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Investigating the potential for volcano flank instability triggered by recent dike intrusions at Fogo volcano, Cape Verde

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Gravitational flank-collapses at volcanoes are rare but catastrophic events that have rarely been witnessed by humans (e.g., Mount St. Helens in 1980). It has been proposed that gravitationally unstable volcanic flanks can be classified in two different types based on the flanks slope: volcanoes characterized by gentle slopes (Hawaiian-like) and that have very dynamic flanks exhibiting high rates of deformation and, conversely, steep-sided volcanoes (Macaronesian-like) showing minimal ground deformation. The two types of volcanoes could therefore reach the stable-state through different mechanisms and experience different mass-wasting processes.
Numerous giant debris-avalanche deposits have been identified offshore the volcanoes of the Canary Islands and Cape Verde. Given the steep slopes of these volcanoes, the mass-wasting events may have occurred suddenly and with minimal precursory signals. Several mechanisms have been proposed as potential triggers and among these the intrusion of shallow dikes feeding fissure eruptions is one of the best candidates.
In this work, we investigate this hypothesis in the light of new and revised results derived from the analysis of geodetic observations at Fogo volcano (Cape Verde). Fogo has erupted twice in the last 20 years (1995 and 2014-2015) and in both occasions the volcano erupted along fissures that seem to be fed by dykes intruding the shallow crust and the volcanic edifice. We re-process radar data from the ERS satellite to obtain state-of-the-art deformation maps spanning the 1995 eruption and revisit previously proposed models of the magmatic system. Our results indicate that both eruptions were fed by sub-vertical dikes, steeply dipping to the SE, and radiating from the Pico do Fogo volcanic cone to the SW. We also study the effect of such magmatic intrusions in terms of the stress regime that they generate and analyze whether the 1995 and 2014 intrusions could potentially destabilize the structures along which a previous volcano flank-collapse has occurred. Finally, we briefly investigate potential mechanisms that could control the propagation of magma along pre-existing fracture systems.