

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

### **Anonymous Referee #3**

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This paper describes an analysis of the structure of the taiga-tundra ecotone (TTE) in north-central Siberia, using a combination of high resolution spaceborne imagery (HRSI), moderate resolution remote sensing, and spaceborne LiDAR. Their methodology includes a delineation of forest patch boundaries, in addition to both a direct estimate of forest patch heights, as well as an indirect modeling of forest patch heights. This approach has the capability of reducing the uncertainties involved with mapping the spatial structure of the TTE, for potential improvement of the land surface structure within earth system models. Generally, I found this paper to be quite good, and a nice contribution to the biogeosciences literature, specifically with regard to high latitude vegetation dynamics. Specific comments regarding scientific, methodological, and clarity issues: 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

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site-dependent, as well as circumpolar. I don't think that "asynchronous" is the best term to describe this phenomenon. 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 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. 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. 4) It wasn't completely clear to me, but only patches  $> 0.5$  ha had height estimates, yes? And,  $\sim 90\%$  of these were made using the indirect method, yes? 5) Probably my biggest concern with this paper is the inferences that are 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. 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 that there is any within-patch information on tree density here, unless I am mistaken – maybe from the LiDAR data?

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Similarly (line 461), how is stem density quantified? 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? 8) Lines 493-494 – Related to #5 above, how do these “general patterns of forest structure” suggest vulnerability and potential for changes? Again, the connection between the information provided in this study and the bigger picture of vegetation change and vulnerability is not well substantiated. Same for lines 525-526. Technical corrections: 1) Line 15 – “is” should be “are” 2) Line 45 – space between “2012” and “and” 3) Line 63 – add “forest” after “boreal” 4) Line 85 – remove “s” from “resolves” 5) Line 100 – space between “scales” and “(Montesano” 6) Line 111 – remove “issues” 7) Line 145 – space between “isotherm” and “(Osawa” 8) Line 252 – move “both” after “specifying” 9) Line 317 – change “is” to “are” 10) Line 361 – remove “the” before “its modeling” 11) Line 393 – remove “s” from “features” 12) Line 394 – remove space between “present” and the period 13) Line 404 – remove “less than” 14) Line 507 – remove extra spaces between “estimates” and “provide” 15) Line 525 – remove “s” from “suggests”

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