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Earth System Dynamics
Discussions

Interactive comment on "Spatial-temporal changes in river runoff and terrestrial ecosystem water retention under 1.5 °C and 2 °C warming scenarios across China" *by* Ran Zhai et al.

Anonymous Referee #2

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This paper presented changes in river runoff and terrestrial ecosystem water retention in China under 1.5 and 2 degree warming scenarios simulated by the VIC model. The simulations are under the HAPPI project framework, and the results are interesting in the context of Paris Agreement and IPCC 1.5 degree special report. There are however major issues in the current version of the manuscript that should be addressed before considering the paper for publication.

1. Although previous research has not investigated the changes in river runoff under 1.5 and 2 degree warming specifically, it is useful to compare with changes under RCP2.6 scenario (the warming level is similar, and aerosol forcing used is also the

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same as RCP2.6's end of 21st century level).

2. For the wide readership of ESD, it would be helpful to expand the model description of VIC and explain briefly the key model features. More details should also be provided for the calibration procedure and validation. Ideally different stations could be used for the validation purpose. It would also be interesting if the authors would briefly explain why the bias for the calibration and validation period is of opposite direction for all stations (Table 2).

3. The uncertainty analysis is currently lacking. Section 4.3 proposed a few potential uncertainty sources but no actual analyses is presented. A better effort to present uncertainty in the results would improve the readability of the paper. For example, for some of the projected changes the authors could show maps of model agreement (number of model ensembles showing the same trend) at each grid point. It is not clear if the changes are statistically significant. The uncertainty range among the ensembles for the GCMs should also at least be mentioned for Figure 9.

4. A more quantatitive conclusion should be provided with some regionally averaged statistics, especially on the difference between 1.5 degree and 2 degree scenarios. In general more quantatitive results should be provided from the analyses as well. The connection to climate change mitigation and adaptation needs is not convincing as the manuscript discussed very little about the risks (which should also have a socioeconomics component) of hydrological extremes, and the effect of human management is also not examined in this study. The last paragraph is a bit far-fetched and is not supported well enough by the results.

A couple of minor points/questions:

- Are there similar results from HAPPI based on a different model other than VIC?

- What is the role of snow accumulation/melting change, especially in/near the Tibetan Plateau?

- What is the reasoning of showing change in Q10 and Q90 based on the full ensemble, instead of for each GCM (similar to the other figures)? Will the results vary among the GCMs? It is also arguable how “extreme” Q10 and Q90 are.

- Figure 5 seems to have a more mixed result on the change of river runoff SD: in some regions the SD increase is larger under 1.5 degree scenario especially for NorESM1.

- How large is the signal of half degree warming compared to model specific difference in precipitation pattern? Figure 8 for example show quite different spatial patterns of changes among the GCMs (the first sentence on page 9 is a bit confusing, please reword).

- Both runoff (generated at grid level) and river runoff are used which may confuse the reader. Is river runoff river discharge (after routing)?

- Table 2 should include units for catchment area, and explain how model grid is selected (note for Zhongaiqiao station, its longitude is at the edge of a 0.5 degree grid box).

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