

## ***Interactive comment on “HETEROFOR 1.0: a spatially explicit model for exploring the response of structurally complex forests to uncertain future conditions. I. Carbon fluxes and tree dimensional growth” by Mathieu Jonard et al.***

**Anonymous Referee #1**

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1. The authors present a new forest growth model HETEROFOR, which is a process-based model including comprehensive ecosystem and ecophysiological processes. As the title indicates, the inclusion of the competition of light for photosynthesis and structure growth between individual trees is one of the main contributions of this model. This manuscript focuses on the carbon budget and growth parts of the model. The processes behind them are well described in detail. The model was tested against inventory data and could predict the growth of trees very well. The authors further demonstrated the scenario simulations of future climate change using the model. In

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general, this is a good manuscript and suitable for publication here.

2. In many places throughout the manuscript, the authors mentioned that there exists very few spatially explicit forest growth models (e.g. P4L22 “Given the lack of process-based models with detailed spatial representation...”). That’s one of the motivations for developing this new HETEROFOR model. However, to my knowledge there are several excellent individual-based models owning this functionality, e.g. the iLAND model (<http://iland.boku.ac.at/startpage>) and the FORMIND model (<http://formind.org/model/>). The authors may want to survey the published models again and renew the manuscript.

3. In the last two paragraphs of the introduction, the scope as well as the strengths of the new HETEROFOR model are stated: it uses ray-tracing approach, hourly time step for calculating photosynthesis and transpiration, complex water balance module, detailed nutrient cycling module, and the CAPSIS platform. It would therefore be exciting for the readers, to explore these strengths by reading this paper. My major concern to this manuscript comes from this point: for what reason should the description of the whole model be separated into two (or more?) papers? I (and the readers) would like to know the main advances of this new model at once, instead of first knowing the carbon budget and growth parts, and waiting for the rest to come up later. The publication of a new and complex forest growth model has often been done in series papers, e.g. (Paper 1): full description of the model; (Paper 2) Verification, validation, and sensitivity analysis of the model; and (Paper 3) Application of the model. In the current manuscript of HETEROFOR, the general structure of the model is given in section 2.1 “Overall operation of the HETEROFOR model”. However, the detailed description of water budget and nutrient cycling, and more importantly, their coupling to carbon budget are lacking. The RCP scenario analysis of the forest growth was performed and presented in the last part of this manuscript. This has been well done and the potential of the HETEROFOR model is well demonstrated. However, due to the lack of detailed model description on water and nutrient modules, we are actually not able to comment

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on the outcome of this scenario simulations, or, even to give fair comments on the simulation results of individual radial growth and size-growth relationships.

4. If the manuscript should still be kept in its current scope, the authors may want to provide more information in section 2.1., including (a) the spatial resolution of the soil chemistry; (b) how the phenological periods are coupled to the ecosystem processes; (c) how does the stand-scale evaporation calculated by the Penman-Monteith method is distributed between soil, bark, and foliage. And how do the latter two compartments are further distributed to individual trees, such that the tree-scale throughfall and stemflow could be calculated? (d) how growth will be exactly regulated by the nutrient cycling? (e) Figure 1 should give an overview of the complete model, including the water and nutrient modules

5. P12L21: The HETEROFOR model takes into account 5 nutrients (N, P, K, Mg, Ca, in descending importance) in calculating the allocation of carbon in fine roots. How does the model deal with the weighting of the 5 nutrients?

6. In section 3.1, the npp of individual trees is compared with the modeled gpp. Please describe the method of calculating npp from the inventory data. On the other hand, why not directly compare the derived npp with the modeled npp?

7. When discussing the performance of calculating npp from gpp (P24), the authors focused only on the maintenance respiration. How about growth respiration?

8. P26L29: the term “threshold” is used here and in Figure 4 and is defined as “the minimum girth for radial growth to occur”. I don’t think that it is a proper way of description. The radial growth is too small to be properly displayed in the figure. However, the small trees do grow with girth smaller than the threshold

Some minor suggestions:

9. P3L6: propose -> proposed

10. P3L18-19: a stable systems -> a stable system

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11. P3L21: short and long-term -> short- and long-term

12. P3L22: response -> responses

13. P3L33: horizontal dimension -> horizontal dimensions

14. P3L33: in both dimensions -> in three dimensions

15. P4L19: short -term -> short-term

16. P4L24: I am wondering if the authors are going to write: HETERogeneous FORests?

17. P9L20: (The, 2006) -> (Teh, 2006)

18. P9L23: the extinction coefficient should be unitless

19. P17L27: LIEBL. -> Liebl.

20. P20L14: run with height different -> run with different

21. P23 Figure 5: use Sessile Oak instead of Common Oak for consistency

22. P29L4: NTOG 3D -> NOTG 3D

23. P44L28: Teh, C. -> Teh, C. B. S.

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