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Climatic and geomorphic controls on the erosion of biomass from subtropical mountain forest

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Erosion of particulate organic carbon (POC) occurs at very high rates in mountain river catchments, yet the proportion derived recently from atmospheric CO_2 in the terrestrial biosphere ($POC_{biomass}$) remains poorly constrained. Here we examine the fluvial transport of suspended $POC_{biomass}$ in mountain rivers of Taiwan and investigate the climatic and geomorphic controls on the rates of transfer. In 11 study catchments we combined previous geochemical quantification of POC source (accounting for fossil POC from bedrock), with hydrometric measurements of water discharge (Q_w) and suspended sediment load over 2 years. $POC_{biomass}$concentration (mg L^{-1}) was positively correlated with Q_w, with no dilution at high flow. This climatic control on $POC_{biomass}$ transport was moderated by catchment geomorphology: the gradient of a linear trend between $POC_{biomass}$ concentration and normalised Q_w increased as the proportion of steep hillslopes ($> 35^{\circ}$) in the catchment increased. This is likely to reflect enhanced supply of $POC_{biomass}$ by erosion processes which act efficiently on the steepest sections of forest. Across Taiwan, $POC_{biomass}$ yield was correlated with suspended sediment yield. This export of $POC_{biomass}$ imparts an upper bound on the residence time of carbon in the biosphere, of on average $\sim$800 yr. Over longer time periods, $POC_{biomass}$ transferred with large amounts of clastic sediment can contribute to atmospheric CO_2 sequestration through burial in marine sediments. Our results show that this carbon transfer should be enhanced in a wetter and stormier climate, and that the rates are moderated on geological timescales by regional tectonics.