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Hydrology and Earth System Sciences
Discussions

Interactive comment on "An integrated water system model considering hydrological and biogeochemical processes at basin scale: model construction and application" *by* Y. Y. Zhang et al.

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Response to Anonymous Referee #1

Dear Review,

Thanks very much for your useful comments and suggestions on our manuscript. We have revised the manuscript accordingly, and detailed corrections are listed below. The revised manuscript is also provided in the Supplement.

This paper aims at presenting a new integrated watershed model for hydrology and several water quality parameters for large complex regulated and polluted basins which

is an important scientific field in the Anthropocene. Thus, the content of the paper fits into the scope of HESS. The functioning of the model is explained using flow charts of process interactions and an Annex with all the equations. After presenting the model, it is tested in a Chinese basin and the results are compared to a former study of the authors (Zhang et al., 2013).

Although I think that the model extension and application of this paper are generally worth publishing, I have great concern about the focus of the paper and the presentation quality. In my opinion, the authors do not present a new model, but a modification to the SWAT (Soil and Water Assessment Tool) model since 90% of the model equations were taken from SWAT. Their modifications are restricted to the infiltration and nitrogen modules. Additionally, the paper would have to be re-structured and some parts (such as the conclusions) re-written from scratch. Thus, in my opinion, the paper should not be published in the present form. I would like to encourage the authors to re-write the manuscript with the focus on the presentation of modifications to the SWAT model code and a model test in the Shaying River Catchment.

Response:

1).Thanks for your clear summary of the paper and suggestions on the revision. We restructured and re-wrote some parts of the paper following the comments, especially in the sections of introduction, model framework, model testing, discussion and conclusions, and appendix (See P2 L16-17,L 21-22, L 24-32; P3 L7-16,L18-24;P4 L8-27; P5 L1-9; P6 L3-33; P7 L1-7; P13 L4-32; P14 L1-18; P15 L21-32; P16 L4-30; P17 L1-11; P19 L9-14, L19-23,L17-21; P20 L1-17, L22-26; P21- P22; P45-54; P56-P63). All the changes in the paper were marked with light blue.

2) We addressed the main structure of "our model (HEXM)" in Section 2 (Model Framework) and specified the main differences from SWAT (See). Like SWAT, our proposed model's modules stem from the existing models: HCM is from DTVGM, SBM from DNDC, CGM from EPIC, SEM from the improved ULSE equation, WQM from QUAL-2E

and mass balance model. Both SWAT and our model used EPIC, improved ULSE and QUAl-2E because they are very representative in crop growth, soil erosion and water quality simulations although the detailed equations are slightly different. For other modules, there are only 10 out of 66 (15%) equations taken from SWAT's model equations (i.e., A5, A6, C1, S1-S6 and S36) but these 10 equations are not the key equations and are required for model completion (P6 L25-33; P7 L1-7). The key differences between our model and SWAT are:

(i).The more accurate processes for hydrological cycle and detailed processes for soil biogeochemistry (nitrogen and carbon) were used in our proposed model, aiming to improve the simulations of runoff and water quality in responding to agricultural management. The results showed that the simulations of runoff and water quality at most stations were greatly improved by the incorporation of soil carbon and nitrogen processes in comparison with our previous simulations by SWAT in the case study. The frunoff was also greatly improved in both calibration and validation periods in most cases (12 out of 16 simulations). The values of fNH4-N decreased obviously except at Zhoukou Station.

(ii).Based on the hypothesis that the cycles of water and nutrients (N, P and C) are inseparable and act as the linkages among all the modules, it is difficult to modify SWAT under its framework because the interactions among these modules were different with SWAT. Therefore, we have to reorganize these modules and link them together by the cycles of water and nutrients, although some equations in our proposed model were the same as SWAT.

(iii).The dam regulation module is extended in our previous work (Zhang et al., 2013) in order to further approximate the actual flow regulation rules of dams and sluices. We therefore integrate this module in the proposed model.

