Biogeosciences

Discussions

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Interactive comment on "Canopy Area of Large Trees Explains Aboveground Biomass Variations across Nine Neotropical Forest Landscapes" *by* Victoria Meyer et al.

Victoria Meyer et al.

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Response to General comments :

Thank you for reviewing our manuscript. We greatly appreciate your comments and did our best to address the issues you brought up. Your comments highlighted the fact that our methodology was not clearly stated. The LCA model was calibrated using inventory data from the four sites referred to as "calibration sites" in the manuscript. Based on both reviews of the paper, we decided to remove Figure 5b and moved the paragraph explaining how AGBLidar (renamed AGBLocal for clarity) was calculated to the Supplementary Information (S.2), to make the paper more straight forward and

focused on LCA. AGBLocal values are now just used as a test for validation of our height threshold in Figure 3. We also added sections comparing the LCA model to a similar model based on MCH calibrated from the same 4 sites, as suggested by both reviewers.

Please note that all references to changes in manuscript correspond to the line numbers of the revised manuscript with track changes. We believe that these changes and the ones described below improved the clarity of our paper.

Comment : "In the methods section, it is unclear whether they are predicting AGB_Lidar and AGB_LCA from an equation that already exists or whether they are doing a regression analysis to find values for parameters 'a' and 'b' in Eqs. 1-3. If it's the former, show the actual values for 'a' and 'b'."

Response: The form of Equation 1 (now Equation S4) is a commonly used model form to estimate AGB from Lidar locally (see Asner and Mascaro, 2014). For each site (or group of sites for Manaus, Tapajos and Cotiguaçu), we performed a regression based on that form and obtained coefficients a and b, presented in Table S1 (SI, ls.50-51:"All coefficients are presented in Table S1"). We decided to move this section to the Supplementary Information, as it is not central to the paper and is just used to obtain Figure 3a in this new version of the paper. Coefficients a and b for Equation 2) and 3) (now Eq 1 and 2) are presented in Table 3. We added a sentence that makes a clear reference to the coefficients in that table. Also, we moved the section presenting the form of the LCA models from the Methods to the Results section, for clarity (ls.358-364). Changes to manuscript: ls.334-335 "The coefficients of the models, as well as their respective coefficients of correlation, RMSE and bias from all training data and cross-validation are reported in Table 3."

Comment: "Either way, it doesn't seem necessary to predict AGB from MCH other than to compare AGB estimates from LCA to those from MCH (eg, show improvement in new method)."

Response: Based on both reviewers' comments, we removed the part of the analysis that compared AGBLCA to the locally estimated AGBLidar. As a result, Figure 5b was removed. Instead, we are now comparing AGB estimations from LCA and MCH based on the same methodology: in both cases, models were fitted using the field AGBinv of the four calibration plots. This is presented in the Methods (ls.218-240), in the Results (ls. 345-379) and in the Discussion (ls.563-569). Changes to manuscript: see ls. 218-240, ls. 345-379 and ls. 563-569. Figure 5 (attached here as Fig. 1).

Comment: "In section 2.3 the authors say they have only 4 calibration sites (instead of 9 in the abstract)."

Response: We realize that the abstract was misleading. We added a sentence stating that the model was calibrated using 4 sites. Changes to manuscript: ls.45-46: "...and ground inventory data in nine undisturbed old growth Neotropical forests, of which four had plots large enough (1ha) to calibrate our model."

Comment: "So, is AGB in the other five sites predicted by Eq 1 (MCH)?"

Response: AGBLCA in the other sites was estimated using the same LCA model calibrated from the 4 calibration sites (Eq 2). AGBMCH was calculated using the MCH model presented in Table S3.

Comment: "I suggest the authors remove AGB_Lidar estimates and focus on relating LCA metrics to AGB determined from ground inventories."

Response: Thank you for your suggestion. We removed figure 5b and removed the paragraphs related to AGBLidar in Section 2.2. The information on AGBLidar (renamed as AGBLocal) are now provided in the Supplementary Information (S.2). AGBLocal is now only used to provide additional information on the choice of the height threshold in Figure 3. (nb: equation numbers have changed). We edited the text to emphasize the role of the calibration plots and show that AGBLocal was just used as an additional/confirmation step. Changes to manuscript: ls.200-206: "We determined the

optimal minimum canopy height threshold calculating the coefficient of correlation between AGBinv and LCA at the four calibration sites. (...).. We also estimated AGB from Lidar data locally (AGBLocal) using a commonly used model fit relating MCH to AGBinv in each site, to further examine the variations of LCA and AGB in all nine sites (see S.2, Table S1)."

