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Assessing Debris Channel Recharge and Transfer Processes with Terrestrial Laser Scanning

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Debris flows can be defined as very rapid to extremely rapid surging flows of saturated debris in a steep channel. Debris flows pose a significant hazard to infrastructure and the loss of life due to the combination of high flow velocities, large impact forces, long runout distances and poor temporal predictability. Entrainment of channel-bed material along the flow path can be an active process in debris flows, which can affect the volume and flow dynamics. The grain size and degree of saturation of the debris has also been noted to affect flow dynamics and runout distance. However, the composition of debris flows is often overlooked because it is difficult to constrain material properties from debris flow deposits in the field, even though the composition of a debris flow strongly affects the deposit geometry, such as the height and width of levees and lobes. Therefore, there is a current need to be able to systematically incorporate the processes and time-frame that recharge debris to the channel and their respective grain sizes into monitoring and characterization of debris flow hazards. The successful incorporation of these parameters will help refine hazard analyses and mitigate future losses.

Terrestrial laser scanning (TLS) has been conducted in the White Canyon in Interior British Columbia (BC), Canada since early 2012 as part of the Canadian Railway Ground Hazard Research Program. The White Canyon located just outside the community of Lytton, BC, has been a central focus of this research effort. Over the 5+ years of TLS monitoring at the White Canyon, several debris flows have occurred on this active slope. In a few cases, these events have overwhelmed mitigation and have directly impacted the track. These events disrupt the safe operation of rail traffic through this major transportation corridor. In this work, we use the high-resolution TLS datasets to derive the volume of in-channel stored sediment and the grain size of the stored debris in select channels of the White Canyon. Machine learning algorithms are applied to characterize the grain size in the debris accumulations in the channels. We additionally link rockfall activity to in-channel stored sediment to characterize the channel recharge processes on this active slope. Developing a better understanding of debris channel recharge processes will continue to advance the practices of natural slope mitigation planning and ongoing control as they pertain to ensuring the safety of the workers and integrity of infrastructure.