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Assessment of the Carbonate Weathering Carbon Sink Potential of Indian Ecosystems for the 21st Century

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The chemical weathering of carbonate minerals in terrestrial ecosystems is governed by a combination of hydroclimatic (surface temperature, precipitation, runoff), geochemical (mineral lithology), and ecological (primary productivity, root zone depth, soil CO_2) drivers. Several climate models project increased rainfall intensity and elevated temperatures over the remaining part of the 21st century. This climate change and the anticipated land-use change are expected to play a vital role in the future chemical weathering of carbonate rocks and the carbon sink flux resulting from it. Recent studies evaluated climate's role on this weathering [1] and modeling approach to project the resulting future carbon sink flux [2]. The knowledge of these environmental drivers' combined role, especially the root zone depth, on carbonate weathering carbon sink flux is still limited for Indian ecosystems. This study aims to quantify the carbonate weathering over the rest of the 21st century for the Indian ecosystems and river basins.

The study considers historical and future climatic data (up to 2100) from different CMIP5 models and their ensemble for four different concentration trajectories (RCP2.6, RCP4.5, RCP6, and RCP8.5). The varying land-use is included using the land-use harmonization (LUH) product. Our model further deals with the thermodynamic and ecological aspects of the chemical weathering, considering the variation in root zone depth for diverse ecosystems, to evaluate the carbon sink flux till 2100 for different concentration pathways. This study highlights the role of root zone depth on carbonate weathering, which may need to be included in similar future weathering modeling approaches.

[1] Gaillardet, J., Calmels, D., Romero-Mujalli, G. Z. & Hartmann, J. (2018), Chemical Geology, 527.

[2] Zeng, S., Liu, Z. & Kaufmann, G. (2019), Nat Commun 10, 5749.