Urban Landslides in Social-Ecological-Technological Systems: the case of São Paulo Metropolitan Region

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Urban landslides are increasing globally caused manly by human-induced changes in hillsides. From 1993 to 2013, more than 12,000 geological disasters events, mostly shallow landslides, were recorded in the biggest urban agglomeration in Brazil, the Metropolitan Region of São Paulo (MRSP). The majority of these events caused low-intensity damages to housing and infrastructure. Social-Ecological-Technological System's approach enables the analysis of urban landslides as the outcome of dynamic socioeconomic and infrastructural conditions alongside climatic and geophysical conditions. Intrinsic characteristics and natural processes of ecological-biophysical domain are altered by urbanization on hillsides. Alterations are controlled by actions of dwellers, land developers and public administration, understood as components of the social-behavioral domain. These actions are materialized in the technological-infrastructural domain, comprising the built environment.

A total of 2,038 events recorded in 2009/2010 were used to model landslides' occurrence in MRSP, associating them to variables characterizing terrain, infrastructural conditions, families and their building practices, as well as the antecedent rainfall calculated for landslides' and non-landslides' points. A multi-step model was used to select the best set of variables and assess their importance.

Results showed that antecedent rainfall plays the most important role, followed by terrain slope. Subnormal conditions, revealing poor building practices and the lack of municipal inspection, alongside with the number of households, which stands for built density and therefore a greater alteration in hillsides, yielded slightly lower contribution. Other variables related to families' income and educational level, infrastructure systems and vegetation provided only a marginal contribution. The value of AUC of the model was of 0.9087, denoting the high level of discrimination achieved. These results reinforce the role of local

ordinances aimed to restrict occupation in steeper slopes and public policies to promote adequate housing and to improve building practices. On the other hand, future climate projections to MRSP point to the increment of intense rainfall days, calling attention to the increasing risk posed by landslides.

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