

Mechanistic influences of sediment and soil organic carbon storage in mountainous headwaters of the Colorado Rocky Mountains

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Abstract. Understanding the terrestrial links in the global carbon (C) cycle is important for determining how societies can mitigate impacts of climate change, implement effective land-use management to maintain integrity of ecosystems, and ensure quality of freshwater for consumptive uses. Recent work emphasizes rivers as a dynamic component of the C cycle and investigates mechanistic influences of C storage in mountain streams, but many aspects of C dynamics remain unknown. Results of a pilot study investigating the role of valley and channel form on sediment and carbon storage in riparian areas in Rocky Mountain National Park (RMNP), found disproportionately large amounts of C (~75% of the total C in riparian areas) stored along multithread mountainous headwater channels (<25% of the total river miles in the study area) compared to single thread channels. Riparian areas, which account for <1% of the total area within the eastern portion of RMNP, account for ~23% of the total estimated C storage in the mountainous uplands. Multithread channels in RMNP occur only in laterally unconfined valley segments where beaver colonies or old-growth forests (> 200 years old) are present. Decline in beaver populations and loss of old-growth forests have driven a positive feedback with a loss of multithread channels that results in channel incision and effective lowering of local water tables. Potential decline in local water tables associated with decreased annual snowpack and early snowmelt is likely to increase metabolism of soil organic carbon (SOC) following desaturation of riparian soils for longer durations throughout the year. Additionally, increased variability in precipitation and likelihood of intense convective storms impacting larger drainage areas at lower elevations are likely to decrease residence time of alluvial sediment and associated SOC. In other words, increased variability of precipitation, loss of old-growth forests, declining beaver populations, avulsion of multithread channels, channel incision and declining water tables may limit natural mechanisms for storing carbon in mountainous headwater streams. Current research examines the role of drainage area, precipitation regime, and frequency of hydrologic disturbance on residence time of riparian sediment and associated SOC flux.