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Improved Net Carbon Budgets in the U.S. Midwest through Direct Measured Impacts of Enhanced Weathering

Background/Objective

- Carbon dioxide mitigation methods are a critical part of climate mitigation strategies.
- Enhanced weathering (EW) is one negative emissions technology by which the artificial acceleration of the natural weathering process of Mg- or Ca-rich rocks leads to inorganic C formation which can sequester atmospheric carbon (C) at time scales relevant to climate mitigation.
- In this study, researchers sought to understand the impacts of terrestrial EW through the application of Mg- or Ca-rich rock dust on the C balance of annual and perennial cropping systems in the U.S. Midwest.

Approach

Ground basalt was applied annually (50 $t \cdot ha^{-1}y^{-1}$) for four years on maize/soybean and miscanthus cropping systems in the U.S. Midwest. Major elements of the C budget were quantified through measurements of eddy covariance, soil C flux, and biomass.

Results

Net ecosystem C balance (NECB) was strongly negative for maize and soybean (-199 to -453 $gC \cdot m^{-2}y^{-1}$), but average EW off-set C loss in the maize/soybean system by 23% - 42%. Miscanthus NECB was positive (63-129 $gC \cdot m^{-2}y^{-1}$), and EW greatly increased inorganic C storage by an additional 234 $gC \cdot m^{-2}y^{-1}$.

Significance/Impacts

This work demonstrates that EW applied in the U.S. Midwest can create measurable improvements to the C budgets of perennial bioenergy crops and conventional row crops.

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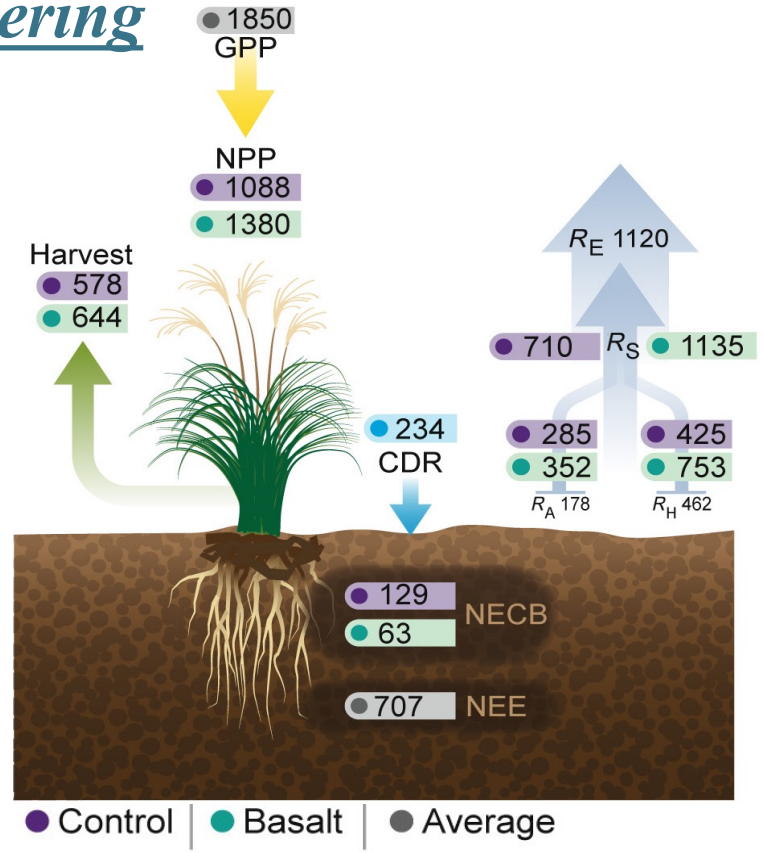

Partial C budget for miscanthus grown with and without basalt amendment (average of 2018, 2019, 2020). If statistically significant difference was not detected, a single average value is represented in gray. (GPP = gross primary productivity; NPP = net primary productivity; NEE = net ecosystem exchange; CDR = carbon dioxide removal)