

Geosci. Model Dev. Discuss., referee comment RC1
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Comment on gmd-2022-8

Anonymous Referee #1

Referee comment on "Soil Cycles of Elements simulator for Predicting TERrestrial regulation of greenhouse gases: SCEPTER v0.9" by Yoshiki Kanzaki et al., Geosci. Model Dev. Discuss., <https://doi.org/10.5194/gmd-2022-8-RC1>, 2022

The present contribution details a new numerical model designed for simulation of the potential efficiency of the enhanced weathering techniques. Spreading crushed minerals over agricultural fields has been proposed as a technique able to mitigate the atmospheric CO₂ rise due to human activities. But the question of the fate of the spread mineral particles has been simulated with very simple methods, and the present contribution aims at improving this description.

The authors describes a mechanistically-based numerical model built to improve the prediction of the amount of CO₂ that will be consumed by enhanced weathering. This model is in the lineage of the CrunchFlow model, which was implemented by Carl Steefle. The new model (Specter) includes a description of the water-mineral interactions based on kinetic laws, the precipitation of secondary phases, the gas diffusion in soils, and the mixing in the upper layer related to the biological activity. All this seems to me correct, and more accurate than parametric methods. I only have a few comments, which can be easily included in a slightly revised version of this ms.

1. Similar models have been implemented since about 30 years. I think that the authors forgot a few references. For examples, ref to the SAFE and PROFILE box-models should appear in the text, because these are the first to apply laboratory kinetic laws to the field. The WITCH model has been also developed to simulate weathering reactions mechanistically, and a version of it includes the CO₂ diffusion (check Godd ris et al., 2006, in GCA; Roland et al., 2013 in Biogeosciences; Beaulieu et al. 2012 in Nature Climate Change; Godd ris et al. , 2013 in Biogeosciences). Although not dealing with enhanced weathering, these simpler box-models demonstrate their ability to simulate weathering processes in the field based on a more mechanistic formulation.

2. I found a bit strange to talk about uplift. Is the model really accounting for uplift ? If I understand it correctly, it seems to me that the model is using a referential in which fresh primary minerals are going upwards as weathering proceeds. In the real world, it is the

regolith which progressively penetrates the bedrock and thus goes downward. This has nothing to do with uplift ?