Carbon dioxide and methane evasion from a temperate peatland stream

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ABSTRACT: Peatland streams potentially represent important conduits for the exchange of gaseous carbon between the terrestrial ecosystem and the atmosphere. We investigated how gaseous evasion of carbon from the stream surface compared with downstream carbon transport at three locations on a Scottish headwater stream. Carbon dioxide was consistently above atmospheric saturation in the stream, with mean concentrations of 159.1, 81.8, and 29.5 μmol L^{-1} at the lower, middle, and upper sites, respectively (i.e., 7.6, 3.9, and 1.2 times in excess of atmospheric equilibrium concentrations). Methane concentrations in stream water were much lower but showed a similar pattern. Rates of gaseous evasion from the stream surface to the atmosphere, determined experimentally using direct measurement of dissolved gas concentrations in conjunction with coinjection of conservative solute and volatile gas tracers, also declined downstream. Combined stream losses of all forms of carbon from the entire catchment (i.e., degassing from the stream surface and exports downstream) totaled 54,140 kg C yr^{-1}. Evasion of carbon dioxide from the stream surface accounted for 34% of this total, compared to 57% lost as dissolved organic carbon via export downstream. When expressed per unit area of watershed, the gaseous C evasion from the stream represents a loss of 14.1 g C m^{-2} yr^{-1}, which equals 28-70% of the estimated net carbon accumulation rate for such peatlands. This study shows that gaseous carbon loss from the surface of temperate headwater streams can be both spatially variable and significant in terms of rates of net annual land surface-atmosphere exchange at the catchment scale.

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