We would like to thank Reviewer 1 for the insightful comments which helped us a lot to improve the manuscript. Below you will find our response to each comment. The reviewer's comments are shown in italic and the responses are shown in bold letters.

 # Reviewer1

[R1-M1] The manuscript evaluates yield potential and water use efficiency of bioenergy crops Miscanthus and switchgrass at global scale using H08 model. The study reads as an adaptation of Trybula et al 2017 to H08 model and calibrating model for field cites from multiple countries to expand to global scale simulation. My major concerns are whether the model parameterization from Trybula et al for Midwest US weather suitable for global scale (specific comments below) and is the general water stress accounting model is reasonable for perennial bioenergy crops. The manuscript is well organized and easy to read.

Response: We thank you for taking time to review this manuscript. Our primary goal is to improve H08 to better simulate the second-generation herbaceous bioenergy crop yield, which is a critical variable in estimating global bioenergy potential. The study of Trybula et al. (2015) provides us valuable information for our work.

Regarding your first concern, as you can find in Table 1, our finalized parameters contains both reference from Trybula et al. (2015) and our own calibration. In the revised manuscript, we identified the site's climate zone and added such information in Fig. 3 and Fig. 4. As can be seen in Fig. 4, the performance of our simulation is good, which demonstrates this parameterization scheme has the capability of global application. Regarding your second concern, as shown in Fig. 3 and Fig. 4, the simulation results agree well with observation hence the water stress method is valid for perennial bioenergy crops.

Specific Comments:

[R1-S1] Selection of hydrologic model H08: Authors mentions H08 as a state-of the art model multiple times in the manuscript. Of the available hydrology models, what makes H08 state of the art model? Additional discussion would be helpful

Response: The strength and uniqueness of the H08 is its considerations of human activities (or water management) including reservoir operation, aqueduct water transfer, seawater desalination, and water abstraction for irrigation, industry, and municipality (Hanasaki et al., 2008a, 2008b, 2010, 2018a, 2018b). Indeed, H08 contains most extensive water management options among the global hydrological models [WaterGAP (Alcamo et al., 2003; Döll et al., 2003, 2012, 2014), LPJmL (Gerten et al., 2004; Rost et al., 2008; Biemans et al., 2011), PCR-GLOBWB (van Beek et al., 2011; Wada et al., 2011, 2014), WBM-plus (Vörösmarty et al., 1989; Wisser et al., 2010), HiGW-MAT (Pokhrel et al., 2012a, b, 2015), and others]

We have added text from line 81 to line 83.

[R1-S2] The study primarily focuses on bioenergy production potential and water use efficiency. The water use efficiency is estimated using simple scenario analysis of with and without water stress (through irrigation). I am wondering whether specific crop model could be better suited for such analysis rather than hydrologic model

Response: The direct goal of this study is to add a function to H08 to simulate the second-generation herbaceous bioenergy crop yield. Our long-term goal is to investigate the bioenergy-water tradeoffs at global scale making full use of the capability of H08 as a global hydrological model. We agree with you that it might be better to use specific crop model, if one wish to investigate the water use efficiency at site or watershed scale, but this is not the case of this study.

[R1-S3] It will be nice if authors list the goals and objectives of the manuscript

Response: Thanks for your comment. We added them at the beginning of the last paragraph in the introduction section.

[R1-S4] Enhancement of H08 for miscanthus and switchgrass: a. Authors chose potential heat units to maturity as 1830 and 1400 for miscanthus and switchgrass respectively based on Tryubla et al (2015). The HU for Trybula et al was estimated for continental climate with winter crop senescence. Is this valid for other climates? b. The water stress representation is similar to many hydrological models with stress as direct function of actual ET/potential ET.

The crop water stress tolerance and impact on biomass production is crop specific. Some additional discussion of the stress functions for specific crops will be interesting since WUE is major focus of the study.

Response: Thanks for your insightful comments. Regarding comment a, adopting the HU identified by Trybula et al. (2015) to the entire globe seems valid based on the results from Fig. 4. HU determines the cropping duration, hence critically sensitive to the results. The good agreement between simulation and observation at various climatic zones indicate the validity of HU setting. Regarding comment b, we agree with you that water stress tolerance should be crop specific (such as implication from Hastings et al., 2009). Ideally speaking, the relationship between water stress and yield must be carefully monitored and modeled. However, such monitoring and modeling studies are not available, as far as we know, and if available, it must be quite challenging to extend the model for global application. This is why many earlier studies (such as Anderson et al., 2007; Yao et al., 2010) and other generic/global models like MISCANMOD (Clifton-Brown et al., 2004), SWAT (Neitsch et al., 2011), and LPJml (Bondeau et al., 2007) all adopt a crop-unspecific formulation. For example, in MISCANMOD, crops are affected by water stress when soil moisture deficit is more than 0.3, Similarly, we adopted a value of 0.25 in this study.

