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Scaling volcanic eruptions. An essential step to estimate the regional volcanic hazard

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The volcanic hazard in a given region may be defined as the probability of occurrence of eruptions in the volcanoes considered active. This simple definition usually makes it difficult to calculate and compare the hazard among the active volcanoes in the region. Is a volcano with frequent moderate eruptions more dangerous than a usually dormant volcano which has produced large eruptions in the past? Questions like this are often difficult to answer, and some times the answers are conflicting. A method that allows objective comparison among different volcanoes is proposed here to estimate the hazard considering the relative probabilities of the occurrence of eruptions with different magnitudes. The probability of a potentially destructive eruption may be estimated in a volcano analyzing the sequence of past eruptions, and assuming that the effects of the eruptions are proportional to the energy (magnitude), and the rate of energy release (intensity). The VEI (Newhall and Self, 1982) sizes the eruptions using both parameters. We introduce here an extension of the definition of volcanic hazard in terms of the expected annual release of energy by eruptions in each VEI category. This concept is based on the averaging property of a large set of volcanoes to release the same amount of energy in each VEI category over a sufficiently large time interval, i.e., a set of volcanoes produce eruptions in such a way that the many smaller ones release about the same energy than the few larger ones (De la Cruz-Reyna, 1991). The annual rate at which energy is released by eruptions is described by log(EmKm)=bM+a, where Em is the energy released by eruptions in the VEI magnitude class M, and Km is the occurrence rate of such eruptions. The parameters a and b depend on the eruptive history of individual volcanoes. The slope b determines the preferred mode of the volcano to release energy: through smaller (negative slope) or through larger (positive slope) eruptions. The parameter a determines the volcano energy potential. As an example, the method is applied here to different volcanoes.