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Title:
Carbon, biogeochemistry, and hydrology: from terrestrial to aquatic systems

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Abstract:
The characteristics of carbon and nutrient transport from terrestrial to fluvial system in the Amazon remains poorly understood. Carbon and nutrient cycles are coupled when leaf litter is mineralized or humified to soil organic matter. While infiltration in microaggregated soils is very rapid, groundwater concentrations of DOC as well as nutrients are generally low as confirmed for our watersheds in Southern Amazonia (Juruena, MT). However, concentrations in headwater streams were significantly greater than groundwater even during base flow. Our detailed observations of deep soil biogeochemistry shed light on the sources of carbon and nutrients in streams. While DOC concentrations decreased from soil solution (0.1m depth) to groundwater (7 mg L^{-1} to 0.2 mg L^{-1}), CO_2 concentrations were high in the groundwater. In our acid soils, NO_3 fluxes to the groundwater were restricted by strong adsorption to the subsoil (250-1100 kg N ha^{-1}) and recycling to vegetation, whereas CO_2 moved freely to groundwater and into the stream in our acid soils indicating a decoupling of nutrient and carbon cycles. CO_2 outgassing within tens of meters of groundwater emergence in undisturbed forested watersheds was significant, groundwater DIC concentrations being fifty times greater than groundwater DOC concentrations. DOC mineralization may contribute somewhat to DIC but DOC amounts could not explain DIC production. A re-coupling of nutrients and carbon cycling occurred after or during groundwater emergence. While emerging groundwater is very low in nutrients but high in carbon (mostly DIC), streamwater showed a significant increase in solute concentrations of DOC (0.2 to 2 mg L^{-1} for May 2003) and Ca (38 to 109 meq L^{-1}) after only tens of meters of stream passage. In-stream generation of DOC and nutrients originated from fine and coarse organic material being transported via overland flow and deposited in the stream bed. In pristine forests, the demonstrated dynamic decoupling and re-coupling of carbon and nutrients are additionally complicated by the mosaic of different soil types which influence flow paths and nutrient retention and are a challenge for regionalization of solute fluxes from terrestrial to aquatic systems. Additionally, landuse and landcover changes could significantly impact the observed dynamics.

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