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Interactive comment on "Developing a Decision Support Tool for Assessing Land Use Change and BMPs in Large Ungauged Watersheds" *by* Junyu Qi et al.

Junyu Qi et al.

f8at3@unb.ca

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Reviewer# 2

This study is a very interesting and important question for water resources management. Thank you for your comments.

Major suggestions: (1) The decision support tool should be established with readily available and measured variables only. Or, some advantages claimed in this study are not realistic. For instance, (a) anyone want to apply this method/framework to another catchment, they have to set up and calibrate the SWAT model first; (b) some of the

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explanatory variables might be catchment (sub-basin, or HRU) scale values and are un-observable, e.g. SOL_K, so regressed equation depends on the performance of the calibrated SWAT model. I suggest authors to set up the tool independently with the SWAT model. Then, using the SWAT model to support the validity and to identify the advantages/disadvantages of the established tool. I think this is the way we usually do in operation, i.e. regressed and physically-based models are complementary and independent with each other for decision making.

In general, we agree with your comments. We do want to develop a decision support tool based on measured variables only and then tested it by comparison with SWAT simulations. However, as we stated in the manuscript, it is almost impossible to get those measured data from field experiments (at least under the budget we have). Probably we could get a few regression equations from our limited field measurements, but they are insufficient to develop a watershed scale decision support tool which contains many land use and soil types and management practices and their combinations. To your specified questions: a) once a decision support tool was developed and validated under a specific climate, vegetation and soil conditions, the decision support tool could be used in many watersheds in that region. We do not need to setup and calibrate a SWAT model for each watershed we are interested in. This is one of advantages of DST over SWAT. For example, the decision support tool developed in the present study could be applied to many similar watersheds in New Brunswick. Without the DST, we probably have to setup SWAT model (or other watershed models) for each of them and then take long time to calibrate and validate models, which is not possible for ungauged watersheds (there are so many ungauged watersheds in New Brunswick) ; b) when we develop the decision support tool we chose physical meaningful variables. Sol_K is saturated hydraulic conductivity which is a standard measurement in many soil survey and maps. We do insist that SWAT simulation could provide information that are not available from field experiments. So, a well calibrated and validated SWAT model could provide more reliable information.

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(2) I don't agree with the conclusion "DST and SWAT are equally well". The performance of DST and SWAT are "equally", which is not surprise as they are dependent, but not "well", which should be concluded on comparison with observations. Results did not well support "well". For the applications in the whole watershed, it is hard to say model was well established (or, it is just a numeric modelling experiment).

We agree with your comment. Both DST and SWAT were not performing very well compared with measurements. However, when it comes to ungauged watersheds, we do not even have measurements to validate the model. SWAT model has been used in many cases without calibration and decision makers still put some trust in its simulations because there is nothing else to consult to. The main purpose of present study it to provide a decision support tool for decision makers. At least, we could conclude that the DST performed equivalently as SWAT for the ungauged watershed and it is much easier to use than SWAT for decision makers.

(3) What is relationship of this study with four published studies of Qi et al. in term of modelling results of SWAT? If there is no new modification, set-up and calibration of the SWAT model, that is fine. But you have to say it explicitly and reduce the length of model introduction significantly.

To apply SWAT in Atlantic Canada region, modification of soil temperature, snowmelt and soil erosion modules are necessary to improve simulations of SWAT to develop DST for New Brunswick. We have revised this section to shorten the manuscript.

Many abbreviations were used without full names where it was appeared firstly. Language should be edited carefully.

We revised those issues as much as we can. Thanks

Length should be reduced significantly (too many tables and figures).

We put some results into appendix and delete several figures accordingly.

Suggest to separate the results and discussions

We understand your suggestion however we would like to keep results and discussion together to reduce manuscript length.

Subplots of all the figuresshould be labelled in order of (a), (b), : : : consistently

We revise them accordingly.

Specific suggestions: (1) Line 111: too many abbreviations in this flow chart. Consider move down to end of this section, or provide more specific information, or extend the caption

We removed the figure as it is confusing and not necessary in the manuscript. Thanks

2) Line 131: Provide information of all the abbreviations used in the figure in the captions

We revised them accordingly.

(2) Line 132: name of weather station should be consistent in form rather than one is "#08" and another one is "St. Leonard".

St. Leonard station is a national station while other stations are all local managed stations without a proper name. What they have is just a number.

(4) Line 139: The word "used by SWAT" is misleading. Land use and soil classes used by the SWAT model are much lesser (section 2.3) than these shown in this figure as many small patches of land cover and soil types are dissolved during the generation of HRUs.

We revised this part.

(5) I suggest authors to provide the "real" and relevant information used by the SWAT (including information in table 3) rather than these maps/values based on raw datasets.

The slope, soil and landuse maps are used to set up SWAT. Thanks

(5) Line 148: what does "St. Quentin" mean? A type of soil?

Yes, it is a type of soil.

(6) Line 176-177: “It is believed that : : : even without calibration”. How do I believe it? We revised it.

(7) Line 180: These two references are not the most relevant ones

We revised it.

(8) Line 193: whether freeze-thaw cycles are considered here? Results said modelling error of sediment load was resulted from not considering freeze-thaw cycles in winter (line 507).

Freeze-thaw cycles were considered by using modified version of SWAT in BBW and LRW. However, the modified K-factor could not fully account for those processes. As mentioned in Qi et al. 2017b, more studies are needed to address this issue in cold regions.

(9) Line 193-194: what are “following changes”? How do I know the accuracy was improved?

We revised the sentence. SWAT model Improvements could be referred to the four papers of Qi et al.

(10) Line 209: use four digital for the year consistently.

We revised that.

(11) Line 313: delete“(LBAT)”.

Yes.

(12) Line 350: what is (3)?

We revised it.

(13) Line 484: In this section: it seems that results do not well support “increasing cell

size increased sediment loading". Additionally, more explanations/discussions should be provided.

Those three sentences should be combined together to understand the fig 4. "Increasing cell size (i.e., slope length) increased sediment loading. However, the mean slope gradient was reduced. As a result, the mean sediment loadings were correlated non-linearly with cell size as shown in fig 4".

(14) Line 486: Figure 13, where it is?

Typo. We revised it.

(15) Line 508: "48" should be "48%".

Yes.

(16) Line 556: R2 should be included in this table

We revised the table and added discussion about the results.

Please also note the supplement to this comment:
https://www.hydrol-earth-syst-sci-discuss.net/hess-2017-423/hess-2017-423-AC2-supplement.pdf

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