Initial Reservoir Evolution Following the Removal of Marmot Dam on the Sandy River, Oregon

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Geography 593
Digital Terrain Analysis
December 8, 2011

Outline

- Background
- Research goals
- Study area
- Photogrammetric model construction methods
- Surface construction and volume calculation methods
- Results
- Discussion and Conclusions

Marmot Dam and its Removal

- Constructed in 1913
- 14.3 m-tall dam
- 3 km-long reservoir
- Removed October 2007
- "Blow and Go"
- Few other studies monitoring reservoir response
- 125,000 m^3 of sediment eroded in the 1^{st} two weeks

Research Goals

- Characterize the changes in reservoir evolution in the first few days following removal
- Measure the erosional volume change in the lower reservoir and identify area of erosion

Research Objectives

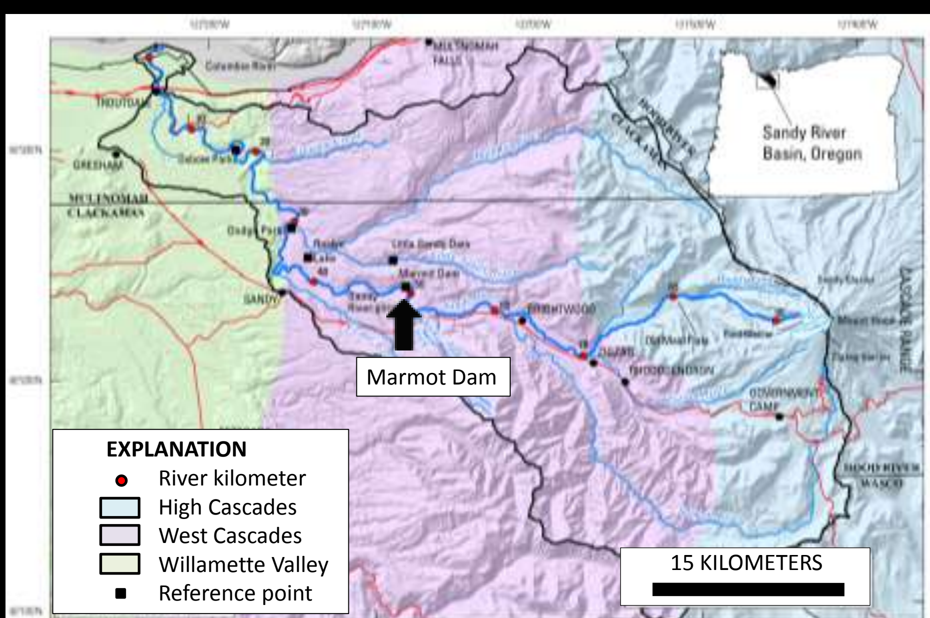
1-Create 2 3D models from terrestrial post-removal photographs

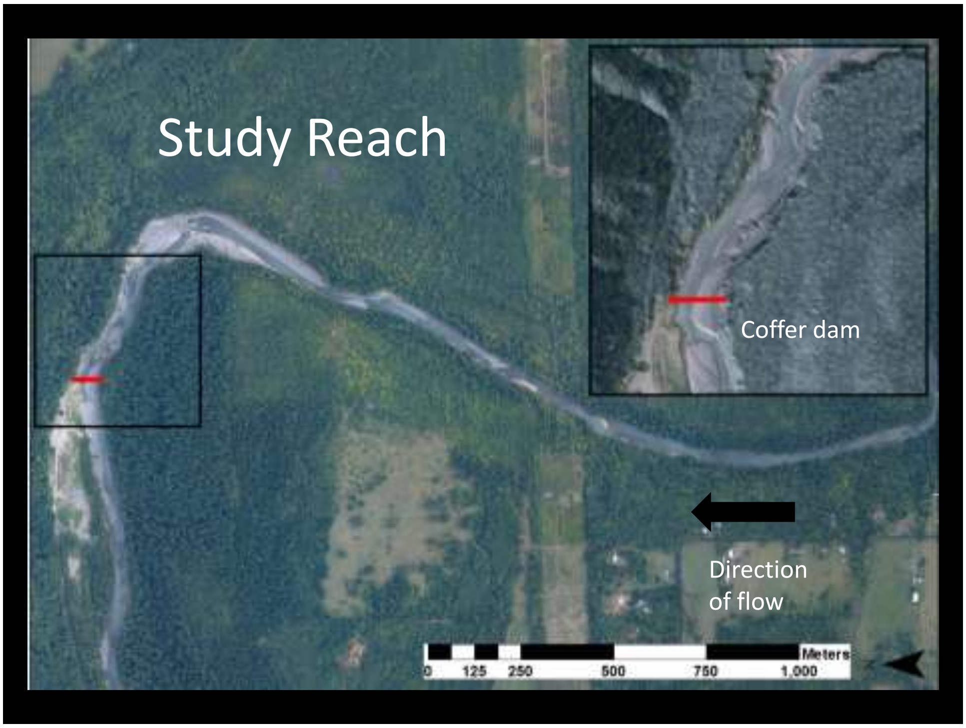
2-Create a DTM from the 3D models and compare it with pre-removal LiDAR

