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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Hybrid climate datasets from a climate data evaluation system and their impacts on hydrologic simulations for the Athabasca River basin in Canada" *by* Hyung-Il Eum and Anil Gupta

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The study evaluates five climate datasets; ANUSPLIN, Alberta Township, PNWNAmet, CaPA, and NARR. The method can be divided in three major parts: (a) comparing climate datasets (identified in the method section of the manuscript as "Performance Measure Module"), (b) ranking the gridded datasets based on their performance measures (identified in the method section of the manuscript as "Ranking Module"), and (c) further evaluating climate datasets and their ranking using the VIC hydrological model (identified in the method section of the manuscript as "Proxy validation").

General comments:

Each part of the method section raises concerns as follows:

Part 1:

In the first part of the methodology, five climate datasets were compared. Three of them (ANUSPLIN, Alberta Township, and PNWNAmet) are climate datasets which are originally generated based on interpolation, and the other two (CaPA and NARR) are generated based on models and satellite technologies. The accuracy of all the datasets is compared to the (observed stations) Adjusted and Homogenized Canadian Climate Data (AHCCD). The main concern is how the authors did this comparison? The study states that "the inverse distance squared weighting method was applied to obtain the values at the AHCCD stations from all the gridded climate datasets. Then, performance measures were calculated by comparing the interpolated values with the data collected at AHCCD stations." This raises major concerns about the method used as follows:

1) First and foremost, the ANUSPLIN, Alberta Township, and PNWNAmet climate datasets were originally generated/interpolated based on "the same source of observed data (AHCCD)." If they are slightly different in the interpolated values, this is simply due to:

a. different generation (updated version) of AHCCD were used to interpolate the data (Vincent et al., 2002, 2012; Mekis and Vincent, 2011). This implies that if one dataset illustrates slightly poor performance compared to the others, it doesn't mean it is still the poor choice as they are continuously being updated.

b. the three climate datasets have been generated based on different interpolation techniques. Therefore, the errors/uncertainties might be associated with the interpolation techniques. In this regard, even if one assumes the three climate datasets were generated using the same version of AHCCD at the time of comparison (which is not the case here), the interpolation method of each individual dataset should have been

used to estimate unknown points based on known points. That is the way to evaluate the performance of each climate dataset generated by different interpolation techniques. Instead, authors used their own interpolation method (inverse distance squared weighting method) “to obtain the values at the AHCCD stations”, “Then, performance measures were calculated by comparing the interpolated values with the data collected at AHCCD stations.” This means the error found in one dataset could be associated with the interpolation techniques used, - not the original datasets. This could be one of the reasons the Alberta Township climate datasets illustrate better accuracy compared to others. Because the Alberta Township climate datasets have been generated based on different versions of the Inverse Distance Weighting method including “the inverse distance squared weighting method” which was used by the authors to do the evaluation.

2) The authors should avoid comparing apples with oranges when the two CaPA and NARR datasets obtained from models and satellites were compared to the ANUSPLIN, Alberta Township, and PNWNAmet datasets obtained from interpolation techniques. This comparison was done based on the observed detests (AHCCD) which was originally used to generate the ANUSPLIN, Alberta Township, and PNWNAmet datasets. Each point of comparison has been initially used as a centre point to generate the ANUSPLIN, Alberta Township, and PNWNAmet datasets, which can result in high correlations between three as well as the AHCCD datasets due the “existing spatial dependency.” The point values should have been used for evaluations which are “spatially independent.” Otherwise, there is no point in comparing the three interpolated climate datasets with CaPA and NARR which were originally generated to address a poor monitoring network density.

Part 2: The gridded datasets have been ranked based on their performance measures. However:

1- We can not necessarily assign a high performance rank to a grid cell just because of being highly correlated with a nearby station - neither due to its distance nor elevation.

2- The ranking concept may not be still valid considering some of the comments mentioned in part 1.

Part 3: Further evaluation of climate datasets and their ranking have been done using the VIC hydrological model.

1- Five VIC models have been calibrated corresponding to each individual climate dataset. How can you justify associating the errors to the climate data rather than to “the calibration parameters and/or the calibration process, and/or the model structure”? arbitrary adjustment of parameters might have been done to compensate for the errors in the input climate data - which has been done for each VIC model separately.

2- It has been mentioned in the manuscript that “The proxy validation also confirmed the superior performance of hybrid climate datasets compared with the other five individual climate datasets investigated in this study.” However, the results of the proxy validation (in Table 6) confirm otherwise. Maybe even going one step further, and ask this question whether the two climate datasets; ANUSPLIN, Alberta Township can confirm that there is no need to generate another dataset called “hybrid climate dataset”.

Overall, I agree the use of various available data sources in hydrological modeling and qualifying them through alternative simulation scenarios prior to calibration of the model parameters (e.g., Faramarzi et al., 2015), but we need way more rigorous method and justification than what are used in this study to introduce ‘a reference climate dataset’ for a province.

Faramarzi, M., Srinivasan, R., Iravani, M., Bladon, K. D., Abbaspour, K. C., Zehnder, A. J., & Goss, G. G. (2015). Setting up a hydrological model of Alberta: Data discrimination analyses prior to calibration. Environmental Modelling & Software, 74, 48-65.

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Vincent, L.A., Wang, X.L., Milewska, E.J., Wan, H., Yang, F., Swail, V., 2012. A second generation of homogenized Canadian monthly surface air temperature for climate trend analysis. J. Geophys. Res. Atmospheres 117, D18110. https://doi.org/10.1029/2012JD017859.

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Specific comment:

Authors may consider using coordinate systems for figures, especially Fig. 3 and 8, that can help readers to locate the study area and better investigate its climate.

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