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Review of bg-2021-80

Thomas Kleinen (Referee)

Referee comment on "Committed and projected future changes in global peatlands – continued transient model simulations since the Last Glacial Maximum" by Jurek Müller and Fortunat Joos, Biogeosciences Discuss., https://doi.org/10.5194/bg-2021-80-RC2, 2021

Review of "**Global peatlands under future climate - seamless model projections from the Last Glacial Maximum**" by Jurek Müller and Fortunat Joos.

In their manuscript – a follow-on study to their previous publication covering the time from the LGM to the present – Müller & Joos investigate the future evolution of peatlands in the LPX-Bern DGVM. They show and analyse the development of peatlands under a spread of climate forcings from an ensemble of CMIP6 models.

Overall, this is a superb manuscript analysing the future of global peatlands. There are, of course, a few minor issues to resolve, but the manuscript is nearly ready for publication.

Initially I had strong reservations about the manuscript, as the authors only used climate model forcings for the years 1975-2100 in most cases, and 1975-2300 in three cases, while they analysed the peatland development for the next 5000 years. This is not the authors' fault, as the output from most GCMs in CMIP6 is only available until 2100, very few modelling groups provide extended scenarios until 2300, and none provide output beyond 2300.

Potentially, the repeated climate forcing from the last years data were available might bias results quite strongly. However, experiments we had performed with MPI-ESM for the next millennium confirm that the bias introduced this ways is rather small, as climate remains quite stable after 2300 in most scenarios. Nonetheless, I suggest that the authors elaborate some more on the potential shortcomings of their use of repeated climate anomalies for several millennia. I'd also suggest that the authors put more of a focus on the extended scenario experiments, as the climate forcing changes quite drastically between 2100 and 2300, certainly for the high radiative forcing scenario.

This was the one (semi-) major issue I have with the manuscript. In addition, I was surprised that the authors deal somewhat half-heartedly with one of the most exciting features of their results: The expansion of peatlands after 2700. Yes, it is clear that the criteria for establishment of peatlands must be fulfilled (page 24) – that is implicit in the design of the model – but which ones? What exactly leads to the establishment / growth? Precip increase? Permafrost thaw? NEP increase? If it is too complicated a picture, would a map be possible?

Finally, there are some minor wording suggestions:

- please do a global search and replace changing all instances of "mayor" (German: Bürgermeister) to "major" (German: größer)

- the same goes for historic: Please change to historical

- the authors sometimes mention the "sample members", for example page 7, line 16, page 8, line 3: I'd suggest to use "ensemble member", as this is the genrally accepted usage.

- sometimes "at the year XXXX" is used – usually one uses "in the year XXXX"

- page 2, line 1: remove first instance of "global"

- page 2, lines 19 and 32: past tense of “lead” is “led” (I think this also occurred in a few other places)

- page 17, line 24: “main reasons for…” (reason plural, not singular)

- page 17, line 29: particularly strong

- page 20, line 10: latitude instead of latitudinal

- page 23, line 2: “depending on multiple…”

- page 23, line 13: “area than would be” (than instead of as)

- page 23, line 23: “as well as in...”

- page 23, line 33: “scenarios than for the historical…” (than instead of as)

- page 26, line 15: CMIP6, not CIMIP6

- page 27, line 11: “climate change than under pre-industrial” (instead of as)

- page 27, line 34: “mediated different regionally”??? I don’t understand this.

- page 28, line 12: “cause”, not “causes”