

Interactive comment on “CO₂ fluxes and ecosystem dynamics at five European treeless peatlands – merging data and process oriented modelling” by C. Metzger et al.

Anonymous Referee #2

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This paper presented a modelling study using an extensive calibration procedure to simulate the CO₂ fluxes and ecosystem dynamics at five European treeless peatlands. A process-based model, called CoupModel, was used in this study. The authors attempted to examine if they can find a commonly acceptable value for each key parameter in the model for simulating the CO₂ fluxes and ecosystem dynamics for these five distinct sites. They found that some parameters could apply common values, however, some parameters needed to be calibrated site-specifically. Some of the conclusions made from this study, for example, separate temperature responses for plant and soil heterotrophic respiration are needed for modelling improvement, were not new. I did not quite get what are the specific key contributions that this modelling exercise has

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made to the peatland modelling communities.

More specific comments: (1) In the abstract, it would be better if some statistical data can be included to show how well the model performed. (2) The conclusion in the abstract did not really match what were stated in the research aims. If I just read the abstract, it seemed that this study was trying to only evaluate the CoupModel for the CO₂ flux simulation of five European treeless peatlands. (3) In the introduction, you only listed what peatland models have been available. But it would be better if you can discuss the specific aspects of the models and point out what were missed in these existing models and why this modelling exercise was needed. (4) With your specific objectives, it would be better if you can also present the specific hypothesis that you would like to test in this study. (5) These five peatland sites are very different to each other. From the existing empirical studies based on chamber and EC measurements, could you please deduce some key differences in the processes governing the CO₂ cycling? These key differences in the processes would be the foundation for the testable hypothesis for this study. If the differences in the CO₂ fluxes were due to the distinct vegetation dynamics and soil processes, then it would lead to a question that a common model, such as the one used in this study, CoupModel, could be used to simulate the C cycling for these sites, although the model can be calibrated so the comparison between modelled and measured values could reach to an acceptable level. (6) In the discussion, it would be better if you could put this modelling exercise in the context of the existing modelling studies and discuss what the key contributions you are trying to make to the peatland modelling communities. (7) In the discussion, you have discussed the interaction between each key parameter and the input drivers. Could you please also discuss how they are specifically handled by the model? I believe that the interaction presented in the discussion should be only reflected by what has been included in the model itself. It would be better if can discuss what are the possible interaction that you can deduce from the empirical studies. (8) You have included the detailed explanation of each symbol in the Supplemental materials. However, without the clear explanation for each symbol, it is very difficult to follow. I have to check back

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and forth to get the representation of each symbol. (9) In Section 2.2.3, how did you subdivide the whole peat profile into slow turnover C pool and fast turnover C pool? Did the water table depth play any role in the subdivision? (10) For Fig.3, it is difficult for me to see the comparison. Is it better to present them in a 1:1 comparison scatter plot as well? I suggest the present Fig.3 will be kept as it was. You can consider to add a new figure to present the 1:1 comparison for each component. (11) It was stated in this paper that the CoupModel was able to disable some of the modules if needed. Would it be possible for you to just simulate the CO₂ cycling using this model but with disabled module of simulating the soil climate, including the soil temperature and soil water content? I believe that these data, including soil temperature and soil water content would be readily available from the biomet station of the EC measurement. By doing so, you could only need to calibrate these biotic parameters, rather than these abiotic parameters included in the model. You may be able to find out what would be the key biotic processes governing the CO₂ cycling for these five distinct peatlands. If some of the key biotic processes have been missed in the present model, this would be where the real modelling improvement is needed. You may even find some of these processes were not only missed in the CoupModel, but also in other existing models. If so, this would be your great contribution to the peatland modelling community from this study. (12) Could you please present more details on how you spin up the peat profile in your modelling experiment? (13) Water table depth is one of the key abiotic parameters in peatlands to governing the ecological functioning, and thus the CO₂ cycling. Could you please present more details on how the model used the water table depth to simulate the CO₂ cycling for peatlands.

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