

We would like to thank the reviewers for their valuable comments. Below please find our answers on the questions and comments raised by the Reviewer in detail. We also attach the revised manuscript (MS) highlighting the changes performed in the light of the comments received.

Note that the comments of Anonymous Referee #1 are shown below in bold with C (=Comment) letter at the beginning of each comment. Our responses to the comments are presented below in italic with R (=Reply) letter at the beginning of each reply.

We hope the revised version of the paper with the implemented corrections and modifications based on reviewers' comments is now clear and understandable.

C: Review of „Biogeochemical model Biome-BGCMuSo v6.2 provides plausible and accurate simulations of carbon cycle in Central European beech forests“

C: In this paper the authors describe a method for calibrating a set of parameters for European beech. Different sets of plots were used for calibrating and validating, parameters were optimized for single sites or for multiple sites. The resulting parameters were compared with available values in literature, with a focus on carbon stock in aboveground wood biomass, soil and litter. The paper clearly presents a method to deal with the large amount of parameters many process-based models have.

R: Thank you for the thorough review of our paper and your valuable comments that considerably improved the manuscript. We have tried to clarify the unclear parts of the text, expanded the discussion based on the reviewers' comments, and modified the conclusion to outline the advantages and disadvantages of the calibration method.

C: Some general comments:

C: The discussion section is very long and very much focused on interdependencies and trends along stand and site gradients. Would it be an option to put all this material in a separate section (with clear subsections) and focus the discussion on the consequences for model development?

R: Accepted, the discussion was divided into several subsections as suggested by both reviewers.

C: Maybe then the discussion and conclusions can even be merged, since right now the conclusion contains (sometimes literal) repetitions of earlier mentioned topics. The very last paragraph of the discussion (starting line 739) is what I actually expected in this section.

R: We created a new chapter 4.5. devoted to future model development and elaborated the topic in more detail. We also modified the conclusion where we focused on advantages and disadvantages of the calibration method.

C: I think it would be interesting to discuss a bit more in depth possible interdependencies between parameters and/or variables. Interdependencies between parameters is mentioned in line 578-579, but possible implications are not really discussed.

R: We created an additional subsection 4.3.1 dealing with the interdependencies between parameters and included additional text. We discussed possible implications at the end of subsection 4.3.1. as follows: "Our results indicate the necessity of analysing the covariance between parameters during a model calibration as it not only enlightens the model behaviour and interdependencies between specific parameters but can also increase the efficiency of the calibration procedure by excluding one of the correlated parameters from the calibrated parameter set and estimating its value only subsequently. In addition, such information may also help to identify the gaps in the available empirical evidence and the direction of future empirical research. "

C: Also, a „tight relationship between AbgwC and SoilC“ is mentioned (line 517) and many parameters influence all three studied variables (Figure 3). It would be interesting to discuss the possible consequences of these interactions and the advantages/disadvantages of the proposed method in this context.

R: We added a paragraph at the beginning of Section 4.1 and in Section 4.2, where we discuss this issue in more detail.

C: Further comments

C: Line 91: which elements?

R: We added the information in the text.

C: Line 123: simulating more realistic dynamics (remove „a“)

R: Accepted, "a" has been deleted.

C: Line 124: again, using dynamic annual mortality rates (remove „a“)

R: Accepted, "a" has been deleted.

C: Line 132: simulations of crop functioning

R: Accepted, "the" has been deleted.

C: Also, to line 132, is this relevant for the forest modelling? Are the crop parameters playing a role for forest modelling or are they completely separate?

R: No, crop functioning parameters are not needed for forests, we modified the text to clarify this.

C: Lines 176-180: I don't fully understand what you mean by extrapolating the E-OBS data. Do you mean that not all necessary input variables are measured and you use the gridded data to fill the gaps? Or are there sites without observations and that is what you use the E-OBS data for?

R: We reformulated the sentence to clarify the issue. Yes, both of the mentioned cases occurred in our data. In some cases we had to fill the gaps in the measured data, while in other cases no measurements were available, and hence we used E-OBS data. In addition, in E-OBS data, some climate variables required by our model are missing. These were calculated by MTCLIM.

C: Line 244: sensitivity analysis (SA) (introduce abbreviation here)

R: Accepted, the abbreviation was introduced.

C: Line 252: change brackets around Verbeeck et al 2006

R: Accepted, the text was changed accordingly.

C: Line 308-310: were the sites also selected to ensure a range of all the mentioned environmental conditions? I only saw a figure of the temperature and precipitation variability.

R: Yes, all available information about environmental conditions were considered, including elevation, soil characteristics, as shown in Table 1. We added the information in the text.

C: Line 501-502: the sentence feels a bit awkward, maybe it is meant like this: would cause a significant deviation from its mean or median of experimental observations.

R: Accepted, the text was changed accordingly.

C: Also, if the parameter should not be changed according to observations, does that indicate a process in the model itself should be improved?

R: We tried to clarify the issue. If observations are available, parameters should definitely be changed based on the empirical evidence, particularly if we are focused at a local scale. Experiments at a larger scale should also consider observations, but if we want to use a generic parameter set, then the optimised value for the whole region may not be equal to observations from a single site.

From our results it does not seem that any particular process is completely wrong, although we identified some processes that may benefit from improvements in the model. We summarised them in Section 4.5.

C: Line 511: change brackets around Thronton et al 2002

R: Accepted, the text was changed accordingly.

C: Line 516: from A very tight positive relationship

R: Accepted, "a" has been added.

C: Line 520-523: the sentence is a bit awkward, please rephrase

R: Accepted, the text was changed.

C: Line 541-542: awkward phrasing, please change (I think the term „averaging out effect“ can be omitted)

R: Accepted, the text was changed accordingly.

C: Line 543: what is a hybrid approach?

R: We explained the approach in more detail.

C: Line 563: remove „the“ → with decreasing plant density

R: Accepted, "the" has been deleted.

C: line 565: change brackets around Timlin et al 2014

R: Accepted, the text was changed accordingly.

C: Lines 568-574: is this paragraph necessary?

R: We believe the information may be useful for other modellers using different models.

C: Line 578: interdependencies

R: Accepted, the spelling has been corrected.

C: Line 605: change brackets around Thronton et al 2002

R: Accepted, the text was changed accordingly.

C: Line 731: Fix citation Kolb 2022

R: Accepted, the text was changed accordingly.

C: Line 754: any process-based model (singular)

R: Accepted, the singular is used.