

To Author:

This research investigates the long-term drivers of streamflow and groundwater using principal components analysis. Overall, the idea of comparing hydrologic and hydrogeologic time series is an interesting study and more research should investigate the intersection of these similar disciplines.

The scientific rigor of the research is fair, but I'm not convinced that the results themselves lend significant insight into the drivers of streamflow and groundwater head. The PC6 explains only 2.2% of the variance and I'm not convinced this is significant enough to scientifically render a conclusion that PC6 is a driver of streamflow and groundwater. I think the PC6 is likely a contributor to a more complex system, but not a "driver" of the system.

It is not clear why p-values are displayed for some PCs, but not others. The statistical significance is needed to justify and support the results. Similarly, it is not clear why autocorrelation is presented for some but not all PCs. Finally, it is not clear why the trend is present for some but not all of the PCs.

All minor and major edits are described below:

Introduction:

1. The justification for the research itself is not clear. You describe in paragraph 1 and 2 that scientists are "tasked with relating heterogeneities", however, you do not explain the perceived heterogeneities or what would cause them. For example, since climate factors are included in your analysis and discussed later in the introduction, it would be relevant here to explain climate change as an important component of shifting hydrologic regimes. Additionally, you mention later that land use is included in your model and previous research – therefore, it would be relevant to highlight the impact of land use on hydrology. Therefore, I am recommending either an extension of paragraph 1 or an additional paragraph where you discuss the overall cause of hydrologic heterogeneities (e.g. climate change, land use, both, others?). Additionally, provide an explanation of the relevance and importance of the research – e.g. for watershed managers, water sustainability, etc.
2. Your introduction is primarily focused on streamflow trends. I am recommending an extension of paragraph three (e.g. line 52) on the interconnectedness of streamflow and groundwater and the importance between the relationship to watershed hydrology. For example, you say in your hypothesis "Here we go a step further and hypothesize, that stream discharge and groundwater head dynamics are nothing than two poles along a common gradient, being subject to the same processes, although at different degrees." – however, you need to provide an explanation on the background between the interconnectedness and for why this is important to study (also, including the literature). How are streamflow and groundwater head "two poles along a common gradient"?
3. The introduction does not explain or justify the importance of the study area for studying the streamflow/groundwater dichotomy. I am requesting an additional paragraph after line 63 discussing the relevance and importance of the study area.

4. Additionally, after the paragraph above, explain the previous literature on using PCA for this research and why it is the best statistical model to answer the question you pose. Why this statistical model and not another factoring model? Why is factoring the most appropriate model for this research?

Data

1. Line 85 – 100 should be the study area section
2. Line 100 should start the data section
3. In line 103 – explain how the measurement sites were selected to reduce anthropogenic bias. You mention it but don't explain it – provide a few more sentences explaining your process?
4. In line 103 – what is the temporal resolution – you say 43 full days – was it daily, weekly, monthly, etc?
5. Line 118 – Land use should be its own paragraph. Additional explanation is needed regarding what land use classifications are present, land use classifications used in the analysis, and a justification of the land use. Additionally, explanation of how the land use data were generated and whether they are raster or discrete data.
6. Line 120 – more information needed on the raster climate data. 1. An explanation of how the data are created (from in situ data – or modelled data?). What is the temporal resolution of the data?
7. With number of snow days – what is the temporal resolution?
8. For potential evapotranspiration – what is the unit?
9. Line 123 should probably go with the land use paragraph.
10. Line 152: An explanation of the parameters used in the PCA package – did you do any manual parameterization or any model defined parameters?
11. Line 155 – it is not clear what package was used for the PCA analysis. The packages provided here cover trends analysis, mapping, and plotting.

Results:

1. The principal components 1-6 explain 77.8% of the variance in the streamflow and groundwater head. It is interesting that each PC was explainable. However, I'm not convinced that a 2.2% variance is significant enough to justify a "driver". I think you need to 1. Provide literature and an iron-clad justification either in the methods or in the results that states your stance for including such low values 2. You need to call the PC with low explained variance something else – e.g. not "drivers" but "contributors" and explain the new organization. These PC categories likely contribute to a complex system, but do not, among themselves act as "drivers"
2. Anywhere that the text mentions a "large correlation" – a p-value and R/R² should be included. For example, line 209 and line 211. Also the R/R² values need to be visualized in a table or figure and referenced in text.
3. Line 214: The r is shown and referred to figure 4 – but the trend line and R value should be present on the figure.
4. It is not clear why p-values are displayed for some PCs, but not others. The statistical significance is needed to justify and support the results. Similarly, it is not clear why autocorrelation is present for some but not all PCs. Finally, it is not clear why the trend is present for some but not all of the PCs. Therefore, I am recommending that all the PCs

have a P-value table of loadings, an autocorrelation plot, and a trend plot (with R/R² values).

Discussion:

1. I found the discussion to be quite good in describing the results in detail. However, if the introduction, methods, and results aren't updated as recommended above, your readers may never get to this section. The literature does a great job of pulling all the results together, however, most of the story and literature is not present in the introduction, therefore, making a clear disjunct/gap between the readers background knowledge, the understanding of the results, and the connection to the literature. Furthermore, the results themselves, as presented currently, do not support some of the literature and claims you make in the discussion. More statistical support is needed in the results for the readers to be truly convinced of the results that you're presenting.