

## ***Interactive comment on “The role of catchment classification in rainfall-runoff modeling” by Y. He et al.***

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I wish to thank Prof. Troch for his comments. Below is my response:

T: I agree with the previous comments this ms has received that the presentation of the material needs to be significantly improved before this paper can be accepted for publication in HESS.

- (my remarks don't necessarily represent the opinion of my co-authors) in my humble opinion as an inexperienced author, a review ought to be independent i.e. devoid of bias from notions opined by previous assessors. It is sometimes unavoidable that a reviewer can be influenced by his contemporaries. I maybe wrong in assuming review

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comments were composed after reading the previous comments. I nevertheless agree that the presentation of the material needs improvement.

T: First, the title needs to reflect the content of the paper. When I read the title I was expecting a paper that dealt with how catchment classification can help to construct more reliable rainfall-runoff models and be applied in ungauged basins (theme of the special issue). Therefore the paper seemed very appropriate for publication in this special issue of HESS. However, the paper is more of a review of different catchment classification methods. The fact that this is a review rather than a research paper should be clearly reflected in the title and abstract.

- One of the goals of catchment classification and regionalisation is in their application to ungauged basins. This is clearly stated in the paper, e.g. the first sentence in the abstract, “A sound catchment classification scheme is a fundamental step towards improved catchment hydrology science and prediction in ungauged basins.” This title doesn't contain the word “review” but I didn't know it was a norm to use the word “review” in a review article. I will consider the word “review” in a new title. I believe the abstract clearly states the nature of this paper is a review paper and the word “review” does appear in the abstract.

T: Second, the authors distinguish between two classification approached: a physiographic and climate properties type of classification and a regionalization/clustering method. The first method attempts to define like-catchments based on external and internal properties without making a link to catchment functioning from a hydrologic point of view. The second looks at the dynamic response (or indices reflecting dynamic response at some defined spatial and/or temporal scale). I believe that those two methods are not independent and should be both part of a GENERAL classification method, as argued by Wagener et al. (2007). The authors should make it clear from the beginning how their vision/opinion/review differs from previous opinion papers, such as Woods and McDonnell (2005) and Wagener et al. (2007).

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- It may be better to remove LCC completely from the paper as it attracted arguments as to whether the division of LCC and SCC is sensible or even merited. The division is only from the author's perspective and may be disputable. In "Concluding remarks", I state the two categories "are NOT completely INDEPENDENT" and "can potentially compensate each other and formulate a hybrid catchment classification scheme." So the author completely agrees with this comment. Regarding "a GENERAL classification method", I believe and argued in the manuscript that "a classification system should be designed for a clear and specific purpose, it hardly serves two or more different purposes equally well. A classification system would lose its precision (or purpose) as an instrument of analysis if it attempts to cover a diverse range of goals; . . ."

T: Third, I think many of the methods described in the ms are too detailed and thus distract from the main message the ms tries to convey. There is no point in repeating details that can be found in the articles cited. Also, I do not like that certain articles are explicitly reviewed in detail. I prefer that a more general approach is taken and that references are added as (good) examples of the different procedures discussed. In that sense the ms will have value as a source or reference for people who quickly want to get informed about all the different methods people have suggested to do classification/regionalization. What is missing is a critical assessment of what the methods try to achieve, what are their limitations, and above all, how they manage to get to the right answer to the question: what is the most efficient way to classify catchment such that we can learn from the classification and more reliably predict hydrologic response in catchments with limited data.

- This concerns the presentation issue and will be revised.

T: Fourth, I think the authors miss the opportunity to clearly express their opinion of what is needed to develop a robust catchment classification system that will serve a practical purpose, namely, to reduce prediction uncertainty in ungauged basins. For that we (as a community) will need to develop theoretical and/or empirical scaling relations between observable catchment features (through spatial databases and/or re-

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mote sensing) and unobservable catchment features that affect hydrologic partitioning, storage and release. How do we do that for large catchments? I would like to hear the authors ideas on this. From my perspective there are two ways to achieve this: either through empirical analysis of rainfall-streamflow and catchment properties that are easily observable (size, land use, etc) or through the use of a process-based model that allows to extract hidden information about the catchment (e.g. rooting depth, groundwater reservoir time constants, etc) and relate those to dynamic response. Ultimately these two methods need to be reconciled if a robust classification approach is to be developed. How far are we from realizing this ambition? And what is required to get there?

- I agree that these two methods need to be reconciled if a robust classification approach is to be developed. I am unable to address the question "How do we do that for large catchments?", as this is beyond the scope of this review paper. Nonetheless, I will think about it.

T: Finally, I suggest that the authors reduce the size of the main body and spend more time in developing the Discussion and Conclusion sections. After all, this type of papers is best received when the authors express clear opinions about what has been done and what needs to be done, rather than a mere summary of things published elsewhere. To achieve this they have to think about the main message, express this clearly in the title, abstract and intro, and finish strong with a well written discussion/conclusion section. I believe these authors are well placed to achieve this goal.

- The discussion will be expanded and consolidated along with a full restructuring of the manuscript.

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