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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Hydrological Modeling in an Ungauged Basin of Central Vietnam Using SWAT Model" *by* A. Rafiei Emam et al.

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The authors would like to thank Dr. Ferrant for his valuable suggestions which help us to improve the manuscript. The responses, and explanations related to those comments are listed below:

Comments 1: The section 2.2 pages 3 gives some detail of soil data, but no details about the agricultural statistics, rice area extent and irrigation practices. A landcover map is missing and crop area extent and their irrigation practices should be mentioned in the text to make clear if it will impact discharge or not. Please also provide any information about the irrigation practices: inundation of the rice from surface or groundwater.

@ Response 1: We agree with you and we have all this information. But we just

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care about the length of manuscript. However, as you suggested we added some more information in the text. As we already mentioned in the manuscript, the land use statistics contains different classes such as protected forest area, evergreen forests, bare lands, residential area, paddy rice lands and other agricultural lands. However, more than 90% of the area covered by forests. Rice is dominant agriculture crop in Aluoi. The crop schedule in the area is presented in the following figure 1 and Table1, but we are not going to present this information in the manuscript due to length of paper. Rice are cultivating two times per year: Summer-Autumn and Winter-Spring periods. The surface water is the sources of irrigation/inundation for rice.

Comment 2: Authors have cited Perrin et al., 2012 as a reference of the use of SWAT in semi-arid area. But the main contribution of this study to the literature is that the SWAT model was calibrated on aquifer recharge rather than discharge, and that the spatial heterogeneity of agricultural practices are essential in the assessment of groundwater availability for irrigation.

@ Response 2: We just tried to show the application of SWAT model in diverse climates from humid to arid zones. We are not discussing about the specific methods they used in their research.

Comment 3: Authors have used AET-PET derived from remote sensing (MODIS) to calibrate SWAT. Material and methods should be improved,

@Response 3: We revised this section and added some more information in the updated version.

Comment 4: Authors have cited Immerzeel and Droogers, 2008, who have used Modis data to spatially estimate the groundwater extraction for irrigation using SWAT in Indian basin, but more recent studies have improved this methodology and are detailed in Cheema et al, 2014 (5). Authors should compare or adapt or discuss their own methodology to this more recent and up to date study.

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@Response 4: Thanks for the new reference. The new reference were used in the updated manuscript.

Comment 5: . . .The content of these studies should be used to identify the limits of the present study and to discuss its results. . .

@Response 5: Any new references are welcome but we are wondering about the page length of the manuscript. However, we used some of the references in our updated manuscript as you have already suggested.

#Comment 6: I have found much methodological confusion throughout the manuscript: Modis PET is used (line3 page 9) instead of Actual EvapoTranspiration for instance. MODIS16 product is the "land surface evapotranspiration product which represents all transpiration by vegetation and evaporation from canopy and soil surfaces, expressed in 1-dimensional vertical mm/day units." (http://modis.gsfc.nasa.gov/data/dataprod/dataproducts.php?MOD_NUMBER=16).

@Response 6: We used both actual and potential evapotranspiration products provided in MOD16. The details explanation is presented in the response of second referee's comment.

#Comment 7: Results of SWAT parameters sensitivity are obvious, well known and should not been presented as results: ESCO is the parameter that allows the modeler to tune the actual evaporation, which impacts obviously the actual evapotranpiration fluxes. BLAI is used to calibrate AET for forested area but also for rice? As stated by the Referee 1, the calibration procedure using these sensitive parameters is not well described. I advise to remove the sensitivity analysis results and replace by a strong justification of the choice of each input parameters that are used to optimize simulations variables rather than selecting the most sensitive.

@Response 7: As you suggested we eliminated figure 2, sensitivity analysis for river discharge calibration, from the manuscript. We calibrated the same parameters in

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different landuse types, and this is the reason of repeating some parameters. We believe same parameters in different landuse types play different role on the model calibration.

#Comment 8: I really don't agree with the statement made in line 8 page 8. Rice yields and evapotranspiration are not directly correlated but evapotranspiration highly depends on the irrigation practices that are not described in this study.

