Mechanisms and controls on post-fire in-channel sediment transport and storage, South Fork Cache la Poudre basin, CO

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Abstract. In June 2012 the High Park Fire burned over 35,000 ha in the northern Colorado Front Range. Many studies have documented increased erosion at the hillslope scale following wildfires but predicting basin-scale response, which requires integrating hillslope and channel processes, has proven more challenging due to increasing heterogeneity and (dis)connectivity at increasing spatial scales. We employed numerous methods to assess channel response to rainfall after wildfire in two severely burned basins tributary to the South Fork Cache la Poudre. These methods include: tipping bucket rain gages, repeat cross-section and longitudinal profile surveys, scour chains, repeat photographs, and automated suspended sediment samplers. In order to test the effects of mulch on channel response a sub-basin in one of the study basins was left unmulched. In summer 2013 scour chains showed that low gradient reaches responded to rainfall by scour and fill, exhibiting no net changes in cross section geometry in either basin. Maximum scour and fill in the mulched basin was 0.06m and 0.03m. In the unmulched sub-basin maximum scour and fill was 0.09m and 0.06m respectively. Field observations of significant geomorphic change further downstream in the basin encouraged us to survey additional cross sections in 2014 in perennial downstream reaches. Two storms occurring on July 12, 2014 with depth 19-22mm and a maximum 30 minute intensity of 34-42 mm hr^{-1} and July 29-30, 2014 with depth 63-66mm with a maximum 30 minute intensity of 13-22 mm hr^{-1} caused geomorphic changes throughout the channel network. Increased suspended sediment concentration recorded along the S. Fork Cache la Poudre corroborate the timing of the two storms in 2014. Maximum incision in perennial channels was 0.8m caused by knickpoint migration. Ephemeral channels showed a scour and fill response controlled by precipitation depth and intensity acting as storage and source zones during precipitation events. Maximum scour and fill in ephemeral channels was 0.11m and 0.08m, respectively. Longitudinal profile surveys show a largely stable thalweg, with many knickpoints and boulder-formed steps resistant to erosion. Repeat photographs indicate that large volumes of material were excavated from the channel during the September 2013 floods. We speculate that this event created channel conditions that were largely resistant to all but the most intense storms in 2014. A sediment connectivity analysis using 1m resolution LiDAR flown in 2013 and vegetation cover will be performed to determine whether channel change can be linked to location in the basin and connectivity to sediment sources.