Finally, as mentioned earlier, although shown in text, estimation of WUE is not the final objective of this model development. Rather this paper is intended to describe a model extension of H08 to properly simulate biomass crop yield. The results of WUE are shown since it is calculatable with a stand-alone model.

We added the abovementioned discussion in lines 273-275, and lines 288-289.

[R1-S5] 2.5 Simulation and analysis: why authors chose to reduce interannual variability in temperature?

Response: Thanks for your comment. As noted by the manual of H08 (http://h08.nies.go.jp/h08/manual.html), we used the mean meteorological data

to avoid the extreme cold air temperatures in early spring. Following the comment of Reviewer 1 and Reviewer 2, in the revised manuscript, we conducted the simulations annually and also revised corresponding text.

[R1-S6] Results and discussion: I appreciate authors efforts to list all model parameters and compare parameters and simulation results with literature. The optimal RMSE and R performance after calibration is on lower side especially for switchgrass.

Response: We presented the parameters set and references in Table 1 and Table 2. Yes, the yield is on lower side especially for switchgrass (*Panicum virgatum*) after calibration. We think this is more accurate compared with the lower observed yield shown in Fig. 4b.

[R1-S7] In section 3.2 authors claim "over estimation and underestimation tendencies having been successfully fixed" for H08 model, this seems to be a strong claim considering low performance indicators. I agree the improved version is better than original H08 simulations. Figure 4 simulated yield relative error well distributed along the 0 line, the range is -100 to +100 and the x axis relatively small and that makes the lines look closer to 0 relative error.

Response: First, we appreciate your agreement on the improvement of the simulation. Second, based on your comment, we have enlarged the x axis in Fig. 4 and modified the corresponding text.

[R1-S7] Section 3.3: "the land available for calculation was set as 10% of the pastureland and cropland" any specific justification for choosing this?

Response: Thanks for your comment. The reason is to make the comparison meaningful since this land set was reported in MISCANMOD country yield estimation (Clifton-Brown et al., 2004).

Reference:

Alcamo, J., Döll, P., Henrichs, T., Kaspar, F., Lehner, B., Rösch, T., and Siebert, S.: Development and testing. of. the WaterGAP 2 global model of water use and availability, Hydrolog. Sci. J., 48, 317–337, https://doi.org/10.1623/hysj.48.3.317.45290, 2003.

Biemans, H., Haddeland, I., Kabat, P., Ludwig, F., Hutjes, R. W. A., Heinke, J., von. Bloh, W., and Gerten, D.: Impact of reservoirs on river discharge and irrigation water supply dur- ing the 20th century, Water Resour. Res., 47, W03509, https://doi.org/10.1029/2009wr008929, 2011.

Bondeau, A., Smith, P. C., Zaehle, S., Schaphoff, S., Lucht, W., Cramer, W., Gerten, D., Lotze-Campen, H., Müller, C., Reichstein, M., and Smith, B.: Modelling the role of agriculture for the 20th century global terrestrial carbon balance, Glob. Change Biol., 13, 679-706, https://doi:10.1111/j.1365-2486.2006.01305.x, 2007.

Clifton-Brown, J. C., Stampfl, P. F., and Jones, M. B.: Miscanthus biomass production for energy in. Europe and its potential contribution to decreasing fossil fuel carbon emissions, Glob. Change Biol., 10, 509-518, https://doi:10.1111/j.1529- 8817.2003.00749.x, 2004.

Döll, P., Kaspar, F., and Lehner, B.: A global hydrological model for deriving water. availability indicators: model tuning and validation, J. Hydrol., 270, 105–134, https://doi.org/10.1016/S0022- 1694(02)00283-4, 2003.

Döll, P., Hoffmann-Dobrev, H., Portmann, F. T., Siebert, S., Eicker, A., Rodell, M., Strassberg, G., and Scanlon, B. R.: Impact of water withdrawals from groundwater and surface water on continental water storage variations, J. Geodyn., 59–60, 143–156, https://doi.org/10.1016/j.jog.2011.05.001, 2012.

Döll, P., Müller Schmied, H., Schuh, C., Portmann, F. T., and Eicker, A.: Global-scale. assessment of groundwater depletion and related groundwater abstractions: combining hydro- logical modeling with information from well observations and GRACE satellites, Water Resour. Res., 50, 5698–5720, https://doi.org/10.1002/2014wr015595, 2014.

Gerten, D., Schaphoff, S., Haberlandt, U., Lucht, W., and Sitch, S.: Terrestrial. vegetation and water balance - hydrological evaluation of a dynamic global vegetation model, J. Hydrol., 286, 249–270, https://doi.org/10.1016/j.jhydrol.2003.09.029, 2004.

