Comment on gmd-2022-237

Anonymous Referee #1

Referee comment on "Evaluation of bias correction methods for a multivariate drought index: case study of the Upper Jhelum Basin" by Rubina Ansari et al., Geosci. Model Dev. Discuss., https://doi.org/10.5194/gmd-2022-237-RC1, 2023

General Comments:

Dear Authors,

This is a very interesting paper on the topic of assessing bias-adjustment techniques, where I am also doing work in. It is relevant to the scope of the journal and could be a useful resource for the community for comparing the performance of univariate bias-adjustment methods vs. multivariate methods in the context of multivariate climate indices. However, there are a number of points that should be further discussed before publication is recommended:

Please provide a comment or two to describe to readers as to why SPEI **and** the Upper Jhelum Basin are appropriate for testing univariate and multivariate bias-adjustment approaches. Based on the results of the bias analysis and the Taylor diagrams, even though biases are reduced via the various methods it does not appear that SPEI is resolved well over all. Is the 50km resolution sufficient in resolving the topography of the region?

Please justify more explicitly/clearly that these findings (that both univariate and multivariate methods for SPEI perform similarly/well) is applicable to different regions in the world, input variables, and/or multivariate indices.

Specific Comments:

Page 4, line 5: I was not familiar with SPEI, so it was not immediately apparent how the Ra parameter was derived in the simplified Hargreaves-Samani equation. It would be useful for readers who aren't familiar with SPEI to indicate that the radiation parameter is derived using the latitude of the site/grid.

Page 4, line 16: Extremes events are defined as SPEI values $\geq$ +1 and $\leq$ -1 in this paper. Please comment on why these values were chosen – were there any past studies that also defined extreme events using these thresholds?

Page 4, line 31: Why were only 20 years (1986-2005) used as the historical and not a slightly longer 30 year period? I believe W5E5v1.0 was available from 1979-2016.

Page 8, section 2.6: When applying these methods, did you aggregate/pool the daily data into month-of-year/seasonal windows before bias-adjustment to account for precipitation biases in the seasonal cycle? Likewise, for MBCn, how many iterations were used? Could you describe in more depth how you applied these quantile mapping algorithms?

Page 8, line 46-48: Could you justify why nearest neighbor interpolation was chosen over other methods such as bilinear/cubic? Can you verify whether the "added value of the higher resolution WAS-22" is still present after remapping to the coarse resolution?

Page 9, line 1: Were the issues of temperature reversals (i.e., Tmin>Tmax) considered, and/or how did you resolve this? Based on Thrasher et al. (2012), temperature reversals may be encountered post bias-adjustment, while Cannon et al. (2021) multivariate bias-adjusted the daily diurnal cycle and Tmean before deriving Tmax & Tmin to ensure reversals are avoided.

Page 13, line 2-3: Is there a reason why the mean biases are expressed as a ratio and not as a delta?

Page 13, line 22: It is unclear what "partially elevated" means in this context, please clarify.

Page 15, line 7: "[…] but still shorter events than in the reference dataset are found after the corrections." Awkward way of phrasing, or possibly a strange placement for the word "still".

Page 18-20, Figures 6 & 7: The study area spans over 30 grid cells at a 50km resolution – are these large enough of a sample size to use for spatial analysis via Taylor diagrams?

Technical corrections:

Page 3, line 30+31: Section numbering should be 2 and 2.1

Page9, line 12: Heading should be spaced after text

Page 20: Legend for model names is a bit fuzzy when zoomed in – would it be possible to have this at a higher resolution?

Figures 3, 4, S1, S2, S3: Lower (left) bound value of the colour bar is not equal in increment to the others

Throughout the paper (e.g., Page 4 line 11; Page 22 line 9): citation formatting, i.e., brackets should just be around the publication year, like other examples throughout the manuscript when authors are directly addressed in the sentence.

I would be more than happy to review again once these comments have been answered and/or addressed.