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Deterministic and probabilistic volcanic risk studies for Popocatepetl and Colima volcanoes in Mexico

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Deterministic and probabilistic volcanic risk studies for the two most active volcanoes in Mexico have been done for three types of volcanic hazard: lava, pyroclastic flow and tephra. The risk study has three main components: hazard, exposure and vulnerability. A deterministic risk study allows computing economic and human losses due to a single event; on the other side, a probabilistic risk study allows the estimation of losses in terms of the expected annual loss as well as a probable maximum loss (PML) for a given return period. For the probabilistic study, the hazard component includes all possible scenarios that can occur for each volcano based on the past historical events. An emission vent and a Volcanic Explosivity Index or Magnitude value characterize a single scenario. Maps with the distribution of the different hazards and their characteristics (height, dynamic pressure and velocity) have been estimated and analyzed for both probabilistic and deterministic studies considering the periodicity of the occurrence of events for each VEI and Magnitude. The exposure component consists of a dataset of rural and urban houses, airports, infrastructure, schools and hospitals which contains information about their locations, areas, building types and values. For each building type, a vulnerability function has been created considering the material and the components of the structure. The final results of the risk studies conducted considering hazard, exposure and vulnerability components are maps with the distribution of human and economic losses caused by an event in the deterministic case and exceedance probability curves with the relationship between losses and frequency, and maps with geographical distribution of the annual losses for probability studies. Examples will be shown, such as the Popocatepetl volcano that presents a particularly high threat because it is located less than 50km from Mexico City, whose urban population is close to 20 million.