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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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General comments

The authors presented a water scarcity assessment of the Yellow River in China using the public database developed by the ISI-MIP project. Since future projections of industrial and domestic water use were not included in the database, the authors estimated them by applying the method proposed by Alcamo et al. (2003) and Flörke et al. (2013). Water scarcity was mainly assessed using the water supply stress index (WaSSI). Future water scarcity was projected to be severe, particularly in the lower stream in late 21st century, mainly due to the growth in industrial water demand.

The Yellow River is widely known as one of the hotspots of water scarcity in the world, hence detailed and comprehensive future water assessments are crucially important.

Although this paper has been excellently prepared as a scientific report, as far as I have observed, the contents are lacking originality and poorly supported by local facts. First, the authors used the WaSSI index. The water scarcity assessment using WaSSI has been established two decades ago by Raskin et al. (1997), Vörösmarty et al. (2000), and Alcamo et al. (2003). Second, the authors used only the output of global hydrological models and highly conceptualized techniques devised for global assessments in this study. I would like to suggest the authors to thoroughly revisit the settings and validate the results of ISI-MIP before using them for local applications. Due to the aforementioned shortcomings, the results and discussion presented in this draft paper are general and not much different from the earlier global water scarcity assessment by Schewe et al. (2014).

Major comments

Line 114 "six global gridded hydrological models": The performance of these models should be validated. In the present form, the authors only showed the mean annual runoff at Lanzhou, Longmen, Sanmenxia, Huayuankou in Supplemental Table S4 without any detailed discussion. At least the reproducibility of monthly river discharge and its inter-annual variations should be assessed. Particularly, Table S4 indicates that the mean annual discharge of MPI-HM and PCR-GLOBWB is approximately half and double of observation in the Yellow River. The rationale of adopting these models in this study must be also clearly described.

Line 121 "The global irrigated and rainfed crop area data (MIRCA2000)": The authors should focus on some of the key simulation settings of ISI-MIP and discuss their validity. For example, ISI-MIP fixed the irrigated and rainfed crop area throughout the 21st century. What are the recent trend in cropland area in this basin? What are the projections by the government and experts? Such local details should be included in this study.

Line 167 "the ratio of human water appropriation (hereafter RHWA)": First, the definition of this term is missing in the current form of text. The definition and background concept should be clearly stated. Second, the rationale of the thresholds of 50%, 70%, 90% should be carefully discussed. It should be well noted that in many densely populated river basins, total water withdrawal may exceed the total river discharge since treated waste water in upstream is utilized in downstream. Even if the total water withdrawal exceeds the river discharge, water scarcity never occurs if waste water is properly treated and returned to the stream.

Line 181 "The GGCM estimated irrigation water demand": First, the authors should provide the settings and assumptions of this simulation related to water use. What type of crops were planted in the basin in the simulations? Was the crop type varied during the simulations to adopt to warmer climate? Such settings are crucially sensitive to the results. Then carefully discuss whether such simulation conditions are valid for the study basin, and what should be noted in interpreting the results.

Line 195 "Using the historical GDP per capita and industry water use per capita data": Although the authors claimed that their industrial water model followed Alcamo et al. (2003) and Flörke et al. (2013) in line 187, there is a fundamental difference in explanatory variables (input data). In reality, the explanatory variables of Alcamo et al. (2003) and Flörke et al. (2013) were electricity production (a rough indicator of the magnitude of manufacturing output) or value added of industrial sectors respectively, not GDP. In general, industrial water grows much gently than GDP in long term (see Alcamo et al. (2003) and Flörke et al. (2013)). Note that the usage of GDP might be one of the reasons why the industrial water exploded in late 21st century in this study.

Line 200 "In the domestic sector, TC was set as 1% per year": SSP narrates substantially different views of the world (O'Neill et al. 2014). It is a bit odd to me that a same parameter was used for SSP1 (sustainable world) and SSP3 (unsuccessful fragmented world) in this study. For instance, Hanasaki et al. (2013) set different parameter for each SSP to make parameter and narrative scenario consistent.

Line 203 "ratio of water demand to water supply": Define this term more precisely. The terms "water demand" and "water supply" are also unclear.

Line 279 "the WaSSI for total water demand is large than under each SSP, meaning that the water would be scarce at the end of the 21st century": Again, if the water withdrawn in upstream is properly treated upstream and returned back to the stream, water scarcity doesn't occur even if WaSSI exceeds one. Elaborate what are the key problems in the basin in reality, and what can be represented by the WaSSI index.

Line 265 "The water resource shortage is most serious under the conventional development scenario (SSP5)": This is contradictory to the original narrative story line of SSP5 (O'Neill et al., 2014) which depicts a technology-oriented world with high capability of adaptation (humans would control negative consequences of environmental problems by technology). What does "SSP" mean in this study? Is this mean that the authors only took the projections of GDP and population from SSP database?

Minor comments

Line 66 "a grant figure": What is this?

Line 114 "H80", "PRC-GLOBWB": "H08" and "PCR-GLOBWB" respectively

Line 267 "meaning than water demand outstrip supply water": Rephrase this part.

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