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Spatial and temporal distribution of precipitation and its relationship with landslides within the Aburrá Valley, northern Colombian Andes.

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Landslides are extensively distributed across the globe. About 17% of deaths due to natural hazards reported in the last decade are attributed to landslides. The spatial and temporal distribution of landslides are related to static and dynamic factors. The first group involves terrain aspects and land use, and the second group includes triggering factors, such as rainfall and earthquakes. The 61% of worldwide landslides recorded are triggered by rainfall. In Colombia, the percentage reaches 92%, becoming the main factor that triggers landslides.

The Aburrá Valley is located in the central northern Andes, characterized by its complex topography and one of Colombia's most densely populated valleys, with 3.9 million inhabitants. In this study, the spatial and temporal relationship between landslides and rainfall in the Aburrá Valley is unraveled. Three kinds of rainfall information are used: pluviograph (145 stations), radar and satellite. Regarding the landslide database, 940 landslides were compiled between 1921 and 2023. The temporal analysis includes the understanding of different time scales: decadal, annual, daily, and hourly because several macroclimatic aspects affect the precipitation regime, such as El Niño-Southern Oscillation (ENSO), Pacific Decadal Oscillation (PDO) and Intertropical Convergence Zone (ICZ). This understanding leads to knowing on what scale there is clear evidence that regional precipitation changes can affect the occurrence of landslides. Regarding the spatial analysis, the radar and satellite information complements the data of punctual pluviographic stations.

The results show that the ENSO affects the development of rainfall regimes on all time scales. When the PDO and ENSO match, the effects of EL Niño and La Niña phases are exacerbated, resulting in lower and higher landslides, respectively. In general, Aburrá Valley exhibits a bimodal precipitation phase, where the annual cycle peak of landslides matches with the peaks of rainfall annual cycle; the Enso affects the cycle mentioned, showing that, especially in dry periods, the effects of Enso increase the rainfall difference and landslides register. The daily analysis demonstrates a peak shift between the two variables evaluated, showing that the landslides will need antecedent rainy days to trigger them. There is no clear relationship at the hourly scale because of the reduced number of hourly landslide events registered. Concerning the spatial variation, a hot-spot of landslide is located in the valley's east hill, where the rainfall events with more duration are placed. Another finding is that satellite information is highly correlated with on-

site measurements when the antecedent precipitation is evaluated for more than 15 days.