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Quantifying fluvial bedrock erosion using repeat terrestrial Lidar

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The Da'an River Gorge in western Taiwan provides a unique opportunity to observe the formation and evolution of a natural bedrock gorge. The 1.2 km long and up to 20 m deep gorge has formed since 1999 in response to uplift of the riverbed during the Chi-Chi earthquake. The extremely rapid pace of erosion enables us to observe both downcutting and channel widening over short time periods. We have monitored the evolution of the gorge since 2009 using repeat RTK GPS surveys and terrestrial Lidar scans. GPS surveys of the channel profile are conducted frequently, with 24 surveys to date, while Lidar scans are conducted after major floods, or after 5-9 months without a flood, for a total of 8 scans to date. The Lidar data are most useful for recording erosion of channel walls, which is quite episodic and highly variable along the channel. By quantifying the distribution of wall erosion in space and time, we can improve our understanding of channel widening processes and of the development of the channel planform, particularly the growth of bends. During the summer of 2012, the Da'an catchment experienced two large storm events, a meiyu (plum rain) event on June 10-13 that brought 800 mm of rain and a typhoon on August 1-3 that brought 650 mm of rain. The resulting floods had significant geomorphic effects on the Da'an gorge, including up to 10s of meters of erosion in some sections of the gorge walls. We quantify these changes using Lidar surveys conducted on June 7, July 3, and August 30. Channel wall collapses also occur in the absence of large floods, and we use scans from August 23, 2011 and June 7, 2012 to quantify erosion during a period that included a number of small floods, but no large ones. This allows us to compare the impact of 9 months of normal conditions to the impact of short-duration extreme events. The observed variability of erosion in space and time highlights the need for 3D techniques such as terrestrial Lidar to properly quantify erosion in this setting.