EGU2020-4464
https://doi.org/10.5194/egusphere-egu2020-4464
EGU General Assembly 2020

Rain and small earthquakes maintain a slow-moving landslide in a persistent critical state

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In tectonically active mountain belts, landslides contribute significantly to erosion. Statistical analysis of regional inventories of earthquake-triggered-landslides after large earthquakes (Mw>5.5) reveal a complex interaction between seismic shaking, landslide material, and rainfall. However, the contributions of each component have never been quantified due to a lack of in-situ data for active landslides. We exploited a 3-year geodetic and seismic dataset for a slow-moving landslide in Peru affected by local earthquakes and seasonal rainfalls. Here we show that in combination, they cause greater landslide motion than either force alone. We also show the rigidity of the landslide's bulk clearly decreasing during Ml≥5 earthquakes. The recovery is affected by rainfall and small earthquakes (Ml<3.6), which prevent the soil from healing, highlighting the importance of the timing between forcings. These new quantitative insights into the mechanics of landslides open new perspectives for the study of the mass balance of earthquakes.