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The Fogo's Collapse-triggered Megatsunami: Evidence-calibrated Numerical Simulations of Tsunamigenic Potential and Coastal Impact

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Volcanic Ocean Islands are very prominent and dynamic features involving several constructive and destructive phases during their life-cycles. Large-scale gravitational flank collapses are one of the most destructive processes and can present a major source of hazard, since it has been shown that these events are capable of triggering megatsunamis with significant coastal impact. The Fogo volcanic island, Cape Verde, presents evidence for giant edifice mass-wasting, as attested by both onshore and offshore evidence. A recent study by Ramalho et al. (2015) revealed the presence of tsunamigenic deposits that attest the generation of a megatsunami with devastating impact on the nearby Santiago Island, following Fogo's catastrophic collapse. Evidence from northern Santiago implies local minimum run-ups of 270 m, providing a unique physical framework to test collapse-triggered tsunami numerical simulations.
In this study, we investigate the tsunamigenic potential associated with Fogo's flank collapse, and its impact on the Islands of the Cape Verde archipelago using field evidence-calibrated numerical simulations. We first reconstruct the pre-event island morphology, and then employ a multilayer numerical model to simulate the flank failure flow towards and under the sea, the ensuing tsunami generation, propagation and coastal impact. We use a digital elevation model that considers the coastline configuration and the sea level at the time of the event. Preliminary numerical modeling results suggest that collapsed volumes of 90-150 km3, in one single event, generate numerical solutions that are compatible with field evidence. Our simulations suggest that Fogo's collapse triggered a megatsunami that reached the coast of Santiago in 8 min, and with wave heights in excess of 250 m. The tsunami waves propagated with lower amplitudes towards the Cape Verde Islands located northward of Fogo. This study will contribute to more realistically assess the scale of risks associated with these extremely rare but very high impact natural disasters.

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