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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Water Scarcity under Various Socio-economic Pathways and its Potential Effects on Food Production in the Yellow River Basin" *by* Y. Yin et al.

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Responses to the Reviewer 2

We truly thank the anonymous reviewer for their constructive comments and suggestions for improving our work. We have addressed all the comments in our revised manuscript. The point-by-point responses to the comments are provided below.

Some general comments:

- Question 1: The writing may need to be improved.

- Answer: Thanks for the comments. We have carefully polished the language and

grammar thoroughly.

- Question 2: I have doubts about the function of GDP's VS. industrial water demand used by the authors, which leads to my doubts about the outcomes of this study.

- Answer: Thank you for the comments. In this study, the industrial water demand means the industrial net water withdrawal which was defined as the total water withdrawal minus the water that returns back to the river channel. The industrial water demand includes manufacturing water demand and thermoelectric water demand. As we are unable to get the electricity production projection in the Yellow River basin or in China, we assumed that the industrial water demand only include manufacturing water demand in this study. The manufacturing water demand is positively correlated with the economic metric manufacturing gross value added (Dziegielewski et al., 2002). It is more reasonable to estimate industrial water demand with manufacturing gross value added in total GDP than GDP. Based on the obtained GDP projection data and the share of manufacturing gross value added in total GDP over the 21st century from the UNEP GEO4 Driver Scenarios (Hughes, 2005), we have calculated the value added of manufacturing sector from 2010 to 2099. In the revision, we have rebuilt the function of the value added of manufacturing sector and industrial water demand followed Flörke et al. (2013) and recalculated the results.

Reference: Dziegielewski, B., Sharma, S. C., Bik, T. J., Margono, H., and Yang, X., 2002. Analysis of water use trends in the Unites States: 1950-1995. Special Report 28. Illinois Water Resources Center, University of Illinois, USA. Hughes, B. B., 2005. UNEP GEO4 diver scenarios (fifth draft). Josef Korbel School of International Studies, University of Denver, Colorado. Flörke, M., Kynast, E., Bärlund, I., Eisner, S., Wimmer, F., and Alcamo, J., 2013. Domestic and industrial water uses of the past 60 years as a mirror of socio-economic development: A global simulation study. Global Environment Change, 23, 144-156, doi: 10.1016/j.gloenvcha.2012.10.018

Some specific comments:

- Question 3: L139: the full name of “SSP” should be provided before the use of abbreviations (e.g. L136)

- Answer: The full name of “SSPs” is “Shared Socio-economic Pathways”. Corrected in the text.

- Question 4: L162-164: There are only 6 GGHMs right? This 7th GGHM is shown as GGHM-GCMs in Table S4. Could the authors provide some explanation about this 7th GGHM?

- Answer: “GGHM-GCMs” in Table S4 is the median of all GGCM-GCMs pairs. We have clarified it in the revision.

- Question 5: L164-165: Based on Table S4, only WBM has “simulated runoff agrees well with the observed runoff”. Maybe add discussion about the performance of different GGHMs and the reasoning of performance difference.

- Answer: We have provided the setting and assumptions of the global gridded hydrological models and have added discussion about the performance of different GGHMs. The global models are usually not calibrated against streamflow observation, thus often show a considerable bias in monthly discharge. However, a recent study showed that the sensitivity of the global models to climate variability is in general similar as that of the regional models which are calibrated (Hattermann et al., 2016). It suggests the model results, after correction for bias, may be used to assess climate change impacts on water supply. We have proposed a simple method to correct model simulated water supply. The corrected simulations were evaluated the ISI-MIP models by comparing the model results against the streamflow observations. The results show that the bias-corrected water supply can reproduce well the reference conditions.

Reference: Hattermann, F. F., Krysanova, V., Gosling, S., Dankers, R., Daggupati, P., Donnelly, C., Flörke, M., Huang, S., Motovilov, Y., Buda, S., Yang, T., Müller, C.,Leng, G., Tang, Q., Portmann, F. T., Hagemann, S., Gerten, D., Wada, Y., Masaki, Y., Ale-

mayehu, T., Satoh, Y., and Samaniego, L., 2016. Cross-scale intercomparison of climate change impacts simulated by regional and global hydrological models in eleven large river basins. Climatic Change, accept.

