Tracking the Fate of Sediment After an Extreme Flood

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Abstract. Assessing the ongoing sediment remobilization and deposition following an extreme flood is important for understanding disturbance response and recovery, and for addressing the challenges to water resource management. From September 9-15, 2013, a tropical storm generated over 350 mm of precipitation across the Colorado Front Range. The resulting 200-year flood triggering landslides and extreme channel erosion along North St. Vrain Creek that feeds Ralph Price Reservoir, an important water supply for the Cities of Lyons and Longmont, CO. The flood resulted in 10 m of aggradation upstream of the reservoir, transforming the inlet into an approach channel. Four years after the flood, downstream transport of flood sediment and deposition in the reservoir continues. This research tracks the fate of flood-derived sediment to understand the evolution and progradation of the delta as well as to inform reservoir management practices. Bathymetric DEM differencing from April 2014, April 2016, May 2017 and August 2017 (years 1, 2, 3 and 4 post-flood, respectively) demonstrates a constant rate of delta progradation of ~50 m per year since 2014. Between April 2016 and May 2017, the reservoir level was dropped approximately 10 m during reconstruction at the spillway. Despite the change in base level, year 4 pre-snowmelt runoff measurements indicate that the rate of progradation has remained comparable to the two years following the flood. Assuming that most sediment is transported during snowmelt runoff, year 4 post-snowmelt runoff bathymetry suggests a decline in progradation rate. However, an additional bathymetric survey in spring 2018 is needed to confirm this interpretation. Bathymetric differencing further indicates net deposition of 67,000 m^3 over 14,000 m^2 (an area covering 94% of the 2017 delta and common to all surveys) of the inlet between years 1 and 3. The drop in base level associated with the lower reservoir level (years 3 to 4) produced visible incision and erosion of 16,000 m^3 and deposited 6,000 m^3 of sediment over the same area. Future analysis of Structure-from-Motion differencing of the approach channel, analysis of sediment thicknesses in reservoir cores, and morphodynamic modeling using measured discharge values will further quantify the post-flood sediment budget. Grain size, loss on ignition, and XRF analyses of cores collected from the delta will additionally enhance our understanding of stratigraphic changes and delta progradation within the reservoir.