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Exploring the provenance of vegetation and environmental signatures encoded in vascular plant biomarkers carried by the Ganges-Brahmaputra rivers

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Organic matter carried by rivers and deposited in continental and marine sediments contains valuable information on past environmental conditions and their impact on the terrestrial biosphere. In order to use sedimentary records to reconstruct past environmental conditions on the continents, such as vegetation cover and type, or precipitation intensity, we need to understand the provenance of the organic signatures and how they are transferred, and potentially modified, by fluvial transport to the sedimentary reservoir. In particular, we need to understand how environmental conditions are imprinted in the composition of riverine particulate organic carbon. Here we investigate the stable carbon and hydrogen isotopic signatures of vascular plant leaf wax biomarkers in the modern-day Ganges and Brahmaputra river complex, one of the largest fluvial system on Earth. The distribution of n-alkanes and n-alkanoic acids in Ganges-Brahmaputra river sediments suggests that vascular plant inputs are consistently a significant component of the organic carbon pool. Molecular 13C measurements reveal that C3 vegetation inputs delivered by the Himalayan rivers are partly oxidized and replaced by mixed C3/C4 vegetation input in the floodplain. This process appears to be rather non-selective in the Ganges basin, affecting both discrete particles of vegetation debris and OC associated with mineral phases. In contrast, in the Brahmaputra basin vegetation debris appears more susceptible to this replacement process. The hydrogen isotopic composition of long-chain (C24+) alkanoic acids, in combination with their stable C isotopic composition, provides constraints on the isotopic composition of the meteoric water used by the plants. Calculated compositions compare well with the depleted 2H isotopic ratios of the heavy rains of the summer monsoon. Notably, in the Ganges basin, the isotopic compositions calculated at the base of the range and in the floodplain are identical, suggesting that H-isotopic compositions of long-chain alkanoic acids are a valuable proxy for the composition of summer monsoon precipitation in the Ganges-Brahmaputra basin. Using sedimentary records near the terminus of this river system, such measurements could provide insights into summer monsoon rainfall intensity in the past.