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# Five years of lahar monitoring at Volcán de Colima, México: outcomes and perspectives

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Volcán de Colima is one of the most active volcanoes in Mexico. One of the most common phenomenon at this volcano is the annual development of lahars that runs mainly through the southern ravines of the edifice. Since 2011 the study and real-time monitoring of these flows has been achieved by means of monitoring stations on the two main actives ravines, Montegrande and Lumbre, along with the systematic surveying of cross topographic profiles of the main channel, and field data. These monitoring sites consist of a geophone, a videocamera, and a raingauge coupled with a moisture sensor, all transmitting data in real-time to the RESCO facilities at Colima University. These monitoring sites helped to understand the triggering mechanisms and flow behavior of lahars developed in Montegrande and Lumbre ravines, along with the data gathered during field campaigns. Correlation of the seismic data with the imagery records of the lahars yield to a main discrimination between single-pulse and multi-pulse events. Each pulse consist of a block-rich front that precedes a flow body in the range of a debris flow, followed by a dilute, hyperconcentrated tail. Topographic surveys along the main channels indicates that during the intra-eruptive period between 2007 and June 2015 the volcano slope recovered its hydrological and sedimentary-yield balance. The results obtained in this project helped to design a proper alert system for future events, along with mitigation strategies for the populations exposed to such phenomenon. More instruments are planned to be installed (i.e. infrasound and flow stage) in order to study the features that are still missing from this research, especially under the ever-changing conditions of the volcano. Based on the successfully results obtained at Volcán de Colima, similar lahar monitoring system will be implemented at other active volcanoes in Mexico.