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A comprehensive risk assessment for tephra accumulation using easily accessible data: the example of Cotopaxi volcano (Ecuador)

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In order to answer the needs of contingency planning, we present a GIS-based method for risk assessment of tephra deposits, which is flexible enough to work with datasets of variable precision and resolution depending on data availabilty. Due to the constant increase of population density around volcanoes and the large dispersal of tephra from volcanic plumes, a wide range of threats such as roof collapses, destruction of crops, blockage of vital lifelines and health problems concern even remote communities. In the field of disaster management, there is a general agreement that a global and incomplete method, subject to revision and improvements, is better than no information at all. In this framework, our method is able to provide fast and rough insights on possible eruptive scenarios and their potential consequences on surrounding populations with only few available data, which can easily be refined later. Therefore, the knowledge of both the expected hazard (frequency and magnitude) and the vulnerability of elements at risk are required by planners in order to produce efficient emergency planning prior to a crisis.

The Cotopaxi volcano, one of Ecuador's most active volcanoes, was used to develop and test this method. Cotopaxi volcano is located 60 km south of Quito and threatens a highly populated valley. Based on field data, historical reports and the Smithsonian catalogue, our hazard assessment was carried out using the numerical model TEPHRA2. We first applied a deterministic approach that evolved towards a fully probabilistic method in order to account for the most likely eruptive scenarios as well as the variability of atmospheric conditions. In parallel, we carried out a vulnerability assessment of the physical (crops and roofs), social (populations) and systemic elements-at-risk by using mainly free and easily accessible data. Both hazard and vulnerability assessments were compiled with GIS tools to draw comprehensive and tangible thematic risk maps, providing thus the first necessary step for efficient preparedness plannings.