Comment: "Furthermore, I suggest trying to optimize AGB estimates from LiDAR by, for example, estimating AGB with both LCA and MCH."

Response: We tested different model forms for Equation 2 and 3 (now Equations 1 and 2), including models using both LCA and MCH as predictors. Using MCH in addition to LCA did not improve the performance of the model. This is stated in the sentence ls.234-237 "We tested different models to infer AGBinv from LCA, henceforth called AGBLCA, at the four calibration sites, and explored if adding more parameters, such as mean wood density of a site, mean wood density of large trees (DBH $\geq$50 cm), mean canopy height or top percentiles of canopy height improved the predicting power of the moded." We added: Changes to manuscript: ls.311-331"Adding more parameters did not improve the performance of the model, except when using WD as a normalizing factor. The two models we retained are therefore of the form of Eq. (1) and Eq. (2)"

Responses to specific comments:

Comment: How is the LCA method weighted by WD if there isn't ground data at 5 sites?

Response: Ground data are available in all sites except Cotriguaçu, but plot size was too small to be used in the LCA model calibration process. Howewer, wood density estimation does not depend on plot size, and wood density information was used from all sites to obtain a site-averaged wood density (see Table 1). A sentence was added to highlight this point: Changes to manuscript: ls.138-145: "For this reason, all plots smaller than 1 ha were excluded from the LCA analysis but were used in estimating average wood density for each site, which does not depend on plot size. Stand averaged

wood density was calculated based on the wood density of all trees present in a site, determined using the commonly used global wood density database, and is reported in Table 1 (Chave et al., 2009; Zanne et al., 2009). For Cotriguaçu, we used stand averaged wood density given by Fearnside, (1997) for a region covering the site."

Comment: Line104: what do you mean by 'unique'?

Response: by "unique", we mean one model that would work across sites in the Neotropics. Changes to manuscript: l.112: We modified the sentence accordingly to "single".

Comment: Line 166: What model? Line 167: what data?

Response: The text was edited to clarify this sentence. Changes to manuscript: SI, ls.55-58 "For the remaining sites of the Central Amazon (Cotriguaçu, Manaus and Tapajós), we developed a model based on existing data in Manaus and Tapajós from a previous study, derived from airborne and spaceborne Lidar (see Lefsky et al., 2007)." Note that this section is now part of the Supplementary Information, as explained above.

Comment: Lines 203-4: This indicates that AGB_LCA is being tested against AGB_Lidar, where LiDAR is being treated as the reference. AGB_Lidar is only an estimate.

Response: This is correct. The goal here was to test AGBLCA against locally derived AGBLidar. Based on both reviewers' comments, we realized that this step was not necessary and was removed from the paper. Changes to manuscript: Figure 5b and any text related to this graph were removed from the paper.

Comment: Lines 205-6: Here you say that these results were compared to 'a traditional model relying on MCH to estimate AGB'. Isn't AGB_Lidar the model relying on MCH to estimate AGB?

Response: Thank you for highlighting this point. Here, we refer to a single model

based on MCH from all the calibration sites, the same way that the LCA model was calibrated. This way, we can compare the LCA model to a MCH model. We realize that this sentence is confusing and edited the manuscript to clarify it: as stated above, AGBLidar is now only used to obtain Figure 3b and is no longer compared to AGBLCA. Instead, we added a new section in the methods, results and discussions comparing AGBLCA and AGBMCH (based on a model calibrated on the same 4 calibration sites). Please report to our response to earlier comment.

Comment: Section 2.5: Is it possible to apply the same methods to logged areas, since you may not know which areas have been harvested or not – or have before and after pictures?

Response: We agree that we need before-after data to detect logging. In the example we are showing, we do have before and after logging lidar data. Details are provided in Anderson et al., 2014. We added a sentence to emphasize on the need for this type of datasets. Changes to manuscript: ls.246-247: "provided that lidar data are available from pre and post-logging.".

Comment: Line 269: Where did wood volume data come from?

Response :we edited the manuscript to clarify this point: Changes to manuscript: ls.307-309: "Since AGB depends on DBH, H and WD (see Chave et al., 2014), average wood volume can be computed approximately as the ratio of AGB divided by the average wood density".

Comment: Lines 315-6: In what way does Antimary not represent Peruvian Amazon and Amazon-Andes gradients?

Response: We added the following sentence to be more specific : Changes to manuscript: ls.418-421: "However, this site does not represent forests in the western Amazon or the Amazon-Andes gradients with relatively lower wood density (Baker et al. 2004) and more fertile volcanic soils impacting the forest structure and dynamics

(Quesada et al., 2011)."

Comment: Line 323: by how much does it explain the variation?