3-Use those same DTMs identify spatial distribution of erosion

4-Compare results to a USGS survey collected 2 weeks following dam removal

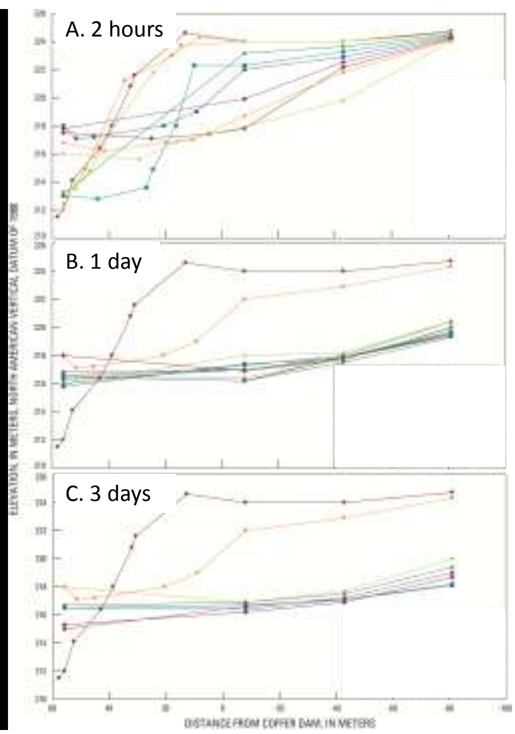
Study Area





Previous Research

- Initial incision and widening rates developed using time-lapse photography
- Long-term erosion calculated through comparison of pre-removal LiDAR to post-removal data sets



Photogrammetric Methods

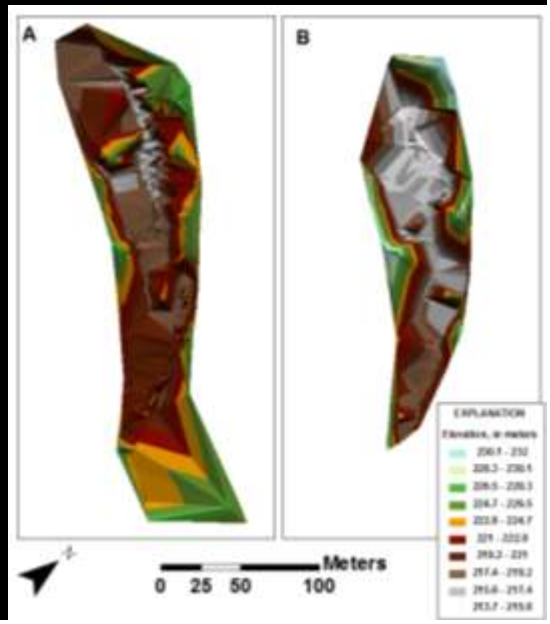
- Time-lapse photography
- PhotoModeler 5.2 software
  - Uses collinear equations to solve the intersection of light rays for a 3D point
  - Outputs coordinates
- Internal controls
  - Focal length, lens distortion, principal point
- External controls
- Tie points
- Point tagging

Photogrammetric Methods

Surface Creation Methods

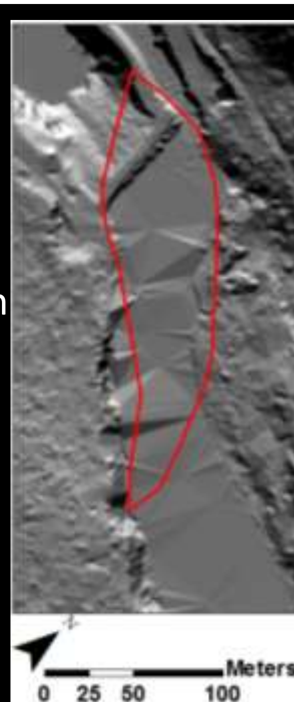
- Imported 3D point array to ArcGIS
- Created a TIN for October 20 (A) and October 23 (B)
- Converted to raster

