BIAM-LSCE meeting, Jan 29&30, 2024

Ecosystem response to rock dust

Goll, D, Gaucher, Y, Tanaka K, Ciais, P et al

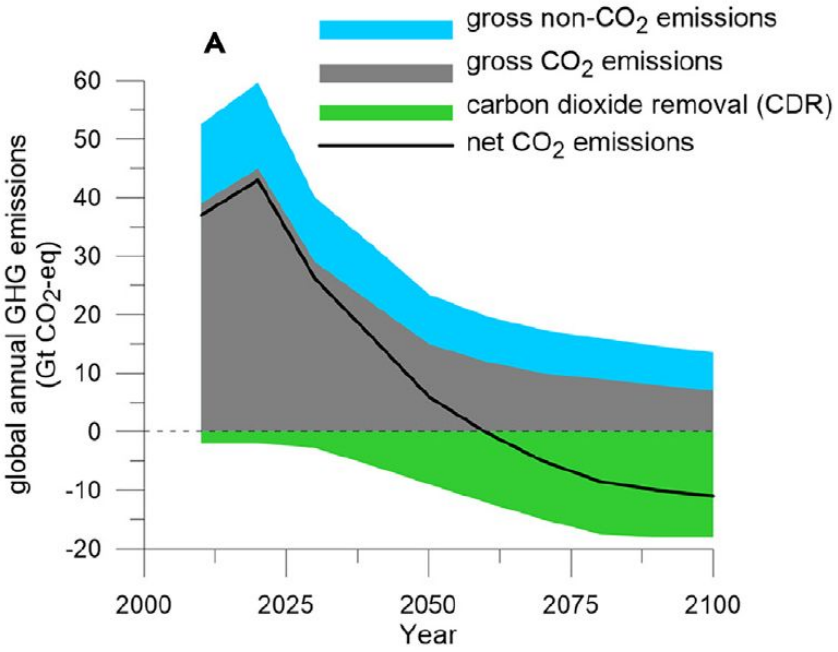
LSCE

ORCHIDEE
LAND SURFACE MODEL

Cland

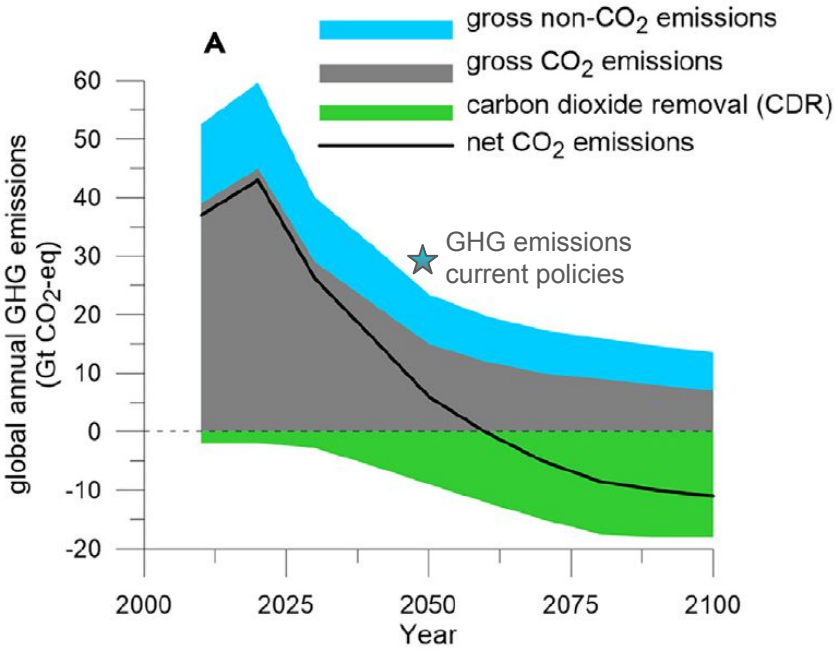
