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A post-2015 lava flow hazard map for Fogo Volcano, Cabo Verde

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In 1995 and in 2014-2015 basaltic lava flows originating from vents at the western flank of the Pico do Fogo stratocone, Cabo Verde, advanced to destroy houses and agricultural lands. Both eruptions were very similar in style and the emitted lava flow volumes were almost equal (0.460 and 0.458 km³, respectively). Reconstruction of the two villages Portela and Bangaeira that were almost completely covered by the 2014-2015 lava flows started soon after the eruption was over. Therefore, lava flow hazard information is an urgent need for the local communities. On the basis of an updated, high-quality digital elevation model (DEM) that was generated from terrestrial laser scanner (TLS) and photogrammetric data, we developed a lava flow hazard map that is valid for the next, post-2015 eruption of Fogo Volcano, before the location of the future vent is known. For this purpose, lava flow simulations were performed for ~83000 possible vent locations using the DOWNFLOW probabilistic code. Our hazard map shows the probability of lava flow invasion at each pixel of the DEM. This is calculated from the sum of all the simulations that reach that pixel, while each simulation is weighted by the lava flow length constraint and the probability of vent opening. The DOWNFLOW model was calibrated by simulating the 2014-2015 lava flow and comparing the results to the actual 2014-2015 lava flow coverage. Our hazard map was validated on the basis of the pre-2014 hazard map scenario. We find that even after the devastating 2014-2015 eruption, lava flow hazard levels remain high at the locations of the Portela and Bangaeira villages. Our results are important for land use planning at Fogo Volcano and have implications for future effusive eruptions elsewhere in the world.