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Soil total and charcoal carbon from mountain shrublands to subalpine forests in the Colorado Front Range

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Temperate conifer forests and mountain shrublands in the Rocky Mountain Front Range, Colorado are fire-adapted ecosystems where wildland fires leave a legacy in the form of char and charcoal. Long-term, persistent soil charcoal carbon pools result from the combined effects of repeated wildland fires, aboveground biomass characteristics and soil transfer mechanisms. However, only a few studies have measured these pools in the dominant vegetation types of this region at a watershed scale. We quantified charcoal C in the upper 10 cm mineral soil with a thermochemical digest method which retains only the most recalcitrant C forms for mid-slope positions with east facing aspects and discovered that charcoal C pools do not follow a linear pattern of increasing amounts with elevation gain. A significant statistical effect of vegetation type on soil charcoal C pools along this ecological gradient suggests fire-derived charcoal C forms and accumulates via unique conditions such as fire regime. There is a bimodal pattern of initial charcoal C gain with elevation between mountain shrublands and the lower montane forest types prior to a mid-elevation decline in upper montane lodgepole pine forests before increasing again in the subalpine forests. Charcoal C amounts did not cause a significant increase or decrease in total SOC pools in these vegetation types in contrast with findings for other temperate ecosystems. Both the range of total soil charcoal C and ratios of charcoal C to total SOC are comparable to but lower than other regional estimates. This study yielded one of the largest collections of soil samples analyzed for charcoal C in the United States. Future modeling and field-based efforts are called for after revealing a landscape-pattern of SOC and charcoal C pools across these vegetation types.