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Comment on esurf-2021-104

Anonymous Referee #1

Referee comment on "Time-Of-Flight monitoring reveals higher sediment redistribution rates related to burrowing animals than previously assumed" by Paulina Grigusova et al., Earth Surf. Dynam. Discuss., <https://doi.org/10.5194/esurf-2021-104-RC1>, 2022

Time-of-flight monitoring reveals higher sediment redistribution rates related to burrowing animals than previously assumed

Main concerns

I like this study and I like the presentation of this novel method to measure soil redistribution. But...I am not sure I agree with all aspects of the application of this technique and the emphasis in terms of objectives in this study.

The authors had two study sites, with different climates, and presumably different species, and I think more could be made of this. How does sediment redistribution differ between the arid and the Mediterranean site, and what is the relative contribution of animal burrowing vs rainfall (which both presumably differ between the two sites) to this? This is an interesting question that the authors sort of get at, but not quite as explicitly, i.e. really teasing the two contributions apart within the two sites. To me that should almost be the main research question and focus. I.e. how effective are animals vs rainfall at moving sediment short distances (the authors are not following the sediment all the way down the slope after all)? I suggest splitting the paper, with one paper being a short methodological paper, with all the technical details of the method, and accuracy testing (I like how that was approached). And the other focusing on this comparison between arid and Mediterranean, using a clearly phrased research question, such as the one that I suggest. But, I would be careful in how to approach answering this question.

The authors tease apart these two contributions by looking at sediment redistribution within areas affected and not affected by burrowing animals and also during and after rainfall. When I read the section about the burrowed and non-burrowed sites the first

time, I assumed some of the hillslopes were burrowed and some were not. But then I realized "affected" and "not affected" is at a much smaller scale, with the unaffected areas being in between and in close proximity to the burrows. How unaffected are the "unaffected" sites at this small scale then really? Surely the burrowing animals walk around in between their burrows, trampling the soil. Essentially, is the sediment redistribution in the non-affected areas representative of sites that do not have burrowing animals at all? If we took away the animals, would the situation in the non-affected sites be representative of how much sediment was redistributed? This has to be discussed a bit or acknowledged if there is doubt.

I also had concerns with upscaling, both spatially (to the size of the hillslope) and temporally (to a year). From a spatial perspective, I could not find anywhere how large a "scan" was, i.e. what are they upscaling from? Or how uniform the burrow sizes at any given point in time were? Burrows in the landscape are presumably at different stages of creation – most natural systems are dynamic systems with burrows being created and destroyed by rainfall continuously. What about other non-burrowed features in the landscape? Big rocks or trees etc. Are the scans and the non-burrowed areas within them really representative of the landscape? Can one just upscale from one burrow to a whole slope of burrows? I also don't think it's necessary to upscale to answer the interesting questions in this study (see paragraph 1 of my comments for what I think this is). That can be done at the smaller scale of individual burrows and non-burrowed areas (with some justification of why the non-burrowed areas are representative and giving careful thought regarding what to use as replication). In terms of the temporal upscaling (from seven months to a year), I am also not convinced. Burrowing animals do not continue burrowing at the same pace. And presumably the authors did not catch the burrowers right in the beginning, when the burrowing first started and was at its fastest. At the most the size of the mound gives an estimate of the minimum volume of soil contributed to the hillslope. How about seasonal effects? Some species dig burrows to nest, but are not fossorial, spending their time thereafter aboveground. I was also missing information on who these burrowers are. What sort of animals are we talking about? I assume it's not the same species in the arid and the Mediterranean system? Or are there multiple species in both systems? This would influence how realistic upscaling is. Again, I also don't think they need to upscale temporally to compare the two systems.

To summarise: I suggest two papers: one methods paper and one focusing on one main research question comparing the two systems (see my paragraph 1). Other interesting research questions that can potentially be answered with the data set are listed below.

- How variable are the burrow sizes in this landscape?
- Does this differ between the arid and Mediterranean system?
- How fast do the animals burrow?
- How variable is this?
- How does this change over time?
- How fast do the burrows deteriorate after a rainfall event?

Most of these questions are more ecological in nature (but can certainly be phrased in the context of biogeomorphology). I understand that this was not the intention of the article,

and the focus is meant to be far more geomorphological, contributing to hillslope erosion modelling. But I am concerned that they cannot really contribute as much from an erosion modelling/geomorph perspective as they think, given my concerns with upscaling. I do see many interesting biogeo questions that can be answered though...

Some smaller issues

- What is meant with autonomous in this context? Do they mean automated?
- Lines 49 to 50: This is exactly where it would be interesting to tease apart how much of this was a result of burrowing and how much was rainfall? Both the rainfall and the burrowing species presumably differ between the systems. This is an interesting question to phrase the whole project around. At the moment, the fact that they had two different systems is almost an "aside".
- Consider adding a study species section after the study site section.
- Is Figure 4 necessary?
- Line 403: Exemplarily is not a word.
- I have not commented on the results and discussion sections, as I think these will change if the focus of the study changes and the paper splits, and the upscaling is taken out.
- In general, I thought the article was quite long, with many relatively complicated diagrams to follow. Can this be simplified? I think splitting the paper in two will already help with this.