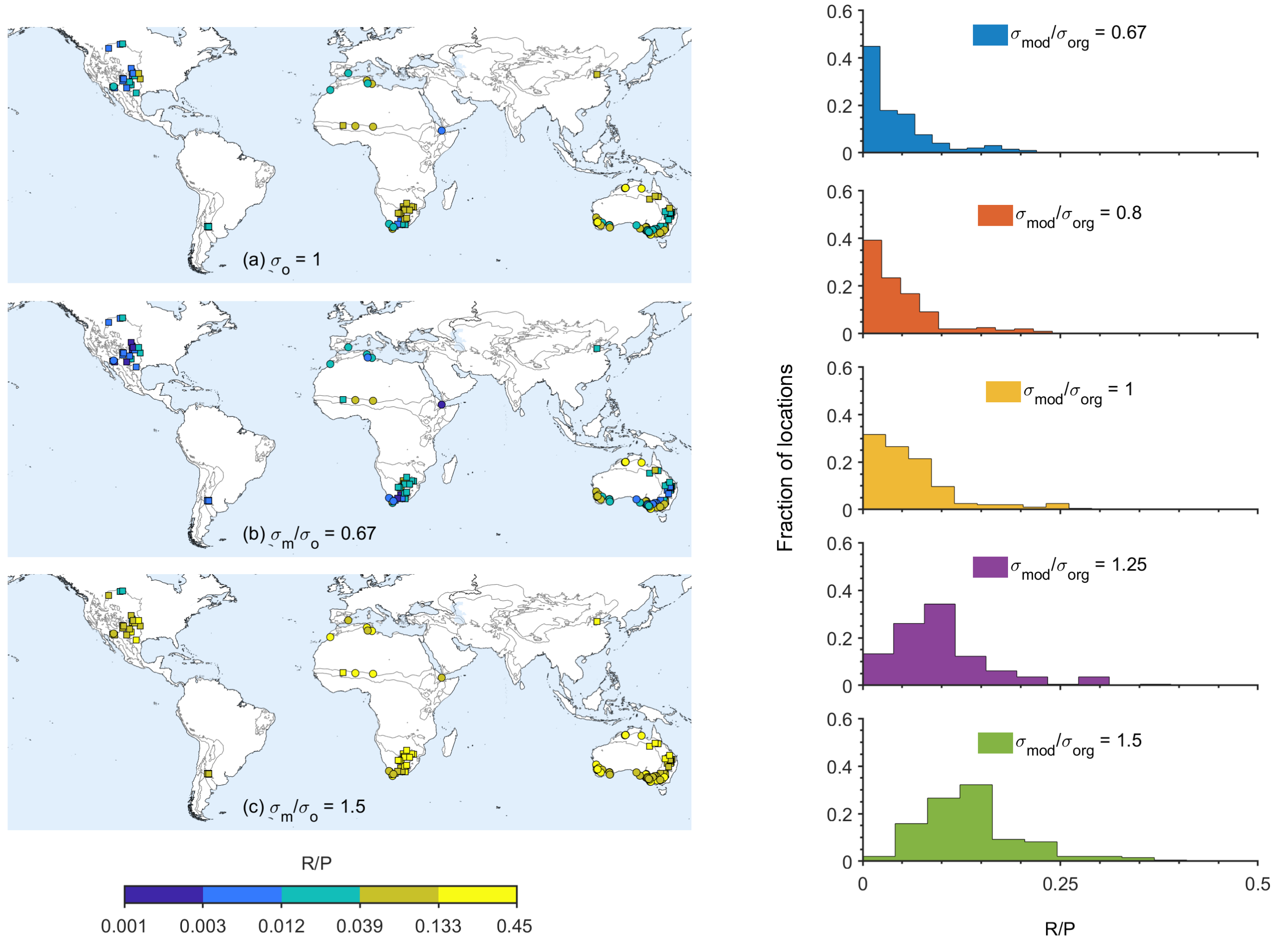


Figure S5: The effect of rain yearly STD modifications on the R/P ratio. The left panels depict the modified ratio in different locations. The right panels depict the histograms of the fraction of locations with different R/P ratios under different rain STD modifications.

