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Comment on hess-2022-315

Anonymous Referee #1

Referee comment on "Increased nonstationarity of stormflow threshold behaviors in a forested watershed due to abrupt earthquake disturbance" by Guotao Zhang et al., Hydrol. Earth Syst. Sci. Discuss., https://doi.org/10.5194/hess-2022-315-RC1, 2022

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Article Type: Research Paper

Title: Increased Nonstationarity of Stormflow Threshold Behaviors in a Forested Watershed Due to Abrupt Earthquake Disturbance

Authors: Guotao Zhang, Peng Cui, Carlo Gualtieri, Nazir Ahmed Bazai, Xueqin Zhang, and Zhengtao Zhang

Summary

Increased Nonstationarity of Stormflow Threshold Behaviors in a Forested Watershed Due to Abrupt Earthquake Disturbance assessed changes in hydrologic response of a forested experimental watershed in the eastern Tibet Plateau following an earthquake. The authors characterized longer-term changes in threshold behavior in the watershed and introduced

a new metric to quantitatively express thresholds for watersheds with areas of disparate land use, ecology, and physiography. The authors found that lower threshold values were observed in disturbed landslide regions and that non-stationarity in thresholds was mainly controlled by changes to the dominant runoff generation mechanisms of subsurface stormflow and the variable source area.

Significance

This work is significant in several ways:

- It contributes to our growing understanding of threshold-mediated hydrologic response.
- It contributes to the further advancement of a unified threshold-based hydrologic theory.
- It assesses longer-term trends in threshold behavior following an environmental disturbance.
- It introduced a new metric to quantify and compare thresholds.

General Suggestions

I found the abstract difficult to digest. Multiple results are communicated, but there is little context for the reader, making it difficult to understand the methodology or the jargon used in the abstract. Consider revising the abstract to be more general to start and highlighting only key results.

Starting at the end of Line 50 the authors suggest that most threshold behavior in rainfall-runoff relationships reported in the literature has been of the hockey-stick diagnostic shape. I think it is notable that most of the listed studies had an identification procedure only compatible with this shape of a threshold. Otherwise, the wording is somewhat ambiguous and may lead to readers assuming that the dominance of the hockey-stick shape is process-driven or a reflection of some common element in watershed behavior.

In L58-59 I see that the authors have referenced Wei et al. (2020) and the proposed three-linear hydrologic behaviors. I find this wording hard to follow, which I also address in comments about the abstract. I think it might make more sense to describe this form of rainfall-runoff relationship as having multiple inflections/thresholds with intervening linear segments.

The paragraph spanning L62-89 was very clear and informative. It contrasted with the writing style of earlier paragraphs. I hope that a revised version of the manuscript more broadly applies the tone and writing quality of this section.

L109-112: I am unsure if this information is a study area description or is an early interpretation of results. Perhaps, it is just the wording, particularly "let to an unstable trend of the disturbance-response-recovery trajectory…." that is confusing me.

In L123-125, the authors mention the disturbance recovery process of vegetation and how analyzing this might help better understand runoff generation. I think that this information is critical, and a more detailed process-based description of these relationships would be a welcome addition to the introduction.

In section 2.4, I was hoping for more details rationalizing the proposed integrated watershed average index for the thresholds. In the discussion, I think that a section should be added to further elaborate on the efficacy of this metric and some introspection about how this metric may or may not be well suited for other environments/conditions where the control factors on the threshold behaviors differ.

In the discussion, I think some attention should be given to uncertainty in the actual threshold values. I understand that the use of PRA in this context is to characterize the relationship shape rather than to be used in prediction. Still, how robust was the PRA, and are there any concerns about the unequal distribution of events and leverage from particularly large events?

In Section 3.2, especially in later parts, interpretation and discussion begin to creep in a bit.

I think that a stronger definition of threshold is needed to maintain clarity throughout the manuscript. On the first introduction of the tipping points, I also feel that a clear distinction should be made so that the reader can more readily determine that different patterns are being assessed.

L237-230: The authors describe bedrock depression storage and soil moisture deficit as the main factors controlling a runoff initiation threshold. How do the environments of the referenced studies compare to that of the area in the current study? Are there common characteristics that make this process-based interpretation transferable to this stud environment?

Figures 6 and 7: I like figures 6 and 7! They were a nice conceptual addition to the

manuscript.

For Section 4.1, controls on threshold behaviors, I found that the author's rationalization of the controls was detailed. With that said, it did read as a mere explanation of different runoff generation mechanisms, and I found there to be a lack of synthesis connecting the experimental observations and analysis results to these more processed-based interpretations. It would be nice if the authors could add some checkpoints in the theoretical explanations to better articulate how their interpretations are supported by their data and how these observations differ from or parallel other studies.

For Section 4.3 point 3. I think that this is an interesting recommendation. Can the authors provide an example of how this could be done? It is a little ambiguous, but I think that this could be a potentially appealing avenue for future work.

Specific Suggestions

Abstract L12: Consider "former hydrologic functioning" rather than "original hydrologic functioning".

Abstract L16: I am confused by "three-linear stormflow threshold behaviors are examined", as graphical representations of threshold behaviors are nonlinear. Also, the following segment refers to "both thresholds", which I also find confusing.

L38-40: This sentence was confusing to me. I interpret these thresholds as emergent patterns or hydrologic signatures that are an integrated representation of processes spanning spatiotemporal scales. If I have correctly interpreted what the authors were aiming for, I do not believe that this is conveyed in their writing.

L40-44: I understand the intent of this sentence, but I found the wording unusual. Consider revising for clarity.

L44-46: Ambiguous wording. I suggest providing a concise definition of the threshold behavior in runoff response being referred to. The Ali et al., 2013 reference provided, offers one such definition.

L46-48: It is unclear to me why threshold is plural in this sentence – I also think that this information can be incorporated into the former sentence where I have suggested clearly defining the author's operational definition of threshold behavior.

L50: “They might indicate…” is vague. Are the authors referring to the different diagnostic shapes or the transition from pre-threshold to post-threshold behavior?

L50: “The runoff behaviors….”. Are the authors referring to the thresholds in the cited literature or in the current study?

L78-L79: I found this hard to follow and after reading it multiple times am not sure about the intended messaging.

L119-L120: Please clarify.

L129: why is *volumetric soil moisture content* italicized?

L129-131: this sentence is unclear/ hard to follow.

L132-134: tense changes from rest of paragraph.

L139-140: please include in-text which method of baseflow-stormflow separation was used.

L193: “non-stationary” rather than “non-stationarity”.

L203-205: I found the first half of this sentence difficult to understand/follow.

L271: “severally” rather than “several”?

L274-277: I am not sure what the authors are saying in this sentence.

L305: “from2011” missing space.

L306: “It triggered…” what are the authors referring to as “it” in this context?

L310: I do not understand the messaging of the Section 4.3 title.

L320: The spatial patchiness of which characteristics?