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Using a ballistic-caprock model for developing a volcanic projectiles hazard map at Santorini caldera

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Volcanic Ballistic Projectiles (VBPs) are rock/magma fragments of variable size that are ejected from active vents during explosive eruptions. VBPs follow almost parabolic trajectories that are influenced by gravity and drag forces before they reach their impact point on the Earth's surface. Owing to their high temperature and kinetic energies, VBPs can potentially cause human casualties, severe damage to buildings as well as trigger fires. Since the Minoan eruption the Santorini caldera has produced several smaller (VEI = 2-3) vulcanian eruptions, the last of which occurred in 1950, while in 2011 it also experienced significant deformation/seismicity even though no eruption eventually occurred. In this work, an eruptive model appropriate for vulcanian eruptions is used to estimate initial conditions (ejection height, velocity) for VBPs assuming a broad range of gas concentration/overpressure in the vent. These initial conditions are then inserted into a ballistic model for the purpose of calculating the maximum range of VBPs for different VBP sizes (0.35-3 m), varying drag coefficient as a function of VBP speed and varying air density as a function of altitude. In agreement with previous studies a zone of reduced drag is also included in the ballistic calculations that is determined based on the size of vents that were active in the Kameni islands during previous eruptions (< 1 km). Results show that the horizontal range of VBPs varies between 0.9-3 km and greatly depends on gas concentration, the extent of the reduced drag zone and the size of VBP. Hazard maps are then constructed by taking into account the maximum horizontal range values as well as potential locations of eruptive vents along a NE-SW direction around the Kameni islands (the so-called "Kameni line").