Response: Overall 78% is explained (R2=0.78). Changes to manuscript: l.428: "and explained 78% of the variation".

Comment: Section 4.3: Would be helpful to refer to tables and figures

Response: Thank you for the suggestion. We added references to table 2 and figure 3. Changes to manuscript: references l.465 and l.468.

Comment: Lines 344-6: This sentence is unclear to me, but it sounds like it supports my point that using AGB_Lidar as a reference is circular and not proving anything

Response: This sentence was not clear and was removed from the manuscript. More-over, we are now comparing AGB from LCA and MCH in a separate section of the results and discussion to avoid any confusion.

Comment: Line 374: Change 'only' to 'primarily' or something similar.

Response: "only" was removed.

Comment: Line 391: Change 'Any' to 'Most'

Response: We changed "'Any' to 'Most'.

Comment: Lines 423-5: Maybe the relationship is not linear at the high end of LCA

Response: It is indeed a possibility. We added this suggestion to the manuscript. Changes to manuscript: ls. 589-591: "It is also possible that the relationship between AGB and LCA is not linear for very high AGB values. This could be tested in the future with a larger number of sites with very high biomass."

Comment: Line 467: If the relationship remains unique across forest types, is it not then broadly applicable?

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Response: Yes, this is an important point of the paper. We added two sentences highlighting this fact. Changes to manuscript: - in the Discussion: ls.538-539: "Our model can therefore potentially be applied to a wide range of forest types, provided that there is information about wood density of the study area in the literature." - in the Conclusion: ls.640-641: ". This linear relationship remains unique across different forest types, making the LCA model broadly applicable."

Comment: Fig 3: Clever way to find the optimal H threshold

Response: Thank you for this positive comment.

Comment: Fig 4b: This doesn't look like a perfectly fit.

Response: With a R2 of 0.78, RMSE of 46 and no bias, we consider the fit to be good. These number are provided in Table 3. R2 was added to Figure 4b to emphasize this point. Changes to manuscript: R2 was added to Figure 4b to emphasize this point.

Comment: Fig 5b: All calibration sites are above the 1:1 line. Why are Nouragues and Choco below the line?

Response: Based on your comments and that of Reviewer 2, we removed this figure. The fact that some plots were above/below the line was likely due to the fact that AGBLidar was estimated locally for different sites and included some error. We are now simply comparing the LCA and MCH methods based on the inventory data only (Figure 5, attached here as Fig.1).

Comment: Fig 7: It would be helpful to see the actual data, not just regression lines.

Response: The point of this figure is to clearly see where the lines cross the y axis. For Fig 7a), we are just showing where the LCA model crosses the y axis, with different wood density from the different sites. Each line represents the model curve with various wood density values. To see the actual data from the calibration sites, see Figure 4b. For fig 7b, actual data could be added, but just showing the lines gives the figure a clean look, considering that the information we are looking for here is the
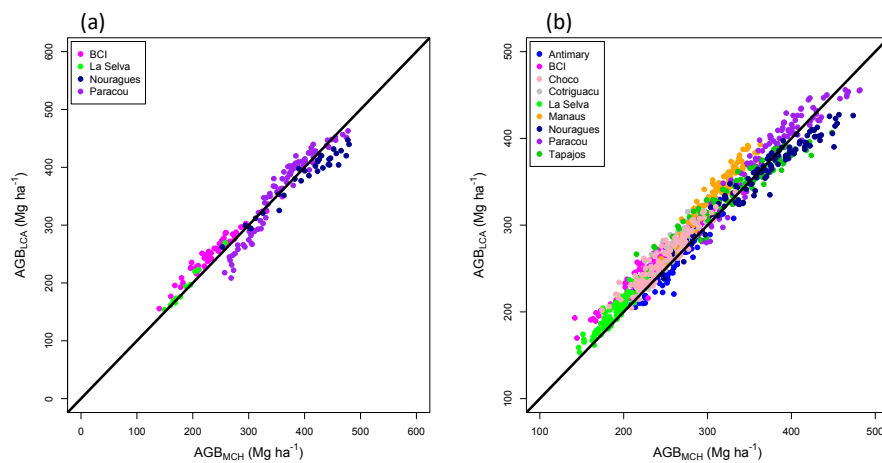
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intercept of each line.

Please also note the supplement to this comment:
https://www.biogeosciences-discuss.net/bg-2017-547/bg-2017-547-AC1-supplement.pdf

Fig. 1. AGBMCH vs. AGBLCA in the plots of the four calibration sites (a), and AGBMCH vs. AGBLCA in the 1km2 images of the nine sites (b). The black line represents the 1-to-1 line.