Hydrology and Earth System Sciences Discussions

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Reply on RC2

Paul H. Whitfield et al.

Author comment on "The spatial extent of hydrological and landscape changes across the mountains and prairies of Canada in the Mackenzie and Nelson River basins based on data from a warm-season time window" by Paul H. Whitfield et al., Hydrol. Earth Syst. Sci. Discuss., https://doi.org/10.5194/hess-2020-613-AC2, 2021

HESSD 2019-613 RC2 Comment

The spatial-temporal variation of streamflow is a relatively common topic in hydrology. This paper has investigated the change of streamflow for the Mackenzie and Nelson River Basins in Canada. While peer studies tend to be based on a small number of stations with a common period of years, this paper makes use of a large number of stations with different series of years by using dynamic time-wrapping. The results show twelve streamflow regime types and also reveal hydrological factors that contribute to the different types. In general, the paper is in a good shape.

[Authors response] We would like to thank the reviewer for taking the time to provide these comments.

There are a few comments for further improvements of the paper:

[1] Firstly, a flowchart that showcases all the datasets and methods is in demand. The paper involves datasets of streamflow and landscape attributes. The different datasets are related to one another through a number of statistical methods. A flowchart would make the methods and results more accessible.

[Authors response 1] The paper is already quite long and a flow chart would not help with that issue.

[2] Secondly, hydrological changes are related to landscape attributes in the analysis. For a given gauge station, its streamflow is affected by landscape attributes of the upstream catchment area. From this perspective, the upstream catchment area ought to be determined for all the gauge stations. If so, please explicitly illustrate this step.

[Authors response 2] This is an interesting suggestion but feel it would be tangential to the main presentation.

The issue of nested basin is noted at line 156. -160. The downstream propagation of the signal is noted at line 487, and the resulting clustering at line 741. We suspect the reviewer is suggesting that some form of differencing between two stations could be adopted to isolate signals to downstream portions of the watersheds.

[3] Thirdly, the dynamic time-wrapping plays a critical role in the analysis. It links a large number of stations with different series of years. It is an existing method. Please illustrate whether the analysis represents a novel application of this method.

[Authors response 3] Dynamic time warping is an important element and while our application is novel, it is not the first use of dtw in hydrology. We have added three references citing earlier work on this topic.

The use of dtw in hydrology to address these issues has been suggested previously (Ehret & Zehe 2011; Ouyand et al. 2010; Mansor et al. 2018). Overall, the use of dynamic time warping overcomes the timing differences due to latitude and elevation.

Ehret, U., and Zehe, E.: Series distance - an intuitive metric to quantify hydrograph similarity in terms of occurence, amplitude and timing of hydrological events, Hydrology and Earth System Sciences, 15, 877-896, 2011.

Mansor, N. S., Ahmad, N., and Heryansyah, A.: Performance of Time-based and Non-time-based Clustering in the Identification of River Discharge Patterns, in: Improving Flood Management, Prediction and Monitoring: Case Studies in Asia, Emerald Publishing Limited, 133-140, 2018.

Ouyang, R., Ren, L., Cheng, W., and Zhou, C.: Similarity search and pattern discovery in hydrological time series data mining, Hydrological Processes, 24, 1198-1210, 2010.