RESCUE

Carbon dioxide removal for reaching climate targets



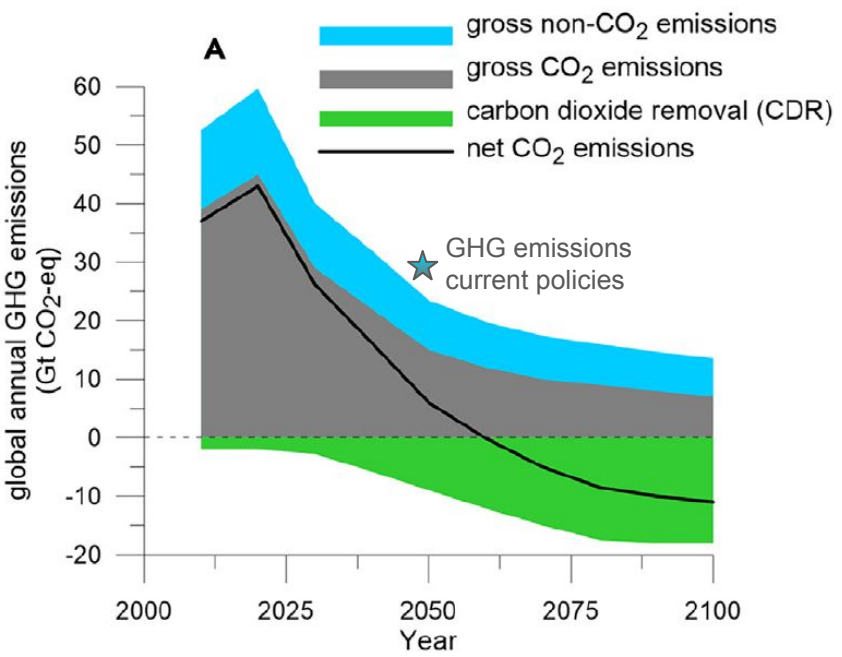
Reisinger& Geden 2023 / IEA

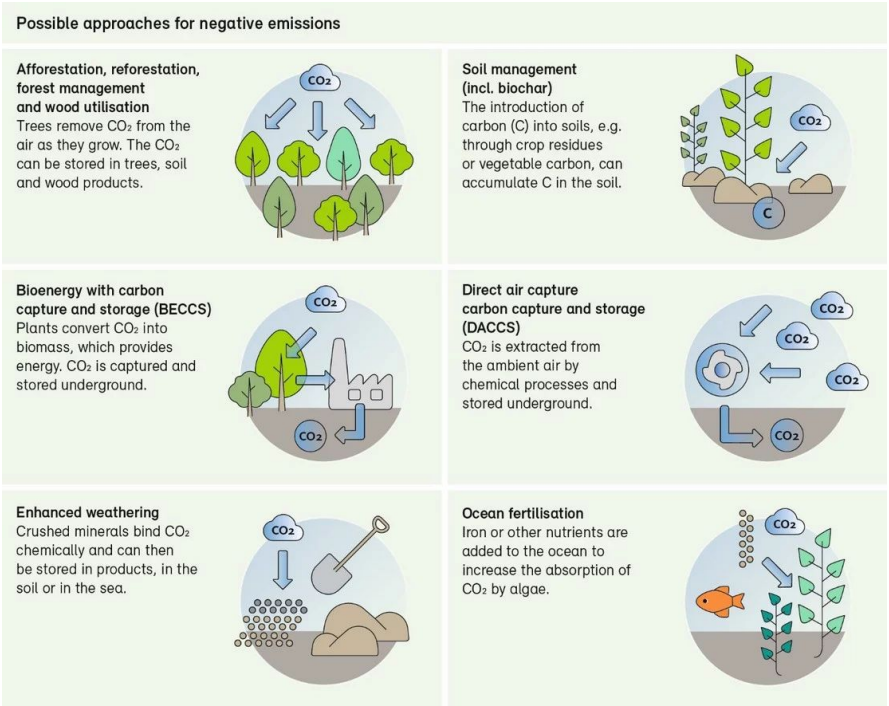
Carbon dioxide removal for reaching climate targets



