

Geosci. Model Dev. Discuss., referee comment RC1
<https://doi.org/10.5194/gmd-2022-121-RC1>, 2022
© Author(s) 2022. This work is distributed under
the Creative Commons Attribution 4.0 License.

Comment on gmd-2022-121

Yuanyuan Huang (Referee)

Referee comment on "Matrix representation of lateral soil movements: scaling and calibrating CE-DYNAM (v2) at a continental level" by Arthur Nicolaus Fendrich et al., Geosci. Model Dev. Discuss., <https://doi.org/10.5194/gmd-2022-121-RC1>, 2022

The authors developed the process-based model that coupling carbon, erosion, transport and deposition processes. They brought in the lateral movement of carbon into process-based land carbon modelling. The community has been expecting this advancement, especially in large scale studies, for long, but with limited progresses partly due to the high computational cost. The authors presented a detailed and exciting case. The well-illustrated their model formulations, how they tackled on the computational bottleneck, the calibration and validation, with adequate discussion of limitations and future improvements. The study is well-designed and informative. The writing is generally clear despite some part might be a little lengthy. My criticisms are between major and minor. Please check below.

It is not clear to me how the matrix-relevant techniques helped the current study. The equations for the lateral carbon fluxes are presented mostly in carbon balance equations (i.e., no need for the matrix form). Are the matrix techniques only used for constructing the ORCHIDEE emulator? If the ORCHIDEE output only an input to CE-DYNAM, or any parameter changes that require a re-do of model spin-up that requires computation resources?

Parameter values for soil discretization are optimized. How about parameter values for other parts of the model? I might miss some part, but is there any table or supplementary information that documents values of relevant parameters used in this study?

Minor comments:

Line 1-11. Is the background for abstract a little lengthy?

Line 24. I would suggest DayCent. For people without background, they don't know what DayCent refers to. DayCent is not mentioned in texts other than here. Besides, the CENTURY vs. DayCent is another layer that needs background. So DayCent here is not necessary to add more information to this already complex manuscript.

Line 88 add in before Table 1

Line 92. Is it better to write ORCHIDEE CENTURY as ORCHIDEE (CENTURY-Carbon type) or other better rewordings. ORCHIDEE CENTURY is confusing.

Line 93. Is the first order kinetics necessary? Current application is with linear-models due to computational cost. In theory, for example, if our studying region is small, the coupling with an nonlinear carbon model is possible, right?

Line 125. Could we write it as "induced by the terrain slope ($S[x,y]$) and the flow accumulation ($w[(x,y)]$)" to reduce confusing?

Table 1. Could you use other symbols for $\omega[(x,y)]$ vs $w[(x,y)]$ (?). They looks the same

Equation 6. Lines 200-205, and across the manuscript. By erosion $b - t$, you mean from lower soil layer to the upper soil layer and the flux is there between adjacent soil layers? Please clarify, by $b - t$, it refers specifically from the third to the first layer, in your context. So it is not clear to me why "losses from the layers below must be added to the layers above"

Line 525. Is the breakdown of aggregates a transport process? Please clarify. Aggregates breakdown could happen without the transport process.

Line 525-530. If the "halfway between...." a cause of the difficulty in finding the optimal resolution, or the computation cost and applications?