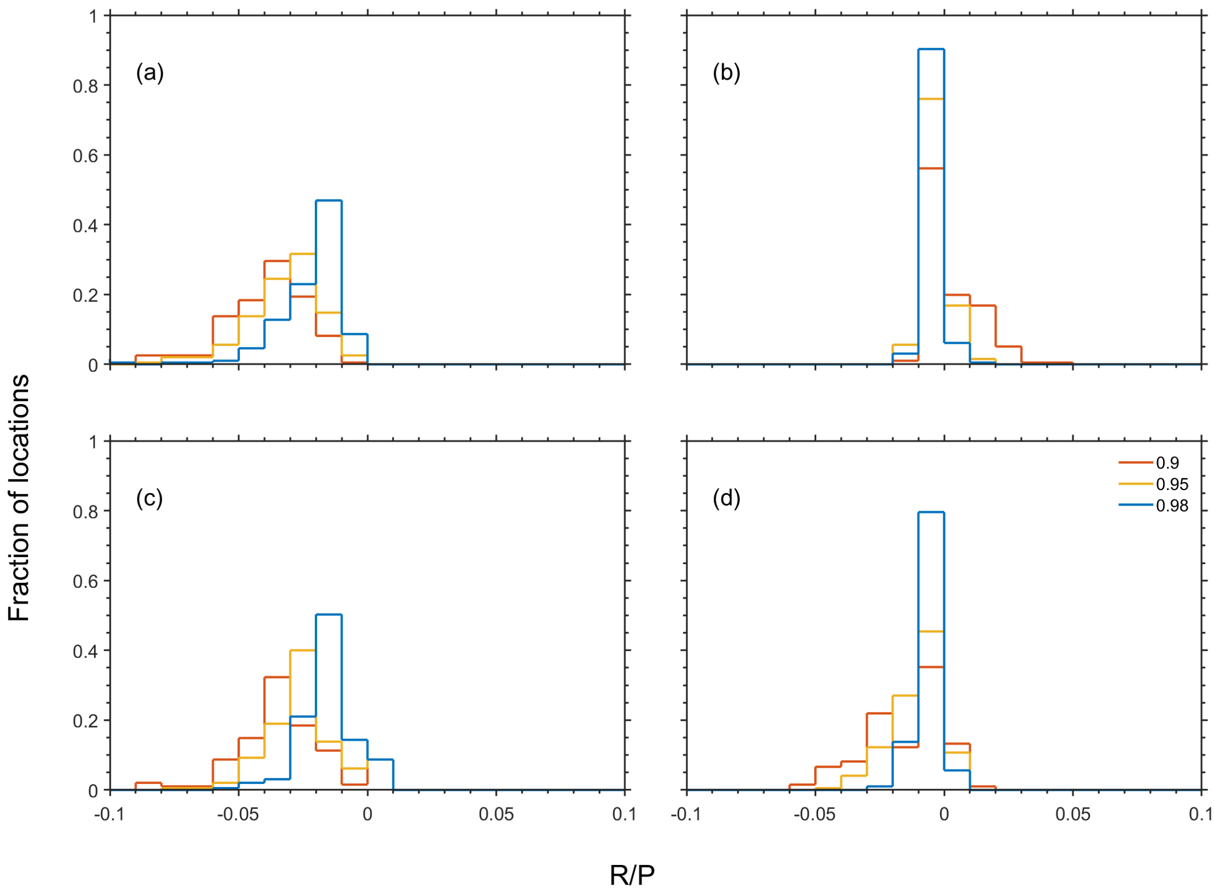
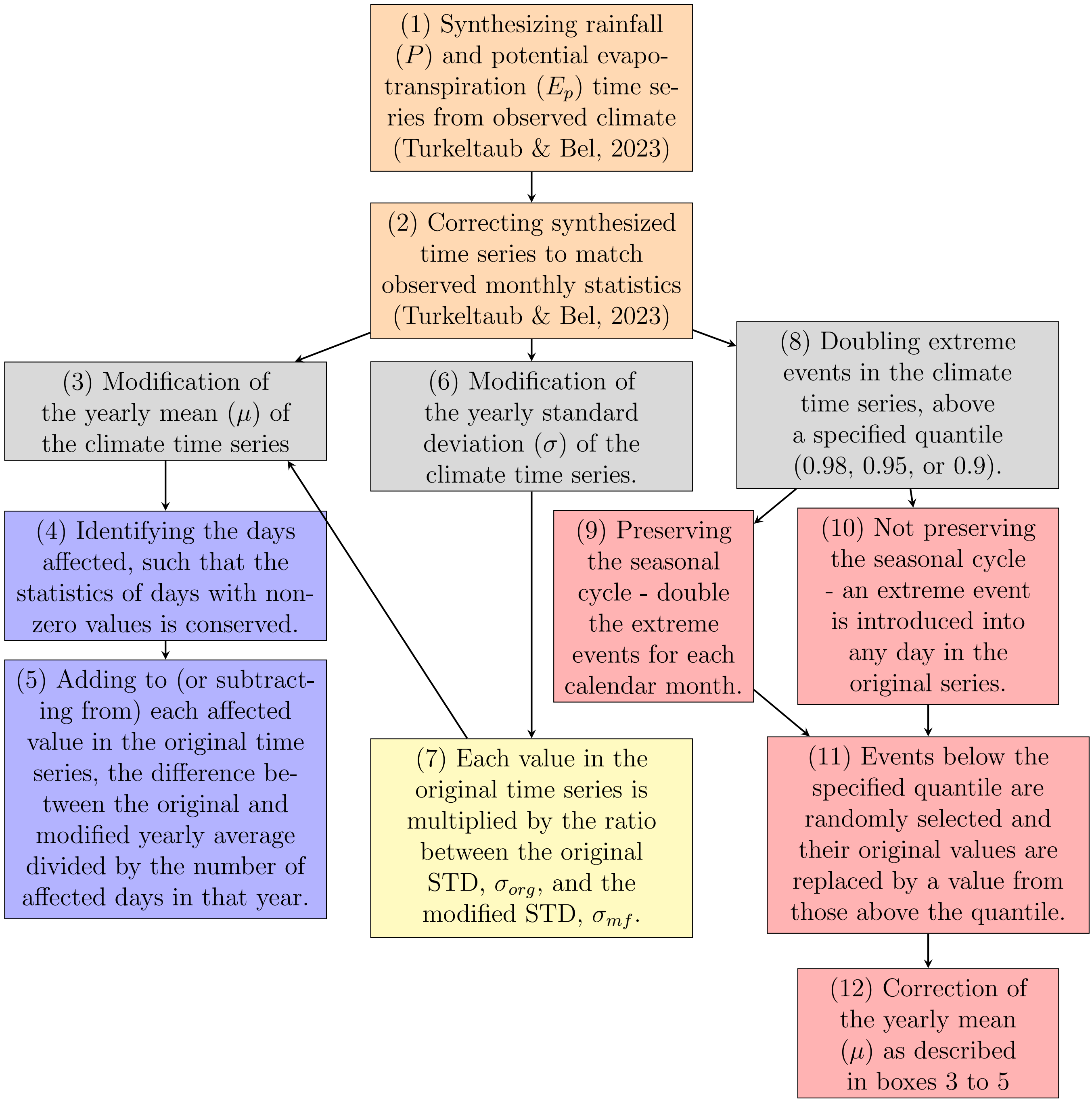