Reisinger& Geden 2023 / IEA

Carbon dioxide removal for reaching climate targets





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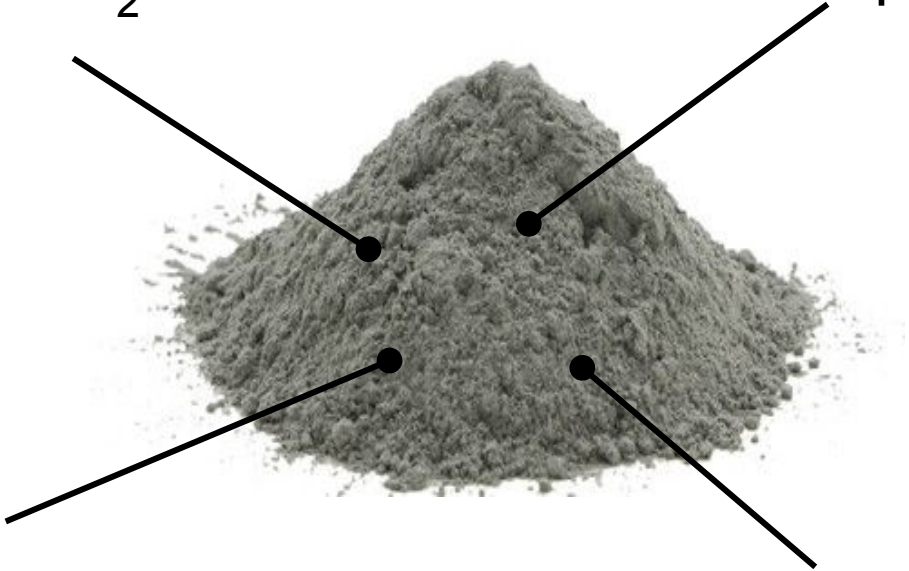
Rock dust: multi-purpose soil amendment

Removes CO_2

positive side-effects



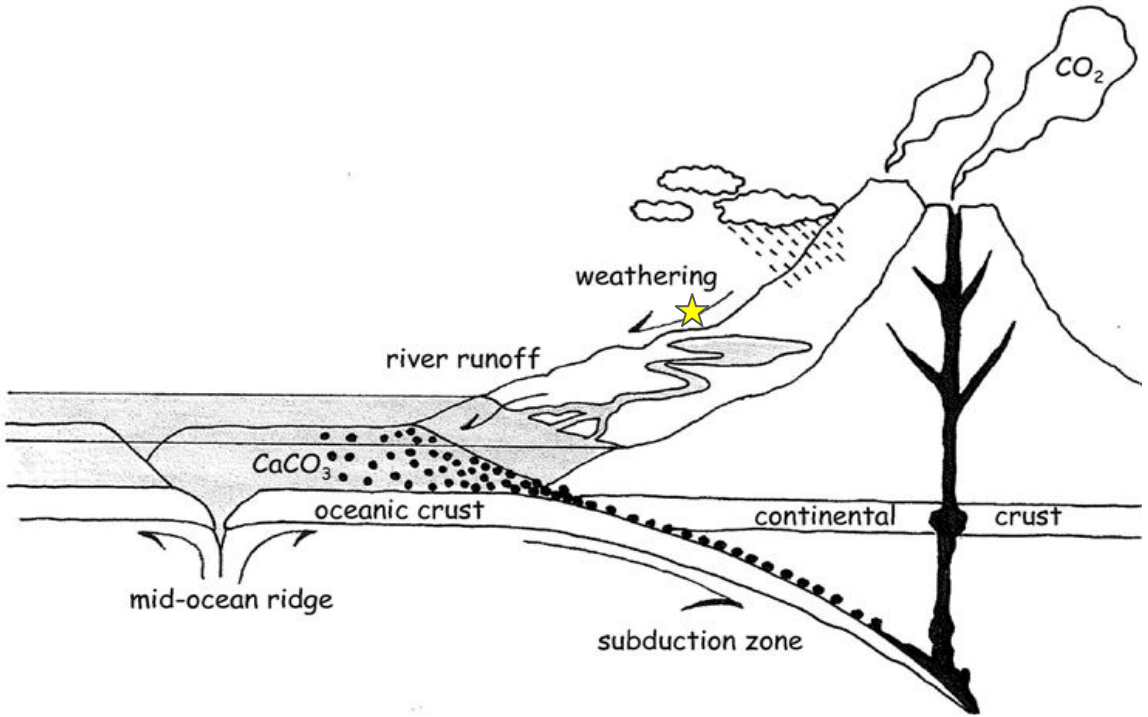
is co-deployed

cheap & widely avail.

