Response to reviewers:

Dear reviewers,

thank you for your comments. We decided to follow the reviewers' suggestion and remove from the present paper the PPA analysis and ecological results. The pattern-process relationships will be furtherly and more accurately investigated in a separate paper. All your suggestions will be used as a valuable asset for that. Please see below the response to all your comments.

Response to Reviewer #1

1. To justify size classes thresholds, we implemented L242-243.

   We removed the facilitation and competition context from the paper. The facilitation-competition context was not removed from the introduction section since our analysis still aims to be devoted to developing a model useful for ecological purposes. Since we did not delve too deep into the ecological analysis, we agreed to remove that part, yet the aim is that mentioned above. The conclusion section was modified accordingly.

2. Small tree detection is more cumbersome than larger trees. Yet, a high amount of small trees were detected reaching percentages above 70% in some of the study sites. As a consequence, we can conclude that small trees can be, and are, correctly detected in our study. With the L381-384 (now L343-350) we are highlighting and discussing potential reasons (and limitations of the methodology) for the low detection rates of small trees in some sites. In addition to being mentioned in this section, the same limitations are mentioned again in section 4.3 in which alternative venues and methodologies to overcome such issues are provided along with their potentials and limits. We rephrased L343-350 so that the concept is clearer to the reader and added L350-354 for further clarification and transparency.

3. See comment above: any reference to facilitation and competition relationships was removed.
   We also removed any conclusion on the facilitation/competition context. Any ecological relationship between the two size classes is no longer mentioned or discussed.
   As suggested, we removed the system-specific case study.

4. The sentence was modified as suggested by the reviewer and reproposed in section 4.3 among the potentialities of the presented approach. We deem the statement

important because it is what makes the paper a novelty. From a RS perspective, this is the first study to investigate treeline ecotones over large surfaces at such spatial extents. Being this the main novelty and contribution of the paper, we would like to keep the sentence.

5. The off-the-shelf model comes with default settings. As specified in L179"iv) hyperparameters tuning and model calibration" various combinations of the model's hyperparameters were changed and tested in order to calibrate the model and obtain the final detection and delineation results provided in the paper. The two validation methods are already described separately and treated separately. Please see L180-181 *"separate validation and evaluation of model transferability through spatial cross-validation."* Please also see, L198-201 "*The model trained in this way was used to perform predictions on the rest of the tiles to generate tree maps."* We specify that the model used to perform predictions was the one trained on 5% of the dataset. Separately (as also shown in Figure 2) we tested the potential of the model transferability on never seen sites.

Follow-up comments:
1. Implemented in L161
2. As suggested by the reviewer all the suggested questions, processes and dynamics will be investigated and answered in a separate paper focusing on ecological analyses.
3. See comment above.
4. See comment above.

Final copyedits:
1. Modified
2. Modified
3. Modified

Response to Reviewer #2

General comments:

Thank you for your comment. Please see *"Response to reviewers"* as it answers to the revision proposals and questions asked in your general comment.

Detailed comments:

Pdf file with yellow markings was not provided as an attached document.

L11-16: rephrased

L51: modified, and checked for consistency throughout the paper

L51: removed

L56-57: heterogeneity is not a problem for studying pattern-process relationship. The sentence aimed at highlighting the importance of conducting studies at multiple sites with large extents. The sentence was modified; we hope the sentence meaning is clearer now.

L61-62: To sentence aims at emphasizing that the combination of ground and RS techniques has potential as a solution to tackle the issue of spatial variability of processes and dynamics over the ecotones and better grasp the feature-process relationship. A combination of UAV and field surveys provides a clearer and more complete view of the ecotone. The sentence was modified and moved to L75-77 after delving into the ground-based and RS-based studies features.

L95: removed

L95-102: hypothesis and expectations formulation changed.

L109-110: corrected

L113: changed to annual ranges of air temperature. Table 1 was modified accordingly.

L130: modified

L142-145: modified for clarity.

L148: modified

L155-157: we understand that the sentence as it was phrased before could be the source of the misunderstanding "A Structure-from-Motion procedure was employed to generate 3D point clouds, from which we derived digital terrain models (DTMs), digital surface models (DSMs), and orthomosaics with 5-cm spatial resolution." The sentence aimed at highlighting all the output that were produced using the Structure-from-Motion procedure, but the DTM is produced in a second step as mentioned afterwards in the same paragraph "the classification of ground and non-ground points in the point clouds was based on a threshold of 10 cm height: points lower than 10 cm were considered ground and used to produce the DTM". We rephrased for clarity.

L163: added

L187: modified to "validation polygons" and checked for consistency throughout the paper.

L188: The Segment Anything software is simply a software that helps the user delineating objects on images, but the software requires the constant input of the user. The software does not perform any kind of image recognition or completely automatic delineation. The user is fully responsible of the visual interpretation of the image and the "manual" delineation of the objects (tree crowns). The software only helps in creating the contours of the object that the user is interested in. From this the term "semi-automatically delineated" (L190) because it is a manual delineation by visual interpretation but with the assistance of a software which helps to speed up the process. Please use this link for further information on how the software works: https://github.com/facebookresearch/segment-anything

L201: the term "from start" was meant to highlight that the entire training and validation processes of the model were repeated (using the procedure explained in the following sentences). This was meant to highlight that the transferability of the protocol was not tested using the already trained model but using instead a complete new one which had yet not seen any image. We removed the term since it created a misunderstanding.

L250 & Figure 4. PPA was removed

L287 see "Response to reviewers"

L278 modified

L304 modified

Figure 4 was always present in the paper

Figure 5: removed along with sections regarding PPA

L336 & L346: see comment above

L340: see comment above

L354: see comment above

L351: modified

L352 modified. This section is discussing data quality as a result of different flight parameters, environmental features, aerial images quality etc. AI capabilities in single-tree delineation task strongly depends also on those variables (because essentially, independently from how good an AI is in delineating objects, it works on images whose quality/ heterogeneity (heterogeneity is important beacuse the higher it is the more complex it is for the AI to identify a pattern in the images that is linked to the object that has to be segmented) is important and impact its performances). As a consequence, the two things are intertwined and cannot be completely separated so it is normal that in certain parts the two get mixed.

L383: changed

L442: section removed

L402: main novelty and potentialities of the approach are now reported at L403-410

L426-427 :modified