Figure S6: Histograms of the change in the R/P ratio for doubling the extreme events above the 90%, 95%, and 98% quantiles. Panel (a) represents the responses to doubling the extreme rain events regardless of the season and panel (c) the response to doubling the extreme rain events for each calendar month separately. For both cases, it is apparent that doubling the extreme rain events results in a higher R/P ratio in all locations. Panel (b) represents the responses to doubling the extreme E_p events regardless of the season and panel (d) the response to doubling the extreme E_p events for each calendar month separately. It is apparent that the doubling of extreme E_p events has a weaker effect. In most locations, it leads to an increase in the R/P and, in a small fraction of the locations, to a decrease in the R/P ratio.

Statistics modifications: a flowchart



The climate data synthesis and correction processes mentioned in boxes (1) and (2) are documented in Turkeltaub and Bel (2023). The mean (μ) modification process is described in boxes (3) – (5). In boxes (4) and (5), the identification of affected days is such that to increase the mean, all the non-zero values are increased to match the desired greater mean. To reduce the mean, the number of affected days is chosen to obtain no negative values for potential evapotranspiration and no values below 1mm/day for the precipitation. These are done without changing the statistics of the original non-zero values. Namely, the statistics of rainy days is conserved. The process for modifying the standard deviation (σ) of the time series is described in boxes (6) and (7). First (box 7) each original value is multiplied by the ratio between the original standard deviation, σ_{org}, and the desired standard deviation, σ_{mf}. This process changes the mean; therefore, it is followed by the mean modification process of boxes (3)–(5) to adjust the mean back to its original value. The modification of extreme event statistics is detailed in boxes (8) – (12). The extreme statistics can be modified using two different methods. One (9) preserves the seasonal cycle and the other method (10) modifies it. In (9) the extreme events are doubled for each calendar month separately. This ensures that the seasonal cycle is conserved. In (10) extreme events are doubled for the entire year. Therefore, a large value may be assigned during a month with non-zero but low values. In our study, the extreme events were defined using the 0.9, 0.95, and 0.98 quantiles. Note that the correction of the μ of the time series in box (12) is identical to the process outlined in boxes (3) – (5).

References

Crosbie, R. S., Jolly, I. D., Leaney, F. W., and Petheram, C.: Can the dataset of field based recharge estimates in Australia be used to predict recharge in data-poor areas?, Hydrology and Earth System Sciences, 14, 2023–2038, https://doi.org/10.5194/hess-14-2023-2010, 2010.

Turkeltaub, T. and Bel, G.: The effects of rain and evapotranspiration statistics on groundwater recharge estimations for semi-arid environments, Hydrology and Earth System Sciences, 27, 289–302, https://doi.org/10.5194/hess-27-289-2023, 2023.