**Responses to Referees Comments**

**We are very grateful for the recommendations and comments we have received from the reviewers. We have addressed these comments in the revised manuscript to the best of our ability. We believe that the manuscript is now significantly improved and we look forward to your decision. We would also like to thank the two anonymous reviewers for their constructive comments, which have been very helpful for improving this manuscript.**

**Anonymous Referee #2**

*General comments*

*This is an excellent study providing most accurate AGB maps based on fusion of forest inventory data and machine learning techniques. The approach combines the advantages of machine-learning algorithms and accounts for spatial correlation among data points, as well as, non-linear relationships between environmental covariates by using the P-BSHADE model. Research questions investigating (1) differences among the presented methods, and (2) how to improve the accuracy of AGB maps are evaluated by providing statistical error metrics, such as mean absolute error (MAE), mean relative error (MRE) and root means squarer error (RMSE). Based on evaluation of these metrics results suggest that among the different methods random forest (RF) in combination with the spatially explicit model produce the highest prediction accuracy for AGB maps and show that in comparison to traditionally applied allometric models estimates are congruent, but differ in local spatial distribution of AGB. Hence, these results indicate that the proposed method based on non-representative sample prediction of AGB maps should be capable of accounting for spatial heterogeneity of AGB and thus could enhance prediction accuracy of AGB maps.*

**Response: Thank you very much for your high affirmation of our work.**

*Specific comments*

*Although this study introduces a very promising methodology – which due to a combination of machine-learning methods with spatial explicit statistical models, should be capable of resolving problems, such as non-linearity, complexity and spatial heterogeneity commonly comprised in available datasets based due to non-representative sampling of forest inventory plots – there are some minor issues that could be addressed:*

1. *Given the fact that environmental parameters (i.e. meteorological variables are missing from the analysis the suitability of the proposed technique for forecasting AGB under future climate scenarios cannot be evaluated.*

**Response: Yes, you’re right. At present, the model established in this paper cannot be applied to AGB prediction under different future climate scenarios due to the lack of meteorological data. Meteorological factors are very important parameters for** **process-based ecological model input, and the predictive results of such models are very important for accurate prediction of climate change scenarios.** **The results of AGB mapping in this study can provide a basis for evaluating the accuracy of process-based ecological models. The method of integrating spatial statistics and machine learning is used to predict the AGB of target sites at the plot level using existing knowledge such as AGB and environmental covariates of sample sites. This is the key to achieving accurate mapping of regional scale AGB. Subsequently, we can use the precise regional scale AGB mapping produced by our method as a basis for calibration when the process-based ecological model is later integrated to carry out AGB prediction of different climate change scenarios. In future research, we will focus on incorporating meteorological factors and process-based ecological models into AGB mapping.**

1. *Therefore, this does not allow to infer conclusions about the behavior of nonstationary systems, such as the response of global forest AGB to climatic signals.*

**Response: Yes, you’re right. Your valuable comments have pointed out future research that needs to be addressed.**

**The response of global forest AGB to climate change is a crucial scientific problem. The key to solving it is to accurately track the dynamic characteristics of global forest AGB. This requires accurate prediction by the process-based ecological model, which relies on optimized model parameters, model structure design, and accurate input data. The accuracy of regional-scale AGB mapping can be improved by optimizing model parameters and improving model structure. Our proposed method, which combines spatial statistics and machine learning, can improve the accuracy of plot-scale AGB mapping and provide a foundation for regional-scale AGB mapping.**

**This study uses only one case study in Nanjing, China, to verify our method and the research expands only from single tree to sample plot to region. However, we believe that this can serve as a universal and high-precision AGB mapping method, which can upscale from single tree to sample plot to regional to intercontinental to global scales to facilitate assessment of AGB changes on a global scale in the future.**

1. *However, under steady-state assumptions, the presented approach can be used to derive management plans based on more accurate assessment of AGB from nonrepresentative sampling plots, which can be compared among different geographic regions.*

**Response: Thank you for your nice comment.**

*Nevertheless, after accounting for these minor issues this study should represent a valuable asset to the available literature focusing on improving prediction accuracy of currently available AGB maps.*

**Response: Thanks again for your high affirmation of our work.**

*L41: design(s).*

**Response: Thanks for pointing this out. We have made this correction.**

*L86: please explain “stability of the second steps”.*

**Response: Thank you for pointing out this issue. “Stability of the second steps” is incorrect. We apologize for this mistake. We meant “spatial stratified heterogeneity,” which is a ubiquitous ecological phenomenon in which the within-strata variance is less than the between-strata variance, such as occurs in ecological zones with many ecological variables. Spatial stratified heterogeneity reflects the essence of nature, implies potentially distinct mechanisms by strata, suggests possible determinants of observed processes, allows the representativeness of observations of the earth, and enforces the applicability of statistical inferences. We have modified this section (Lines 86-88), as follows:**

**“Second, the assumptions of the spatial statistical method (e.g., spatial autocorrelation and spatial stratified heterogeneity), which may not always be valid in forest AGB.”**

*L94: remove “tantamount” and focus on concise description of the research questions to be investigated in the discussion section, i.e. by (1) comparing the RMSE among different methods and (2) to interpret the accuracy of AGB maps.*

**Response: Thank you for your kind advice. We removed “tantamount” and rewrote the research questions (Lines 101-104), as follows.**

**“Our aim is to answer two specific questions: (1) What are the differences in prediction accuracy of AGB maps for different methods? (2) Can the integration of spatial statistical and machine learning methods improve the accuracy of AGB models at plot-level?”**

*L439-453: maybe start of this section based on the advantage of your method over the other studies presented here?*

**Response: Thank you for your kind advice. We have revised this section (Lines 458-481).**

*L479-486: this seems to be your main results, put up front and discuss according to the points presented here!*

**Response: Thank you for your kind advice. We have revised this section (Lines 489-500).**

**“Upscaling results will have the large uncertainties (Figure C.4, S3 of Supplementary Material) (Chen et al., 2015). The current study found that the relative percent difference in total AGB between RF & P-BSHADE and the allometric method was 0.17%. Meanwhile, the relative error (RE) of AGB between the two methods ranged from 0.04% to 99.8% with an MRE of 19.93%. This suggests that the two methods are similar in terms of overall estimates of AGB, but that the local spatial distribution of AGB is different. Differences in AGB spatial distribution have been reported in many studies of AGB maps. Babcock et al. (2015) asserted that the main reasons for the differences in the spatial distribution of AGB maps between different methods include the following: (1) The structural framework of different research methods and schemes cannot truly reflect actual forest growth. (2) The model is usually a simplification of an ecological process and ignores spatial heterogeneity at the regional scale. (3) The model does not consider the influence of multiple environmental covariates (vegetation, topography, and others) on forest growth in the region.”**

*L519 (and throughout the text): please explain “single analytic trees” and “forest resource inventory data”.*

**Response: Thanks for pointing this out. We have corrected “single analytic trees” to “harvested trees,” (Lines 139, 472, 512, 514) and “forest resource inventory data” to “Forest Management and Planning Inventory (FMPI) data” (Lines 257-258, 483, 488). In addition, we explained the method for obtaining harvested tree data in section 2.2 (Lines 129-135).**