@Response 8: We disagree with the referee in his first comment, because there is relationship between evapotranspiration and crop yield (please see the references Vaghefi et al., 2014; Faramarzi, 2010). But, however, we agree with the referee's comment concerning the second issue. We used auto-irrigation method in order to deal with irrigation practices of rice cultivation. We also used soil water content not plant water content to deal with water stress identifier in the SWAT model.

#Comment 9: We do not have any details of final range of these plant parameters that are optimized for the rice

@Response 9: As we mentioned in the manuscript (page 6, lines 7-10) some parameters affect the crop yield (i.e. Heat unit, Harvest index, Bio target). The final ranges of these parameters are presented in the new version of the manuscript (Table 2).

#Comment 10: The figure 5 shows crop yield in T/ha between 25 to 30. The rice yields in Vietnam are around 6.5 T/ha (source FAO). The authors should better explain what they did.

@Response 10: Data of FAO is the average in whole country. But we used data from Tháżńa Thiên-Huáž£ agricultural organization, and we checked again these data farmers. In Aluoi district the average of rice yield is approximately 28 ton/ha.

#Comment 11: Main limits of this study are that ETP is corrected bias (not clear why), AET is not calibrated or discussed neither on forest nor on rice, agricultural context (area extent, pressure on water) is not described and the calibration of rice yield is

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made on non appropriate parameters rather than irrigation practices of AWC only. The ratio model is not well described, and the comparison between both model ishould be better justified.

@Response 11: We calibrated ETa in the forests area not ETP. We just compare the ETP of MOD16 with our calculation. We explain more about it in the manuscript. Crop yield (i.e. rice) is calibrated by the parameters such as heat unit, harvest index, bio target. The other physical parameters such as soil water contents and . . . already parameterized before. However we used also auto-irrigation with emphasis on soil water content in order to deal better with soil physical parameters. We used the ratio method to predict the river discharge data in our ungauged basin. However, we changed this strategy and transfer the parameters from calibrated-gauge basin into our ungauged basin; therefore, the ratio method was eliminated from text.

Comments on figures:

#Comment 12: Figure 1 should be revised with the land cover map.

@Response 12: As suggested, we have just added the Land use map in figure 1.

#Comment 13: Figure 2 does not provide any useful information and any of the many sensitivity analysis that have been published previously should be cited to explain what are the main sensitive parameters.

@Response 13: The figure 2 was eliminated from the manuscript as you suggested.

#Comment 14: Figure 3 should be improved by giving the monthly discharge and cumulative daily discharge for each period to assess the ability of the model to simulate discharge volume rather than daily dynamics.

@Response 14: We calibrated the model in daily discharge which is more details and more precise than monthly. The performance of the model shows by NS and R2 statistical analysis. Therefore, when model calibrated by daily it does not make sense to shows discharge in monthly!

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#Comment 15: Figure 4 is not appropriate as each simulated value (daily discharge) depends on the previous discharge. Again, monthly discharge should be compared between models.

@Response 15: The authors disagree with the referee's comment to show the results by monthly, while the model calibrated by high details information (i.e. daily). When model calibrated by finer information it means that the model is also valid for coarser information (i.e. monthly), but the inverse approach would not be acceptable.

#Comment 16: Figure 5, there is probably a problem with the definition of yield (Aerial Biomass, which is not a yield)

@Response 16: We are talking exactly with yield not aerial biomass. We refer you to the SWAT theoretical documentation for more information.

#Comment 17: Figure 6 is a summary of the methodological problem of this study. Why comparing Potential evapotranspiration that is forced (or computed with forcing climatic variables, please specify) in SWAT with the PET derived from MODIS? Is it Actual evapotranspiration? There is more interest comparing AET rather than PET.

@Response 17: In this figure we are trying to show that although ETP computed by SWAT and MOD16 have high correlations; the MOD16 data are not correct because of globally scaled (figure 7). The result of figure 6 and figure 7 should see together as we have already discussed in the text.

