Hydrology and
Earth System
Sciences
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Discussions

Interactive comment on "An interdisciplinary swat ecohydrological model to define catchment-scale hydrologic partitioning" *by* C. L. Shope et al.

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The authors present an interesting study about the potential of using the integrated river basin model SWAT in a mountainous, monsoonal environment in South Korea. Although the general objectives of the study are very good, the authors need to shorten the paper and focus much more on the actual and specfic problems in their study areas and the methodological challenges. I recommend "major revision" for the study - after a sound revision of the paper this could make a valuable contribution to the journal HESS. I have listed my comments and suggestions in the following - I hope that it helps the authors to improve the quality of the paper.

Title: The current title is confusing. As an integrated river basin model SWAT is inter-

disciplinary and you do not need to mention that in the title. I would also be careful with using the term "eco-hydrology", since there are several discussions from different sides about its meaning. As options, you could use something like

i) "Using SWAT to define hydrologic partitioning to support river basin management in a South Korean region"

or

ii) "Improving process description in a South Koeran catchment by using SWAT to define hydrologic partitioning"

These are just a suggestions, you can modify it like you want. In general, the title should express the main message of the study / paper. Think in general about why you used SWAT. Usually, it is used for simulating the impact of land use / land management on hydrology, nutrient- and sediment transport, etc. This is currently not in the focus of your study (might be the base for your next steps). Might be important to explicitly mention your reasons to choose the model in the paper. Have also a look at Ann van Griensvens (et al.) critical reflection of using SWAT in the Nile basin (Hydrol. Earth Syst. Sci., 16, 3371–3381, 2012). It is a different region, but with similar problems.

page 7237 Abstract General comments: The use of the term "ecosystem services" (ESS) is at present very popular. You start your abstract with it, but "ecosystem services" as a (methodological) concept play actually no role in your study. You mention it, but you do not mention explicitly on which services you work nor do you work on trade-offs amongst land use and ESS or between ESS itself (important part of the ESS concept). In addition, what you define as ESS in the first sentence of the abstract are to a large part not ESS: Water provision is a service (includes provision of clean water), water quality and quantity themselves are not. Biodiversity is not regarded as an ecosystem service itself, but rather as a pre-requisite underpinning each of them. You further write then that "to account for future effects on ESS, the integration of physical, biological, economic, and societal data must be implemented..." . Could be that this

all will be of growing importance in the TERRECO project that you mention later in the introduction, but it plays yet no major role in the paper. I would suggest to skip the ESS part and start with problems in (East Asian) river basins like the presented study, caused by human impact, (extreme) natural conditions, data scarcity, and the resulting monitoring and modelling challenges to describe the processes. Then you can continue with the objectives. Please check if the mentioned objectives are really your main one - also in that order. - line 19: "The results of this study provide.." Please focus on the results (what you "really" investigated in your study and what you present in the paper). Sediment load and nutrients are not (yet) in the focus. - line 24: I would remove "ESS" (see my comments above) and write "...understanding of of their hydroecological impact."

page 7238-7242 Introduction General comments: As already mentioned before, please focus to the actual and specific problems in their study area and the methodological challenges. The introduction is currently very long and includes redundant or partly "trivial" information (you want to publish in the journal "Hydrology and Earth System Sciences"). Either remove the ESS part or make it a stronger part in your study - you need then explicity mention the ESS you work on and also look for the trade-offs and discuss it also at the end of your paper. I would recommend to skip it and focus on the natural conditions / environmental and monitoring - modelling challenges in your area. The strong part of your paper is the attempt to improve the process description by using monitoring and a model - environmental management is not yet really addressed. - line 6: "..(Goldstein et al., 2012)". If you are interested in trade-off studies (partly using SWAT) have a look at:

Lautenbach, S., M. Volk, M. Strauch, G. Whittaker & R. Seppelt (2013): Optimization-based trade-off analysis of biodiesel crop production for managing an agricultural catchment. Environmental Modelling & Software 48: 98–112

Seppelt, R., S. Lautenbach & M. Volk (2013): Identifying trade-offs between ecosystem services, land use, and biodiversity: a plea for combining scenario analysis and opti-

mization on different spatial scales. Current Opinions in Environmental Sustainability (article in press): http://dx.doi.org/10.1016/j.cosust.2013.05.002

Whittaker, G.W., R. Confesor Jr., S.M. Griffith, R. Färe, S. Grosskopf, J.J. Steiner, G. Mueller-Warrant & G.M. Banowetz (2009). A hybrid genetic algorithm for multiobjective problems with activity analysis-based local search. European Journal of Operational Research 193, 195-203.

