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Geoscientific Model Development Discussions

Interactive comment on "Enhancement and validation of the state-of-the-art global hydrological model H08 (v.bio1) to simulate second-generation herbaceous bioenergy crop yield" *by* Zhipin Ai et al.

Anonymous Referee #2

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This manuscript enhanced the capability of a global hydrological model named H08 in simulating two perennial bioenergy crops, Miscanthus and switchgrass. The results were validated against site-level and country-level observed crop yields. The enhanced model is applied to simulate the impact of irrigation on crop water consumption and water use efficiency compared to rainfed condition. This study makes contribution to study the impact of large-scale deployment of bioenergy crops on water resources. However, I have some major comments as listed below.

General comments: 1. Model validation: This study only validates the simulated yield

results against observations for Miscanthus and switchgrass. While the main contribution/innovation of this study is on hydrological applications, this study didn't validate any variables for the water cycle, including evapotranspiration, runoff, and irrigation. Without such validations, I feel difficult to be convinced for the reliability of the simulated results for crop water consumption and WUE.

2. Study innovation: The Introduction didn't well motivate the study and present the novelty/uniqueness of this study. For example, the argument "However, it is noted that the model performance for the simulated bioenergy crop yield was not validated at all." is a little bit difficult to be taken as an innovation of this study. And almost all the parameter values were directly taken from Trybula et al. 2015, which makes me wonder what are the main differences/improvements of this current study compared to Trybula et al. 2015? Given the difference between H08 used in this study and SWAT used in Trybula et al. 2015, can the authors justify the applicability of directly using SWAT's parameter values?

3. Model description: This study only describes the crop module in H08 without much descriptions for the hydrological module in the model, especially given the important role of hydrological processes in this study. In addition, many indices and simulations (e.g., using new meteorological dataset) were not well described in the methods section, such as how WUE is calculated, how irrigation works, and how many simulations were conducted in total and their respective purposes.

4. Paper organization: The main context is missing many important information (e.g., sensitivity test results, model descriptions, equations). Many important information and results were given in the SI rather than directly presented in the main context. The methods section is missing descriptions for the simulations conducted in this study and many new simulations came out suddenly in the Results sections. It will be necessary to reorganize the paper and move some important information from SI to the main context.

5. Limitation in discussion: the current results and discussions are quite limited. For example, quantitative evaluations for model improvements were missing. What are the improvements of the enhanced H08 compared to its old version which uses C4 grass to characterize switchgrass and Miscanthus? One of the most important features of switchgrass and Miscanthus is their perennial features and longer growing seasons, but this study didn't have any discussions on this kind of perspectives.

Specific comments: Lines 31-36: Actually, CLM5 also has the irrigation scheme and river routing and CLM5 also includes both bioenergy crops and the water cycle.

Line 34: typo, should be "bioenergy and the water cycle"

Line 61: I am curious does it mean H08 can only simulate hydrological processes and crop growth as a 0.5 degree and at a daily scale? How about other spatial and temporal resolutions? Can H08 simulate GPP and LAI? If so, how about the simulation results for GPP and LAI?

Lines 61-64: What are the six sub-modules? It will be great if the authors can add more descriptions for the H08 model (e.g., calculations/illustrations for the hydraulic processes), as not every reader is familiar with H08.

Line 75: what is single-irrigated and double-irrigated mean?

Line 85: what is "substantially" mean? Can you quantify the changes?

Section 2.2: Can you change some descriptions into equations? For example, how did you calculate the output item for water consumption and WUE? If they are already in the supplementary materials, it will be great if you can move some key equations to the main context. What is the bug in the original code?

Section 2.5: How is irrigation calculated in H08, such as the irrigated area and irrigated amount?

Line 23 under section 2.5: since 1944 simulations were conducted, can you give more

results for the ensemble runs rather than just present the one with lowest RMSE? For example, what are the uncertainty ranges for the calibrations? What are the sensitivity results for all the calibrated parameters? Here the authors only mentioned the most sensitive parameter names in line 20 but no results were given to support it.

Line 38 in section 3.1: change to "because only few sites were irrigated".

Line 38 in section 3.1: can you add reference after the "previous reports"?

Line 50 in section 3.2: can the authors add more quantitative results and discuss the reasons/mechanisms for why the over- and under-estimations have been addressed in the enhanced H08? Actually Miscanthus is still underestimated in the enhanced H08, why?

Line 58 in section 3.2: what are sites 1, 2, and 10? Can you refer to more specific names or descriptions for those sites, as these site numbers are not quite meaningful?

Line 59 in section 3.2: again, adding irrigation scheme in H08 in the methods section will be helpful.

Line 64 in section 3.2: the two results were similar, but what are the implications? What are the differences between the two meteorological datasets? Also, it makes me wonder how many simulations or how many kinds of simulations were conducted in this study? This new simulation with additional meteorological dataset never mentioned in the methods section. I will suggest the author add a new table or at least a new paragraph in the methods section to better illustrate the simulations conducted in this study, including their names, descriptions, differences, purposes, etc.

Section 3.3: can you add those correlation and significant level values in Figure 5 as well?

Line 10 in section 3.4: grammar error for the sentence

Line 55-58 in section 3.6: again, how is the current results compared to old H08 which

uses C4 grass to represent Miscanthus and switchgrass?

Line 63-65 in section 3.6: I doubt the argument that the enhanced H08 is the only model that can simultaneously simulate Miscanthus and switchgrass with consideration of water management, as CLM5 also has this capability.

Tables 1 and 2: could you add the long name or descriptions for these parameters? What is “step” mean in Table 2?

Figure 1: could you add a flow chart or schematic figure for the hydrological processes in H08 or the overall model structure?

Figure 3: can the authors decrease the maximum magnitudes for figure b and d, like to be 40, since no data exceeds 40 and right now most of the points are centered to a very small range? And can the authors add a third axis (e.g., different colors) to distinguish the locations/climate zones for the points?

Figure 6: it will be helpful to add a title name in the figure, e.g., (a) Rainfed Miscanthus.

Figure 7: it may be helpful to move Figure S6 to the main context and combined with Figure 2 to better illustrate the methods section. But the authors can decide after revise the methods section.

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