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Discussions

Interactive comment on "Historical and future trends in wetting and drying in 291 catchments across China" *by* Zhongwang Chen et al.

Zhongwang Chen et al.

jjssczw@163.com

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We thank you for your patient attention on our manuscript entitled "Historical and future trends in wetting and drying in 291 catchments across China" (hess-2015-588) and valuable feedbacks. Your valuable comments and remarks really inspire us to improve our study and our manuscript. Following your comments and remarks, we have finished the revised version of our manuscript. Detailed responses to your comments are listed below:

Review comment 1: Runoff trends may have been caused by human alterations, water abstractions and land cover changes. Many papers have already shown the relevance of this for runoff trends in China. How were catchments selected to the keep this influence low? What would be the effect on the interpretation of the results?

Author response 1: To keep this influence low, we adopted the "restored" discharge data in our research, meaning the effects of the human activities to the runoff generation within catchments are mostly removed via some technical means by the Hydrological Bureau of the Ministry of Water Resources of China. Of course the effects cannot be completely removed, but we take it as the most credible data set we have got to describe the natural discharge. We have revised Section 2.1 in the revision.

Review comment 2: Discuss patterns of historical precipitation changes in China, do these trends in P follow the DDWW pattern?

Author response 2: This is an inspiring advice, and we added relevant contents to our revision in Section 3.2. By relating trends in P with mean annual runoff Âŕ("Q"), we find a similar pattern as the new DDWW pattern we proposed in our revision that "more precipitation are more likely in wetter areas, and vice versa", which interprets the DDWW pattern from the perspective of the climate change that the more uneven precipitation results in more uneven runoff.

Review comment 3: I believe that the existence of a DDWW pattern has many implications also for water resources. A brief discussion of the implications would emphasize the relevance of the findings!

Author response 3: We agree with you! In fact, we meant to reflect the more uneven distribution of the water resources by the existence of the DDWW pattern, but we didn't express it well in the original manuscript. Therefore, in our revision, we tried elucidating the DDWW pattern in the aspect of the water resources. In Section 3.1, after proposing our new DDWW pattern that "drier regions are more likely to become drier, whereas wetter regions are more likely to become wetter", we interpreted it as a signal of the more uneven trends in the distribution of the water resources in China since 1950s.

Review comment 4: add which significance test was used in methods.

Author response 4: Following your suggestion, we used the t-test, and we added this contents in Section 2.2.

Review comment 5: add details for computation of Penman potential evaporation (observations and GCM) in methods or appendix.

Author response 5: Following your suggestion, we gave a detailed description of the computation of Penman potential evaporation using GCM outputs in Appendix A, and that about the observed PET data are offered by Yang et al., (2014).

Review comment 6: please explain better Fig 11 such that the reader can understand the conclusions in section 4.2.

Review comment 7: Fig. 11 maybe add the Budyko curve with n = 1.8 to the plots.

Author response 6 and 7: We highly appreciate your suggestions. We deleted this part of contents in our revision for the obscurity of them and focused on elucidating P is the most key factor in the climate change.

Review comment 8: discuss the role of bias correction / spatial resolution of GCM output - when looking at Fig 12 it seems that P was corrected but not all variables needed to calculate E0

Author response 8: This is a meaningful suggestion to our study because we didn't realize that it might be the role of bias-correction that led to different simulated results in P and Ep until you referred to. After inquiring the data provider from the Institute of Environment and Sustainable Development in Agriculture, the Chinese Academy of Agricultural Sciences, China, we assured that the bias-correction process had been implemented to all GCM outputs (precipitation; mean, maximum and minimum air temperature; solar radiation; wind speed; and relative humidity), meaning all variables needed to calculate Ep were corrected simultaneously. Then why did there still exist so huge discrepancy between the simulated and observed Ep? We speculated that it might be related to the disparate effectiveness of the bias-correction process in different outputs, resulting in good fit to P and bad fit to Ep.

Review comment 9: do GCMs reproduce the runoff trends / patterns?

Author response 9: This is also a good question that we were also concentrated on. However, we found out that there is a great discrepancy between the observed and simulated Ep in historical period. Consequently, we think that the runoff trend based on GCMs results has a large uncertainty, which leads to a difficulty in verifying the DDWW. In addition, we have already got observed P and Ep data to verify the DDWW pattern. Therefore, in this study, we didn't estimate historical runoff trends according to GCMs result.

Review comment 10: I checked some GCM projections for precipitation changes in China (Roderick et al.,2014, Hagemann 2013 ESD, IPCC AR5) and the projected precipitation changes are indeed different from the runoff trends shown in Fig. 8. Thus it seems that the GCM simulated precip changes in China are different from the historical ones observed in China.

Author response 10: Indeed, there are different trends in the historical and future periods. It was reported that the observed precipitation has a decrease trend in the eastern part and an increase trend in the western part of China (Yang et al., 2015), which is consistent with the observed runoff trend as shown in Figure 8 of the original manuscript. At the same time, the projected future precipitation has an increase trend (Roderick et al.,2014, Hagemann 2013 ESD, IPCC AR5).

Minor comments:

abstract: P1L12: be more precise than "simulated data"

P1L25ff rephrase

P3L14: what is meant with restored streamflow data?

P5L15: for which period was n determined?

P8L3: it is somewhat unclear for which variable and period the coefficient of variation

Cv was actually determined? Please specify.

Author response to minor comments: Thank you for your pertinent comments! We have seriously modified our manuscript according to these 5 comments.

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