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Friction weakening in granular flows deduced from seismic records at the Soufrière Hills Volcano, Montserrat

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Accurate modelling of rockfalls and pyroclastic flows is still an open issue, partly due the lack of measurements related to the dynamics of such events. Using seismic data from the Soufrière Hills Volcano and granular flow modelling, we show that the power laws relating the seismic energy E_s to the seismic duration t_s and relating the loss of potential energy ΔE_p to the flow duration t_f are very similar ($E_i \propto t_i^\beta$ with $i = s, p$), as observed previously at Piton de la Fournaise, Reunion Island. Observations showing that $t_f \simeq t_s$ suggest a constant ratio $E_s/\Delta E_p \simeq 10^{-5}$. This similarity in the power laws can be obtained only when the granular flow model uses a friction coefficient that decreases with the volume involved. Furthermore, with this volume-dependent friction coefficient, the simulated force applied by the flow to the ground correlates well with the seismic energy, highlighting the signature of this friction weakening effect in seismic data.