Hydroclimate forcing of the terrestrial organic carbon cycle during the last deglaciation

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Using compound-specific stable hydrogen (δD) and radiocarbon isotopic compositions of terrestrial plant waxes preserved in the channel-levee system of the Bengal Fan, we reconstruct variations in the strength of the Indian summer monsoon and attendant consequences for the rate of C exchange between reservoirs since the Last Glacial Maximum. Long-chain fatty acids display radiocarbon age offsets varying between 680 and 6180 ^{14}C years, reflecting their storage in soils within the Ganges-Brahmaputra (G-B) system prior to deposition in the Bengal Fan. Furthermore, these show a strong correlation with hydroclimate, in particular with the intensity of the summer monsoon, revealing protracted storage of organic matter on land during drier periods. The age structure of these biomarkers in the modern G-B system shows they are dominated by a slow-cycling component with an average residence time of ca. 1000 yrs. Thus, the high reservoir age offsets observed during the late glacial period can only be explained by a large residence time increase of the slow-cycling component. Our data indicate that weaker monsoons characteristic of the late glacial promoted protracted storage of organic carbon in soils. During the deglaciation, increasing summer monsoon intensity resulted in a transient doubling of soil organic carbon respiration rates. Thus, we have identified hydroclimate change as a driver of the rates of C exchange between the atmosphere and terrestrial biosphere, demonstrating the potentially global-scale feedbacks of climate-driven changes in terrestrial C storage and export dynamics.