How disturbing: The complications of sequential fire and floods in mountain catchments

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Abstract. Fires and floods are important drivers of geomorphic change. While the hydrologic and geomorphic effects of fires have been studied at the hillslope scale, a lack of watershed-scale studies has limited our understanding of post-fire runoff and sediment production at larger spatial scales. Here we document geomorphic changes at the watershed scale in catchments that were burned at high intensity and 15 months later experienced an extreme flood resulting from a long-duration rainstorm with a several-hundred-year recurrence interval. Following the 2012 High Park Fire, we began detailed field studies of channel geomorphic change using cross sections and longitudinal profiles, and local terrestrial laser scanning in two 15 km^2 watersheds, Skin Gulch and Hill Gulch, in the Rocky Mountains of north-central Colorado. The fire effects resulted in complex response within the valley bottoms, where deposition occurred as a result of summer thunderstorms and incision through those deposits occurred due to elevated baseflow from spring snowmelt. The watersheds were then subjected to an extreme flood in September 2013. As a result of the 2013 flood the channel area has expanded and bed has been armored with coarser substrate, subsequently reducing the effects of future floods, and denuding the fire-specific signature. These changes are similar to anecdotal and photographic accounts of changes to Hill Gulch following the catastrophic 1976 Big Thompson flood. Our results suggest that in the Rocky Mountains, fires can produce significant and dynamic geomorphic changes over sub-decadal timescales, but unusually long or intense rain storms cause more persistent and longer-lasting changes.