

Associate Editor Decision: Reconsider after major revisions (10 Jun 2021) by Jens-Arne Subke

Comments to the Author:

Dear Dr Zha,

Thank you for responding to the comments by both referees. I have looked through the comments and your response, and have a number of remaining important queries. Could I ask you to respond to the issues below in another round of revisions, please?

One crucial point remains ambiguous in your response and edits in the manuscript. Referee 1 had asked for clarification on the parameterization, as the manuscript suggests that TEM_Moss has a site-specific calibration, whereas TEM 5.0 uses general ecosystem parameters. This means that a direct comparison is not meaningful, as a site-specific parameterization will always produce a better fit to measured NPP or NEP. Your response to referee 1's query at line 238 (original manuscript) suggests that parameterization is not comparable. Your response to the query at line 289 refers to 'representative ecosystems'.

Please revisit referee 1's main concern, which was "My main criticism is around how the TEM-Model is calibrated and validated, and whether the comparison to TEM 5.0 is valid. It may be that I haven't understood the methods fully, but it seems TEM-Moss is based on ecosystem-level calibrations of the 'moss parameters', but TEM 5.0 is not based on representative ecosystem level calibrations. If this is the case, it doesn't make sense to compare the performance of the two models. It also means that the calibrated 'moss parameters' will be compensating for un-calibrated 'non-moss parameters' i.e. the optimal moss parameters for an ecosystem will likely reflect differences in the properties of the higher plant vegetation which have not been captured by the 'default' version of TEM 5.0." You have not fully acted on this, with no changes to the text. Please also address the point raised in the last sentence, regarding parameterization also reflecting vascular plant properties, not just moss properties. As this is important, yet not clear, you will have to add or edit text in the methods to explain whether parameterizations allow a direct comparison of model results.

Response: Thanks for the concern. In this revision, we clarified this issue on model parameterization by adding a few sentences as below "*Note, in TEM 5.0 and its application, the parameters were also calibrated for each representative ecosystem in northern high latitudes. Specifically, TEM 5.0 was parameterized for mixed grassland/sub-shrublands, moist non-acidic tundra, mixed hardwood and conifer forests, tallgrass prairie, savanna tropical forests, tussock tundra, and conifer forest in the region. TEM 5.0 was then extrapolated to the region to quantify carbon dynamics without considering the role of moss in boreal ecosystems (Zhuang et al., 2003). Here our revised model TEM_Moss was parameterized for representative ecosystems in the region by explicitly considering the role of moss in soil physics and carbon and nitrogen dynamics. The TEM_Moss optimized parameters were then used for model validation and extrapolation as well as comparison with TEM 5.0 simulations.*"

Still on the subject of parameterization, you indicate that your reference to Zhuang et al., (2010) and Zhuang et al. (2015) had been wrong, and that the correct reference should be Zhuang et al. (2003). The revised manuscript still refers to Zhuang et al. (2010). Please clarify if Zhuang et al. (2003) is a relevant reference here, and why it isn't cited.

Response: Thanks to point this out. In this revision, we made correction on this. The citation has been changed to Zhuang et al. (2003).

In Figure 11, RH is shown in panel b, so the referee was correct when pointing out that in original line 359, reference should be to Figure 11b.

Response: Thanks. We corrected this in this revision. Since we have inserted a new figure 4, now the reference should be Figure 12b.

New Figure 4: Please clarify that one of the sites is in fact in Canada, not the US!

Response: In this revision, we have clarified it as “five are in the US and one is in the Canada”.

I look forward to your response.

Best wishes,
Jens-Arne Subke