Hanasaki, N., Kanae, S., Oki, T., Masuda, K., Motoya, K., Shirakawa, N., et al. (2008a). An integrated model for the assessment of global water resources—Part 2: Applications and assessments. Hydrology and Earth System Sciences, 12(4), 1027–1037. https://doi.org/10.5194/hess-12-1027-2008

Hanasaki, N., Kanae, S., Oki, T., Masuda, K., Motoya, K., Shirakawa, N., et al. (2008b). An integrated model for the assessment of global water resources—Part 1: Model description and input meteorological forcing. Hydrology and. Earth System Sciences, 12(4), 1007–1025. https:// doi.org/10.5194/hess-12-1007-2008

Hanasaki, N., Yoshikawa, S., Pokhrel, Y., & Kanae, S. (2018). A global hydrological. simulation to specify the sources of water used by humans. Hydrology and Earth System Sciences, 22(1), 789–817. https://doi.org/10.5194/hess-22-789-2018.

Hanasaki, N., Inuzuka, T., Kanae, S., & Oki, T. (2010). An estimation of global virtual. water flow and sources of water withdrawal for major crops and livestock products using a global hydrological model. Journal of Hydrology, 384(3–4), 232–244. https://doi.org/10.1016/j. jhydrol.2009.09.028

Hanasaki, N., Yoshikawa, S., Pokhrel, Y., & Kanae, S. (2018). A quantitative. investigation of the thresholds for two conventional water scarcity indicators using a state-of-the-art global hydrological model with human activities. Water Resources Research, 54, 8279–8294. https://doi.org/10.1029/ 2018WR022931

Heaton, E. A., Dohleman, F. G., and Long, S. P.: Meeting US biofuel goals with less land: the potential of Miscanthus, Glob. Change Biol., 14, 2000-2014, https://doi:10.1111/j.1365-2486.2008.01662.x, 2008.

Miguez, F. E., Maughan, M., Bollero, G. A., & Long, S. P. (2012). Modeling spatial and dynamic variation in growth, yield, and yield stability of the bioenergy crops Miscanthus× giganteus and Panicum virgatum across the conterminous United States. Gcb Bioenergy, 4(5), 509-520. https://doi.org/10.1111/j.1757-1707.2011.01150.x

Pokhrel, Y., Hanasaki, N., Koirala, S., Cho, J., Yeh, P. J. F., Kim, H., Kanae, S., and. Oki, T.: Incorporating Anthropogenic Water Regulation Modules into a Land Surface Model, J. Hydrometeorol., 13, 255–269, https://doi.org/10.1175/jhm-d-11-013.1, 2012a.

Pokhrel, Y. N., Hanasaki, N., Yeh, P. J. F., Yamada, T. J., Kanae, S., and Oki, T.: Model. estimates of sea-level change due to anthropogenic impacts on terrestrial water storage, Nat. Geosci., 5, 389–392, https://doi.org/10.1038/ngeo1476, 2012b.

Pokhrel, Y. N., Koirala, S., Yeh, P. J. F., Hanasaki, N., Longuevergne, L., Kanae, S., and Oki, T.: Incorporation of groundwater pumping in a global Land Surface Model with the representation of human impacts, Water Resour. Res., 51, 78–96, https://doi.org/10.1002/2014wr015602, 2015.

van Beek, L. P. H., Wada, Y., and Bierkens, M. F. P.: Global monthly water stress: 1. Water balance and water availability, Water Resour. Res., 47, W07517, https://doi.org/10.1029/2010wr009791, 2011.

VanLoocke, A., Twine, T. E., Zeri, M., & Bernacchi, C. J.: A regional comparison of water use efficiency for miscanthus, switchgrass and maize,

Agric. Forest Meteorol., 164, 82-95, http://dx.doi.org/10.1016/j.agrformet.2012.05.016, 2012.

Vörösmarty, C. J., Moore III, B., Grace, A. L., Gildea, M. P., Melillo, J. M., Peterson, B. J., Rastetter, E. B., and Steudler, P. A.: Continental scale models of water balance and fluvial transport: an application to South America, Global Biogeochem. Cy., 3–3, 241–265, https://doi.org/10.1029/GB003i003p00241, 1989.

Wada, Y., van Beek, L. P. H., Viviroli, D., Dürr, H. H., Weingartner, R., and Bierkens, M. F. P.: Global monthly water stress: 2. Water demand and severity of water stress, Water Resour. Res., 47, W07518, https://doi.org/10.1029/2010wr009792, 2011.

Wada, Y., Wisser, D., and Bierkens, M. F. P.: Global modeling of withdrawal, allocation and consumptive use of surface water and groundwater resources, Earth Syst. Dynam., 5, 15–40, https://doi.org/10.5194/esd-5-15-2014, 2014.

Wisser, D., Fekete, B. M., Vörösmarty, C. J., and Schumann, A. H.: Reconstructing. 20th century global hydrography: a contribution to the Global Terrestrial Network-Hydrology (GTN-H), Hydrol. Earth Syst. Sci., 14, 1–24, https://doi.org/10.5194/hess- 14-1-2010, 2010.

Thank you very much for your comments and suggestions.

Sincerely yours,

Zhipin Ai (on behalf of the co-authors)