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Characterization of past landslides and slope susceptibility analysis for Lima and Callao provinces, Peru

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85% of people exposed to earthquakes, hurricanes, floods and drought live in developing countries (IPU, 2010). This population is also exposed to the landslide risk as this phenomenon is mainly triggered by earthquakes and rainfall. There is an urgent need to propose methods to evaluate and mitigate the landslide risk for developing countries, where few studies were undergone and data, and information on data, are scarce. In this study, we characterize a landslide inventory set up for the megalopolis of Lima, Peru, by the local geological bureau (INGEMMET). This inventory was set up using satellite images and includes landslides of all ages. It is composed of two landslide types: rockfalls and debris flows (huaycos) that we investigate together and separately. First, we describe qualitatively the landslide occurrences in terms of geology, slope steepness, altitude, etc. We notably find that debris flows occur at altitudes larger than the ones of the rockfalls, probably due to the climatic conditions. Then we find that the rockfalls and debris flows area distributions follow a power law when investigated separately whereas it does not follow a power law when investigated together. This highlights a logical difference of mechanics between the two landslide types. Then, using the dimension of correlation D (Grassberger and Procaccia, 1983) we show that the event spatial occurrences are not uniformly distributed but clustered. It supports the existence of controlling parameters on the spatial occurrence of landslides and the research to identify them. Last, we investigate the relationships between different landslide parameters (geology, altitude, slope steepness, ...) using the linear correlation coefficient r, and we find that all these parameters are independent to each other. This allows us to investigate each parameter separately in terms of landslide susceptibility and to define values for which the landslide susceptibility is low, medium or high for each parameter.

The characterization of the landslide database is a necessary step to assess the good quality of the data. It then allows us to pursue our investigation and set up a robust landslide susceptibility analysis using our good-quality inventory.