

Geosci. Model Dev. Discuss., referee comment RC2
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Comment on gmd-2022-8

Anonymous Referee #2

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-RC2>, 2022

The authors report the development of a much-needed second model with time-dependent capability for determining CDR from EW that complements that of Beerling et al. published in Nature last year. I sympathize with the lack of empirical datasets to evaluate the model against. Nevertheless, I'd urge the authors to consider the (extensive) geochemistry literature on basalt grain dissolution across a wide range of particle sizes, temperatures and pH units as a source of potentially useful information in this regard. The manuscript is detailed and comprehensive. I have only a few minor comments for the authors to consider.

- l. 15. Suspect the authors of the Beerling et al. would quibble with the notion it lacked mechanistic detail. Theirs was a 1-D model calibrated against a phreeqc RTM of comparable to detail to the present one. That strategy gave great flexibility both for integrating into a broader EW techno-economic framework and future development in terms of adding geochemistry details and year-to-year particle size treatment.
- l. 47-48. Agreed. Ensembles of traceable EW models for CDR estimate will be an important advance in this field.
- l. 480. Treatment of biotic weathering seems to be mainly through the production of SOM and its subsequent decomposition, as it affects the acid-base balance. But there is also the effect of nutrient uptake (base cations) by plant and release of protons by fine roots likely to be in direct contact with silicate rock grains, and production of organic acids by fine and mycorrhizal fungi which also produce a focused release of H⁺ from explorative hyphae (this is partially noted in the conclusions but the omission might be flagged here too).
- l. 615. Part of the explanation in the timescale of CDR efficiency between the present model and Beerling et al. may be related to the treatment of particle size distributions in the soil from one year to the next (discrete vs continuous).