

Interactive comment on “Process-based modelling of the methane balance in periglacial landscapes with JSBACH” by S. Kaiser et al.

Anonymous Referee #2

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General comments

The manuscript extensively documents a new process-based methane module for use with a global land surface scheme. The processes methane production, methane oxidation, methane transport from the soil to the air by ebullition, diffusion and plants are all included in the module. The model has been tested for the Samoylov research site in Siberia, which harbours polygonal tundra consisting of wet centers enclosed by relatively dry rims. Of course the model simulates higher methane emission in the wet centers than in the rims, because of the differences in soil moisture. Methane transport by plants seems to be underestimated, which might be related to uncertainty regarding the parameter values, e.g. root surface properties. Plants may also influence methane emission by root exudates; a source of labile organic carbon brought into the water-saturated layer by sedge roots, from which methane can be produced. I do not know

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how important this mechanism can be, but I would like to see some discussion about this role of plants. An interesting finding is the simulated spring burst of methane that has accumulated over winter, although it is not clear if this happens in reality. Overall, a promising methane module, but improvements regarding the hydrological scheme, which currently does not allow for standing water, and fine-tuning of parameter values are required in follow-up studies, before it can be applied on a global scale.

Specific comments

L.1 Remove the word consistent; not clear what is meant and it implies that other methane modules were not consistent.

L.4-6 Is the simulation of oxygen processes new compared to other methane models? If yes, please let the reader know, for example: In this model, oxygen has been explicitly

...

L.14 Please add a concluding sentence about potential applications of the model.

L.135 It is not clear to me why water content at field capacity is used and not water content at saturation. What soil type is used in these simulations, peat or mineral soil? At least in peaty soils there can be quite some difference between water content at field capacity and saturation. What value has been used for field capacity?

L.398-402 Here I need some more information about soil carbon decomposition and particularly about the depth distribution. Do soil temperature and soil moisture influence the decomposition rate (which would lower the decomposition at depth)? Is there one soil organic carbon pool, or is it divided into labile and more stable carbon pools?

L.393-394 This is confusing: OK, diffusion through the root exodermis is very slow, but this layer is very thin compared to the water layer. Is there still a lower rate of transport through plants than through water?

L.523-524 This was also the conclusion of the previous section. Please combine sections 3.3. and 3.4 as there is quite some overlap.

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L.572-574 Isn't this already taken into account by defining saturation as ... % of field capacity?

GMDD

Although I am not a native English speaker, the manuscript needs some editing with regard to the English language.

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