- Question 6: L192: It should be “Figure S3 (a)”.

- Answer: Corrected.

- Question 7: Figure S3: Typos in X-axis, change “pre” to “per”, change “captia” to “capita”

- Answer: Corrected.

- Question 8: L196: As I mentioned earlier. The relationship of GDP and industrial water demand has significant impact on the trend of water demand in the projection period, and therefore it has dominating effect on the outcome of this study. The authors should provide better literature review and methodology explanation about this relationship to future validate their results. One concern I have about this hyperbolic curve is that the range of GDP per capita that the curve is based on, as shown in Figure S3, is not matching with the GDP per capita range in the projection period as shown in Figure S2. After 2050, all the SSPs have GDP per capita greater than 50000 yuan, which is the maximum in Figure S3. As a result, for most part of the projection period, the GDP vs. industrial water demand relationship is at the plateau part of the curve, suggesting a linear increase of industrial water use with GDP increase. I’m not sure if this is a valid assumption, which leads to my doubts about the study outcome that industrial water demand will be the main contributing factor to water scarcity in the future.

- Answer: Thank you for the comments and suggestions. A number of models have been developed to calculate the industrial water demand quantitatively (e.g. Alcamo, 2003; Hanasaki et al., 2006, 2008; Flörke et al., 2013). Dziegielewski’s work (2002) showed that the manufacturing water demand is positively correlated with the economic metric manufacturing gross value added. We have rebuilt the function of the value added of manufacturing sector and industrial water demand and have recalculated the results (see responses to Question 2).

Reference: Alcamo, J., DoÌĹll, P., Henrichs, T., Kaspar, F., Lehner, B., RoÌĹsch, T., and Siebert, S., 2003. Development and testing of the WaterGAP 2 global model of water use and availability. Hydrological Sciences Journal, 48, 317-337. Hanasaki, N., Kanae, S., and Oki, T., 2006. A reservoir operation scheme for global river routing models. Journal of Hydrology, 327, 22-41. Hanasaki, N., Kanae, S., Oki, T., Masuda, K., Motoya, K., Shirakawa, N., Shen, Y., and Tanaka, K., 2008. An integrated model for the assessment of global water resources–Part 1: Model description and input meteorological forcing. Hydrology Earth System Sciences, 12, 1007-1025. Dziegielewski, B., Sharma, S. C., Bik, T. J., Margono, H., and Yang, X., 2002. Analysis of water use trends in the Unites States: 1950-1995. Special Report 28. Illinois Water Resources Center, University of Illinois, USA. Flörke, M., Kynast, E., Bärlund, I., Eisner, S., Wimmer, F., and Alcamo, J., 2013. Domestic and industrial water uses of the past 60 years as a mirror of socio-economic development: A global simulation study. Global Environment Change, 23, 144-156, doi: 10.1016/j.gloenvcha.2012.10.018

- Question 9: L198-202: The effect of technologic advance on water use efficiency is considered in the study as explained here. It seems pretty minimal based on the results. I would suggest linking TC with GDP growth or at least test the sensitivity of industrial water demand to TC.

- Answer: Thanks for the suggestion. We have taken into account of the effect of technological change and recalculated the water demands following Hanasaki et al. (2013).

Reference: Hanasaki, N., Fujimori, S., Yamamoto, T., Yoshikawa, S., Masaki, Y., Hijioka, Y., Kainuma, M., Kanamori, Y., Masui, T., Takahashi, K., and Kanae, S., 2013. A global water scarcity assessment under Shared Socio-economic Pathways – Part 1:

Water use. Hydrology and Earth System Sciences, 17, 2375-2391, doi:10.5194/hess-17-2375-2013

- Question 10: The writing in Section 4.1 and 4.2 needs to be improved. To list a few: L251 Please revise this sentence; L267 Please revise this sentence; L283: Please revise this sentence.

- Answer: We have read through the manuscript and improved English writing with help from English editors.

Please also note the supplement to this comment:
http://www.hydrol-earth-syst-sci-discuss.net/hess-2016-188/hess-2016-188-AC2-supplement.pdf

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