- line 12: "..(Forman and Alexander, 1998)." If you are interested in a newer study working on best management practices with regard to sediment reduction in a tropical river basin:

Strauch, M., J.E.F.W. Lima, M. Volk, C. Lorz & F. Makeschin (2013): The impact of Best Management Practices on simulated streamflow and sediment load in a Central Brazilian catchment. Journal of Environmental Management (article in press): http://dx.doi.org/10.1016/j.jenvman.2013.01.014

- line 19-22: As mentioned before, skip this and focus on your topic in this paper.

page 7238 (line 26) - page 7239 (line 14) Please shorten this section. You will find several papers with reviews on river basin models or scenario applications (e.g. Volk et al., 2009, Land Use Policy, many others more). Just tell the reader why you decided to use SWAT (see my comments before).

page 7239 - line 15-20: Shorten this, belongs to the calibration / uncertainty analysis section later in the paper. - line 20: I would cite the paper by Gassman et al. (2007) that give a great overview on world-wide SWAT use :

Gassman, P.W., M.R. Reyes, C.H. Green and J.G. Arnold (2007): The soil and water assessment tool: historical development, applications and future research directions. Transactions Of The Asabe 50, 1211-1250.

- line 22: "..simulation code.." What do you mean with that?

page 7239 (line 28) to page 7241 - Think about moving parts of the text concerning your catchment more to the beginning of the paper. Just an idea (possible structure "Big Problem", own area, models, own procedure). Just think about it, no must.

page 7241 - line 14-23: I very much like your monitoring and field measurement program. Perhaps it needs a bit more related to the modelling strategy. As mentioned a few times before, right now there is not much focus on (simulated) management, sediment or nutrient transport. You could mention that in the outlook.

page 7242 - line 7: Write Shope et al. (2013)

page 7242 - 7243 Catchment characteristics I would not divide that in sub-chapters. Give a short but precise description of your catchment (location, terrain, elevation, soils (including characteristics such as permeability / infiltration capacity), river network, hydrologic regime (is needed!!), climate, land cover, land management... It is important for the reader to get a first, precise overview on the study area (specifics, problems, etc.).

page 7243 - line 11: Is the minimum temperature (January) really -26.9 °C??

page 7244 General comment: Please shorten chapter 3. Not all information that you provide here is relevant. Suggestion for slight changes of section titles (at the beginning): 3. Methods, 3.1 Model description, 3.2 Model inputs, 3.2.1...(as it is)

page 7246 - Did you develop this algorithm by yourself or do you have to refer to a reference here? - line 19 to 25: Perhaps you should mention already here that you examined the model sensitivity to alternative precipitation interpolation methods (as described at page 7253) - this is good and important.

page 7249 Land use and land cover - How did SWAT perform with the forests? There are several studies where the simulation quality for the forest regions have been more or less weak.

Management parameter estimation - Very good. However, I think that you did not use

all this information for your study. Focus on what you used. If you like to extend your SWAT study (simulation of sediments, nutrients, pesticides) explain it in the outlook. In the cited reference of Shope et al. (2013), the word(s) (land) management appears two times with a - assumed ! - influence on the hydrologic dynamics; the term heat units does (of course) not appear. Any other problems with plant growth simulations? Dormany / Non-dormancy of non-agricultural land or any other issues? If yes, mention it.

page 7251 Rice paddies, potholes, and water abstraction - line 9: There is a big difference if you abstract the water from the river reach or from the deep aquifer. As far as I know, if you take the water in SWAT from the deep aquifer it has no impact on the landscape water cycle anymore - in contrast, if you take it from the river reach, it has. How and why did you decide which amount you took from which "source? - line 12: Rice paddies. Beside the study of

M.S. Kang, S.W. Park, J.J. Lee, K.H. Yoo, Applying SWAT for TMDL programs to a small watershed containing rice paddy fields, Agricultural Water Management, Volume 79, Issue 1, 10 January 2006, Pages 72-92

there is a lot of work going on using SWAT for rice paddies. I do not know if you are familiar with it, just a hint. You should contact Phil Gassman (he was recently at a SWAT conference in Indonesia (June 2013), have a look at the SWAT homepage) or R. Srinivasan - perhaps you know that all better than I do ;o)

page 7252 Results and discussion - line 3: "...modelling applications." Have a look at

Strauch, M., C. Bernhofer, S. Koide, M. Volk, Carsten Lorz & F. Makeschin (2012): Using precipitation data ensemble for uncertainty analysis in SWAT streamflow simulation. Journal of Hydrology 414-415: 413-424

page 7253 - line 3-12: This is good and important. As mentioned, you should mention that already earlier in the methods section (see my comments for page 7246).

page 7253 ff Sensitivity and model parametrization - Please shorten and focus. You will find a lot of your "starting text" (lines 15, p 7253 to line 2, p 7254) in this section in a huge number of other papers and you do not have to repeat that all.

page 7254 ff General comment: - Please explain the SWAT parameters in a table. You use a lot of the SWAT abbreviations for these parameters and there might be a lot of people that might have no idea what that means (CH_K2, REVAPMN, GWREVAP, GWQMN, GWDELAY, ALPHABF, ESCO, CN2, etc.). In the interpretation / explanantion of the results in the text, I would group their "impact" into groundwater, baseflow, river channel, plant- or soil-processes-relevant, etc. It makes the reader much easier to understand their impact. Some of these parameters are "measureable" or derivable others are not (problematic!), which makes also a difference. You should mention that.

