

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.

(Short comments from M. Hipsey, matt.hipsey@uwa.edu.au, Received and published: 16 March 2016)

Authors' response to Short comments from M. Hipsey

17 May 2016

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Response to review “Short Comments”: Thank you for your time to review our manuscript. You have mentioned valuable points, which we really appreciate. Please find our response below to your comments, questions and suggestions. The referee’s comments are first recalled in *italics, blue colour font*, and then followed by our answer.

As an Australian, I have read the submission with great interest and was pleased to see the analysis undertaken. I highlight the substantial amount of work that has gone into curating and making sense of such a large dataset at this scale. This is important progress and important not only for scientific purposes but for shaping policy in Australia.

I would like to make a few short suggestions that could be considered during the discussion/revision process.

I think there are some problems with the section headings. Aside from the fact the sub-sub-heading is larger font than the sub-heading, I also note that section 4 is “Results and Discussion” and section 5 is “Discussion” ... There is also a Section 6 with “Conclusions”. I suggest these 3 sections and their sub-headings could be carefully looked at, and would suggest to split results and discussion into separate sections, with sub-headings used in the discussion to help navigate the reader to the significant findings.

Answer

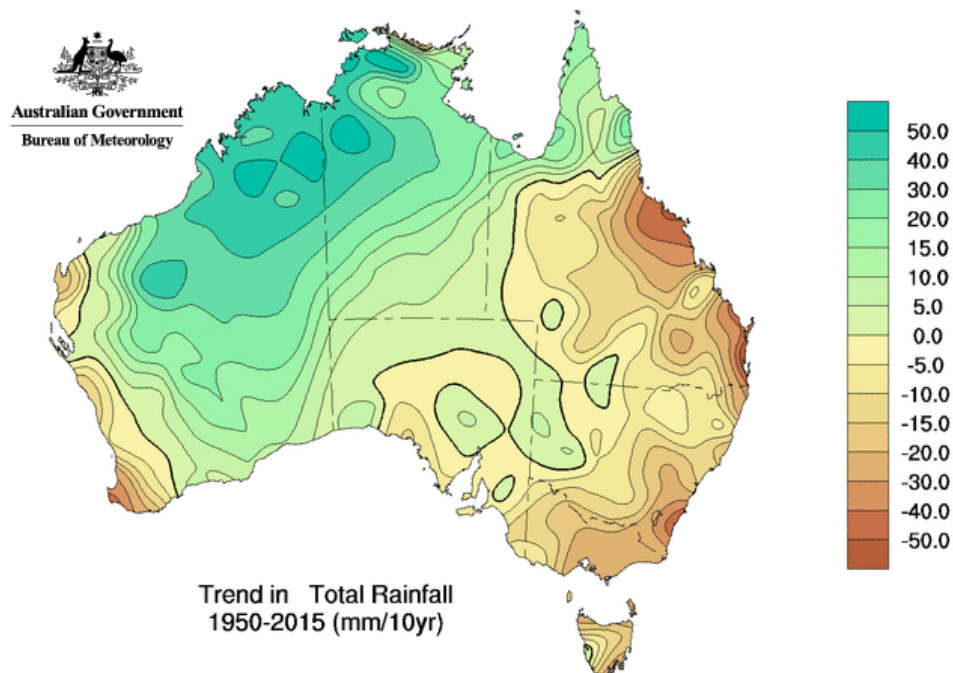
Thank you for noticing this and helpful suggestions to improve the structure of manuscript. We will adjust all the headings at different levels in a systematic way to reflecting the hierarchy structure clearly. Also the section or sub-section titles will be modified, in the way to keep “Results and Discussion” while merge “Discussion” into it, and as suggested, with sub-headings used in the discussion to help navigate the reader to the significant findings.

Further from the above, the aim as stated at the end of the introduction is to provide a nationwide assessment of trends in streamflow which is achieved well. Of course one of the powers of compiling the dataset is to try tease out the science of why trends are occurring and it would be nice to see this as an aim. I notice a brief paragraph on this point (Page 13) highlighting general drying trend in the climate etc, but I felt the study would become much more powerful if there was a more significant attempt to explain the non-stationary behaviour. This could range from a quantitative

assessment of changes in the rainfall-runoff coefficient (is the streamflow change amplifying or dampening the broad rainfall trends in each region?) or at a minimum could consist of a more detailed and focused discussion on Page 13 introducing and citing previous studies explaining mechanisms for the trends. For example, Smettem et al 2013 undertook an analysis on the forest response to drying trend impacts streamflow; Ummenhofer et al., 2009 on mechanisms for increasing drought; there are obviously many more papers relevant to different regions that could help readers understand the mechanism and significance of the trend. It is stated as being beyond the scope (in In376), however, I would suspect it would be of key interest to the HESS readership and I would suggest that space could be made by moving section 3 and Figure 3 to an Appendix; in fact I would encourage the authors to refocus the aims on the hydrological trends AND their explanations, rather than the focus on the web portal itself.

Answer

We agree to this point. Though a thorough investigation of reasons behind the hydrological trends is beyond scope of this article, we added relevant literatures on past climate changes, non-stationarity in streamflow Australia (including the papers you mentioned - Smettem et al 2013; Ummenhofer et al., 2009), and extend the discussion accordingly, also to relate the flow changes with rainfall. An example for that, adding a trend map of rainfall for discussion. The Figure below gives an example showing an updated summary of long-term rainfall trends (1950-2015). Changes in precipitation or other climate variables impact on the rainfall-runoff process directly, and indirectly causing changes in flora, relief and soil erosion. The identified trend patterns in annual total streamflow are spatially consistent with trends in annual total rainfall as shown in this Figure, where most of eastern and south-western Australia has experienced substantial rainfall declines since 1950; while north-western Australia has become wetter over this period. This similarity implies that hydrological variability is closely related with changes in rainfall patterns.



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(source: <http://www.bom.gov.au/climate/change/index.shtml#tabs=Tracker&tracker=trend-maps&tQ%5Bmap%5D=rain&tQ%5Barea%5D=aus&tQ%5Bseason%5D=0112&tQ%5Bperiod%5D=1950>)

About section 3 on web portal development, it provides important information for key users of this study. It will be kept in the main text however we will make it concise.

Lastly, whilst it is related to the above, it would be ideal for the discussion to cover the projections of climate change for the different regions to address the question of whether the the past changes are likely to continue, and as justification for the ongoing monitoring and assessment at the nation-wide scale. This need not be an extensive addition, just some targeted references cited for interested readers, potentially within a dedicated sub-section in the discussion.

Thank you very much for the opportunity to comment on this great study, and I do hope these comments will be seen as constructive criticisms to help improve the overall paper and usefulness of the analysis.

Answer

This study is focused on the flow changes that we observed from the historical data records, and not trying to refer it to the future. From the sustainable yield study done by CSIRO (<http://www.csiro.au/en/Research/LWF/Areas/Water-resources/Assessing-water-resources/Sustainable-yields>), It is likely that rainfall/streamflow trends in the Murray-Darling Basin, southern Australia and south-west Western Australia is likely to continue.

The suggestion you raised here will be an interesting point to look at, but unfortunately it's out of scope of this paper. We added relevant literatures on past climate changes (as mentioned above), and included discussion on relating the flow changes with rainfall trend, which we hope will provide some useful information for readers to understand and interpret the trends and step changes presented.

Thanks again for your valuable comments!