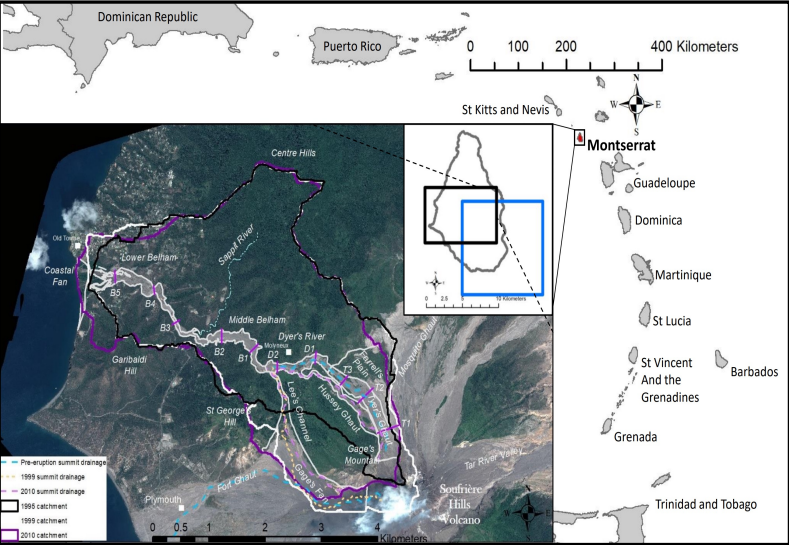


SedCas_Volcano: Simulating decadal patterns of lahar hazard and sediment transfer following volcanic disturbance in the Belham River Valley, Montserrat

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Explosive volcanic eruptions are among the most significant natural disturbances to landscapes on Earth. The widespread and rapid influx of pyroclastic sediment, together with subsequent changes to topography and vegetation cover, drives markedly heightened runoff responses to rainfall and increased downstream water and sediment fluxes; principally by way of hazardous lahars. The nature and probability of lahar occurrence under given rainfall conditions evolves as the landscape responds and subsequently recovers following the disturbance. The relationship between varying sediment supply, rainfall patterns, vegetation cover and lahar activity is complex, and impedes forecasting efforts made in the interest of hazard and land use management. Thus, developing an improved understanding of how these systems evolve in response to volcanic eruptions is of high importance.

Here we present SedCas_Volcano, a conceptual sediment cascade model, designed to simulate the first-order trends, such as magnitude-frequency distributions or seasonal patterns, in lahar activity and sediment transport. We use the Belham River Valley, Montserrat, as a case study. This small (~15km²) catchment has been repeatedly disturbed by five phases of volcanic activity at the Soufrière Hills Volcano since 1995. The multi-phase nature of this eruption, together with the varying nature and magnitude of disturbances throughout the eruption, has driven a complex disturbance-recovery cycle, which is further compounded by inter-annual climatic variations (e.g. ENSO). Lahars have occurred frequently in response to rainfall in the Belham River Valley, and their occurrence has evolved through the repeated disturbance-recovery cycle. This activity has resulted in significant net valley floor aggradation and widening, consequent burial and destruction of buildings and infrastructure, as well as coastal aggradation of up to ~250m. Within SedCas_Volcano, we account for evolving sediment supply, vegetation cover and rainfall, to simulate the lahar activity and channel change observed in the Belham River Valley since January 2001. Following this, we test the model under different hypothetical eruptive scenarios. Our goal is to assess the efficacy of such models for reproducing patterns of lahar activity and geomorphic change in river systems that are repeatedly disturbed by volcanic activity.

Data sources: Montserrat Volcano Observatory, NASA GPM, Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER), Landsat, Airbus, PlanetLabs

