Nitrogen Inputs Via Rock Weathering Point To Higher CO_2 Uptake Capacity Of Terrestrial Biosphere Than Previously Suggested

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Empirical evidence of widespread scarcity of nitrogen (N) and phosphorus (P) availability in natural terrestrial ecosystems limits the CO_2 uptake capacity of the global biosphere. Recent studies have exposed the importance of rock weathering in supplying both N & P to terrestrial soils and thus vegetation. However, the potential of this N & P to weather from different rocks and consequently alter the global carbon (C) cycle, remains an open question particularly on a global scale.

Here, we combine empirical measurements and a new global simulation model to quantify the flux of N and P released from rocks to the terrestrial biosphere. Our model considers the role of tectonic uplift and physical and chemical weathering on rock nutrient cycling. Based on simulations using mean climate data for the past 10 years, we estimate annual values from 11.6 to 16.2 Tg of N to weather from rocks to the terrestrial biosphere. While this flux is much less than the global atmospheric deposition, the difference diminishes considerably when compared over only natural ecosystems. Given that current generation of models are yet to consider nutrient supply from short-term weathering of rocks, this previously unaccounted weathering flux of N highlights the importance of rock weathering in supporting production in terrestrial ecosystems.

Highlighting the geochemical aspect of carbon-climate feedback and using a global vegetation model we find that this additional flux of rock-N causes the global NPP to increase by an average of 0.5 PgC/yr for the past century, which is ~25% of the terrestrial carbon sink. Increased productivity and an expansion of vegetation can been seen predominantly in the high latitudes. In addition, we will present results for CO_2 uptake capacity for the future based on scenarios of least and highest mitigation measures, i.e. RCP 2.6 and 8.5 in order to investigate how emission scenarios change the relative role of rock-N and atmospheric-N deposition in the C-cycle.