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Hydrology and Earth System Sciences
Discussions

Interactive comment on "HESS Opinions: Advocating process modeling and de-emphasizing parameter estimation" *by* A. Bahremand

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Dear Editor Prof. Zehe,

I thank you very much for giving me enough time to rework my paper. I have prepared the revised version of the opinion paper. This revised version is also refined and enhanced by Hoshin Gupta. I had comments of 3 referees, your comments as the editor and the comments of 4 other researchers left on the HESS website which I accepted all of them and used them to improve my work. I must say I could not do this work without the comments and encouraging emails which I have received during one year being involved with this paper. The paper received comments and positive remarks of 25 hydrologists, perhaps due to its clear message. To some scientists like Prof.

Hoshin Gupta and Prof. Florimond De Smedt and the three referees (Prof. Beven, Prof. Montanari, and Prof. Schaefli) and you the editor Prof. Zehe, I owe a lot. Their comments were highly significant for the improvement of the work. In my opinion, the main and major comments, which I addressed them in the paper and used those to improve my work, were these: 1. As it was commented by Montanari and Schaefli, the paper was pessimistic on auto optimization I moderated my statements and also I wrote about the advantages of auto calibration. More than 15 lines are discussing the auto calibration now (lines 356-374). 2. The paper had few examples of physical models, I improved this very much by adding many examples of physics based models. Some of the examples present no calibration in physical based distributed models, some mention limited calibration or just parameter adjustments, and some are the examples of expert knowledge in calibration or parameter specification. For this issue, in addition to the previous citations, I cited and discussed 29 papers as references. All reviewers and the editor had asked me to mention some examples of physics based models. So I did my best to fill the gap. Lines from 84 to 120, then from 149 to 165 are new. 3. I wrote a full new text (whatever I could) about parameter allocation. I owe this to the referee Prof. Schaefli who mentioned several good questions. So while I tried to answer those questions I found out that I have extended my work several pages more! I am happy that I could improve the paper in this regard (more than 135 lines are added for parameter allocation). It was much longer, but fortunately I could decide to delete 3 long paragraphs upon Hoshin Gupta's suggestion. 4. I had several long email conversations with Prof. Beven which I learned a lot through those emails and his thoughtful comments. In most of those emails, he asked me "how it works?". I really did my best to write my paper in this direction to have an answer for his question. I do not know if I was successful, but I have to say the entire Section 5 (196 lines) might provide an answer for this question. Trying to answer this question, I improved and extended the paper very much, it became twice as before. So, I really owe Keith Beven for making the review procedure so challenging for me. 5. I had the feeling that a modeling based upon a thermodynamic approach is the right track which I should emphasize

it but I was not sure until receiving the editor's comment. So an important change in my revised version is the emphasis on energy centered hyrological modeling. Editor comments really helped me a lot to make a much better paper. 6. The first version had nothing about data and measurement. Prof. Beven and Dr. Sheikh pointed out this gap, so, I wrote a paragraph to feel this gap (lines 506 to 511, also please see lines 77 to 81) 7. Apart from the comments, some newer approaches like REW modeling, Behavioral modeling, optimality approach, models of everywhere, and community model were discussed (they are discussed in different parts of the paper but mainly in section 5, in particular subsection 5.3, e.g., lines 464-486). I wrote my opinion about the future of hydrological modeling in an original example which I have explained it as spherical jigsaw puzzle modeling (subsection 5.3). 8. I also wrote more about the wrong physics being used in our modeling (327-346 from the first version, and 512-516 of the revised version).

I really appreciate the very good choice of appointing the right referees for this work. I have to say the referees and the editor comments made the work very much better. The mentioned gaps were filled in, as so the length of the paper increased more than twice. While the previous submission was 428 lines, the new version is 914 lines (despite being shortened by Hoshin). The new version has 114 references, while the first submission had only 40 references. I made a marked-up manuscript too. More detail is written as the marked-up comments.

The changes according to each reviewer, separately: 1. Prof. Beven: he asked me a revised version after a long email discussion. I tried to use all his comments in different parts of the paper. But mainly these lines are directly related to Beven's comments: 77-84, 347-577. In the marked up file, I have commented in different parts, for example, I deleted the GLUE example which was correctly mentioned as a bad practice. I gave a special attention to the model of everywhere and learning process in the jigsaw puzzle example, as well as several other significant opinions of Prof. Beven briefly mentioned (e.g. equifinality, GLUE, modeling protocol, self-organized dissipation of sin-

gular events, hyper resolution and community model, closure problem, wrong physics, uniqueness of place, etc.). 2. Prof. Montanari: he recommended me to consider 3 corrections in my paper, he clearly told me how to do them (It is appreciated). Lines 64-65 (trial and error for initial values), lines 84-120 (knowledge based optimization and physics based modeling examples), line 356-374 (advantages of auto calibration). Prof. Montanari also asked me to clarify my idea about calibration, which I did this very clear now. I can say one third of the paper now proves how I think of calibration but please see lines of 356-374, several other sentences talking about limited calibration, parameter adjustments, and calibration not only according to local data but also in conformity with the higher level water balances as well as organizing principles, etc. I also wrote the calibration is unavoidable (line 357). 3. Prof. Schaefli: she posed several clarifying questions which I tried to address them all. The entire subsections 5.1 and 5.2 are written in response to her comments. By the way, I built a close discussion between my opinion and her opinion presented in Schaefli et al. 2011. Schaefli had also emphasized on comments of Montanari. 4. Prof. Zehe: I added many examples of physics based modeling to over shadow some examples of conceptual bucket models. So, almost 80% of the examples are now of physics based models. These are some of the models: hydrograph model, TOPKAPI, CATFLOW, MIKE SHE, WetSpa, WetSpa-Python, MARINE, THREW, etc. I had a special emphasize on new works which consider energy balances too. This can be seen in the entire marked-up file. Although, while discussing my opinions often I mentioned other opinions too, but because, I did not see my message something against the common practice in hydrology so the paper did not become much in dialectic sense, but I am convinced it has clear messages without disregarding other opinions. 5. Prof. Sadeghi and Dr. Sheikh: I avoided to use the word "conceptual" in the abstract, the "empirical" (proposed by Hoshin Gupta) serves better. I wrote a paragraph about data and measurements (506-511).

At, the end again I thank you very much for all your guidance and support, and I hope this version suits the high level journal HESS. I also appreciate the referee's valuable comments. I am ready to improve the manuscript more as much as it needs.

Best regards, Abdolreza Bahremand

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 12, 12377, 2015.