CO_2 removal

1. Weathering:
reaction of CO_2 with minerals
(rate limited by surface area)

2. Enhancement:
grinding and spreading of
rocks (increase surface area)



Walker et al. 1981; Berner et al. 1983; Seifritz 1990

Side-effects: e.g. improve soil fertility

by

1. Enhances availability of nutrients present in soils (‘liming effect’).
2. Addition of nutrients contained in rocks.

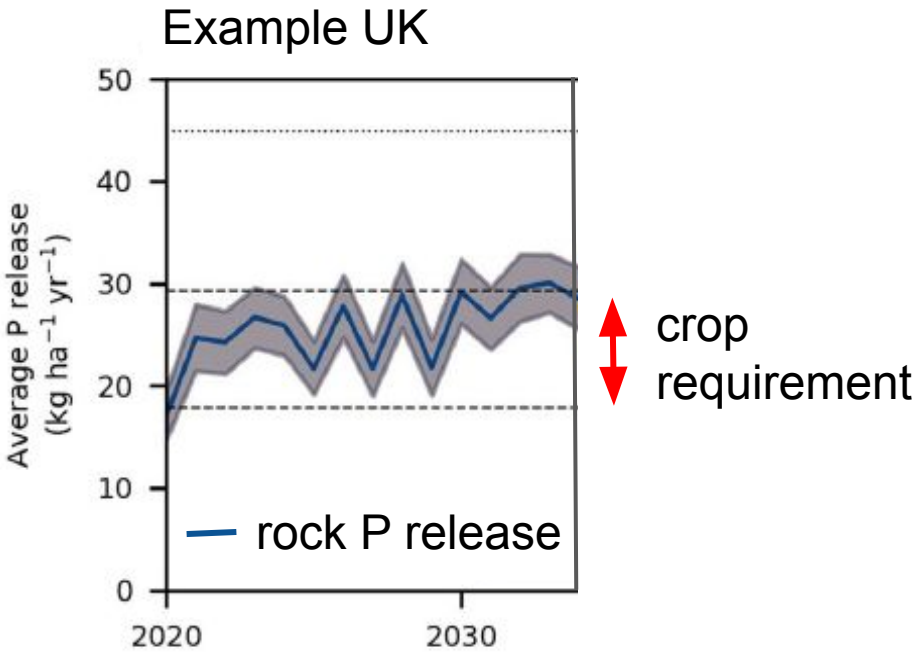
e.g. Beerling et al. 2018, Vicca, et al. 2021

Application in agriculture

Infrastructure for transport and spreading is available.

Fertilization effects an incentive for farmers to do CO_2 removal.

Reduced environmental risks, as nutrients are released gradually.



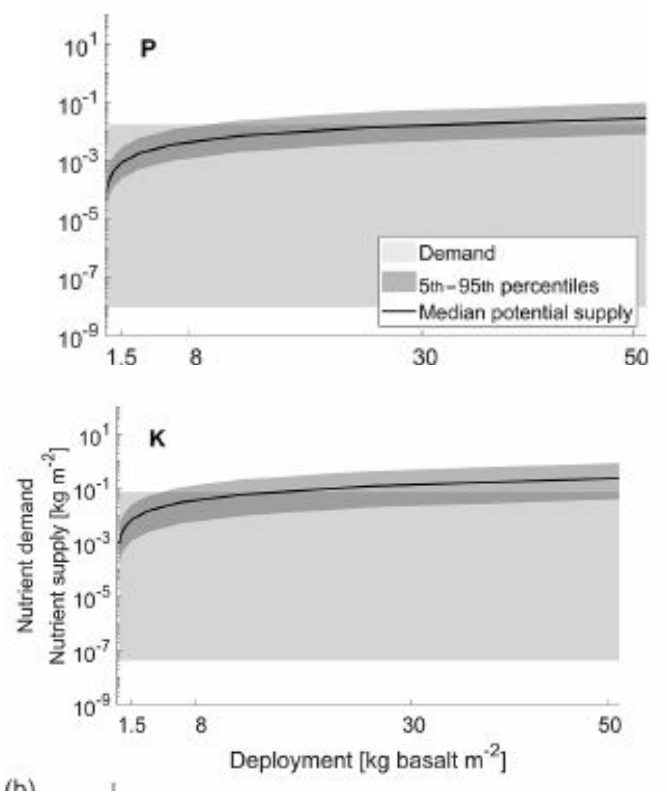
Beerling et al 2018, 2020, Kantzas et al. 2022