(iv).The three levels of spatial calculation cell are designed in our proposed model, i.e. subbasin cell, landuse cell and crop cell from largest to smallest. The subbasin cell

is divided on the basis on the DEM, the position of observation stations, dams and sluices, and used in HCM (e.g. flow routing in both land and instream), MMM, WQM and DRM. Seven specific landuse cells of each subbasin are partitioned according to the landuse classification. The related modules are HCM (e.g., water yield, infiltration, interception and evapotranspiration) and SEM. In current version of HEXM, crop cells are divided into ten specific categories for the crop farming land (forest, grassland, paddy land and dry land), including fallow, grass, fruit tree, non-economic tree, early rice, late rice, spring wheat, winter wheat, corn, and mixed dry crop. The crop cell category of a certain landuse is variable and depends on cultivation structure and timing. The related modules are SBM and CGM. All the outputs of crop cell are summarized at landuse cell scale, and subbasin scale based on the area percentage of different cells, respectively. The partition of different scale cells accords to the spatial information data (e.g. DEM, landuse), the national landuse classification standard and the local agricultural management patterns. All the levels of spatial cell are visible, more reasonable and flexible than the virtual hydrologic response unit of SWAT (Neitsch et al., 2002).

General comments

The title of the paper should be changed accordingly if the paper is re-written with a new focus. The structure of the paper is rather unusual. I recommend to re-structure the manuscript according to the scientific standard of Introduction – Methods – Results & Discussion – Conclusions (see specific comments).

Response: Thank you for the suggestion. The title of the paper was revised as "An integrated water system model considering hydrological and biogeochemical processes at basin scale with the application to Shaying River Catchment". The paper structure was also revised as "introduction- model framework- model testing- discussion and conclusions". The objective of this paper is to develop an integrated water system model focusing on the improvement of the existing models in the practices and module applicability, and the model performance was tested by a case study in China. Thus the model framework was grouped in a single section and the description of study area,

model setup and evaluation were grouped in another single section (model testing). (See P1 L1-3; P5;P14;P21)

The language of the paper should be double-checked, probably by a native speaker. Often, articles are missing and the wrong tense is used which prevents a fluent reading of the paper.

Response: Thanks for your careful review and good suggestion. After our revision, we asked a native English speaker to check the language. We believe that the revision is much more readable.

The research gap identified in this work consists of the assumption that the modules in the SWAT model are over-simplified (p. 9224, l.6-7). However, there is no reference given supporting this statement. In the context of a research gap there should be a literature review providing the basis for this assumption.

Response: Thanks for your comments. A discussion was added about SWAT in the literature review of the introduction section, instead of the emphasis on the over-simplification of SWAT modules. (See P4 L8-25). As suggested by both reviewers, we also clearly provide the improvement of our proposed model in Section 2 (See P6 L3-33; P7 L1-7).

In the discussion, the authors should set their results in a broader view by comparing with other modelling studies in large complex basins around the world. The conclusions are rather an extension/repetition of the results and discussion section. All passages containing references are not conclusions of this work but of other studies. The conclusions should be re-written from scratch to become clear and concise.

Response: Thanks for your great suggestions. The conclusions section was replaced by the section of conclusions and discussion and restructured greatly. The theoretical implication, scale issues and practical implication of the proposed model were discussed. References in the conclusions were deleted. (See P21 L4-32; P22 L1-31)

Since the major part of the model is taken from the SWAT model, it is not necessary to create flow charts and to provide all the equations in the ANNEX. A reference to the SWAT Theoretical Documentation (Neitsch et al., 2011) would be enough. Only provide these Figures for the new model code. If the authors want to stick to all the equations, they should include the sources/references for the equations.

Response: Thanks for your comments. Like SWAT, the modules of HEXM stemmed from the existing models, but the main modules were different, i.e. hydrological cycle, soil biochemical modules. Both SWAT and our model used EPIC and QUAl-2E because they are very representative in crop growth and water quality simulations although the detailed equations are slightly different. For other modules, there are only 10 out of 66 (15%) equations taken from SWAT's model equations (i.e., A5, A6, C1, S1-S6 and S36) but these 10 equations are not the key equations and are required for model completion. The construction of HEXM is based on the hypothesis that the cycles of water and nutrients (N, P and C) are inseparable and act as the critical linkages among all the modules. Thus, the interactions among these modules were different from SWAT(See P6 L25-33; P7 L1-7).

