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Dissolved CO2 in Small Catchment Streams of Eastern Amazonia

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Production of carbon dioxide (CO2) in soils can lead to supersaturation of dissolved CO2 (pCO2) in groundwater. As groundwater enters streams and rivers, the pCO2 may evade to the atmosphere, thus transferring C that was fixed in terrestrial ecosystems to the atmosphere via an aquatic pathway. It has been postulated that this process could be a significant pathway for return of terrestrially fixed C to the atmosphere in the Amazon Basin. We conducted a study of pCO2 along three streams from their headwaters in remnant mature forests, through pastures, secondary forests, and agriculture in the municipality of Paragominas, Pará. The watershed areas ranged from 3000 to 16000 ha, and the mean downstream discharge ranged from 0.3 to 2.9 m3/s. Concentrations of pCO2 were measured monthly at 3-7 stations along each stream for a two-year period. The measured pCO2 averaged about 600 uM in headwaters and decreased to about 100 uM downstream. For an upper limit estimate of CO2 loss by this pathway, we assume that all of the water entering the stream had the same pCO2 as was measured in the headwaters, and that all of the pCO2 eventually was evaded to the atmospheric. With these assumptions, the amount of C lost from the terrestrial environment through aquatic evasion of pCO2 would be on the order of 20-40 kgC per hectare of land area per year, which is about 3 orders of magnitude lower than annual estimates of soil CO2 efflux. Hence, while the groundwater may be supersaturated in pCO2, this is a trivial pathway of carbon flux from the terrestrial ecosystem in these small watersheds. Large reported fluxes of CO2 evading to the atmosphere from Amazonian rivers likely represents decomposition of organic matter entering the river either from aquatic primary production or as detritus associated with eroded soils and litter inputs from streamside vegetation.

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