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Interactive comment on "Forest aboveground biomass stock and resilience in a tropical landscape of Thailand" *by* Nidhi Jha et al.

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Dear Reviewer,

Thank you for the careful and attentive assessment of our manuscript. We are very pleased with the positive and constructive comments provided for our work. Please find below our point-by-point response to your comments. The changes marked in the revised manuscript are given within quotation marks after response.

On behalf of the authors, Nidhi Jha

Reviewer #1: This is a robust and well-written study that combines field measurements, multitemporal satellite imagery, and airborne laser scanning data at the landscape scale to estimate rates of biomass accumulation in naturally regenerating forest

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vegetation in Khao Yai National Park in central Thailand. As such high-quality information is lacking from most regions of Asia, this study will be a landmark case and illustrates how combinations of different data sources can be used to track changes in landscape-scale biomass accumulation and carbon storage in the absence of long-term monitoring data from forest sites. I applaud the authors on a job well done.

Response: Thank you.

Reviewer #1, C1: One shortcoming of their model is that very few field sites had low ABG values, so the model may not be as accurate at predicting AGB at low levels.

Response: We agree with the reviewer that we do have a limited number of field plots in low-biomass areas. That said, we do not believe that this constitutes a major problem as model uncertainty is expected to be higher for large biomass values than for small biomass values (Zolkos et al. 2013, Remote Sensing of Environment), as suggested by Fig. 2 of our manuscript. Thus, getting a higher representativity of large AGB values in the model is recommended to minimize model calibration errors. However, we followed the recommendation of Reviewers 1 and 2 and added the following sentence in section 4.1 in the revised manuscript.

“Due to a limited number of field plots in low-biomass areas we were, however, unable to test whether predicting errors vary with AGB or not.”

Reviewer #1, C2: With the data that they have, the authors estimated the distribution of AGB values across the landscape. These data were used to estimate mean landscape-scale AGB (and carbon density) for 2017. With the information on changing states of pixels from non-forest to forest (or from forest to non-forest), it should be possible to estimate how the distribution, mean, and total AGB within the landscape changed from the mid-1970s to the present day. This would be fascinating to do (if not in this paper, then in another one).

Response: We agree that tracking the AGB distribution over time would be extremely

informative and would provide important insights on the carbon balance of the landscape. However, we here face one important limit of our approach that prevent us to assess the landscape scale carbon balance over the study period. Our approach only allows to assess the AGB dynamics of pixels that experienced a single shift from non-forest to forest during the study period. Although this approach generates much more data than usually available through field-based approaches (n=550 in our case), these pixels only represent 4% of the landscape and are thus not representative of the whole landscape carbon dynamics. In ongoing work, we are adopting another approach where we use field estimates of carbon dynamics and extrapolate them through a LiDAR-based forest successional map to estimate the carbon balance of the landscape. Thus, this objective will be rather achieved in another upcoming paper.

Additional comments: Reviewer #1, C3: Line 36-38: this statement does not describe what Chazdon et al. 2016 concluded. They found that 40 yr of carbon storage in regenerating forests of lowland regions of Latin American tropics alone offset the past 19 years of carbon emissions from fossil fuel burning and industrial sources from all of Latin America (not total carbon emissions).

Response: We agree with the comment and thank the reviewer for pointing this mistake. We rephrased this statement in the revised manuscript as follows:

"A previous study estimated that 40 years of carbon storage in regenerating tropical forests from Latin America offset the past 19 years of carbon emissions from fossil fuels and industrial production at the scale of Latin America (Chazdon et al., 2016)."

Reviewer #1, C4: Line 102: what is the age and prior land use of this secondary forest?

Response: This area is a regenerating successional forest resulting from farming activities (mostly rice cultivation) that stopped in the 1960s. Our analyses suggest that these areas shifted from a non-forest to a forest status in 1975 (see SES4 and SES5 in Fig. S4 of the original manuscript, now Fig S5 in the revised manuscript).

Reviewer #1,C5: Line 112: were there any stands in the understory initiation phase? Some details from Chanthorn et al. 2017 should be included here

Response: None of the plots are in the understory re-initiation stage. To make it clear we added the following information in the revised manuscript after L112 of the original manuscript.

"The classification is based on the framework of Oliver and Larson (1996) who studied successional gradients in temperate forests. Although the original framework considered four successional stages, we did not find any area corresponding to the understory re-initiation stage in the study landscape. Most second-growth forests have regenerated since the Park was established about 40-50 years ago so that older second-growth forests, where understory re-initiation occurs, is very rare in this area. In our study, the SES stage is represented by the forest of upto 35-40 years, while other SES areas in the landscape may typically range upto 55 years (since 1962), as suggested by some hand-drawn historic maps (Smitinand, 1968; Cumberlege & Cumberlege, 1964). On the other hand, OGS forest stands mostly correspond to forests with no obvious sign of human disturbance during the last 100 years (Brockelman, 2011)."

Reviewer #1,C6: Line 155: but only those > 5 cm dbh, right?

Response: Yes, correct. For sake of clarity we modified the sentence in the revised manuscript as follows: "AGB at the plot level was then estimated in Mg ha-1 by summing individual tree AGB for all trees with dbh $\geq$ 5cm belonging to the plot."

Reviewer #1,C7: Line 241: I would take out the word "probably" Why wouldn't it? How has the carbon storage in the landscape changed over time? That would be great to show, not just for 2017 (would just need to assess these changes for the 17% of pixels that showed changes and keep the same AGB figures for the remaining 83% of the pixels). This projection would be nice to include in the final version of the manuscript.

Response: Please, see our response to comment C2. Keeping the same AGB values

for the 83% pixels would lead to a strong underestimation of the carbon sink in this landscape, as revealed by our ongoing work. We, however, removed the word probably in the Line 241 and add the following sentence in section 3.2 in the revised manuscript:

“Focusing on the 17% pixels that experienced at least one shift from non-forest to the forest since 1972, we thus estimate that the study area has stored a minimum AGB of 455 Gg, equivalent to 214 GgC during the study period.”.

Reviewer #1,C8: Line 270: The Poorter et al. 2016 study is based on trees > 10 cm DBH. This may explain some of the discrepancy. Can you evaluate the contribution of trees 5-10 cm DBH in the total stand ABG? May be useful for comparing results with other datasets from other regions.

Response: Thank you for pointing this issue. According to our field data, the contribution of trees 5-10cm dbh to the total stand AGB ranges from 1% to 39% (average of 4.5%) and tend to decrease with successional stage. Thus, we indeed cannot exclude that part of the difference is due to the inclusion of trees of 5 to 10 cm in dbh. We have added the following sentence in revised manuscript to acknowledge this.

“After 20 years of recovery, our model predicts an AGB accumulation of 143 Mg ha−1, an estimate slightly higher than the one predicted by Poorter et al., (2016a) in Neotropical secondary forests (122 Mg ha−1). However, this difference can partly be explained by the inclusion of trees between 5 and 10 cm dbh in our study, contrary to Poorter et al. (2016)’s study.”

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