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Craving for gigatons: carbon dioxide removal in coastal environments via enhanced silicate weathering

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Negative emission technologies (NET) target the removal of carbon dioxide (CO_2) from the atmosphere, and are being actively investigated as a strategy to limit global warming to within a 2°C increase. Enhanced silicate weathering (ESW) proposes to exploit the natural process of mineral weathering for the removal of CO_2 from the atmosphere. Here we discuss the potential of applying ESW in coastal environments as a climate change mitigation option. By deliberately introducing fast-weathering silicate minerals onto coastal sediments, alkalinity is released into the overlying waters, thus creating a coastal CO_2 sink. As other NETs are principally directed to land applications (afforestation, biochar, BECCS, and terrestrial ESW), coastal ESW has the advantage that it provides CO_2 sequestration capacity in a new realm, the coastal ocean, thus avoiding competing land claims.

The bottleneck for coastal ESW is not so much its technological feasibility. Compared to other NETs, coastal ESW has the important advantage that it is largely “technology ready”. Mining and dredging industries have ample expertise with the transport, processing and manipulation of the large volumes of mineral sand as needed for coastal ESW. In contrast, the present uncertainty is largely linked to questions about the economic viability and environmental safety of coastal ESW. We need to determine whether the CO2-sequestration efficiency is high enough to render it a cost-effective NET, and at the same time, we need an impartial assessment of the ecosystem impacts – both positive and negative - from the released weathering products.

Here, I will report results from a set of large-scale experiments that are currently being conducted to investigate the rate of ESW and associated CO_2 uptake under realistic natural settings (bioturbation, waves, currents). Within this context, I will discuss potentially important influences on the biogeochemical cycling and ecosystem functioning in coastal ecosystems (release of trace metals, alkalinity and dissolved silicate). These results enable a first evaluation of whether coastal ESW can be developed into a sustainable and cost-effective approach for creating negative emissions.