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Quantifying CO_2 removal through enhanced weathering: Grassland and pot experiments

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Weathering of silicate minerals stabilises climate on geologic time scales by consuming carbon dioxide (CO_2). Artificially enhancing weathering rates by crushing and spreading rocks containing silicate minerals has been suggested as an effective carbon dioxide removal (CDR) technology. When applied to soils, elements released in the weathering process may overcome nutrient deficiencies, while soil chemical changes resulting from the weathering process can impact nutrient bioavailability and plant uptake. Enhanced weathering (EW) may furthermore not only mitigate CO_2 via consumption during weathering, but also by reducing the use of agricultural lime. At the same time, the concurrent increase in soil pH as well as other chemical changes may impact the stability of soil organic carbon (SOC) and thus soil CO_2 exchange and net C sequestration.

Due to uncertainty in the above processes, the efficacy of land-based EW will vary with climate, plant, soil, and rock type. This poses a challenge to upscaling this method and robustly quantifying net CO_2 drawdown at the field scale. Project Carbdown addresses this challenge by setting up various field trials across Europe and testing a variety of methods to quantify weathering rates. In this part of Project Carbdown, we aim to 1) quantify net CO_2 sequestration on a grassland; and 2) compare all treatments from the various field sites in the project under controlled conditions.

To achieve the first goal, we apply basalt at a rate of 4 kg/m^2 to a grassland site in the Netherlands and automatically measure CO_2 exchange every ~15 minutes. We additionally install custom-built lysimeters to collect soil solution and monitor soil temperature, moisture, pH and conductivity *in-situ*. For the second goal, we set up a greenhouse experiment, using different kind of rock flours, biochar (0.3 kg/m^2) and species (maize, cotton, grass) that are applied at the various field sites [1,2]. In both experiments, we analyse soil water for dissolved inorganic carbon (DIC), pH, alkalinity and K and Mg ions. In soil samples we additionally determine CEC, SOC and N, P, Ca, Ni, and Cr.

[1] Smet et al., presentation Goldschmidt 2021

[2] Bijma et al., presentation Goldschmidt 2021