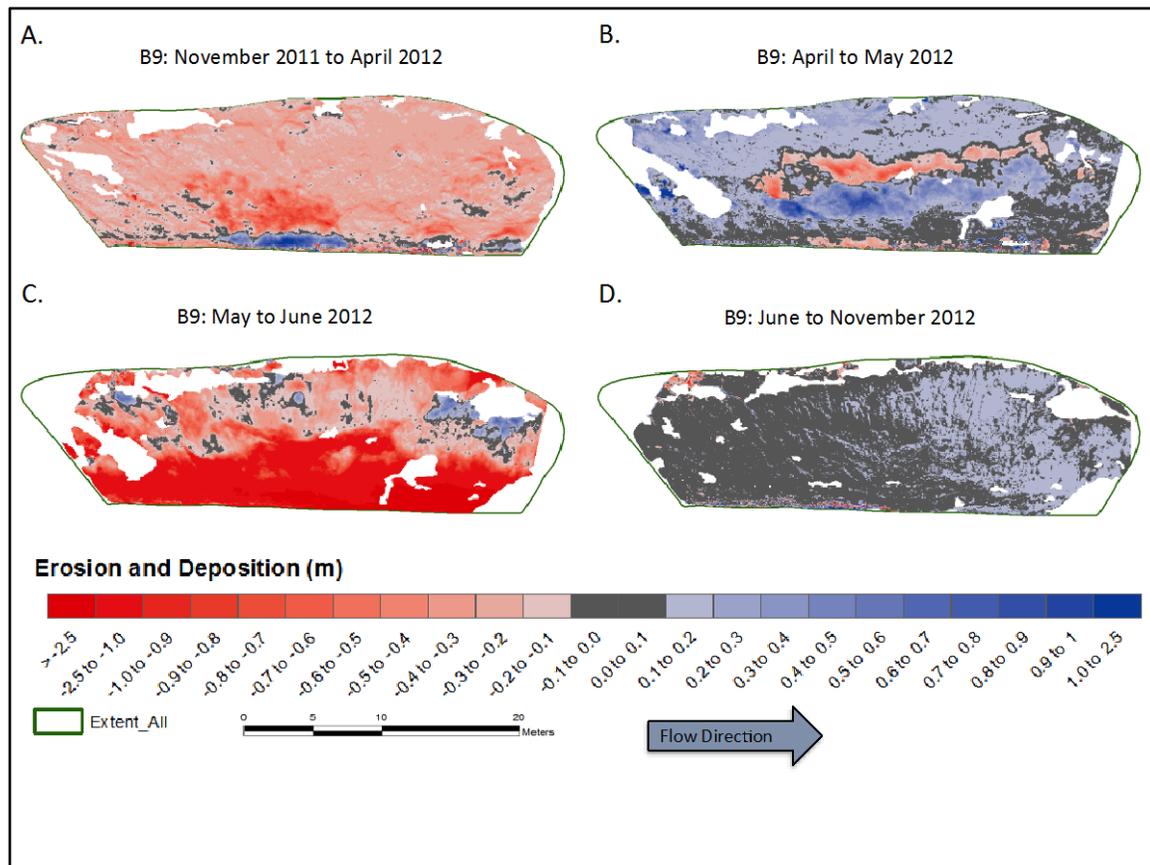


Monitoring Event-Scale Stream Bluff Erosion with Repeat Terrestrial Laser Scanning: Amity Creek

Summary:

The primary goal of this research was to determine if the bluffs in the Amity Creek watershed experience increased erosion as a result of high-flow events using Terrestrial Laser Scanning (TLS) technology. Additionally, we used our TLS results to determine the extent to which bluff erosion contributes to the turbidity impairment of Amity Creek. Eight bluffs were selected for TLS analysis and scanned following spring melt/runoff, large precipitation events such as the 500-year flood in June 2012, and during times of low flow. Digital Elevation Models (DEMs) were created for each bluff using TLS data collected in the field; individual DEMs represented a given bluff at a certain point in time. By comparing or overlaying chronologically successive DEMs, we were able to quantify the amount of sediment being eroded or deposited from the face of the bluff, and essentially isolate any change to a particular event. The location of any erosion/deposition and the time period in which it occurred provided insight into the processes responsible for causing the geomorphic change.



Event-scale net change at site B9 (lower main Amity); flow from L to R. (A) November 2011 to April 2012; slump observed in middle of lower face; erosion above, deposition below. (B) April to May 2012; slumping continues further up bluff face; scarp of erosion along middle of face. (C) May to June 2012; extreme erosion following June flood (247m³ net loss); fluvial erosion/undercutting along entire base of bluff. (D) June to November 2012; bluff inactive.



Slumps in study bluffs observed from April to May 2012. (A) Site B9 (lower main Amity); slump observed in early April. (B) Site B9; slumping continues up face of bluff following heavy precipitation May 23 to 28; significant undercutting along bluff toe. (C) Site B7 (lower Lester); slump observed in early April. (D) Site B12 (lower East Branch Amity); slump following heavy precipitation in late May.

Conclusions & Implications:

- Lots of bluff erosion occurs in a short, focused time period
 - Late winter/early spring: freeze/thaw; high soil water pressure; seepage erosion & slumping
 - Spring/summer: fluvial erosion during high flow events
- Largest source of erosion is fluvial scour along base of bluffs related to high shear stress during extreme high flow events (June 2012-500-year storm); minimal erosion occurring during times of low base flow
- Large percentage of the total sediment load in the Amity watershed comes from bluff erosion
 - Mitigating bluff erosion in watershed is critical to reducing fine sediment load reaching channel and improving water quality
 - Reducing sediment load in Amity Creek (and other MN watersheds) must emphasize bluffs
- Management options include: lowering peak flows; reducing flow volume; decrease time spent above a flow threshold; bank/bluff stabilization; OR a combination