Linking urban hydromodification to bedload sediment transport

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Urbanization is a significant driver of change in river systems, particularly with respect to hydrology. The expansion of impervious surfaces coupled with growing Stormwater practices leads to drastic hydromodifications in urban rivers that have important consequences for other significant river processes. Bedload sediment transport is the key process that links changes in hydrology to adjustments in river morphology. Additionally, bedload material is an important physical habitat for aquatic organisms, meaning it plays a key role in the ecological resiliency of the stream. Despite its morphological and ecological significance, bedload transport has not been studied in detail in the context of urban hydromodification. The goal of the current study is to assess how bedload transport characteristics differ in rural and urban rivers with various hydromodifications. Specific objectives are to i) characterize hydrographs based on various metrics such as peak flow, time of exceedance and cumulative excess shear stress, ii) measure bedload transport in response to flood events, and iii) assess which hydrologic metrics best predict the mobility and travel distances of bedload particles in the studied systems. Five systems in the GTA were chosen with varying levels of urbanization and management practices. Water level data was collected at 2-minute intervals, and Radio Frequency Identification (RFID) sediment tracking was used to monitor bedload transport over a period of 2 years. A MATLAB program was developed to characterize the hydrographs of transport events. Hydrologic metrics included the peak discharge, peak stream power, cumulative excess shear stress and cumulative effective work index. Bedload sediment transport metrics included the fraction of mobile particles, and the mean travel distance of mobilized particles for each event. Relationships between hydrometric and sediment metrics were developed and compared between streams to assess which types of events were significant drivers of sediment transport in each system. Preliminary results suggest that cumulative flow metrics are generally a good and consistent predictor of bedload transport. Short-duration, high-intensity events produce higher rates of sediment transport in non-regulated urban streams, while long-duration, low-magnitude events are the primary drivers in systems with SWM. Furthermore, rural streams experience bedload transport at a much lower frequency than their urban counterparts, even when exposed to the same precipitation events. These trends suggest that hydromodification due to urbanization and SWM alter the frequency and magnitude of sediment transport. These differences between systems show how developing appropriate relationships between hydrology and bedload sediment transport specific to each type of system is imperative for the successful management of urban watersheds.

Biography

Elli is a PhD candidate at the University of Waterloo working with Dr. MacVicar. Her thesis focuses on urban rivers and the effects of hydromodification and restoration efforts on bedload transport dynamics. Her project is a part of a larger, multidisciplinary project that aims to understand and restore the resiliency of urban river systems.