Repeat LiDAR as a Tool for Investigating Geomorphic Change in a Watershed: A Case Study of Catastrophic Erosion in Frijoles Canyon, Bandelier National Monument, New Mexico, USA

Elaine Jacobs, Rick Kelley\(^1\) and Brian Jacobs\(^2\)

\(^1\)Los Alamos National Laboratory, Earth and Environmental Sciences Division, Los Alamos, NM, 87545, ejacobs@lanl.gov
\(^2\)Bandelier National Monument, 15 Entrance Road, Los Alamos, NM, 87544

Repeat aerial LiDAR imagery was acquired for the Frijoles Canyon watershed (~17.5 mi\(^2\)) located within Bandelier National Monument in May 2010 and again in September 2013. This sequence captured landscape-scale changes that occurred as a result of the July 2011 Las Conchas wildfire which severely burned a majority of the upper watershed and left the area vulnerable to post-fire flooding. The largest flood occurred in response to an unprecedented multi-day precipitation event totaling ~8-inches (approximately one third of the annual rainfall), which generated a peak flow of ~9500-cfs on September 13, 2013. Numerous smaller rain events have also generated large magnitude runoff including a ~7000-cfs flood in August 2011 and a ~6000-cfs flood in July 2013. Erosional impacts include landslides, debris flows, scour of the main stem and tributaries, undercutting of canyon walls, development of rills on side slopes, and widening of the channel. Changes in drainage density, ruggedness, and gradient record the effect of reduced vegetative cover and elevated storm intensities on drainage morphology. Subtraction of the 2010 LiDAR grid from the 2013 LiDAR grid provides quantitative values for regions of scour and aggradation. Hydrographs, repeat photos, and footage of fire and floods complement the LiDAR imagery as a record of this sequence of catastrophic change.

Keywords:
LiDAR, Bandelier National Monument, geomorphic, Frijoles Canyon, Las Conchas fire, flood

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