Geoscientific Model Development Discussions

Geosci. Model Dev. Discuss., author comment AC1
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Reply on RC1

Arthur Nicolaus Fendrich et al.

Author 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-AC1, 2022

Dear Dr. Huang,

First, thank you for the thoughtful review, which will certainly improve our manuscript. We answer the major questions below and will address the minor comments in the next round of manuscript revision.

Question: "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?"
Answer: The matrix techniques are used only for constructing the emulator, as the Reviewer asked. The ORCHIDEE output is used as an input to CE-DYNAM, in such a way that if we run CE-DYNAM without enabling erosion, transport, and deposition (ETD) modules, we recover the original ORCHIDEE results. However, when we enable these modules, the results change, and spin-up calculations must be re-done because a new equilibrium state is obtained when new processes are included. In CE-DYNAM, this is done with the emulator by using the rates extracted from the original ORCHIDEE plus the new rates of ETD dynamics presented in the manuscript. Regarding how the matrix technique helped the study, we agree that all equations refer to carbon balance. However, the dependence between adjacent cells significantly impacts the time demanded to calculate the new equilibrium state and the model dynamics. As we mentioned in the paragraph L.480-501, the matrix approach allowed us to overcome the existing barriers to the implementation of CE-DYNAM at a continental scale, as we could precalculate the matrices for every simulation month (L.478-479) and increase the number of parallel threads compared to the previous implementation (L. 485). In the next revision, we will improve this part of the text to clarify for the readers.

Question: "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?"
Answer: In this study, we intend to isolate the effects of ETD on the carbon cycle. Therefore, the parameters presented refer only to those introduced by the current formulation. We opted not to modify any of ORCHIDEE's default values, which can be

found in other publications such as Krinner et al. (2005) [10.1029/2003GB002199].