The major different modules between HEXM and SWAT were given in the ANNEX and the other similar modules were moved into the supplementary material. The references of all the equations were provided (See P56-P63) .

Specific comments:

p.9221, l. 2: '. . .faced over. . .' should be '. . .faced all over. . .'.

Response: It was revised correspondingly. Thanks. (See P1 L17)

p.9221, l. 13: '. . .all stations. . .' is wrong, use '. . .most stations. . .' instead.

Response: It was revised correspondingly. Thanks. (See P1 L28)

p.9221, l. 14: '. . .low flow events. . .' From Table 5 can be seen that this statement is wrong, the model has a clear weakness at low flow events.

Response: Thanks for your careful review. We missed part of the sentence. We in fact intended to compare the simulation results of low and high flows with and without dam regulation. The sentence was changed into "The model performance of low and high flow events was improved when the dam regulation was considered although the low flow simulation was still not satisfactory." (see P2 L1-3)

p.9221, l. 19-20: '. . .good agreement . . . city scale.' This part is not clear to me.

Response: Thanks for your careful review. All the collected data of nonpoint source pollutant load and grain yield were from the official report (HRC.,2011) and the statistical yearbooks from 2003 to 2005 (Henan Statistical Yearbook, 2003, 2004 and 2005), respectively. Thus we could compare the simulated nonpoint source pollutant load and grain yield of each city with the statistical data. The outputs had good agreements with the statistical data of each city and the bias were 21.31% and 19.93%, respectively. We revised the sentence as "the nonpoint source NH4-N load and grain yield were simulated for each administrative region and the results had good agreements with the data from the official report and the statistical yearbooks, respectively" in the abstract. (see P2 L6-8)

p.9221, l. 21-25: A more humble attitude would be appropriate here. The HEXM model will not solve all the problems all over the world but may contribute to the solution.

Response: Thanks. The sentence was revised as "This model is expected to give an improved water system modeling in complex basins, and provide a scientific support for the implementation of integrated river basin management." (see P2 L11-13)

p.9222, l. 8: change '. . .and other. . .' to '. . .and the other. . .'

Response: It was revised. Thanks. (See P2 L22)

p.9222, l. 15: It should not be 'Singh et al., 2002' but 'Singh and Woolhiser, 2002'

Response: Thanks for your careful review. It was revised.. (See P3 l3)

p.9222, l. 15-25: Please provide references for the statements in this section.

Response: Thanks for you suggestion. Several references were added to support our statement, including, Li et al., 1992; Wigmosta et al.,1994; Burt et al., 2005; Lohse et al., 2009. (See P3 L8)

p.9223, l. 2-10: 'Furthermore. . .macro-scale.' This section should be removed since it has nothing to do with the specific contents of this paper.

Response: Thanks for your suggestion. We removed these several sentences. In order to make a proper connection in the context, we also revised paragraph 2 and 3 as a single paragraph in the revision (See P2 L30-P3 L16).

p.9223, l. 11-13: 'Since. . .ecology)' Please support this statements with references.

Response: Thanks for your suggestion. The reference was added as Singh and Woolhiser, 2002. We also revised these sentences following Reviewer 2's suggestion. (See P3 L18)

p. 9224, l.6-7: '. . .the mechanism of each module in SWAT is over-simplified. . .' I agree that some modules in SWAT might be over-simplified. However, in the context of this paper it would mean that also 90% of the modules in HEXM are over-simplified since it uses the SWAT equations. . . Is that really what the authors wanted to say?

Response: Thanks for your comments. We thought this statement again. As simplified modules may not reduce model performance, we deleted this statement. In fact, we adopted more accurate and/or detailed modules with aim to improve model performance, especially runoff and water quality in complex basin (P4 L8-25;P5 L5-6) .