#Comment 18: Again, I do not understand the figure 7: PET from Modis is systematically higher than PET estimated by SWAT from the climatic variables (please precise the method priestley-Taylor, Penman, Hargreaves). It may be because natural land cover such as evergreen forest evapotranspirate more than PET (which is define by the evapotranspiration of a herbaceous cover). I have a doubt about the relevance of the corrected MODIS ETP. Please be more persuasive or try to find methodology applied in previous studies (Cheema et al. for instance)

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@Response 18: As we discussed before, PET of MOD16 is overpredicted and this is due to globally scaled of MOD16. The MOD16 used Penman-Monteith method and therefore we also used the same method in order to compare both ET results (potential and actual) (page 8 line 22).

#Comment 19: I do not understand the Figure 8. Generally, captions of all figures give not enough details. Readers should be able to understand a figure by reading the caption.

@Response 19: As mentioned in the caption, this figure shows the spatially pattern of evapotranspiration.

#Comment 20: Figure 9 is not convincing: it seems that the sensitivity of each parameters is tested using only 3 runs, with a spatially homogeneous value throughout the catchment. This is not realistic for AWC for instance.

@Response 20: The caption of this figure is clearly described the method. To summarize this method usually used before globally sensitive analysis and in the initial steps of choosing parameters for calibration. I refer you to the SWAT-CUP documentation (swat.tamu.edu/media/114860/usermanual_swatcup.pdf) for further information.

Reference:

- Faramarzi, M., 2010. Assessment of regional water endowments, crop water productivity, and implications for intra-country virtual water trade in Iran, PhD thesis, ETH University, Sweden.

- Ashraf Vaghefi, S., S. J. Mousavi, K. C. Abbaspour, R. Srinivasan and H. Yang, 2014. Analyses of the impact of climate change on water resources components, drought and wheat yield in semiarid regions: Karkheh River Basin in Iran. Hydrological Processes Volume 28, Issue 4, pages 2018–2032, 15 February 2014

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Table 1. Fertilizer time schedule for rice cultivation

Types / Time	Manure	P_2O_5	Nitrogen	K_2O	Description
Before planting	8-10 Ton/ha	50-60 Kg/ha			
10-12 days after planting			33 kg/ha	30 kg/ha	- 30% of whole nitrogen - 50 % of whole Phosphorous
15-20 after last fertilization			44 kg/ha		- 40% of whole nitrogen
In the flowering period			33 kg/ha	30 kg/ha	

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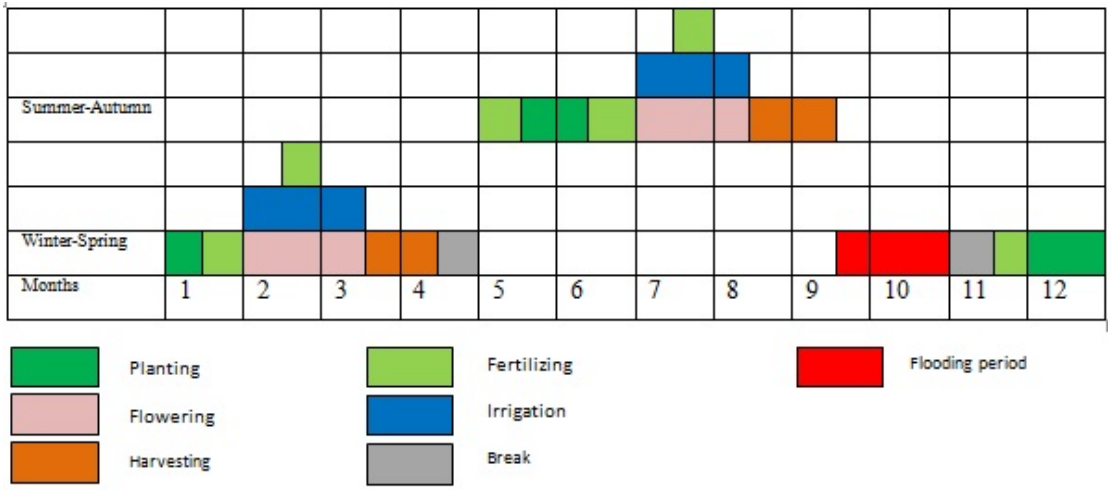

Fig. 2. Figure 1. Seasonal calendar of rice cultivation in the study site

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