

Sedimentation from widespread mass wasting events in Puerto Rico

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Puerto Rico is especially vulnerable to mass wasting, given its topography, tectonic setting, geology, climate, and land use patterns. In 2017, Hurricane Maria triggered more than 70,000 shallow landslides across the island. More recently, Hurricane Fiona in 2022 reactivated many of the same hillslopes that failed in 2017. Because of the high drainage density in the island, most shallow landslides transition into fast moving debris flows that enter first order streams. This results in remarkably little volumes of sediment being stored as “landslide deposits”.

To track the landslide-derived sediment transport, we have carried out several bathymetric surveys of reservoirs in Puerto Rico that drain mountainous zones that suffered mass wasting in hurricanes Maria and Fiona. Data from these surveys are show that Hurricane Maria caused the equivalent of around 15 years of background 21st century sedimentation in Lago Dos Bocas and Lago Caonillas, both located in the municipality of Utuado in the central interior of the island. This excess sedimentation in each lake is compatible with the LiDAR analysis estimates of volume of material lost at landslide sites in each respective basin. Both lakes are part of the Puerto Rico’s “super-aqueduct” system that provides water to the island’s San Juan metropolitan area. At the time of our surveys, Lago Dos Bocas (2021) was 64% filled with sediment and Lago Caonillas (2020) was 38% infilled. We also surveyed Lago Cerillos in Ponce in 2023. The results from this study show that Lago Cerillos is 10% infilled and that sediment mobilized by hurricanes Maria and Fiona may have accounted for storage loss equivalent to several decades of background sedimentation.

Mitigation of sediment infilling of the fragile reservoir system in Puerto Rico will be important to ensure viable water supply for the future. The research highlighted here shows that sediment influx derived by mass wasting is a major component of reservoir capacity loss. Watershed management strategies must account for this input.