Interactive comment on "Reviews and syntheses: On the roles trees play in building and plumbing the Critical Zone" *by* Susan L. Brantley et al.

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Response to "Reviews and syntheses: On the roles trees play in building and plumbing the Critical Zone" We appreciate the insightful questions and comments we received on our paper, "Reviews and syntheses: On the roles trees play in building and plumbing the Critical Zone" from L. L. Taylor, P. Zion Klos, and an anonymous reviewer. We would like to revise our paper to take into account the points that were made. In doing this we will seek to even out some of the treatments among the hypotheses. The reviewers made many small points and posed many small but pertinent questions that we can address throughout (about slope angle, dust properties, citations, etc.). On the other hand, many of the questions mentioned by the reviewers already show how our hypotheses are stimulating questions for future work (questions about biogeochemical impacts, hydraulic redistribution, and others). Below, we discuss the reviewers' more

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general comments that we have binned into categories.

First, we welcome the insights from several of the reviewers about the title of our paper. Perhaps this would be a better title: "Reviews and syntheses: On the roles tree roots and mycorrhizal fungi play in building and plumbing the Critical Zone". We still argue that we need both "building and plumbing" because we want to emphasize that the growth of weathered material and soil from bedrock and the functioning of this part of the Critical Zone is very much affected by trees in terms of both physical (building) and chemical (plumbing) processes. Of course, "building and plumbing" are metaphors for processes that are not mutually exclusive – nor do they emphasize the many biological parts of the processes – but we think the words give the reader the sense of the paper in a short and succinct title. Our paper is meant to focus attention on the need to develop conceptual and numerical models that yield better understanding of how trees impact the architecture of the Critical Zone.

Second, we received many comments about Figure 2 and about the nomenclature for mobile soil, weathered immobile material, and fresh bedrock. Although it is not our intent to argue too much about nomenclature, we now realize we need to go through the manuscript carefully and reduce ambiguity by using only the three defined names for layers throughout. In choosing these three names we were trying to solve the problem (at least in this paper) of different definitions among different disciplines, among different countries, and even among different parts of individual countries. Obviously this part of the Critical Zone represents a gradient from ambient conditions at the land surface to deeper-earth conditions at depth, and gradients cannot always be sub-divided easily into layers. We also see that we need to make some changes in Figures 2 and 3 as suggested by the reviewers with respect to these naming conventions and concepts.

Third, the reviewers ask for more synthesis. We agree that we need to do a better job in the Conclusions wrapping together some of the implications that cross-cut the hypotheses. For example, we propose to emphasize the relationship of roots with preferential flow (tying together H1 and H9) and elucidate the inter-relationship of dissolution and

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cracking (tying together H1 and H2). Furthermore, we agree with Taylor that lack of discussion of macropores is a major oversight. Such a discussion would fit in very well with H9 where we could discuss the idea of vertical and horizontal macropores and how these features inter-connect – and how they can be influenced by tree roots. Likewise, we feel that the importance of stress corrosion cracking – the phenomenon where corrosive fluids hasten the propagation of cracks in rocks – has been under-emphasized in the Critical Zone literature and could be amplified in the current paper, as requested. Addressing such topics in the conclusion will be used to synthesize the hypotheses.

Fourth, one reviewer asked for a re-phrasing of our hypotheses as questions. We resist that idea because we would lose clarity and because questions tend to multiply so quickly, while hypotheses are difficult to phrase (so they do not proliferate so easily) and are also instructive to test. On the other hand, testable hypotheses do demand experiments, as discussed below.

The one last overarching request by the reviewers is a roadmap for the future. We originally wrote a section with a summary of some proposed experiments. But such a set of experimental strategies is not that easy to design when communicating across disciplines and when problems remain undefined. Ultimately, the section on proposed experiments that we wrote felt like an add-on to us: we felt that the real meat of our work had been accomplished by defining the questions.

Thus, we decided that it might be beyond the scope of this paper to put together an experimental roadmap: the paper is already long, and the roadmap is not clear. We think, however, that the reviewer may have pointed a way forward for both synthesis and roadmapping: several of the hypotheses can be tested by experiment (H1, H2), others can be tested by identifying samples or mapping across space and time or by modelling (H3, H4, H5, H6), while others may require careful comparisons among techniques of water extraction (H6, H7) or use of tracers (H7, H8, H9). Perhaps a discussion along those lines would be an appropriate way to not only point to the future

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but also tie the paper together. This is the response we propose. However, if the editor requests a section with experiments (and a longer paper), we are also happy to outline the specific CZ experiments we had originally discussed in an earlier, longer draft of this manuscript. We are happy to proceed on either approach after guidance from the editor.