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Seismic-acoustic energy partitioning during a paroxysmal eruptive phase of Tungurahua volcano, Ecuador

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Abstract

Studies of discrete volcanic explosions, that usually last less than 2 or 3 min, have suggested that the partitioning of seismic-acoustic energy is likely related to a range of physical mechanisms that depend on magma properties and other physical constraints such as the location of the fragmentation surface. In this paper, we explore the energy partition of a paroxysmal eruptive phase of Tungurahua volcano that lasted for over 4 hr, on 2006 July 14–15, using seismic-acoustic information recorded by stations on its flanks (near field). We find evidence of a linear scaling between seismic and acoustic energies, with time-dependent intensities, during the sustained explosive phase of the eruption. Furthermore, we argue that this scaling can be explained by two different processes: (1) the fragmentation region ultimately acts as the common source of energy producing both direct seismic waves, that travel through the volcanic edifice, and direct acoustic waves coming from a disturbed atmosphere above the summit; (2) the coupling of acoustic waves with the ground to cause seismic waves. Both processes are concurrent, however we have found that the first one is dominant for seismic records below 4 Hz. Here we use the linear scaling of intensities to construct seismic and acoustic indices, which, we argue, could be used to track an ongoing eruption. Thus, especially in strong paroxysms that can produce pyroclastic flows, the index correlation and their levels can be used as quantitative monitoring parameters to assess the volcanic hazard in real time. Additionally, we suggest from the linear scaling that the source type for both cases, seismic and acoustic, is dipolar and dominant in the near field.

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