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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Temperature controls production but hydrology controls export of dissolved organic carbon at the catchment scale" *by* Hang Wen et al.

Anonymous Referee #2

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Scientific significance: DOC export is an research important topic that fits well into the scope of HESS. The authors provide an interesting study based on a systematic combination of field data sets and modelling. The model allows to compare the relevance of local process and the catchment-scale effects (e.g., L. 549 – 555) and to evaluate the sensitivity towards different influencing factors. The case study adds to catchment studies such as to expand the understanding how different factors such as climate or local hydrological conditions may influence DOC export.

Scientific quality: Overall, the study seems to be carefully done and provides a broad discussion about the relevance and interpretation of the findings. Some aspects are

only presented briefly (see below). This makes it difficult to properly judge all relevant details.

Presentation quality: Generally, the paper is well written and easy to understand. However, the method section does only provide incomplete information (see below for more details). Despite having published many methodological aspects before, the manuscript should contain more information to be able to evaluate what the authors have actually done.

Detailed comments:

Abstract:

From the abstract it remains unclear how well the internal states of the catchment as described by the model are confirmed by field observations. Please explain how well the model performed and what gain in insight was achieved by using the model.

Introduction:

L. 55: What is the role of particulate organic matter (POM) in this context? How relevant is it for carbon export and for affecting DOC concentrations?

L. 65: It has been shown in that hyporheic biogeochemical cycles may be more affected by POM than by DOC (Diem *et al.*, 2013).

L. 78 - 79: Why should the conversion to DOC concentration reveal the same pattern? Is this an expectation or confirmed by data analysis?.

L. 93: Can you provide examples for such multiple optima?

L. 99 - 101: What has been done so far to address this issue?

L. 102 - 105: What is the state of the art of DOC modelling by these kind of models? What have others done? What are known limitations? Please provide a short overview that provides context for this work from a modellers perspective.

L. 106 - 113: Why did you select this study area?

L. 109 - 111: To which extent are these expectations based on prior data analyses of measurements in the study area?

Methods:

General comment: the methods are described very briefly only. Please provide more information even if the method description has been already published elsewhere.

L. 135: How large were the lysimeters and which depths did they sample?

L. 137: How was DOC measured in the stream? What was the temporal resolution?

L. 190 - 191 : Why is *n* set to 1.0?

L. 195: Is this exponential decline with depths supported by the data from the catchment? Would one not expect more stepwise changes given the soil profile and horizontation?

L. 201 - 204: Did you consider any temperature-dependence of the thermodynamic equilibrium?

L. 209: How was the model parameterised for the 535 land elements regarding their soil properties?

L. 219: How was the effective macropore conductivity assessed across the entire unsaturated zone?

L. 227: Setting the DOC concentration in groundwater to a fixed value implies that there was no coupling between DOC dynamics in the unsaturated zone and the groundwater in the model?

L. 243: Multi-objective calibration raises a number of questions that haven't been addressed here. Using different variables for joint calibration generally causes the problem of trade-offs between different objective functions leading to Pareto fronts without

one single optimal solution. How did you solve this problem?

L. 245 - 250: Which were all the parameters that were calibrated? What were the ranges of parameter values considered and how was the calibration performed (manually or by any automated procedure)?

L. 278 - 284: According to the text, the ratio $\frac{CV_{DOC}}{CV_Q}$ is always < 1. It seems that the categories are only defined based on parameter*b*. Please clarify.

L. 303: Did you assume a constant fraction of groundwater across the entire discharge range? Why did you specifically select 18.8%?

Results and discussion:

L: 322: Twice *that of*.

L. 328: Why is high ET coinciding with expanding *AND* shrinking of the connected zone?

L. 349: What does this NSE represent? Is it the average across the NSE values for each of the six sites? Provide these site-specific values as well.

L. 489: What is the meaning of *2.5GW*?

Figures:

Fig. 4: The DOC model simulations for the soil DOC values are site-specific. How was this localised model calibration achieved? How was the standard deviation for each data point calculated?

Recommendation:

The manuscript provides important and interesting insights and should get published after properly addressing the critical points mentioned above.

References

Diem, S., Rudolf von Rohr, M., Hering, J. G., Kohler, H.-P. E., Schirmer, M., von Gunten, U., 2013. NOM degradation during river infiltration: Effects of the climate variables temperature and discharge. Water Research. 47: 6585-6595.