Geoscientific
Model Development
Discussions

Interactive comment on "EcH$_2$O-iso 1.0: Water isotopes and age tracking in a process-based, distributed ecohydrological model" *by* Sylvain Kuppel et al.

Anonymous Referee #1

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General comments

This paper introduces the isotopic tracking of the ecohydrological model EcH2O. The new model development is evaluated using isotope time series from a montane, low-energy catchment in Scotland. The isotope tracking addition to the model is interesting for the GMD readership and the approach is in general well-documented. The availability of isotope time series in different parts of the study catchment is also very useful for gaining scientific insights. However, . . .

1. the paper lacks a clear focus at times, and the writing varies between being very detailed to very general. The authors know the topics very well, and occasionally

make jumps or sweeping descriptions that easily lose the reader. (Examples in specific comments.)

2. Also, the model development rationale is not entirely clear, which makes it difficult to understand whether the evaluation procedure and criteria are sound, well defined, and in proportion to the goals the model are set to achieve.

3. The authors also do not test the sensitivity of neither parameters, mixing assumptions, nor isotope model structure, which limit the insights that could have been generated in the subsequent evaluation process.

4. The authors repeatedly refer to Kuppel et al. (2018) and at times assume the reader to have taken part of it. This is a bit unfortunate, as Kuppel et al. (2018) is not open access (and also was not accessible for me during my review). Please consider including key information, if only in Supplementary information.

5. The paper is lengthy and readability could be improved by e.g., summarising tables and more condensed graphs that can act as reference, or point the reader to the key results (e.g., notations table, definitions table, and scatterplots etc., more figures like Fig 8).

6. The authors mention in their literature review and discussions other models ranging from local to global scale, but it's not clear if the authors mean that their modelling procedure can be scaled up.

7. In the abstract and conclusions, the authors claim that the framework is useful beyond the type of low energy catchment simulated here. However, I feel this statement is misleading and goes well beyond the evidence provided in the paper, and would require e.g. validation in other types of catchments.

8. Equations: subscripts and superscript should be in upright font when constituting a describing word (e.g., out, in, snow etc.) and only in cursive for variables (e.g.,

t). Function names such as "max" and "min" should also be in upright font.

Specific comments

Abstract: Very sweeping and general, and raises many questions. Please consider to be more specific. E.g., what is meant by "good [. . .] match in most cases", "powerful tool", "some model development"? What kind of cases, why is it powerful, what kind of model development? And what is the model development rationale? What can the model be used for? "Celerity" – a term used in the abstract, introduction, discussion and conclusion, but not clearly explained in the analyses and results sections.

Introduction: It could be useful for the authors to explain how such their study is linked to practical and societal meaningful issues. For example, the authors explains many times how isotopic characterisation could "provide insights into water pathways", linked to "water flux partitioning", and understanding "catchment functioning", but the reader is left to figure out on her own if these topics are interesting and important also in a broader context. E.g., could improving our understanding of catchment functioning also for example be directly linked to our capacity to design models capable of forecasting floods, and works well under a rapidly changing climate? No need to be lengthy, but just to provide a context. Some interesting debates about evaporation partitioning is also not included, among others: (Coenders-Gerrits et al., 2014; Evaristo et al., 2015; Jasechko et al., 2013; Schlesinger and Jasechko, 2014; Wei et al., 2017).

P2L10: What do the authors mean when writing that the "hydrology has remained simplistic" in land surface models? Please specify. And why are dynamic vegetation models and global hydrological models not mentioned?

P3L9: "evaporative losses in ET". Please consider "terrestrial evaporation".

P3L11: "transpiration (T)". Please consider using "E_t" for transpiration, to avoid the confusion with temperature T.
P3L19: Key features are described, but the rationale is not explained. E.g., why the model developed is the described way? What are the authors hoping to achieve?

P3L28: Please consider new paragraph for the research questions.

P3L30: The research questions could be formulated in a more specifically way. E.g., What are "physics"? Are "mixing assumptions" really investigated in this paper? What kind of "implications and opportunities" do the authors have in mind?
P4 Sect 2.1: Please describe the key features and main limitations of the EcH2O model. Including examples of where and for what kind of purposes the model has been used would also be useful.

P5 Fig 1: Please consider illustrating the isotope tracking assumptions within the model chart, e.g., transpiration is not considered fractioning, throughfall is not aging etc.

P6L9: "One exception. . ." Perhaps new paragraph?

P6L14 "No spill-over". Not sure what is meant. There is throughfall, right?

P8L13 "PET" Please consider using E_{pot}, as PET could also be precipitation, evaporation, and temperature.

P11L3-4 "Autumn" Lowercase letters

P13L26-27 "model-to-data ratio of standard deviation and model-data Pearson's correlation factor". Please consider discussion the merits and pitfalls of using these evaluation metrics. See for example (Biondi et al., 2012) for review of different validation procedures that might be of relevance. '

P14 Sect 4.1. The time series section is detailed and provide considerable amount of information. However, it is also difficult for the reader to quickly get a grasp of the main strength and weaknesses of the model. Please consider including e.g., scatterplots.

P21 Fig 9, P23 Fig 10: Possibly consider moving some of the maps to the SI, and condense the information by grouping (by e.g., riparian/upstream/downstream etc types of regions).

P26L9- "By keeping the..." Parts of this could also be modelling rationale that could been useful in the introduction section or model set-up.

P3019: "ecohydrological feedbacks". A bit general, and not clear what the authors mean. Ecosystem response in terms of CO2 fertilisation and root depth development?

References

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