RC3: 'Comment on essd-2021-361', Anonymous Referee #3, 07 Jan 2022

It is my pleasure to review the paper entitled “HCPD-CA High-resolution climate projection 1 dataset in Central Asia for ecological and hydrological applications” by Qiu et al. The authors produced a high-resolution (9km) climate projection dataset over Central Asia based on the dynamically downscaled results being combined with multiple bias-corrected global climate models. This dataset is assumed to serve as a scientific basis for assessing the impacts of climate change over Central Asia on many sectors.

Given the importance of this work and its potential impact, I would like to providing the following comments for improving the manuscript.

(1) The time range in 2.2 (1981-2005/2026-2050) is different from that in 2.3 (1985-2005/2060-2050). Could you please explain or make them consistent for readable?

Reply: The bias-correction technique is developed by Bruyère et al. (2014). They produced the bias-corrected CCSM4 outputs (DOI: https://doi.org/10.5065/D6DJ5CN4) with a 25-year base period (1981-2005) during the bias correction. In this study, we produced the bias-corrected MPI-ESM-MR and HadGEM2-ES outputs with the same base period as them. The base period used during the bias correction is not necessary to be consistent with the reference period (1986-2005) of the RCM simulations.

“The bias-corrected CCSM4 outputs (DOI: https://doi.org/10.5065/D6DJ5CN4) is produced by Bruyère et al. (2014) with a 25-year base period (1981-2005) during the bias correction. In this study, we produced the bias-corrected MPI-ESM-MR and HadGEM2-ES outputs with the same base period as them. Note that the base period used during the bias correction is not necessary to be consistent with the reference period (1986-2005) of the RCM simulations.” (L127-130 in the revised MS)

Ref: Bruyère, C. L., Done, J. M., Holland, G. J., and Fredrick, S.: Bias corrections of global models for regional climate simulations of high-impact weather, Climate Dynamics, 43, 1847-1856, 10.1007/s00382-013-2011-6, 2014.

(2) Fig. 2 should be explained in detail, especially for the right side of the figure. There are some sub-questions are occurred from this figure:

- How to achieve the action named “WRF with the optional combination of physical schemes” with the input from Bias-corrected GCMs and Observation data?
- The term “WRF with the optional combination of physical schemes” seems to run WRF model again, however, WRF model has been executed in previous step. This term can be renamed properly.
- Is the spatial resolution of Bias-corrected GCMs same to the one of the WRF model output? If not, how to match them?

Reply: I explained Fig. 2 in the revised MS.

“Fig. 2 shows the flow chart to produce the HCPD-CA dataset. The procedure can be divided into four steps. First, multiple-source observational data is used to evaluate the WRF model with different combinations of physical schemes and then we found the optimal combination of physical schemes for the WRF model. Second,

the original GCMs are bias corrected and the bias-corrected GCMs are used to drive the WRF model with the optimal combination of physical schemes. Third, we conducted the dynamical downscaling and produced 9-km resolution downscaled results. At last, the HCPD-CA dataset with certain variables and standard file formats is derived from the downscaled results." (L141-147 in the revised MS) As the driving data, the bias-corrected GCMs have much coarser spatial resolution than the WRF model outputs.

(6) In Fig.3, the observational data for temperature is CRU data, the ones for precipitation and other variables are ERA data. Could you please give more reasonable explanation?

Reply: We found the CRU TS v4 dataset generally has good performance to describe the climatology of surface air temperature over CA (Qiu et al., 2021). Thus, we used it to evaluate the simulated T2MEAN/T2MAX/T2MIN. Because the rain-gauge-observation merged in the CRU TS v4 dataset is sparse and unevenly distributed over CA, the precipitation data in it has limitations in depicting the climatology of precipitation in CA, especially over the mountainous areas. In addition, the CRU TS v4 dataset does not have other variables (e.g., relative humidity, wind, and shortwave and longwave radiation). As a results, we used the ERA5-Land dataset to evaluate precipitation and other variables.

Ref: Qiu Y., Feng, J., Yan, Z., Wang, J., and Li, Z.: High-resolution dynamical downscaling for regional climate projection in Central Asia based on bias-corrected multiple GCMs, Climate Dynamics, 10.1007/s00382-021-05934-2, 2021.

(7) It is recommended to do more comparisons between the simulation from control experiment and the one being combing Bias-correction GCMs, and to show the improvement by introducing the Bias-correction GCMs.

Reply: "In a recent study (Qiu et al., 2021), we conducted the sensitivity experiments of using the bias-correction technique, to quantify its contribution to improving the RCM simulation. The results show that using the bias-correction technique largely reduced the biases in the simulated annual and seasonal precipitation over CA respect to not using it and slightly improved the model's skill in simulating the spatial pattern of precipitation (see Fig. 4 in Qiu et al., 2021)." (L123-127 in the revised MS)

Ref: Qiu Y., Feng, J., Yan, Z., Wang, J., and Li, Z.: High-resolution dynamical downscaling for regional climate projection in Central Asia based on bias-corrected multiple GCMs, Climate Dynamics, 10.1007/s00382-021-05934-2, 2021.

(8) Please use the data doi linkage instead of the uuid linkage for accessing the dataset in Lines 22-23 and Lines 187-188.

Reply: Revised.

"It has the DOI https://doi.org/10.11888/Meteoro.tpdc.271759 (Qiu, 2021)." (L23-24 in the revised MS)

"The HCPD-CA has the DOI https://doi.org/10.11888/Meteoro.tpdc.271759 (Qiu, 2021)." (L267 in the revised MS)