page 7255 ff Metrics of model performance for calibration procedures General comment: - Please think about using also other metrics to evaluate the model performance (instead of using only the "classical ones"). Have a look at the paper:

Bennett, N.D. et al. (2013): Characterising performance of environmental models. Environmental Modelling & Software 40: 1-20; http://dx.doi.org/10.1016/j.envsoft.2012.09.011. (http://www.sciencedirect.com/science/article/pii/S1364815212002435)

page 7256 Manual and automated calibration - I know that in order to cover the heterogeneity of your relatively small study area you might need to "discretize" it in many subbasins and HRUs. You write correctly that due to some studies the number of subbasins and HRUs might have only small influence on the results, but others (also my experiences) showed in contrast that it can have a big influence - it depends on the natural conditions, data quality and scale. Sometimes it is a only a pretence of a accuracy that is actually not there or not covered by the real accuracy / solution of the data. But how did you come to 13 subbasins (instead of 142 "topographically based" at the beginning)? Any investigations on that before (sensitivity?). Please excuse me,

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perhaps I did not get the point before.

page 7257 - line 3: Write "The SWAT model was ..." - line 3 ff: The simulation periods are relatively short - why? For the calibration period, you usually use years that cover a relatively wet, dry and normal year (or an extreme) - did you consider that?

page 7258 - line 8: "..was sufficient". How did you "measure" that your manual calibration was "sufficient" - there are many ways to come to good results with a manual calibration. What was the criteria for "sufficient"? Maybe one step back - why did you decide to perform also a manual calibration? To get an idea about the initial parameter ranges for the autocalibration? Should be based on as much as possible on measurements and "expert knowledge".

page 7259 (line 8ff) - page 7260 (line 6) - Sorry, but this section reads as you just modified the parameters to get higher model performance metrics. These parameter all have a more or less physical meaning (see my comments for page 7254 ff). Group them more, let the reader know which one are "measureable" or derivable and which ones are problematic (such as the channel parameters (CH_K, CH_N, etc.), to name a few examples of numerous!!). You should try to relate your parameter adjustments more to "reality". I am sure you did that, but you need to explain that also explicitly in the paper - tell the reader also all the problems of that - which is not new, but necessary to mention, even in a more or less data scarce region like yours.

page 7260 Spatiotemporal flow partitioning with respect to river discharge - line 22 ff: Which methods did you use? The baseflow filter by Arnold and Allen (1999)? I cannot find the "digital filter hydrograph separation technique" you mention in the cited refernce of Shope et al. (2013). Please explain. These filters are great, but sometimes not suitable for some river types / hydrological regimes. If you used the baseflow filter by Arnold and Allen (1999) (which is downloadable from the SWAT homepage), did you use also the ALPHA_BF value from it? You could also have a look at non-linear filters, which do sometimes better (Wittenberg and Sivapalan, Journal of Hydrology

219 (1999)).

page 7261 - line 4: Write "PBIAS statistics" or "value". - line 22: "..significantly decreased observation data..". Please change expression (e.g. less observation data, only scarce observation data, ..). - line 22: Write "NSE statistics" or "value".

page 7262 - line 19: Write "As shown in Fig. 5 and..."

page 7263 - page 7264 Agricultural management and production - Think about to skip the crop part (line 10 to 25, p7264) and focus on the LAI studies (good!) related to your hydrological topic. You might have the chance to publish another paper that is related more to the land management part of your study.

page 7264 - page 7266 Influence of engineered landscape structure - In general, this is a great idea. However, I do not understand how you route the water through the roads and culverts (if I understand it correctly). Could you please explain that? There is a difference between the rivers, roads and culverts ;o) The influence of the roads and culverts on the hydrology and trasnport processes depends on how you have routed the water here.

page 7266 ff Summary and conclusions - line 16: I would title it just Conclusions. Think about adding a separate discussion section. It is currently somehow mixed. - line 17: Make in the paper more clear what is really "novel".

page 7267 - line 22: You could have used the Green-Ampt infiltration method for the subdaily level.

page 7268 General comment: It would be helpful for the reader if your would structure this section by answering explicitly in how far you accomplished the four objectives that you list in the intro. - line 12-13: "However, the addition od roads..". The impact of roads / culverts depends on how you realized the routing in the model (see my comments for page 7264).

Tables - page 7277, Table 1, line "Discharge and loads" - Which loads? - page 7278,

Table 2. 1. Comment: I think it is not necessary to list the number with two decimal places (see also "drainage area" in Table 6). 2. Comment: Give the reader an information about the hydrological characteristics of the soils (in the text). - page 7279, Table 3. Do you have comparable values from literature? - page 7281, Table 5. You need to explain the parameters (see my comments before). The "normal" reader that is not familiar with SWAT mght have no idea if the parameter ranges are reasonable. - page 7283, Table 7. Think about skipping this table. Not in the focus of your paper.

Figures - Partly to small (legends, "labelling", etc.)

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 10, 7235, 2013.