

Geosci. Model Dev. Discuss., referee comment RC2
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Comment on gmd-2022-139

Anonymous Referee #2

Referee comment on "Assessing methods for representing soil heterogeneity through a flexible approach within the Joint UK Land Environment Simulator (JULES) at version 3.4.1" by Heather S. Rumbold et al., Geosci. Model Dev. Discuss.,
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General comments

Rumbold et al. describes improvements to the soil tiling scheme at different levels of complexity in the land surface model JULES. The preferred soil tiling scheme is determined by balancing the available resolution of soil types/surface types in a grid box and computational time required. A synthetic example grid box located in the UK is used to illustrate the effect on energy and moisture fluxes using the four different improved soil tiling methods along with the original simplistic method. Conclusions about the required complexity of the soil tiling scheme is mode based on this synthetic example grid box.

The improvement to the model is a highly desirable one and the methods and experimental setup is described in a clear and logical manner. Some improvements to the text should be done, especially avoiding repetitions. To the reader not familiar with the detailed representation of vegetation in JULES, some added information in this regard would help to ascertain the theoretical maximum complexity of soil/surface connectivity.

Specific comments

The complexity of the vegetation in the model should, to some extent, determine the ideal level of complexity of the soil tiling. How is vegetation demography represented in JULES ? Would the different pixels within a surface type in Fig.1 have different age distributions or different land use histories ? If yes, the "mosaic" soil tiling approach would perhaps be the ideal alternative, not considereing data availability and computational limits. If no, the

tiling approach would be enough. It would be helpful for the general reader if some information regarding this question was added.

Can the version used, 3.4.1, be related to newer versions, which seem to include e.g. managed forests (?) and cropland as well as land-cover/land-use change ? Does v.3.4.1 contain any of these capabilities ? As already mentioned. these features would seem to influence the necessary complexity of the surface/soil tilling scheme.

What is the temporal resolution of the processes in the model ? It is not described (or it evaded me) how the consumption of water by vegetation from a single soil tile works with multiple surface tiles as in the DC and HResTexAgg options. A naïve reader's guess could be that the interactions with the different tiles are done sequentially in the code, which would make the question of temporal resolution relevant.

(Noticing that this is a special JULES issue, I realise that some of these questions are probably answered by other articles in this issue, so they may not be so critical.)

Why are not carbon fluxes considered ? Is it because the focus is on meterological rather than climate applications ? This should be mentioned.

I'm not sure the format of this journal requires it, but ideally, example grid cells from other climates would seem necessary. Unless the intended usage would be for the UK only, but this should be mentioned in that case.

Also ideally, real-case example sites using real land cover and soil type data at different resolutions would be beneficial to illustrate the significance of selecting one soil tiling scheme over the other.

L.203: "the addition of soil tiles (and therefore more soil columns) has allowed each surface tile to have different rooting profiles and rates of water extraction." How does this harmonise with L.71 "The root density is assumed to follow an exponential distribution with depth, with the depth scale varying between the different PFTs.", which I assume is independent of the soil tiling method ?

In section 3, the text should be pruned much more stringently to avoid repetitions (see some examples below). Section 4 seems to repeat a lot of section 3, but in a much more readable form. I wonder if section 3 can be shortened significantly, e.g. removing the explanations that are repeated in section 4 (keeping section 4 as is).

Technical corrections

L.41: "Due to the non-linear nature of soil processes, the dominant soil type is used for each grid box and soil parameters associated with this soil type are then used." What would the alternative be when only using one soil tile ? A soil type with some sort of weighting of the different soil parameters ? Perhaps this is the "aggregated" soil properties used in the CLS and ISBA models, but it reads a bit obscure in the text before this is mentioned a few lines later.

L.69, 72, 191, Fig.4: β is called "soil moisture availability factor" on L.69 and in Fig.4 and "soil moisture stress factor" on L.72 and L.191

L.70, 72: The definition of β is split into two sentences, surrounding a description of root density. Can the first sentence be merged with the second ?

L.190: "are gradually become"

L.191-197 (and further on). description of the line colours and styles in the text seems a bit redundant

L.204: β written as "beta"

L.210-212, L.259-260: Repetition of the same information.

L.222-227: Seems to be a lot of redundant information in these sentences. Compress ?

L.235-237, L.248-249. Repeating more or less the same thing.

L.239-245, L.249-251: Repeating the same thing, but less detailed.