**Hydrology and Earth System Sciences**

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Discussions

# *Interactive comment on* "One-way coupling of an integrated assessment model and a water resources model: evaluation and implications of future changes over the US Midwest" *by* N. Voisin et al.

## Anonymous Referee #2

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The paper presented by Voisin et al. concerns modeling water supply deficit over the US Midwest region. A newly developed integrated model was applied to project sectoral water demand that was combined with water availability projection based on SRES B1 emission scenario. The paper presents interesting findings and is overall well-written. However, I do have some major concerns regarding the methodologies that were applied for the future simulation detailed in the following.

1. I think the paper would be benefited if the authors clarifies further why this specific

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regions was chosen. The paper uses global models (GCAM), but it is not so clear the rationale behind the choice of the region, as water demand (human influences) appears not to be a major factor contributing to the increase in future water supply deficit over the region (only locally). As noted by the authors, climate change appears to be the dominant factor affecting the water supply deficit over the region.

2. Page 6362-6363: The authors mentioned that "This region is chosen because it represents many crosscutting issues on climate, energy, land use, and water. For example, the Midwest is a major area for bioenergy resource, representing potential conflicts between food and fuel." How does your model consider the interaction between food and fuel production? I understand that irrigation water demand was prescribed by the outputs from another model. How is rainfed crop treated in your model?

3. I would suggest to include more literature review over the region or part of the region. For example,

Frans, C., E. Istanbulluoglu, V. Mishra, F. Munoz-Arriola and D. P. Lettenmaier (2013), Are climatic or land cover changes the dominant cause of runoff trends in the Upper Mississippi River Basin?, Geophys. Res. Lett., 40, 1104–1110, doi:10.1002/grl.50262.

4. Only one climate scenario (SRES B1) was applied to simulate potential future water supply. I would prefer to see at least two scenarios to comprehend the climate uncertainty, which gives a wider implication of your results. What is the benefit of selecting this specific scenario for your assessment? How was the biase in the climate projection treated? Any statistical bias-corrections were performed?

5. Page 6367: "...an inter-dependency database that allows managing the request of water to reservoirs and the distribution of supply to grid cells." How is this done? Could you explain it in more details?

6. Page 6369: Sectral water demands were downscaled to 0.5o by 0.5o grid. But the hydrological simulation was conducted at 0.05o. And the climate forcing was pre-

scribed at 1/8 degree resolution. I guess all the assessments were performed at a 0.5o grid? The authors should make clearer about the spatial resolution of the assessment and upscaling/downscaling employed in this study. Are there any finer spatial data (for water demand) available over the selected region?

7. Irrigation water demand was prescribed by the GCWM model. Does the seasonal course of irrigation water demand change per year? Or the seasonal trend remains always the same as the present during the future simulation? How does climate change affect the seasonal irrigation water demand? The GCWM model calculates irrigation water demand at 0.083333..o. Why not use the finer spatial resolution data? The uncertainty of irrigation water demand arising from a specific model is substantial (for example, multi-model projections and uncertainties of irrigation water demand under climate change, doi: 10.1002/grl.50686). How was the uncertainty arising from irrigation water demand treated?

8. I think it would be interesting to show the relative impacts of climate change and water demand increase on future water-supply deficit (for example, Table 3, Figure 8, etc).

9. Page 6376: "...the supply deficit is around 3%....1.5%..." How accurate are these numbers? What is the uncertainty on these values? I would suggest to include validation or comparison with other studies of water demand estimates. The USGS provides water use estimate per county; http://water.usgs.gov/watuse/

10. It is know that over this region climate tends to be a dominant factor affecting water supply (e.g., Frans et al., 2013). It is not so clear why this study was conducted over this region considering change in water demand and climate, and the implications therein, since the cropland is mostly for rainfed, rather than irrigated crops.

11. Page 6381: "Socio-hydrology"...suddenly appeared in Conclusions. Some more background information is needed and the relevancy to this study is not so clear.

12. The authors should at least address further about the importance of groundwater pumping over the region.

13. Figure 3: Could you provide in normal scale?

14. Figure 5: It is good that the authors show the monthly water demand, but it is quite difficult to see the seasonal trends from this figure.

15. Figure 11: I think this figure is benefited with different colour scheme, for example, blue-tone colour for water supply, red-tone colour for water demand. The colour scheme for water supply deficit may remain the same.

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