

## Comment on bg-2022-35

Anonymous Referee #1

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Referee comment on "The European forest carbon budget under future climate conditions and current management practices" by Roberto Pilli et al., Biogeosciences Discuss., <https://doi.org/10.5194/bg-2022-35-RC1>, 2022

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The manuscript BG-2022-35 by Pilli et al. presents a broad and comprehensive modeling study of expected carbon budget of European forests under different climate change and current management scenarios. By combining plant growth and ontogenetic development trends (age structure) under two different climate scenarios (RCP 2.6 and RCP 6.0) and land use and management trends, the authors are able to partition the relative effects from each of these factors, and assess their likely limitations.

Overall, the study is well conceived and well executed, addressing a question of great practical importance. At the same time, the exclusive focus of the analysis on fluxes, relegating the changes in stocks to the Supplement, may allow misinterpretation and misappropriation of the findings to justify further intensive management policies. This concern has two components – the change in stocks themselves under different scenarios, and the dynamics of heterotrophic respiration (Rh). I suggest moving figures 5S and 6S to the main body, and discussing the interaction of fluxes, pools and management all together. While the short-term flux dynamics certainly will reflect the developmental stage they are currently in, the harvest intensity must be balanced with the long-term NEP. Maximizing NEP does not maximize the climate mitigation potential of forests.

Second, it would be appropriate to acknowledge that the depiction of Rh in LPJ-GUESS does not reflect the latest understanding that Rh can be partly decoupled from NPP (<https://doi.org/10.1029/2020GL092366>), and that management-related disturbances can stimulate Rh for years to decades (<https://doi.org/10.1016/j.foreco.2015.05.019>; <https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2010JG001495>; <https://www.nature.com/articles/d41586-019-01026-8>). These factors likely contribute to Rh being underestimated in the LPJ-GUESS simulations. I understand that a rigorous evaluation of these aspects is not feasible, but adding a paragraph to summarize remaining unknowns about soil C dynamics is appropriate, in my opinion. This section could also include references to the effect of nutrient availability (including deposition) on productivity, carbon allocation and the dynamics between plants and rhizosymbionts. There is growing evidence that these relationships are currently changing and may affect the growth and fitness of organisms involved, including changing the functional balance of

soil microbial communities (leading to higher Rh).

While the use of wood in various products was not a factor in the current analysis, it may be appropriate to acknowledge that recent assessments of the substitution benefits of forest products conclude that these have likely been overestimated (<http://dx.doi.org/10.1088/1748-9326/ab1e95>, <https://doi.org/10.1038/s41598-020-77527-8>).

Finally, while the paper is overall well written and easy to follow, there are a number of typographical errors (duplication of words and punctuation marks, and minor grammatical errors) that are easy to fix using the spell checker.