On the role of headwater catchments in terrestrial carbon cycling

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Headwater systems have been described as 'aqua incognita' in reference to the poorly understood nature of these systems yet they typically represent up to 80% of the stream length in a catchment. In terms of carbon cycling, biological theory characterises headwater streams as systems dominated by coarse organic matter which is exported downstream. This material is largely derived from catchment biomass and soils and is delivered to the stream system during high magnitude sediment transport events such as landsliding or storm events. Geomorphological understanding of lateral carbon fluxes in headwater systems has advanced rapidly in the last decade but the integration of this geomorphological understanding with knowledge of the biological processes determining the fate of organic matter in headwater river systems is poorly developed. This paper considers evidence from forested, peatland and glaciated headwater systems to develop a conceptual 'carbon land-system model' of headwater systems. This model suggests that a more nuanced view of the role of headwaters in carbon cycling is required. Headwater catchments are sources of OM for downstream systems but can also in some circumstances be sites of carbon storage or of dynamic carbon turnover.