

Geosci. Model Dev. Discuss., referee comment RC1  
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## Comment on gmd-2021-263

Anonymous Referee #1

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Referee comment on "A new approach to simulate peat accumulation, degradation and stability in a global land surface scheme (JULES vn5.8\_accumulate\_soil) for northern and temperate peatlands" by Sarah E. Chadburn et al., Geosci. Model Dev. Discuss., <https://doi.org/10.5194/gmd-2021-263-RC1>, 2021

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The manuscript titled "A new approach to simulate peat accumulation, degradation and stability in global land surface scheme (JULES vn5.8\_accumulate\_soil)" introduces a new version of the JULES earth system model (ESM) which, as the title suggests, includes peat accumulation dynamics. The manuscript clearly demonstrates a substantial contribution to the science of modelling peat in ESMs. The authors describe a version of JULES that can track the vertical accumulation of peat coupled with thermal and hydraulic soil properties, which is novel for global-scale modelling. The authors do an excellent job of describing their methodology, including appropriate supplementary materials, as well as providing a link to the model code with what seems to be enough detailed information to reproduce the work. Their results were clearly and appropriately presented. The model is not performing well at the site-level for some site conditions, and I believe that some very minor adjustments to the discussion around this is required (see suggested revisions below). However, the model performs relatively well when spatially aggregated and is a major step towards improving the representation of peat in ESMs. I highly recommend that this manuscript is published after a few very minor revisions.

Suggested minor revisions:

L227. Authors refer to a 'dump' file here. I suggest the authors explain where the data came from in the dump file more clearly? In Table 2 there is one line in the caption, which states that the profiles came from Auchencorth but the rationale for this was unclear and should be explained in the main text.

L354. The authors conclude that "mineral soil carbon profiles can be adequately

represented with all model versions”, however in the previous paragraph and in Figure 2, it’s clear that the model does not perform well for certain sites. The phrase is therefore misleading and should be re-phrased to reflect the appropriate scale at which the model can be applied (i.e. site-level accuracy still requires improvement, but all versions of the model perform well when aggregated/scaled-up).

L385. The statement that “simulations without lateral water flow out of the soil compare best against observations is an indication that the model behavior is reasonable” did not make sense to me. I assume that the observations came from sites with lateral flow, so I’m not sure I understand the point the authors are trying to make here. I understand that more peat should accumulate in areas with wetter conditions and less lateral flow, but I do not understand the link between the observational data made here.