With respect to the similarity with SWAT, please see our response to the second part of the overall comments, which is copied below, See P6 L25-33; P7 L1-7). We addressed the main structure of "our model (HEXM)" in Section 2 (Model Framework) and specified the main differences from SWAT. Like SWAT, our proposed model's modules stem from the existing models: HCM is from DTVGM, SBM from DNDC, CGM

from EPIC, SEM from the improved ULSE equation, WQM from QUAL-2E and mass balance model. Both SWAT and our model used EPIC, improved ULSE and QUAl-2E because they are very representative in crop growth, soil erosion and water quality simulations although the detailed equations are slightly different. For other modules, there are only 10 out of 66 (15%) equations taken from SWAT's model equations (i.e., A5, A6, C1, S1-S6 and S36) but these 10 equations are not the key equations and are required for model completion. The key differences between our model and SWAT are:

(i).The more accurate processes for hydrological cycle and detailed processes for soil biogeochemistry (nitrogen and carbon) were used in our proposed model, aiming to improve the simulations of runoff and water quality in responding to agricultural management. The results showed that the simulations of runoff and water quality at most stations were greatly improved by the incorporation of soil carbon and nitrogen processes in comparison with our previous simulations by SWAT in the case study. The frunoff was also greatly improved in both calibration and validation periods in most cases (12 out of 16 simulations). The values of fNH4-N decreased obviously except at Zhoukou Station.

(ii).Based on the hypothesis that the cycles of water and nutrients (N, P and C) are inseparable and act as the linkages among all the modules, it is difficult to modify SWAT under its framework because the interactions among these modules were different with SWAT. Therefore, we have to reorganize these modules and link them together by the cycles of water and nutrients, although some equations in our proposed model were the same as SWAT.

(iii).The dam regulation module is extended in our previous work (Zhang et al., 2013) in order to further approximate the actual flow regulation rules of dams and sluices. We therefore integrate this module in the proposed model.

(iv).The three levels of spatial calculation cell are designed in our proposed model, i.e. subbasin cell, landuse cell and crop cell from largest to smallest. The subbasin cell

is divided on the basis on the DEM, the position of observation stations, dams and sluices, and used in HCM (e.g. flow routing in both land and instream), MMM, WQM and DRM. Seven specific landuse cells of each subbasin are partitioned according to the landuse classification. The related modules are HCM (e.g., water yield, infiltration, interception and evapotranspiration) and SEM. In current version of HEXM, crop cells are divided into ten specific categories for the crop farming land (forest, grassland, paddy land and dry land), including fallow, grass, fruit tree, non-economic tree, early rice, late rice, spring wheat, winter wheat, corn, and mixed dry crop. The crop cell category of a certain landuse is variable and depends on cultivation structure and timing. The related modules are SBM and CGM. All the outputs of crop cell are summarized at landuse cell scale, and subbasin scale based on the area percentage of different cells, respectively. The partition of different scale cells accords to the spatial information data (e.g. DEM, landuse), the national landuse classification standard and the local agricultural management patterns. All the levels of spatial cell are visible, more reasonable and flexible than the virtual hydrologic response unit of SWAT (Neitsch et al., 2002).

p. 9224, l.13: The reference Neitsch et al. (2000) is missing in the reference list.

Response: Thanks for your careful review. The reference was added. (See P32 L13-14)

p. 9225, l. 7-9: This is a very ambition aim. It is not a very "scientific attitude" to expect to have the gold-standard for a scientific question. The authors might expect that their model contributes to solving these questions in the case study and elsewhere.

Response: Thanks for your comment. This sentence is deleted following the reviewer 2's suggestion.

p. 9225, l. 17-20. I agree that the SCS model can be questioned and other infiltration model might be superior. However, it should be noted that there is the option of using the Green and Ampt infiltration model in the SWAT model (Neitsch et al., 2005, 2011). Why did the authors not use this more sophisticated option instead of implementing a

new conceptualization?

