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Learning from nature: favoring small lahars formation for hazard mitigation

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Lahars represent one of the world destructive natural phenomena as number of casualties (Manville et al., 2013). Lahars originate as mixtures of water and volcanic deposits frequently by heavy rainfalls; they are erosive floods capable of increase in volume along its path to more than 10 times their initial size, moving up to 100 km/h in steeply sloping as far as an extreme distance of hundreds of kilometers.

Beside tools of early warning, security measures have been adopted in volcanic territory, by constructing retaining dams and embankments in key positions for containing and deviating possible lahars (Leung et al., 2003). This solution could involve a strong environmental impact both for the works and the continuous accumulation of volcanic deposits, such that equilibrium conditions could lack far, triggering more disastrous events.

The growing frequency of lahars in the Vascún Valley area, Tungurahua Volcano Ecuador, maybe for the climatic change, has recently produced smaller (shorter accumulation periods) and therefore less dangerous events.

Momentary ponds form along rivers in volcanic areas, when they become usually blocked by landslides of volcanic deposits, which are originated by pyroclastic flows and lahars. The most frequent cause of a breakout of such natural ponds is the overflow of water across the newly formed dam and subsequent erosion and rapid downcutting into the loose rock debris.

Dam collapse can occur by sliding of the volcanic deposit or by its overturning. By eroding the blockage and flowing out river channel downstream, the initial surge of water will incorporate a dangerous volume of sediments. This produces lahars with possible devastating effects for settlements in their path (Leung et al., 2003).

The use of simulation tools (from the cellular automata model LLUNPIY) and field data (including necessary subsoil survey) permit to individuate points, where dams by backfills, easy to collapse,

can produce momentary ponds.

Small temporary dams with similar (but controlled) behavior of above mentioned dams can be designed and built at low cost by local backfills in order to allow the outflow of streams produced by regular rainfall events. This result is achieved by properly dimensioning a discharge channel at the dam base (Lupiano et al., 2020).

So small lahars can be triggered for minor rainfall events, lahar detachments can be anticipated for major events, avoiding simultaneous confluence with other lahars (Lupiano et al., 2020).

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