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Developing a Digital Elevation Model for lahar channels to facilitate prevention parameters during eruptive periods: Popocatépetl volcano, Mexico

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Volcanic activity on Popocatépetl, Mexico (19º02'N, 98º62'W; 5424 m), resumed in December 1994 and continues even today. The pyroclastic falls and flows that covered the glacier triggered the formation of lahars in 1995, 1997 and 2001. The largest flows travelled through the Tenenepanco -Huiloac Gorge on the North slope of the volcano to a distance of 17 km, threatening the towns of Santiago Xalitzintla and San Nicolas de Los Ranchos (State of Puebla).

The lahars formed in rapid succession during this period of violent activity. To determine the flows' erosive capacity along the lahar channel and parameterise flow and flood detection models, it was necessary to quickly obtain basic parameters such as velocity, viscosity, impact force, the dimensions of the gorges, etc. The only information representing the terrain available was a topographic map generated in 1978 at the 1:50,000 scale for Huejotzingo (E14B42). The map lacked the detail to depict landscape changes caused by the lahars.

The presence of dense forests covering the lahar channel made it impossible to use aerial interpretation (photographic and satellite imagery), and geodesic techniques based on GPS technology were nonfunctional because the relief and vegetation interfered with the readings. Traditional, total station topographic surveying were eval-

uated as the most accurate methodology, but it is costly and time consuming. These problems are typical of areas with active volcanoes, particularly in developing countries where highly accurate maps and georeferenced control points are scarce and only limited economic resources are allocated for hazard risk mapping and prevention.

In view of these difficulties, a specific methodology was developed to create a detailed Digital Elevation Model (DEM) to represent the lahar channels and its surrounding area. The methodology requires only two to three people for a few days of work to produce satisfactory results. The method consists of tracing a polygonal of the channel thalweg and cross sections at points where the thalweg varies. Once this data is obtained, it is transferred to a Geographic Information System (GIS) where it is mathematically converted to an array of points for each section.

This process was applied at the Tenenepanco-Huiloac channel, and the results were used to create a more detailed DEM for the lahar channel areas (up to 2x2 m pixel). Higher resolution made it possible to identify the paths of the lahars and determine the spatial distribution of some of the basic parameters such as velocity. It also greatly enhanced the accuracy of flow and flood detection simulation models.

It is believed that whenever there is an urgent need for creating or updating hazard risk maps and aerial interpretation or topographic surveying techniques are not viable or to costly, this new methodology is capable to provide a way of acquiring the essential data needed.