Post-glacial hydroclimate forcing of tropical soil-carbon storage

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Climate-driven changes in temperature exert a primary control on soil organic carbon storage at mid and high latitudes over centennial to multi-millennial timescales. In contrast, tropical soil carbon storage responds primarily to hydroclimate; however, the sensitivity of tropical soil carbon turnover to large-scale hydroclimate variability remains poorly understood.

Here, we first reconstruct changes in the strength of the Indian summer monsoon over the last 18,000 years using compound-specific stable hydrogen (δD) compositions of terrestrial plant waxes derived from the Ganges-Brahmaputra rivers and preserved in the channel-levee system of the Bengal Fan. Comparison of these results with radiocarbon ages of bulk organic carbon and biomarkers of these same samples reveals a negative relationship between monsoon rainfall and soil organic carbon stocks on a millennial timescale. Specifically, during Heinrich Event 1 (H1) period, we record a reduction in the amount of summer monsoon rainfall by an order of magnitude as compared to modern, resulting in muted seasonality, and a *ca.* 3x reduction in annual precipitation amount. Increased rainfall following H1 resulted in a decrease of the mean age of slow-cycling organic matter—that temporarily stored in basin soils—by a factor of nearly two. This corresponds to an acceleration of soil-carbon turnover and rapid depletion of basin-wide soil carbon stocks in response to enhanced soil respiration rates.

These results suggest that future hydroclimate changes in tropical regions are likely to accelerate soil carbon destabilization, further increasing atmospheric CO_2 concentrations.