Response: Thanks for your careful review. In our model development, we noted that Green-Ampt infiltration model is not widely used because it is usually limited to simulate flow events at micro scales (temporal: hours or minutes, spatial: fields or 10-1 to 10 km2 watersheds) (Brakensiek, 1977; King et al.,1999). The Time Variant Gain Model (TVGM) is adopted in our model to calculate surface runoff yield because of its strong theoretical basis and easy applicability (see P4 L8-25; P6 L25-33; P7 L1-7). We demonstrated the improvement in the surface runoff in the case study (see Section 3.3.2 or P17 L17-P18 L27).

p. 9231, l. 17. and p. 9232, l. 10: The reference Neitsch et al. (2002) is missing in the reference list.

Response: Thanks for your careful review. The reference was added (See P32 L13-14).

p.9233, l.7: Please explain 'GDP'.

Response: "GDP" means "Gross Domestic Product". Because it was not used in our model, it was deleted following the editor's comments.

p.9233, l.20: What is 'GB/T21010-2007'? I couldn't find it in the reference list.

Response: Thanks for your careful review. The reference was revised to (CNS,2007) (See P29 L24-25).

p.9234, l.2-p.9236, l.3: 'As an example. . ./2]' Please move this whole part to the new Methods section. Results start from chapter 3.3

Response: Thanks for your suggestion. The contents of parameter sensitivity analysis, hydrological simulation, water quality simulation, crop yield simulation were moved to Section 3.3 (Results). (See P16 L25-P21 L1)

p. 9235, l.7-8. Please elaborate more on LH-OAT and SCE-UA and provide the refer-

ences. What are these methods doing?

Response: Thanks for your comments. The LH-OAT and SCE-UA were two methods specified in Section 2.5 (See P12 L27-30). We revised the sentence by following Reviewer 2's suggestion.

p.9236, l.7: '. . .112 distributed parameters for each subbasin. . .' Does this mean that the parameters have different values in each subbasin, i.e. 112 parameters multiplied by 46 subbasins? Please clarify!

Response: Thanks very much for your comments. Like most catchment models, each subbasin has its own set of parameters but different subbasins share many common parameter values. In our case study, the 112 distributed parameters are divided into 48 overland parameters, 18 stream parameters and 46 water project parameters (only for these subbasins owning water project) on the basis of their spatial distribution. These parameter values were determined by the properties of overland landscape and soil, stream patterns and water projects.

Following Reviewer 2's comment, this sentence was revised as "Over 200 parameters (93 lumped and 112 distributed) control the hydrological, ecological and water quality processes of HEXM according to the degree of spatial heterogeneity. The 112 distributed parameters are divided into 48 overland parameters, 18 stream parameters and 46 water project parameters (only for the subbasin owning water project) according to their spatial distribution. These parameter values were determined by the properties of overland landscape and soil, stream patterns and water projects, respectively. Different subbasins share many common parameter values because of the same properties above." (See P16 L25-P17 L3).

p.9236, l.9: Please change '. . .LH-OAT is. . .' to '. . .LH-OAT was. . .'

Response: Thanks. It was revised (See P17 L3) .

p.9236, l.10: Please change '. . .parameters are. . .' to '. . .parameters were. . .' The prob-

lem with the tense is appearing so often in this manuscript that I stop writing it down from here on.

Response: Thank you for the suggestion. The tense of the manuscript was revised.

p.9236, l.19-22: 'Hydrological . . . 2002).' I can't see how this sentence connects to the surrounding text. Please clarify or leave out.

Response: Thank you for the suggestion. The sentence was deleted.

p.9237, l.26-27: 'All the dams and sluices are designed to control floods and supply water (Zhang et al., 2013). Is this a general statement or catchment specific? If it is the latter, please change the sentence to 'All the dams and sluices in the Shaying River Catchment are. . .'

Response: Thanks for your comments. We found that the sentence is a catchment specific statement. However, we would like to provide a general statement here. Therefore, we revised the sentence to "the regulation of dams and sluices usually disturbs the intra-annual distribution of flow events e.g. flattening high flow and increasing low flow."(See P16 L15-17)

p.9237, l.28: Please change '. . .decrease. . .' to '. . .decreased. . .' Response: Thanks for your careful review. This sentence was revised to " the regulation of dams and sluices usually disturbs the intra-annual distribution of flow events e.g. flattening high flow and increasing low flow." for general statement was changed (See P16 L15-17).

p.9238, l.1-3: 'The high. . .low flow.' This is a (short) explanation of the method used to separate high and low flows. Please move this part to the 'Methods' section and expand it.

