Geophysical Research Abstracts
Vol. 16, EGU2014-8607, 2014
EGU General Assembly 2014

An ergodic approach to eruption hazard scaling

Servando De la Cruz-Reyna and Ana Teresa Mendoza-Rosas
Universidad Nacional Autonoma de Mexico (UNAM), Instituto de Geofisica, Mexico D.F., Mexico (sdelacrr@geofisica.unam.mx)

The complexity and indeterminacy of volcanic processes demand the use of statistical methods to analyze the expectations of the occurrence and size of future eruptions. The probability of a volcano producing potentially destructive eruptions in a given time interval may be estimated analyzing the sequence of past eruptions assuming a physically plausible process. Since the threat posed by eruptions depends on their mass or energy release (magnitude) and on their emission rate (intensity), the Volcanic Explosivity Index is a suitable measure to quantify the eruptive events, particularly considering that the largest available global catalogues use that measure. The definition of volcanic hazard is thus posed here in terms of the expected annual release of energy by eruptions in each VEI category. This concept is based on the ergodic property of a large set of volcanoes to release about the same amount of energy in each VEI category over a sufficiently large time interval. This property is however constrained to the VEI range of eruptions that constitute complete catalogues (VEI >2) in the lower end, and to the extreme eruptions that may destroy or significantly alter a volcanic system, such as the large caldera-forming eruptions (VEI < 7). In such conditions, a simple power law for eruptions at the global level relating the global rate of energy release to the eruption magnitude has been proposed as a statistical basis for eruptive event model development. Following the above mentioned arguments, we assume that a similar scaling law rules the annual rate at which energy is released by eruptions at individual volcanoes as log(EmRm)=bM+a, where Em is the energy released by eruptions in the VEI magnitude class M, and Rm is the occurrence rate of such eruptions over times ranges in which catalogues may be considered complete. The parameters b and a depend on the eruptive history of individual volcanoes, the former determining the preferred mode of the volcano to release energy: through smaller (negative slope) or through larger (positive slope) eruptions while the latter is a measure of the volcano energy potential. Examples comparing the relative scales of the hazard defined with this procedure among Mexican volcanoes such as Colima, Citlaltepetl, El Chichón and Popocatepetl are presented to illustrate the method, aimed to provide an objective criterion to assess the relative hazard posed by different volcanoes.