**Biogeosciences
Discussions**

Interactive comment on "Temperature response functions introduce high uncertainty in modelled carbon stocks in cold temperature regimes" by H. Portner et al.

Anonymous Referee #3

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Review of the manuscript "Temperature response functions introduce high uncertainty in modelled carbon stocks in cold temperature regimes" from H. Portner, H. Bugmann, and A. Wolf submitted to Biogeosciences

The authors investigate the suitability of five temperature response functions to project changes in future soil carbon stocks. They conduct an uncertainty analysis of modelled soil organic matter decomposition. To parameterize the response functions, measured site data were used. The response functions were integrated in the LPJ-GUESS model and the uncertainty of short term carbon fluxes and long term carbon stocks was estimated for an elevational gradient in a catchment in the Swiss Alps for current and

future climate conditions.

In general, much effort has been put on the fit of the functions to the data and the evaluation of the fit and the statistical methods (calibration). Finally, the equations are used in a biosphere model to project soil carbon stocks. This part is described in less detail but would actually be very important in order to get the whole picture of the "story". I wonder if it would have been of interest to conduct a sensitivity analysis for all the parameters used in the LPJ-GUESS soil module (e.g. turnover times, autotrophic respiration). Personally, I would have been also interested in how good the vegetation was represented e.g. in the Ticino catchment, because I would guess that this is important for the estimation of the soil carbon stocks. The uncertainty for the soil carbon stocks in the Ticino catchment were estimated but not compared to observed data. The link between short-term and long-term carbon stocks is not clear. How can you conclude from estimating the response functions for short-term carbon stocks to long-term carbon stocks?

Specific comments:

- p. 8130, l. 12 and throughout the manuscript: The terms "short-term soil carbon dynamics", "short-term carbon flux" are used. Do they always refer to "heterotrophic respiration"?

- p. 8131, l. 27/28: Could you give some examples of the models?

- p. 8133, l. 19/20: Is the model able to predict vegetation in the (rather small-scale) Ticino catchment? Does it simulate the tree-line at the right position? How much does the simulated vegetation influence the soil carbon stocks?

- p. 8133, l. 22: litter, slow SOM, fast SOM, does not correspond with p.8134, l. 7 turnover times. Later on p. 8136 it is described that it has been sampled over a different timescale. Please explain.

- p. 8134, l. 21: Please insert "(Table 1)" after "C=B=0".

- p. 8136, l.5-6: The method could be explained better. E.g. what is the "method of expected-value parameters"?

- p.8136, l. 26-28: The methods are not clearly described. It is unclear why these two cases have been discriminated.

- p. 8137, l.15: Did you run the simulations for these 11 sites? Later the results are only shown for 3 sites. Later (p. 8138, l.19) you state that simulations were run for 30 "independent ... patches". Are these the sites?

- p. 8138, l. 1: The description of how you have derived the set of daily values from "randomly selected years" and "mothly values of the CRU dataset" is not clear.

- p. 8138, l. 20: Does the length of the model spin-up influence the soil carbon stocks? If yes, what would be the effects on your uncertainty analysis?

- The results would be easier to understand if you would place section 3.3 before section 3.2. Also section 4.3 should be moved before section 4.2

- The parameters for the temperature response functions were estimated for low altitudes but then applied to high altitudes, is that problematic?

- p. 8143, l. 15: "reliability" instead of "explanatory power"?

- p. 8145, l. 28: "in regions where soil temperature normally does not exceed values of $20°C$, for instance in forests at high elevations and high latitudes"... but this is expected to change under future climate conditions?

- Figure 1: The legend is hard to read, please change boxes to line types.

- p. 8149, l.14: The last two sentences are too long, please rewrite.

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