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Influence of landslide geometry on the dynamics of large debris-avalanches: a comparative study on Tenerife and Tahiti volcanic islands

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Giant landslides affecting volcanic islands can generate voluminous debris-avalanches (DA) and provoke destructive tsunamis. A number of triggering factors have been proposed over the past twenty years but their mutual interactions are still controversial. In addition, the dynamic behavior of submarine DA remains largely unknown, though it constitutes a key element for risk assessment and hazard planning. We present here a comparative study of two large landslides, which affected the volcanic islands of Tenerife (Canary) and Tahiti-Nui (French Polynesia), respectively. In each case, the geometry of the volcanic complex before and after the landslide and the surrounding topography are reconstructed and computed from available on-land and offshore geological constraints. These reconstructions are then used to simulate the propagation of the DA with the volcflow code, which includes various rheological models. The volume of the Icod landslide on Tenerife is here estimated at about 200 km^3, i.e. twice the value generally admitted. The DA products were generated from a 15 km wide collapse headwall and moved through a narrow submarine canyon where they experienced significant slow-down and subsequently deposited as an 80 km-elongated narrow lobe to the North of the island. A laminar flow – like velocity pattern is observed, reflecting shearing of the material along the lateral walls of the canyon. This most probably provoked crushing of the landslide products, which can explain the scarcity of large blocks identified from sonar data in the Icod DA. To the North of Tahiti, voluminous DA ($>$400 km^3) bearing numerous large km-sized blocks were generated

from a 25km-wide and more opened amphitheater. In contrast with the Icod landslide, the Tahiti northern DA experienced a rapid spreading and deceleration, which most probably results from the absence of significant lateral confinement. The smaller runout of Tahiti northern DA can be explained by a more efficient energy loss by basal friction of the blocks over a larger area, in good agreement with the purely frictional rheology that best describes the motion of the flow. This preliminary study highlights the great influence of landslide geometry on the dynamics of fast-running DA and thus constitutes a promising research topic for future work on the impacts of flank collapses on volcanic islands.