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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Hurricane impacts on a pair of coastal forested watersheds: implications of selective hurricane damage to forest structure and streamflow dynamics" *by* A. D. Jayakaran et al.

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This manuscript contains an interesting analysis of a long-term ecohydrological dataset that shows how two watersheds responded to passage of a hurricane quite differently. I enjoyed reading the paper, which performs an excellent synthesis of the literature and decades of data. Findings from this impressive dataset will be of general interest to watershed hydrologists and ecologists and show that hurricanes can affect watersheds quite substantially over longer periods of time than is typically included in monitor-

ing plans. Findings are also of specific interest because they provide insight into the ecohydrological dynamics of southeastern coastal forests, which have not been well studied.

I recommend moderate revisions to the manuscript to address a few main issues. One rough part of the manuscript is the Introduction. It begins by describing shortcomings of paired watershed experiments, followed by a paragraph about how runoff generation is poorly understood, followed by a paragraph about how hurricane effects are poorly understood, with little linkage between these disjointed paragraphs or to the objectives. The paper would be made more compelling and clear to readers with some simple reorganization and rewriting here. Here is what I suggest:

Start with the description of runoff generation: why it is important and how it is poorly understood. Follow that with a description of how runoff generation might be studied with paired watershed experiments. Be sure to define what a paired watershed experiment is and how it might be used to improve our understanding of runoff generation. Then describe the shortcomings of paired watershed experiments, introducing the example of how the response of the two watersheds in Santee illustrates one of those shortcomings–that adjacent watersheds may respond differently to climatic forcing or extreme events. Conclude with a description of how this study improves the state of the science, which should lead nicely into the objectives.

As with the Introduction, the Discussion also seems a bit disjointed with respect to the relationship between the first paragraph (about the limitations of paired watershed analysis) with the rest of the discussion. Either clear statements about how these sections of the discussion are related or use of subheadings would make for a clearer read.

On a related note, one of the concerns I have is that this manuscript falls into the trap of some of the very paired watershed experiments that it criticizes with its inability to distinguish between water losses due to transpiration and evaporation and, I would

add, infiltration to groundwater. The discussion presumes that changes in the relationship between rainfall and runoff can all be attributed to transpiration differences due to changes in tree cover but without any discussion of the other factors in the water balance–evaporation and infiltration. I would imagine that changes in tree cover could have an impact on infiltration to groundwater, and because groundwater watersheds may differ from surface watersheds, the statistical analyses would also reflect changes in infiltration. Though I think the authors' attribution of changes in the regression relationships to changes in transpiration is reasonable, I do think the complete water balance in these watersheds deserves more discussion. I also think the authors are missing an opportunity to show some first-order statistics that would help readers quickly understand the temporal changes and changes between the two watersheds before delving into LOESS and MOSUM. Namely, I would have found plots of the difference between rainfall amounts and runoff over time and for each watershed valuable in trying to understand the basic water balance. Similarly, plots of runoff for each watershed would be helpful in illustrating the "radical changes in runoff flowing Hurricane Hugo" (p. 11534, line 12) and subsequent recovery. In short, I think that through the text and figures, more of a water balance perspective is needed in this manuscript.

I would also encourage the authors to consider including a conceptual figure illustrating the differences between the watershed. I envision that the figure would have two columns (representing WS77 and WS 80) and several rows. A schematic diagram of low-density large trees for WS 80 and high-density skinny trees for WS 77 would be one or the rows. Underneath, characteristics of each of the watersheds during the Pre, Flip, and Flop period would be summarized in a few words (e.g., lower/high flows, biggest difference in flows during the summer (ET), etc.). I drew such a figure for myself as I was perusing the paper in order to more readily grasp the differences between the watersheds and found myself often referring back to it as a guide. To accommodate this and the other extra figure request, I would suggest eliminating either Fig. 7 or 8, or combining them into a two-part figure.

A major concern for me deals with some of the terminology used. To a geomorphologist, "flow reversal" means a literal reversal in the direction of streams. I would advise the authors to be very careful about this terminology, referring instead to a reversal in the relative magnitude of stream flow between the watersheds. Relatedly, the terms "flip," "flop," "catastrophic shift" (in the abstract), and references to discrete, threshold-like changes (as on line 10 of page 11538), all imply a dynamic that I do not believe these watersheds exhibit. The phrase "catastrophic shifts" (unfortunately overused or improperly used in many recent papers) implies the existence of alternate stable states, with sudden changes between them, which these watersheds do not exhibit. I would even argue that these watersheds don't exhibit threshold behavior. Instead, the relative difference in stream flow between the two watersheds undergoes a "reversal" because its sign changes, but the approach to each sign change is gradual and continuous (even across the sign change), due to the gradual regrowth of trees.

Finally, I would recommend combining the Summary and Conclusions for conciseness. I also recommend that in the combined section, the time required for these watersheds to return to their prior conditions after the hurricane should be stated explicitly. This is something that would be of interest to many readers.

Minor comments: 1. In a few places in the manuscript (e.g., line 20, p. 11534), changes in runoff for the watersheds are referred to in uncertain terms (e.g., "suggests a net decrease in runoff). But aren't these analyses based on actual runoff data? Refer to the actual data in more certain terms wherever possible.

2. Second paragraph of Discussion: This paragraph is long difficult to wade through and would benefit from revision. I think what it is trying to say is that pine grew faster in WS 77 than in WS 80, causing runoff to return to normal sooner than in WS 80. The paragraph needs to be more clear and probably shorter.

3. Summary: Please check the dates of transition and revise accordingly. In the first paragraph, 1993, 1992, and 1990 are all invoked as being the year of transition.

4. Line 8, p. 11537: Three methods of flow analysis? LOESS, MOSUM, and what was the third? Maybe I missed something, but I don't believe any results were presented for a third method of flow analysis.

5. Figure 5: Why not show actual dates on the x-axis? Having the non-rescaled years on the axis would be much more useful in trying to relate the figure to the text.

Editorial comments: 1. Line 8, p. 11522: add "is from" after "knowledge."

2. Line 3,p. 11532: take out the second "counts."

3. Suggested change for line 5, p. 11532: "The differences in mean count were significant, with trees counted by aerial photography (6.74 trees per plot) fewer in number than those counted by inventory (7.60 trees per plot)."

4. Line 20, p.11534: Sentence beginning with "Interestingly" should be rewritten. Try "Interestingly, WS77 showed more regeneration of pine seedlings during this period, suggesting that it would have experienced a neat decrease of runoff."

5. Line 8, p. 11537: Take out "or decrease in WS77" for conciseness.

6. Figure 3 caption: capitalize LOESS.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 10, 11519, 2013.