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Can earthquakes lead to delayed avalanche release ?

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Strong earthquakes often trigger snow avalanches, sometimes with observable delays. Most existing models assume that snow slab avalanches happen simultaneously during or immediately after their triggering. Therefore, they cannot explain the plausibility of delayed avalanches that are released minutes to hours after a quake. Resolving this shortcoming is critical for improving safety, as emphasized by deadly delayed avalanches in Western Himalaya and, most recently, by the devastating Rigopiano avalanche in Italy's Abruzzo region, which occurred more than 30 min after the last in a series of major quakes on 18 January 2017. This work establishes the basic mechanism of delays in earthquake-induced avalanche release using a novel analytical model that yields failure scenarios consistent with the Western Himalaya and Rigopiano cases. The mechanism arises from the interplay between creep, strain softening and strain-rate sensitivity of snow, which drive the growth of a basal shear fracture. Our results imply that earthquake-delayed avalanches are rare, yet possible, and could lead to significant damage, especially in long milder slopes. The generality of the model formulation opens a new avenue for exploring other questions related to natural slab avalanche release.