

## ***Interactive comment on “Spaceborne potential for examining taiga-tundra ecotone form and vulnerability” by P. M. Montesano***

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Responses to RC3

Comment 1. In the second line of the Abstract (line 13), the authors use the term “asynchronous” to describe the fact that changes in vegetation structure can be site-dependent, as well as circumpolar. I don’t think that “asynchronous” is the best term to describe this phenomenon.

Response: We will remove this term from the abstract.

Comment 2. As the paper transitions from Introduction to Methods, the authors should state the objectives of the study much more clearly than they do. In the final paragraph of the Introduction, there is a “long-term goal,” but that seems to be a goal for the

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scientific community, not necessarily for this study. Then there is a “short-term goal,” which is to examine the uncertainty of mapped forest patch heights and to discuss the implications of this uncertainty. However, I think what the study actually does is more explicit than this short-term goal, i.e. maps forest patch distribution and develops remote sensing approaches to more accurately determine the heights of these patches – it does also address the uncertainty of these estimates.

Response: We agree that the objectives can be stated more clearly. We will clarify the specific objectives of this paper, and explain how they fit with longer term scientific objectives for examining forest structure change in the TTE.

Comment 3. “Non-forest” areas with mean roughness > 3 and mean NDVI < 0.25 were classified as forests. The authors may want to clarify what these forests actually look like. NDVI values of < 0.25 are very likely not indicative of forest vegetation. However, I can imagine that at the TTE, if the forest density was somewhat low within moderate resolution pixels, then it could be a patchy, low density forest with NDVI < 0.25. But, it might be a good idea to clarify this. I’m assuming this is not a mistake in the text.

Response: We agree that clarification is needed, and that the description as it exists now is confusing. Due to the iterative nature of the classification, initial classification steps provide temporary classes that are refined with subsequent classification steps. Please see Comment #2/Response to Reviewer #1 and Comment #6/Response to Reviewer #4.

Comment 4. It wasn’t completely clear to me, but only patches > 0.5 ha had height estimates, yes? And, 90% of these were made using the indirect method, yes?

Response: Correct, the minimum mapping unit (patch size) was set at > 0.5 ha. and 90% of these patches featured height estimates that were derived indirectly. We can adjust our wording of this.

Comment 5. Probably my biggest concern with this paper is the inferences that are

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made with regard to monitoring of forest patch heights. One instance is the first line in the Discussion, but it occurs throughout the Discussion. The authors state that monitoring of forest structure (in this case patch height) “will help quantify the potential for changes in forest structure and. . . broader TTE dynamics,” and “provide insight into the vulnerability to climate warming of current TTE structure.” In my opinion, the leap from knowing the distribution of forest patch heights to assessing vulnerability to climate warming is a big one – it would be nice if the authors provided some further discussion of this inference.

Response: The Reviewer expresses concern with portions of the Discussion where inferences are made with respect to the monitoring of forest patch height. This concern may arise from some wording we use to describe the link between forest structure patterns and vulnerability to structural changes. We note the Reviewer’s concern, and plan to modify the first paragraph of the Discussion to reflect the following: Recent literature suggests that TTE form, or pattern, may reflect which portions of the TTE are controlled primarily by temperature. With remote sensing, TTE forms/patterns can be identified by characterizing the horizontal and vertical structure of trees. By identifying these forms, TTE controls may be inferred. The ability to characterize horizontal and vertical structure is a precursor to both (1) distinguishing one TTE form/pattern from another, and (2) identifying areas where TTE form/pattern suggests tree growth is temperature limited. The intersection of such temperature limited TTE form/pattern with regional warming trends may point to areas where TTE structure is vulnerable to changes in structure. Our work demonstrates the potential from spaceborne remote sensing for depicting a key structural characteristic of TTE form (height), and suggests where improvements are needed in order to identify portions of the TTE vulnerable to warming-induced structural changes. Also, see Comment #1/Response to Reviewer #4.

Comment 6. On line 458, the authors state that “tree density is addressed with the delineation of forest patches.” Tree density is addressed only coarsely, if at all. I don’t think

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that there is any within-patch information on tree density here, unless I am mistaken – maybe from the LiDAR data? Similarly (line 461), how is stem density quantified?

Response: The Reviewer points out that tree/stem density is addressed in a coarse manner, and asks how stem density is quantified. We agree with the Reviewer that stem density is coarsely addressed. However, we indicate that we use image roughness/texture as a general proxy for horizontal vegetation structure, which includes tree/stem density. Image texture measures have been used to examine horizontal forest structure (e.g., Wood et al. 2012; <http://www.sciencedirect.com/science/article/pii/S0034425712000156>, Wood et al. 2013; <http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0063211>)

Comment 7. Lines 489-490 – Why does the current reported patch-level forest height uncertainty preclude an understanding of the most vulnerable portions of the TTE? Do we have any idea what are the most vulnerable portions of the TTE?

Response: The Reviewer identifies an insufficient explanation as a source of confusion regarding the link between patch height uncertainty and the identification of temperature-limited portions of the TTE. It would be helpful if we more clearly define our terms. Please see Comment #1/Response to Reviewer #4.

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