Application in forest ecosystem?

Nutrients supplied by rock dust high enough to balance exports by harvest.

Acid-rain impacted forest, US show enhanced tree growth due to rock dust.

Oil palm plantation, Malaysia show high soil retention of rock derived cations.



Oliveira-Garcia et al 2020, Tayloer et al 2021, Larkin et al 2023

Application in forest ecosystem (in a model)!

Model experiment with ORCHIDEE-CNP

CO_2 removal (CDR) by

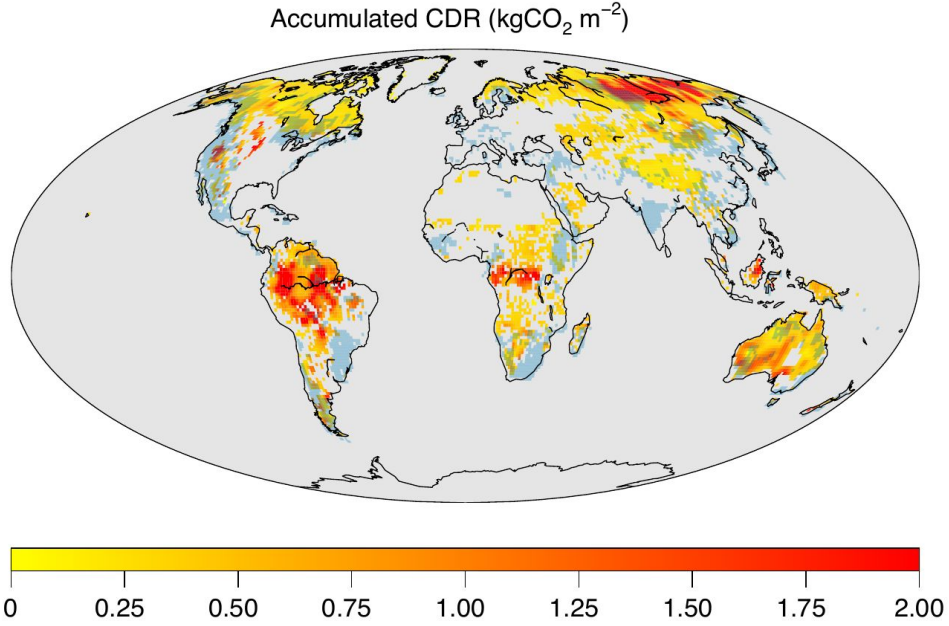
1. Enhanced weathering (EW)

