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Modeling Fire-Related Debris Flow Volumes in MATLAB Using Surveyed Data Collected from the Middle-Fork Salmon River, Idaho to Determine Contribution of Episodic Fire-Related Debris Flows on Long Term \(10^3 - 10^4\) Sediment Yield

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Introduction

Fire-related debris flows play a significant role on the long term sediment yield of the Salmon River Basin. Previous studies (Kirschner et al., 2001) quantified the total long term sediment yield of the Salmon River at 261.36 t/yr. This study aims to quantify the Middle Fork’s contribution of sediment from fire-related debris flows to the long term sediment yield.

Multiple debris flow deposits were surveyed on the Middle Fork and the Kotch Creek deposit was analyzed using the program MATLAB to find the volume of deposition. Using charocal found in stratigraphic profiles of the deposits and C14 dating, the timing and occurrence of periods of deposition were found. Volume calculations coupled with timing data from charcoal dating allows for the reconstruction of the long term sediment yield contribution of fire-related debris flows on the Middle Fork Salmon River.

Sediment volumes were calculated with estimated volumes from empirical formulas based on remotely sensed spatial data (burn severity and slope), measured geometric data (longitudinal profile, cross sectional area, flow banking angle), and precipitation records (Cannon et al., 2010).

Methods

Approach

- Upload surveyed data into MATLAB and separate fan and levee points
- Using surveyed points, construct triangulated surface connecting all data points and create interpolation of fan and levee surface
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Sediment Yield Calculations

- Total eroded mass = (Event volume * sediment bulk density (assuming bulk density 2250 kg/m3)) where A is area with slopes > 30% (km2)
- Total eroded mass = (Event volume * sediment bulk density (assuming bulk density 2250 kg/m3)) where A is area with slopes > 30% (km2)
- Elevation = 2250 m3 = 560 m3
- Sediment lost directly to river = 650 m3
- Fan deposit = 14,393 ± 1330 m3
- Levee deposit = 975 ± 1170 m3

Measured Volume

Total volume = 15,922 ± 2500 m3
Sediment lost directly to river = 560 m3
Fan deposit = 14,393 ± 1330 m3
Levee deposit = 975 ± 1170 m3

Conclusions

1. Estimated volumes using empirical formulas produce values within error bars of calculated values found using surveyed data points and MATLAB.
2. More than 50% of total sediment yield for Salmon River Basin over the past 2000 years is accounted for in estimates of fire-related debris flows from the Middle Fork Salmon River.

References


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