- Same methods for field survey, November 5



Surface Creation Methods

- 2007 LiDAR collected pre-removal
- Converted to common projection and vertical units
- All surfaces covered different spatial extents
- Re-sampled to similar cell size, clipped to coincident area (10 % of 2 week erosion area), and snapped to LiDAR surface



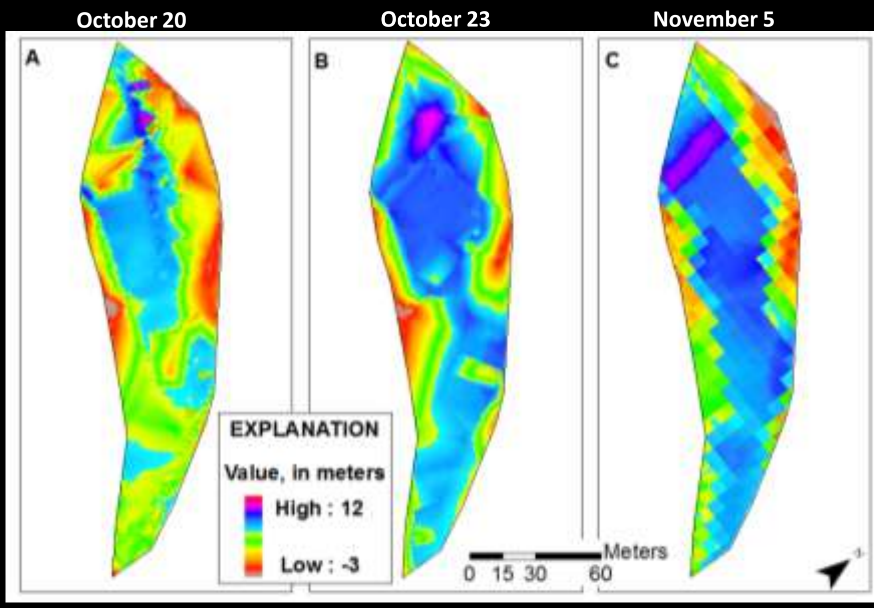
Volume Calculation and Erosion Map

- Cut/Fill tool
- Raster Calculator
  - LiDAR to October 20 surface
  - LiDAR to October 23 surface
  - LiDAR to November 5 surface

Erosion Volume Results

Date	Volume (m^3)	Cumulative Volume (m^3)	Percent of Total November 5 Erosion
October 20	39,622	39,622	32
October 23	15,855	55,477	44
November 5	-316	55,161	44

Spatial Erosion Results



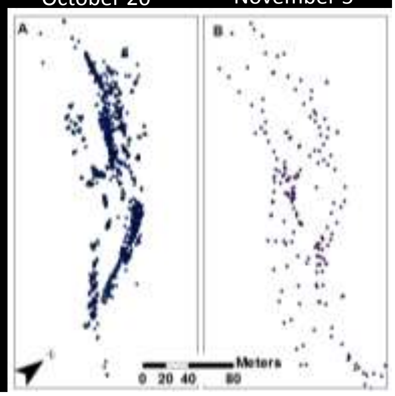
Are results valid?

- Field observations and other terrain analyses show rapid erosion in the early hours and days following dam breach
- October 20th accounts 32 % of total 2 week erosion volume
- October 23 accounts for an additional 12 %
- Results are reasonable considering the distribution of the impoundment and timing of flows

Sources of Error

- Error could stem from a variety of sources
  - Coarse resolution of field-based surveys
  - Variation in river discharge
  - Deposition could be sourced from outside study area
  - Multiple stages of processing

October 20 November 5



Quality of Photogrammetry

- 3D photogrammetric models can provide sturdy foundation for addressing response
- Results are close to what should be expected
- Improvements and future work
  - Increased density of points possibly with updated software
  - More expansive camera network
  - Define geomorphic surfaces for more diverse results

Conclusions

- 1 day
  - ~40,000 m^3 eroded
  - Downstream portion of analysis window near the central reservoir
- 3 days
  - ~55,000 m^3 eroded
  - Erosion spread laterally across impoundment and longitudinally upstream
- Results are consistent with field and photo observations
- Photography can be used effectively to address response to dam removal at certain spatial and temporal scales

References

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Questions?