Mountain meadow source-sink dynamics: Disentangling legacy land-use effects on water and fluvial carbon storage relationships

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Abstract. Fluvial networks of mountain landscapes alternate between confined and unconfined valley segments. In unconfined reaches, river-connected wet meadows often establish, and recently have become recognized as ecological nexus points in mountain landscapes. These meadows are characterized by broad well-connected floodplains, high groundwater tables and extensive riparian corridors. Although comprising less than 25% of channel length in mountain fluvial networks, meadows such as these can store as much as 75% of fluvial and floodplain carbon, making bulk DOC source-sink dynamics in these meadows an important consideration in discerning carbon storage and cycling patterns. In addition to having direct effects on catchment carbon balances, DOC flux dynamics have indirect controls on aquatic ecosystem productivity, denitrification rates, and immobilization of heavy metals. The unique characteristics of wet meadows make them crucial locations for water, sediment, carbon and nutrient storage. Cumulatively, these meadows provide important ecosystem services at the network scale, transforming water quality, attenuating floods and maintaining baseflows, and playing a significant role in global inland-water carbon dynamics. Despite these benefits, historical and contemporary land-use practices often result in the simplification of wet meadow systems, leading to a lower water table and reductions in storage and hydrologic buffering capacity. In this recently established NSF-funded study, we are quantifying the hydrologic-carbon relationships across a gradient of valley confinement and wetness states (wet, mesic, dry) within the Central Colorado Rockies. Ongoing data analysis combines hydrologic recession curve analysis and simple geospatial modeling with fluorometric assays to assess shifts in fluvial storage and carbon balance patterns. Preliminary results suggest significant differences between meadow types in hydrologic and carbon source-sink dynamics across the season. These data and analyses should not only provide insight into fundamental catchment storage processes, but also highlight areas for targeted management strategies to improve water quantity and quality.