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IncrementalDebrisFlowVolumeAnalyzer: A Python tool for estimating volumes along a debris flow path

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Software

- Review
- Repository
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Summary

Debris flows are common, costly, and deadly post wildfire hazards. As wildfire activity is expected to increase in the coming decades (Calvin et al., 2023; Mueller et al., 2020; O'Connor et al., 2014; Singleton et al., 2019; Westerling et al., 2006; Westerling, 2016), a precipitous increase post-fire debris flow hazards is expected. The tool presented here allows for the semi-automated estimation of erosional and depositional volumes along the path of a debris flow. This tool is in use as a part of ongoing, longer-term research which aims to better understand the intra-channel mechanisms of bulking and deposition. Understanding these field-scale mechanics will play an important role in better focusing mitigation efforts, improving modeling for runout and hazard prediction, and predicting locations of volume growth or decline.

Statement of need

The `IncrementalDebrisFlowVolumeAnalyzer` is a Python tool for estimating intra-channel volume of erosion and deposition along a flow path. The series of semi-automated scripts which make up `IncrementalDebrisFlowVolumeAnalyzer` can be looped using a master text file and/or the `glob` package depending on the user file structure, to efficiently run volume estimations across an area of interest. The `IncrementalDebrisFlowVolumeAnalyzer` relies heavily on the `Fiona`, `Rasterio`, and `Shapely` packages for reading and writing geospatial data.

This tool was designed to be used by geohazard and geomorphology researchers in tandem with external data, field work, and geomorphometric analyses. Students may also use this tool to gain familiarity with debris flow hazards, change detection data types, and geospatial data manipulationin Python with hands-on application to real world problems.

The `IncrementalDebrisFlowVolumeAnalyzer` has been used in multiple forthcoming scientific publications, and has been previously presented on (Guido & Santi, 2024). This work builds off the concepts of volume estimation demonstrated by (Scheip, 2022; Scheip & Wegmann, 2022), with improvemnts in: - Standardizing sample areas, - Generalization with the ability to handle complex tributary systems - Direct referencing volume estimates to hydrological locations in the watershed, and - Increasing the capacity for automation.

These improvements, combined with the growing need to investigate intra-channel debris flow dynamics and increasing availability ofhigh-resolution topographic data, will enable exciting scientific exploration and developemnts in mitigation, modeling, and hazard prediction in debris flow and geohazard research.

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Graphical Summary

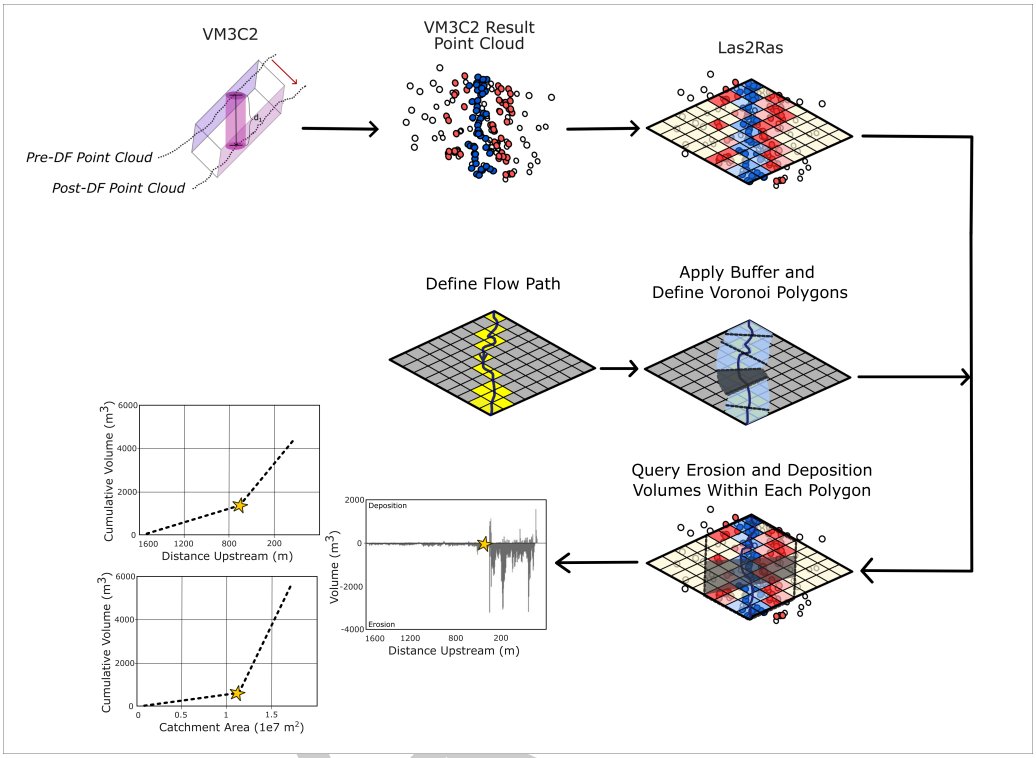

Figure 1: This figure illustrates an overview of the `IncrementalDebrisFlowVolumeAnalyzer` functionality. Pre-processing of lidar (or other change detection) data may be required depending on user needs.

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