Response: Thanks for your good suggestion. The determination and simulation of high and low flow were explained in section 3.2 (model setup and evaluation). (See P16 L14-22)

p.9239, l.3: '(Zhang et al., 2013)' This reference has been used quite often in this text. For the purpose of the specific statement in this sentence there are also other references (e.g. Gassmann et al., 2014)

Response: Thanks for your suggestion. The reference (Zhang et al., 2013) was replaced by Gassmann et al., (2014) (See P19 L10).

p.9239, l.3-4: '. . .the unacceptable. . .hydrological processes.' This sentence is not clear to me, please revise.

Response: Thanks for your comment. The hydrological processes at Fantaizi station was not calibrated because of the lack of observed runoff data. The sentence was revised as "the unacceptable bias at Fantaizi might be attributed to the possible large error in the simulated hydrological processes which was not calibrated due to the lack of observed runoff data." (See P19 L9-12).

p.9239, l.23-24: 'highly correlated. . .(r=0.506) and rice yield (r=0.799).' I don't think that r=0.5 is 'highly' correlated (considering that it is an R^2 of 0.25). Please provide significance levels of the regressions. Otherwise the r values have hardly any meaning, especially with a low number of points like this.

Response: Thanks very much for your suggestion. The significance level of the regressions was set as 0.001 and the p-values of all the testing were less than 0.001. We added the p-values in the revised and changed the sentence to "The spatial pattern was significantly correlated with the distribution of paddy fields (r=0.506, p<0.001) and rice yield (r=0.799, p<0.001)" (See P20 L7).

p.9239, l.28: Replace 'easy' by 'prone'.

Response: Thanks for your suggestion. It was replaced. (See P20 L11)

p.9239, l.29: The reference Gao et al. (2008) is missing in the reference list.

Response: The reference was changed to (Zhu, 2000; Xing and Zhu, 2000) and added

in the reference list. (See P20 L10)

p.9240, l.2: '. . . by statistics.' Which statistics? Please provide a reference.

Response: Thanks for your careful review and sorry for the confusion. The statistics we used was to summarize the entire observed point source load used in the model. We revised the sentence to "Given that the observed average annual point source NH4-N loads into rivers were about 4.70×104 t year-1 in Shaying River Catchment, the nonpoint source load contributed 38.57% of the overall NH4-N load on average from 2003 to 2005, which was little greater than the statistical results (29.37%) given in the official report (HRC., 2011)". (See P20 L13-17).

p.9240, l.11: '. . .28.10 to 762164. . .' Please provide units. It is not necessary to give digits for such huge numbers.

Response: The unit was t km-2 year-1 and added in the text. We also changed the units by following Reviewer 2's suggestion. The new number is easier to understand. (See P20 L22-23)

p.9240, l.18: '. . .subbasins results in the simulated errors. . .' I don't think that only the boundary mismatch is responsible for the errors. Thus, I advise to change the sentence to '. . .subbasins may contribute to the simulation errors. . .'

Response: Thanks for your suggestion. The sentences were revised accordingly to "The boundary mismatch between region and subbasin might contribute to the simulated errors, as well as the different cropping patterns in such huge basin. Higher resolution remote sensing image and field investigation might further improve the model performance." (See P20 L30-P21 L1)

p.9240, l.20: Please change '. . .investigations can further. . .' to '. . .investigations might further. . .'

Response: Thanks. It was revised accordingly(See P21 L1).

p.9241, l.2: '. . .a new research direction. . .' I disagree. For example, the SWAT model is developed and applied for decades now.

Response: Thanks for your comments. This statement was deleted. The section of conclusions and discussion was rewritten (See P21 L3- P22 L30).

p.9241, l.6ff: 'The results showed that: . . .' Most of what is written in the list after this sentence is not a result/conclusion of this study!

