Hydrology and Earth System Sciences Discussions

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Comment on hess-2021-231

Anonymous Referee #1

Referee comment on "A conceptual-model-based sediment connectivity assessment for patchy agricultural catchments" by Pedro V. G. Batista et al., Hydrol. Earth Syst. Sci. Discuss., https://doi.org/10.5194/hess-2021-231-RC1, 2021

General Comments:

The paper is excellent in terms of organization, writing, and content. The results and figures are convincing, and I am particularly excited about how the authors utilize changes in model structure to address sediment connectivity, which is timely and quite important in terms of advancing watershed sediment simulations. Overall, I have very minor comments regarding some clarifications in a few instances and I believe that a few statements made by the authors should be relaxed a bit. Additionally, I would suggest including a brief paragraph at the end of the discussion regarding limitations of the WaTEM/SEDEM approach, and how we can further move to improve the spatial and temporal resolution of sediment connectivity simulations.

Specific Comments:

- L 32: Perhaps you can also mention that the paper is, for the first time to my knowledge, advancing tools to assess connectivity by quantifying structural uncertainty within the sediment simulations (not referring to *structural* connectivity here, by the way, just how there are inherent uncertainties within how the model is configured to predict fluxes/loads).
- L 159-167: It would be helpful within the text to tell readers the temporal resolution of the model. It seems like it's yearly according to the RUSLE equations but could be clarified.
- L 180: Is this of the individual pixel or along the slope length?
- L 188: Does this include bank erosion?
- L 188-190: If this is a yearly model then perhaps this statement can be slightly relaxed... For example if the system is known to not aggrade or degrade over longer-term (decadal) timescales then instream erosion and deposition are approximately in equilibrium and so I would not be as concerned with the instream.
- L 205: How did you decide 1200? Is this enough? Sometimes people will utilize 100,000

monte carlo simulations. I'm not saying that you need to run the model for more realizations, just a bit more justification please.

- L 205-208: Right, the typical approach is to calibrate the model and along the way assess sensitivity/uncertainty such that sensitivity/uncertainty of the model is addressed within solution spaces that are plausibly behavioral. I'm not rejecting your approach by any means, but perhaps some additional acknowledgement of the traditional approach and how you are slightly deviating here could be helpful to readers. Some readers might question why you present realizations that will not adequately describe the sediment load/flux in the system.
- L 208: *model assumptions* – I would clarify you are making assumptions about the structure of the model, so quantifying structural uncertainty.
- L 238: can you clarify why a value for *Pcon* wouldn't be applied everywhere in the catchment, but instead for just the forest and buffer strips? What if there is disconnectivity from microtopography in the roadside ditches, for example? Again – I'm not asking for additional analyses, just a sentence or two for clarification and that you *might* parameterize this other places in the watershed if you had overt reason to.
- L 255-259: can you please add a sentence that details the difference between scenario two and three? The way I understand it is that in scenario three sediment deposition does not occur on the road or in swales/ditches along side the road, but deposition can still occur downstream, for example in between the road and the stream network. In scenario two sediments are automatically connected to the stream, correct?
- L 270: Again I might suggest using the word *structural* uncertainty of the model.
- L 275-276: This was a bit confusing to me.
- L 306: What is the mean squared error in relation to? The yearly predicted sediment load and the yearly average sediment load from the rating curves? Please clarify.
- L 323: Fig. 6g – what about interrill erosion?
- L 323: Fig 6b,c; L 333: Is it worth showing land use for all the details here?
- L 374: Perhaps you can say in the caption that the short-cut generally overlaps the IQR better than the other 2 scenarios... this could help readers quickly interpret the figure.
- L 385: Out of bound percentage – is this a fraction or a percentage what is presented in the table?
- L 388: It would be great if we could see at this same time scale how SEDEM was performing… but I think this is just a limitation of the model since it runs at a yearly scale, correct?
- L 424: Perhaps also the rating curve is underestimating the load, as you previously mentioned? Which would improve the performance of simulations with respect to the short cutting, correct?
- L 451: I believe Mahoney et al., 2018 talks about importance of road networks a bit in the USA.
- L 463-465: I think this last sentence should be relaxed a bit... quantifying all of the sources of uncertainty due to observation data, model input data, model output data, parameter uncertainty, etc. etc. is quite the undertaking. In fact, in my opinion, it might be an impossible task. Does this invalidate the use of models, however? In my opinion, no, it does not. We can still discern important information from models even though we don't account for 100% of uncertainties. It ultimately will depend on what questions we are trying to answer with the model and what the model is attempting to do, which can be equally as important as quantifying certain uncertainties in my opinion.
- L 465-466: It would be nice if a paragraph on limitations of the modeling approach and future opportunities could be included. For example, while RUSLE is relatively easily implemented and approachable, it would be nice if the RUSLE approach was a bit more physically based. Additionally the RUSLE approach limits the temporal resolution of the model, so seeing event- and seasonal-scale connectivity seems a bit limited. Furthermore, the advanced geospatial data that facilitates this novel connectivity modeling is wonderful, and can help to elucidate hotspots of connectivity. Additionally there is recent sentiment to move towards high-temporal resolution models to quantify

hot-moments of connectivity. The yearly timescale inherent to the RUSLE approach perhaps is underserving this sentiment.

- L 466: I'd suggest perhaps emphasizing that exploring structural uncertainties in the model framework - and not just parameter uncertainties, as is the traditional method - allowed for advanced understanding of connectivity processes. This type of approach in my opinion is quite underserved in modeling work and should be considered in the future where high-resolution geospatial data is available.

Technical Comments:

- L 312: I’m not sure if the different colors are helpful here, maybe consider symbols?
- L 324: typo
- L 364: typo, confusing.