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Hydrology and Earth System Sciences
Discussions

Interactive comment on "How streamflow has changed across Australia since 1950's: evidence from the network of Hydrologic Reference Stations" *by* S. X. Zhang et al.

Anonymous Referee #1

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Peer review for "How streamflow has changed across Australia since 1950's: evidence from the network of Hydrologic Reference Stations by S. X. Zhang et al. MS No.: hess-2015-464 MS Type: Research article

General comments

This article is well written overall and provides important results relevant to historical changes in Australian streamflows. It appears to be the first comprehensive analysis of streamflow trends and variability for Australia. It utilizes a newly available data set of minimally disturbed streamflow basins, which is critical for looking at climate driven changes. I don't see any major technical problems, however, more information is needed as it appears that catchments with different time periods are analyzed

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together, this limits the comparability of catchments which is important for this type of trend/variability analysis. The results and discussion in places could be clarified, and better match the article figures. It's important to add at least a first cut at relating streamflow variability to large scale atmosphere/ocean patterns, particularly with the large number of step changes that were found.

Specific comments

Line 109, Was there a criteria for the Hydrologic Reference Stations for extensive basin water use or groundwater pumping? This could be hard to quantify, but is important, especially for low flows and in dry areas.

Line 109, Was any consideration given for catchments with substantial overlap in area (nested basins). Basins with substantial overlap would not offer independent information for an analysis.

Line 133, It's stated that "the primary data used in this study" are from the HRS network. Does this mean that stations outside the HRS network were used? This is problematic, if this is the case for this analysis.

Line 145, Could use more specifics on how well the model did for filling in data gaps; "perform well" is quite vague.

Line 159, I don't recall any discussion of the data collection agency/agencies. Were they collected by the same agency? If not, do they meet the same standards for inclusion in the HRS? If not, how do you assure consistency across regions when analyzing trends or variability? Have collection methods remained constant over time? This should be addressed. If not consistent over time, monotonic trends or step changes could be biased.

Line 173, Why isn't Qmin (for 1-day, 7-day or similar) analyzed? These low flows are typically important for water managers and ecological flows.

Line 186, Does the Median Crossing and Rank Difference test consider the possibility

of long-term persistence? If not, an important type of autocorrelation is being ignored.

Line 192, it doesn't appear that consistent periods of record were used for the various trend/step change tests in the article. This limits the comparability of results between catchments. Please provide more information. Authors should consider doing tests for selected periods and only including sites with mostly complete data for those periods. Multiple periods could be used, such as a 30 year period up to the present and a 50 year period up to the present. I don't recall a mention of what the last water year in this analysis is. This is important.

Line 194, Why not use the non-parametric Sen slope instead of least squares regression. Regression is sensitive to non-normality and outliers. Skewed distributions and outliers were noted previously in the article.

Line 251, The first sentence that summarizes trends seems inconsistent with the second sentence. Please reword.

Line 261, I think of trends as being one type of non-stationarity.

Line 261, Not clear what this paragraph is getting at, suggest expanding or contracting it.

Line 267, Need quick summary of trend methods.

Line 271, Suggest rewording, this statement seems incorrect. All stations showing significant trends are in the south (depending on how you define south) and all increasing trends are in the north.

Line 274. Why not test the importance of the last decade on trends? This could be done by repeating analyses but removing the last decade. This would be easy or hard, depending on how automated the trend testing is.

Line 275, Need Murray-Darling labeled on the figures and also the major regions of Australia (boundaries already in place for the major regions) for readers not from Aus-

tralia.

Line 280, Did you do trends in baseflow or baseflow index? The former is described in the methods and the latter is labeled in Table 2. The interpretation of these is obviously different.

Line 302, Why aren't the numerous step change decreases from the 1970s in south-eastern Australia (Figure 6) mentioned?

Line 306, Rainfall changes, whether they are monotonic trends or step changes would force streamflow changes. Please clarify.

Line 307, Please state what percentage of sites in different regions had significant Mann-Kendall trends, step changes, or both, and comment on whether, for the latter, this implies that Mann-Kendall significant trends were due to step changes.

Line 329, Why mention only winter trends for southern Australia, all seasons seem to have significant downward trends, with autumn having fewer than the others. Please clarify.

Line 358, Specify what parts of Australia these are here for non-Australians (to avoid people having to look for this earlier in the article).

Line 361, Rainfall deficiency "observed all over the continent" is not consistent with streamflow increases in the north.

Line 362, The accuracy of the statement on drought conditions depends on what type of drought you're referring to (meteorological, hydrological, soil moisture, etc.). This statement isn't correct if it refers to rainfall deficiencies, as those drive streamflow (not the reverse).

Line 368, need reference after "decade."

Line 370. It would be very useful, in helping to interpret trends (especially with the large number of step changes) to look at the relation between streamflow statistics

and major atmosphere/ocean patterns. A thorough analysis I can understand being beyond the scope of the article, but a first cut I think is reasonable and important. For example, you could correlate the interannual variability of streamflow statistics to major atmosphere/ocean indices. I'm not familiar with which ones are important for Australia, but ones that are known or suspected to be important to rainfall or streamflows could be tested. These could be relatively easy and may provide valuable information for interpreting the step changes. The discussion could also focus on the timing of known changes (what year) for indices that are important to Australian hydrology and compare those to the years that catchments showed step changes.

Line 396, It seems like the text describing trends for different regions doesn't match Figure 5. Rather than "Northern Territory and north-west of Western Australia, shouldn't it be "northern part of Northern Territory"? There's only one weak trend in northern Western Australia.

Line 401, Catchments in the southeast of S. Australia have significant downward trends in Figure 5.

Line 413, Both areas have a mix of step changes in the 1990s and 1970s in Figure 6.

General comment on figures: the trend symbols are too small in Figures 5-8.

Technical corrections and typos

Line 396, incorrect figure reference.

Figure 5 caption, change "decrease" to "decreasing"

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