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The source and fate of organic carbon across the terrestrial-aquatic boundary in RIL impacted tropical rainforest: a case study from a paired catchment experiment in central Guyana

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Tropical headwater rivers at the interface between terrestrial and aquatic environments directly respond to changes from climate and land use. We investigate two small-scale tropical rainforest river catchments in a paired catchment experiment to study how the abundance and composition of carbon entering the aquatic environment in lowland tropical rainforest headwaters is changing by examining the effects of reduced impact logging (RIL) practices. We show bulk soil and soil water carbon measurements that indicate RIL may have supplied more organic matter to forest soils compared to a control catchment. Bulk radiocarbon (Δ^{14}C) measurements of organic matter in surface soils and river bed sediments from both catchments show that the majority of carbon is relatively young (60 years BP). However, deeper soils (up to 1 m) from water saturated wetlands show a clear potential for carbon storage with Δ^{14}C ages up to 1200 years BP. Stable isotopes of young carbon confirm that a majority of OM is fixed by the C_3 pathway with the most enriched δ^{13}C signatures in soils occurring with age. We therefore suggest that the observed isotopic fractionation between surface and deep soils is likely the result of either biodegradation or different transport processes. Further experimental data investigating the partitioning of soil OM using syringyl (S), cinnamyl (C) and vanillyl (V) lignin phenols show fractionation of S:V/C:V and (Ad:Al)v/(Ad:Al)s between soil and water matrices. The ratio between syringyl, cinnamyl and vanillyl phenols change unpredictably; however, the acid to aldehyde ratios consistently show a more oxidised signature of lignin compounds when dissolved within water. These experimental results imply that lignin mobilised from tropical forest soils in Guyana is relatively undegraded and labile. This new dataset further emphasises the need to identify end-member signatures when applying lignin biomarkers to investigate effects of land use change on storage, transport and degradation processes of organic matter.