2. Stimulated plant growth by rock derived nutrients

Goll et al. *Nat Geosc* 2021

Stimulating the natural carbon sink

Substantial CO_2 removal (CDR) in global hinterland area …

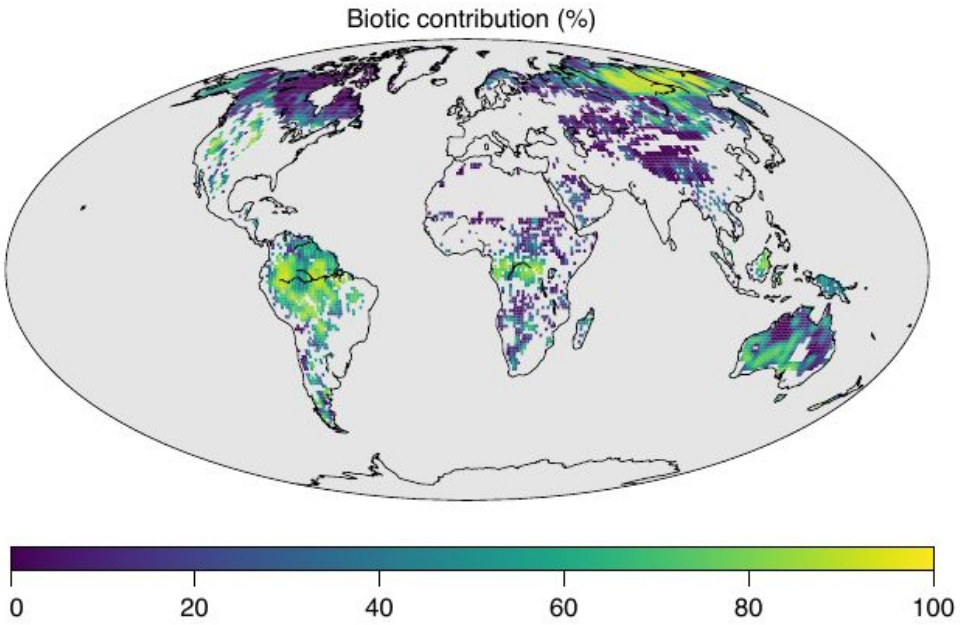


Goll et al. *Nat Geosc* 2021

Stimulating the natural carbon sink

Substantial CO_2 removal (CDR) in global hinterland area …

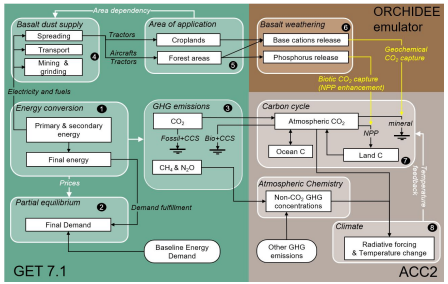
… with a large contribution from stimulated plant growth / fertilization.



Goll et al. *Nat Geosc* 2021

ERW might help to achieve climate targets

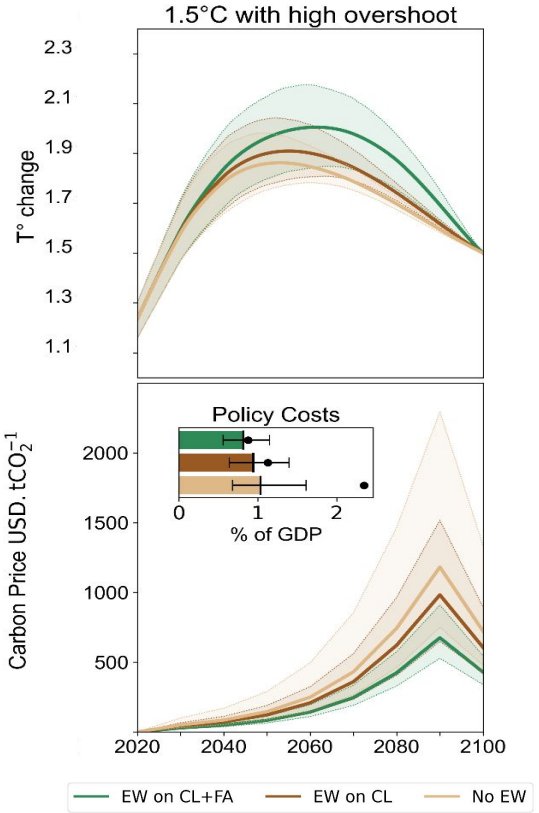
Coupled climate, energy & carbon cycle model



3 Scenarios:

Bioenergy & carbon capture and storge (BECCS) only

+ ERW on croplands
+ ERW on croplands & forests



Gaucher et al. *Nat Comm* in revision

Current status of ERW as CDR

+ Modelling suggests substantial CDR potential
  e.g. if applied on FR cropland could offset their GHG emissions
+ Several field trails have been initiated
  mixed results, but their duration too short
+ Start-ups explore commercialisation

- Unknown side-effect: SOC response, heavy metals, among others
- Challenging MRV

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