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Local and regional rainfall thresholds for landsliding in the Serra do Mar, Brazil: statistical and environmental analyses.

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ln the tropical environment of the municipality of Angra dos Reis, located in the Rio de Janeiro State of Brazil, the frequency of rainfall-induced landslides is particularly high because of the rugged terrain of the Serra do Mar, heavy summer rainfall and increasing urbanization. Since such landslides repeatedly interfere with human activities and infrastructures, improved knowledge related to spatial and temporal prediction of the phenomenon is of interest to municipal authorities managing the risk. This study is an analysis of rainfall thresholds, which aims to establish local and regional scale correlations between rainfall and the triggering of landslides in the municipality of Angra dos Reis, while paying a special attention to the spatial variability of the geological, geomorphological, climatic and anthropogenic conditions that may affect threshold values. A statistical analysis combining quantile regression and binary logistic regression was performed on 1640 and 526 landslides triggered by daily rainfall between January 2008 and March 2013 in the municipality and the urban center of Angra dos Reis, in order to establish probabilistic and normalized event rainfall-rainfall duration (ED) thresholds and assess the role of antecedent rainfall. 98 landslides that occurred in the urban center between May 19 of 2011 and June the 30th of 2013 were also investigated to evaluate the effect of sub-hourly rainfall measurements on the threshold limits. The results show that the frequency of landslides depends strongly on the monthly and annual rainfall, and the proposed thresholds are particularly low compared to most of the thresholds established in the scientific literature for Brazil, the tropics and other places around the world. Paragneiss, urban areas and 15 days antecedent rainfall are the parameters that appear to contribute to the lowering of the thresholds. The results presented in this study provide new insight into the spatial and temporal dynamics of landslides and rainfall conditions leading to their activation in this tropical and mountainous environment.