

Response to Reviewer 1

Thank you for your valuable comments on our manuscript. We truly appreciate the time and effort that you have dedicated to the review process, including the first submission and the revision, and your positive feedback on this work. Please see below, in **blue**, the original review comments, and in **black**, our responses to the comments and how we implemented the changes in the revised version.

Araki and colleagues demonstrate in a very elegant and novel way the underlying controls of catchments by analyzing a large sample dataset for the United States. Their study brings old insights and new ways of analyzing correlations into a very interesting study and results. Since a while people debate about the role of landscape attributes in large sample studies when most of the results show that climate overshadows the earlier in most analysis. The authors have answered each of my points in a very nice way, and after very minor technical corrections (some are actually only suggestions) the paper should be ready for publication.

Thank you very much for positive feedback and providing thorough review.

L14: Should U.S. not be spelled out at the first appearance?

We have spelled out the term in the abstract and at its first appearance in the introduction, with the abbreviation explicitly introduced.

L39: Reference issue

Fixed it.

L56: target general

Thank you, it has been corrected.

L161-163: I believe that this is a typo in the paragraph.

The formatting has been corrected.

L210-217: see above.

The formatting has been corrected.

L310: typing issue.

Gulf coast has been updated to Gulf Coast throughout the manuscript.

Figure 5: In case it is not a big effort, would it be possible by the authors to spell out the signatures names in this figure? Perhaps with some small abbreviation when needed, but trying to keep the name spelled out would facilitate the readers understanding without the need to come back to the tables (e.g., BFI = Baseflow index).

Thank you for your suggestion. We agree and have updated the naming in Figure 5, the signature names in the manuscript, and in the Table.

Figure 6: I make the same suggestion as from the previous figure. Perhaps something like Addor et al. (2017) could be nice? I know the real full names might be long, but something in their style would make the readers happier. This is a suggestion.

Same as above, we have updated the naming in Figure 6, the landscape attribute names in the manuscript, and in the Table.

L400-405: Typo?

The formatting has been corrected.

L595-597: I feel that the paper brings several points as clear novelties. I have the impression that maybe phrasing it with words as “novelty” in terms of what that the paper brought would be worth noting and not a oversell. The authors clearly demonstrated that using more detailed landscape attributes could explain the demonstration of variables other than climate as “dominant” in comparison to climate even when using such a large sample. This builds onto recent findings by other authors such as do Nascimento et al. (2025) (already cited), and in my option brings significant awareness to the LSH community.

Thank you for highlighting the novelty of this study; you phrased it more clearly than we did. We have added the following sentence to the conclusion section: *“The novelty of this study is in demonstrating that incorporating more detailed landscape attribute elucidates non-climate variables as dominant controls on hydrologic processes, even with a large sample across multiple climate regions.”*

Furthermore, we have added the reference to the discussion section as *“This highlights the need and opportunity for development of new landscape attributes that characterize the subsurface, echoing the call by Tarasova et al. (2023) and do Nascimento et al., (2025).”*

Response to Reviewer 2

Thank you for your thoughtful feedback on our manuscript. We sincerely appreciate the time and effort that you have dedicated to the review process, including the first submission and the revision, and your support to this work. Please see below, in **blue**, the original review comments, and in **black**, our responses to the comments and how we implemented the changes in the revised version.

The authors have satisfactorily addressed the majority of points outlined in the first round of revisions. I only have a few minor comments before final publication:

Introduction: I do not think that the sub-sections (1.1 etc) are necessary. Consider deleting. We have removed the subsections in the introduction.

L 38: I think the study of Wu et al., 2021 should at least be mentioned in this paragraph, because that is a continental scale study investigating more than one process.

Thank you for pointing that out. We have added a sentence:

“One of the few studies to holistically investigate storm runoff generation at continental scales (Wu et al., 2021) demonstrates that large-sample analysis aligns with previous conceptual understanding of runoff mechanisms across landscapes (Dunne et al., 1978) while highlighting the roles of precipitation volume and geology.”

L 502-503: Any other reference for this statement?

We thank the reviewer for this comment. However, we believe there may be a confusion in the line numbers referenced. L502-503 correspond to a section heading and its summary statement (“5.2 Informing model selection and evaluation: Our results support hydrological modeling by enabling hydrologists to check whether key processes in a watershed are well represented by a candidate model prior to application,” Lines 402–403 to a figure caption, and Lines 602–603 to the conclusion section.

References:

Wu, S., Zhao, J., Wang, H., & Sivapalan, M. (2021). Regional patterns and physical controls of streamflow generation across the conterminous United States. *Water Resources Research*, 57(6), e2020WR028086.

List of changes made

- Spelled out “U.S” at its first appearance in the abstract and introduction, with the abbreviation explicitly introduced
- Removed subsections (1.1, etc.) from the introduction
- Added a sentence to discuss Wu et al. (2021) to the introduction
- Added a sentence at L38 acknowledging Wu et al. (2021) as a continental-scale study investigating multiple processes
- Fixed a reference issue at L39
- Corrected typo “target general” at L56
- Updated Figure 5 and Table 1 to spell out signature names
- Updated Figure 6 and Table 2 to spell out landscape attribute names
- Updated signature and attribute naming in the manuscript tables accordingly
- Fixed formatting issues at L161–163, L210–217, and L400–405
- Corrected typo “Gulf coast” to “Gulf Coast” throughout the manuscript and in Figure 4
- Added a reference do Nascimento et al. (2025) to a sentence in the Discussion section
- Added a novelty statement to the conclusion: *“The novelty of this study is in demonstrating that incorporating more detailed landscape attributes elucidates non-climate variables as dominant controls on hydrologic processes, even with a large sample across multiple climate regions.”*