Carbon sequestration uncertainties: bridging the model-data gap for enhanced weathering

EGU24-9664, updated on 05 Sep 2024
https://doi.org/10.5194/egusphere-egu24-9664
EGU General Assembly 2024

Carbon sequestration uncertainties: bridging the model-data gap for enhanced weathering

Salvatore Calabrese[1], Matteo Bertagni[2,3], Giuseppe Cipolla[4], Leonardo V. Noto[4], and Amilcare Porporato[2,3]

[1]Biological and Agricultural Engineering, Texas A&M University, College Station, United States of America (salvatore.calabrese@ag.tamu.edu)

[2]The High Meadows Environmental Institute, Princeton University, Princeton, NJ, USA

[3]Department of Civil and Environmental Engineering, Princeton University, Princeton, NJ, USA

[4]Dipartimento di Ingegneria, Università degli Studi di Palermo, Palermo, Italia

Enhanced weathering (EW) is a promising strategy for sequestering CO_2 by amending cropland and forest soils with crushed silicate materials. However, current model-based estimates suffer from numerous uncertainties resulting from the incomplete representation of the weathering process in soils and a lack of model-data comparisons. Here, we address this gap by improving and validating an ecohydrological and biogeochemical soil model that captures the EW dynamics in the upper soil layers. We present a systematic model-experiment comparison leveraging four experiments with different degrees of complexity, ranging from simple closed incubation systems to fully open mesocosm experiments. The comparison reveals an encouraging observation-model agreement for the primary variables of interest, such as rock alkalinity release and CO_2 sequestration. The comparison also demonstrates that the weathering rates consistently fall below those of flask dissolution experiments, underlining the need to update mineral weathering rate formulations in soils. As measurements from field trials become available, further model-data comparisons will help refine the model in support of large-scale EW deployments.