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Interactive comment on "DYPTOP: a cost-efficient TOPMODEL implementation to simulate sub-grid spatio-temporal dynamics of global wetlands and peatlands" *by* B. D. Stocker et al.

Anonymous Referee #1

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In their manuscript, Stocker et al. describe and evaluate their implementation of TOP-MODEL, a hydrological model to determine wetland extent. They implemented DYP-TOP in the DGVM LPJ in order to determine peatland extent and accumulation, as well as methane-generating wetlands. Their evaluation of their modelling approach appears complete and sheds a rather interesting light on the conditions under which peatlands can occur.

Overall I am rather impressed by this manuscript by Stocker et al. It is very well written, the description of the modelling approach is very clear, and the example implementation provided in the supplement will considerably facilitate re-implemetation by potential users of the algorithm. There are only a few details, which I think can be improved in

the manuscript. I therefore recommend publication with very minor revisions.

One issue that is unclear in the manuscript is the scale the CTI is averaged over (page 4883, line 16, below equation 2). The authors write about "catchment scale", but "catchment" could in principle mean a primary catchment like the entire Mississippi catchment, a secondary catchment like the Chippewa, a tributary to the Mississippi, or a tertiary catchment, i.e., a tributary to the Chippewa. I assume the latter is the catchment scale the authors have averaged over, but this is not quite clear. This issue appears to be rather important, judging from the comments on page 4908 about the differences to previous implementations. Furthermore, the R package also allows to the identification of the river network itself – it might be argued that the river points should be excluded from the CTI catchment scale average, so a sentence clearing up this detail would improve clarity.

In the water table calculation (page 4886, eq. 8), the grid cell fraction $f_{oldpeat}$ is considered as well. A mineral soil with high organic content, which is what $f_{oldpeat}$ would be in the field, tends to have a rather high water holding capacity in comparison to your average mineral soil, which would tend to raise the water table, everything else being equal. Is this considered at all? To my mind it's perfectly justifiable to treat it exactly as the mineral soil fraction, but it would be worthwhile discussing this point for completeness.

With regard to the minimum peatland fraction f_{min} (page 4888, line 15), the reader is left wondering how much of an impact it really has. Since the area fraction is extremely small, I assume it is negligible, but it should be easy for the authors to determine the total carbon stored in the f_{min}s in all grid cells. This will likely be just a few kg of carbon in total, but it would ease the reader's mind about this implementation detail, if the authors could provide the number.

Finally, on page 4889, the authors introduce the criterion POAET>1 to limit the occurrence of peatlands to areas with a positive water balance. Here it is unclear over which

time frame the authors apply this criterion – I assume it's at least an annual mean, possibly a multi-year mean, since during the summer season POAET < 1 over large parts of the boreal area (which contain quite a number of peatlands...).

With regard to the model evaluation (page 4897/4898), two improvements come to mind which the authors might want to consider (I regard these as "optional"): 1) Maps of the areas of rice cultivation should be available, so it should be possible to mask these areas and thereby disregard them in the model evaluation. 2) Since GIEMS masks areas covered by snow, a similar treatment of DYPTOP results, i.e., removing all snow-covered grid points from the analysis, might improve the agreement between GIEMS data and model results.

Figure 1: The legend seems to disagree with the main text, especially page 4883: Here, the authors write about getting the CTI values from ETOPO1, while the figure legend gives the impression the CTI from HYDRO1k is used. Maybe the authors can clarify this.

Figure 2: "Empirical" is not entirely clear. Please clarify that this means the distribution of the original CTI based on the ETOPO1 data.

In addition a few wording change suggestions:

- page 4876, line 4: relied on **prescribed fixed** peatland maps

- page 4877, line 9: is above **the** surface

- page 4881, line 8: not activated **in** this study

- page 4896, line 19: lower **than** suggested

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