Response: Thanks for your suggestion. The section of conclusions was replaced by the section of discussion and conclusions and restructured greatly(See P21 L3-P22 L30).

p.9241, l.19-24: 'The proposed. . .complex basins.' It was not shown in this paper that the model is able to correctly simulate 'different forms of N/P/C' or 'leaf area index' or 'greenhouse gas emission'. Only the ability to simulate NH4-N and discharge was shown. Please change.

Response: Thanks for your suggestion. The sentence was revised as " The proposed model includes the major hydrological elements (viz., soil water and evaporation, plant transpiration, runoff and water storage in the dams and sluices), environmental elements (viz., nonpoint source pollutant load of nutrient, water quality variables in water bodies), ecological elements (leaf area index, crop yield and greenhouse gas emission) in the complex basins which could be calibrated if the observations were collected." (See P21 L17-22)

p.9242, l.5: '. . .reference point. . .' This is an ambitious aim which has to be proven by many more studies using HEXM for modelling different water quality and quantity parameters.

Response: Thanks for your suggestion. This sentence was removed and the section of conclusions was replaced by the section of conclusions and discussion and restructured greatly. The application of HEXM will be carried out further in the future (See P22

L16-30).

p.9242, l.15: '. . .with existing model results.' It would be more clear to write something like '. . .with prior SWAT model results.'

Response: Thanks for your suggestion. It was revised accordingly(See P22 L12).

p.9242, l.17: '. . .and low flow events.' Prior in the manuscript the authors stated that the low flow simulation was bad and has to be improved further. Please change accordingly.

Response: Thanks for your careful review. This statement was not suitable and deleted in the conclusion and discussed in the discussion part as ".more complex humanity activities and water-related processes in the dam regulation, agricultural management, urban area and economy system will be incorporated into this model once the interaction mechanisms with natural hydrologic cycle could be depicted accurately." (See P22 L21-24)

p.9243, l.2-4: Please avoid using references in the conclusions. What is meant by 'advanced mathematic analysis technologies'?

Response: Thanks for your suggestion. The advanced mathematic analysis technologies were specified as multi-objective optimization algorithm, Markov Chain Monte Carlo method, and so on. The references were deleted. (See P22 L30)

Equation A1: 'SWi+1' should be 'SWi-1'

Response: Thanks. It was revised. (See P23 L3)

Table 5: Explain 'Range'.

Response: The range was the difference of objective function value between considering regulation and without considering regulation. (See P40 L2-5)

Figure 1: There is a typo in 'traspiration'

Response: Thanks. It was revised as "transpiration". (See P43)

Figure 2: A typo in 'Runoff yeild model of surface water TVGM'

Response: Thanks. It was revised as "runoff yield model of surface water TVGM". (See P44)

Figure 3b): What is 'Domancy'?

Response: It was "Dormancy". (See P45)

Figure 3b): Please arrange the text in a way that it doesn't overlay the boxes (e.g. Crop base temperature).

Response: Thanks. The overlaid texts were re-arranged. (See P45)

Figure 5: There is a typo in 'Water torage'.

Response: Thanks. It was "water storage". This figure seemed to be redundant, thus it was deleted.

Figure 7: Not much can be seen on this Figure because of the huge number of data points. Since Figure 8 already presents a (x,y)-style point diagram, Figure 7 might not be necessary at all, especially since the time series is not discussed any further.

Response: Thanks. We agreed that figure 7 and 8 contains some repeated information of runoff simulation. We removed Figure 8 because the evaluation results of low and high flow simulation performance were directly shown in Table 6 (See P40).

Figure 10: Please provide the significance level of the regressions in this figure. This is especially necessary since the number of considered points in the regression is low.

Response: Thanks for your suggestion. The significance level of the regressions was set as 0.001 and the p-values of all the testing were less than 0.001. Thus the correlations of Paddy area or Rice yield were significant with NH4-N load. (See P20 L7 and P54)

Please also note the supplement to this comment:
http://www.hydrol-earth-syst-sci-discuss.net/11/C4647/2014/hessd-11-C4647-2014-supplement.pdf

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Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 11, 9219, 2014.