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Reply on RC5

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-AC5, 2021

Reply to HESS-613 R5

Review of "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 Whitfield et al.

The manuscript investigated seasonal trend in streamflow observations over the Mackenzie and Nelson River basins. The authors maximized the number of observations to analyze in the study by using a warm season time window instead of common period of years. They identified 12 streamflow regime types using the dynamic time warping, six trend patterns, and three particular areas of change relating to the trends in the satellite indices. They showed that the clustering method can organize similar hydrographs that vary in magnitude and timing due to different timing of snow accumulation and melt by latitude and elevation. The streamflow trends were explained w.r.t. the changes in NDVI, NDWI, and NDSI that exhibited complex spatial variation and connection. I think that the analyses method is innovative and promising in studying seasonal trends that can shed lights on localized and shorter time scale phenomena that do not appear in annual trend analyses. The manuscript is highly relevant and worth a publication, however it is a bit difficult to follow in its current form and reorganization and modification of presentation are desirable as most of the concerns raised by referees. My specific comments are below.

[Authors response] We thanks this reviewer for taking the time to review our manuscript.

Major concern

While figures are illustrative in showing different nature of data availability, hydrograph, and trends across the stations, some figures seem better suited in the Supplement section (Fig 5, 8, & 9). I concur with a referee's suggestion on focusing on the main findings (Streamflow Regime Types, Trend patterns, and three areas of changes) and separating/expanding figures related to them (Fig 7, and 12). Fig 6 is one of the main findings but claimed it's difficult to see and Fig 8 is the simplified version that is referred more in the text. While Fig 6 lines are color-coded for different stations, no corresponding map of color-coded station is provided, and the centroid is washed out. I recommend combining Fig 6 and 8 by using lighter colors for the stations (or make them less opaque) and using black thick line for centroid to make them stand out. Figure 7 and 12 are the main findings as well but it's difficult to distinguish stations because they overlap, and also the color shading for ecosystems clash with the markers. I think that it's worth separating into several maps showing a few Regime Types and Patterns per map like maps of S16-21. I also recommend using gradient shading for the ecosystems. I did not find Fig 9 to be significant.

[Authors response] We have separated the elements in this paragraph and addressed them individually below.

[1] While figures are illustrative in showing different nature of data availability, hydrograph, and trends across the stations, some figures seem better suited in the Supplement section (Fig 5, 8, & 9).

[Authors response] Previous reviewer's requested figures that provided more information about the methodology. It was for this reason that these Figures 5 & 9 were added to the paper. Figure 8 was added to make the cluster centroids comparable. Again, Figures 6 and 8 were produced using dtwclust.

[2] I concur with a referee's suggestion on focusing on the main findings (Streamflow Regime Types, Trend patterns, and three areas of changes) and separating/expanding figures related to them (Fig 7, and 12).

[Authors response] We have rewritten the abstract to improve the focus on the main findings.

It is our opinion that Figures 7 & 12 which are supported by S16-21 are sufficient to show

the Trend Patterns and the Regime Types within that Pattern. Table 5 demonstrates the intersection between the Patterns and Types. To show a Figure and a description for each Pattern or each intersection between Type and Pattern would unnecessarily increase the length of the paper.

[3] Fig 6 is one of the main findings but claimed it's difficult to see and Fig 8 is the simplified version that is referred more in the text. While Fig 6 lines are color-coded for different stations, no corresponding map of color-coded station is provided, and the centroid is washed out. I recommend combining Fig 6 and 8 by using lighter colors for the stations (or make them less opaque) and using black thick line for centroid to make them stand out.

[Authors response] As we responded to R4:

This is an issue with the originating software that uses "ggplot" where the centroid is plotted first and over-plotted with the individual lines that are coloured based on internal code in that function. We have changed the description to be more precise:

"Each of the twelve plots contains a line for each gauged basin in that Type and the heavy dashed line, where visible, is the centroid of all members; the colour of the lines is based upon stationID."

[4] Figure 7 and 12 are the main findings as well but it's difficult to distinguish stations because they overlap, and also the color shading for ecosystems clash with the markers.

[Authors response] Using colour requires many considerations. Where we had control, we have used contrasting and consistent colours and line types. Two important constraints we faced were [1] using the ecozone colours conforming to those commonly used in ecosystem/ecoregion mapping, and [2] using package default graphs in dtwclust that are produced using "ggplot" for Hydrological Types.

[5] I think that it's worth separating into several maps showing a few Regime Types and Patterns per map like maps of S16-21.

[Authors response] It is our opinion that Figures 7 & 12 which are supported by S16-21 are sufficient to show the Trend Patterns and the Regime Types within that Pattern. Table 5 demonstrates the intersection between the Patterns and Types. To show a Figure and a description for each Pattern or each intersection between Type and Pattern would

unnecessarily increase the length of the paper.

If the Editor feels it necessary, we would make a csv file available that provided the details for each station including: StationID, Latitude, Longitude, Ecozone_name, Ecozone_number, H_Type, and Trend_Pattern.

[6] I also recommend using gradient shading for the ecosystems.

[Authors response] We chose the colour scheme of ecozones conforming to those commonly used in ecosystem/ecoregion mapping.

[7] I did not find Fig 9 to be significant.

[Authors response] Figure 9 provide a simple example of trends at one station and how the observed trends link into the large group of station in Figure 10. This Figure was added based on a previous reviewer comment suggesting that this step in the analysis be made explicit.

Minor corrections

Ln#71: hydrological repeated

[Authors response] corrected

Ln#294: "having than three years of data"=> having more than three..

[Authors response] Corrected.

Ln#342: what is bfast? R function name?

bfast is the acronym for "breaks for additive season and trends"

[Authors response] Verbesselt et al. (2010, 2012) and de Jong et al. (2012) used breaks for additive season and trends (bfast) to detect change, particularly phenological change, in satellite imagery; bfast iteratively estimates the time and number of abrupt changes within time series derived from satellite images.

We have underlined the letters to help:

Verbesselt et al. (2010, 2012) and de Jong et al. (2012) used breaks for additive season and trends (bfast) to detect change, particularly phenological change, in satellite imagery; bfast iteratively estimates the time and number of abrupt changes within time series derived from satellite images.

Ln#446: typo "bsin"

[Authors response] Corrected.