



Socio-geoenvironmental vulnerability index (SGeoVI) derived from hybrid modeling related to populations at-risk to landslides

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Abstract

In the present study, we propose a transdisciplinary investigation aimed at developing an index to assess the vulnerability to landslides in the Brazilian municipality of São José dos Campos. The proposed Socio-Geoenvironmental Vulnerability Index (SGeoVI) was developed using a hybrid modeling approach that integrates socioeconomic data with landslide susceptibility mapping. Landslide susceptibility was derived from the FS FIORI deterministic model, which calculates the Safety Factor (FS) using the concept of limit equilibrium. The mapping of land use and land cover enabled the inclusion of new parameters related to certain anthropogenic conditions and vegetation cover, such as the overabundance of buildings and the presence or absence of tree vegetation, which are significant factors influencing landslide occurrence. Socioeconomic indicators were extracted from Brazilian Institute of Geography and Statistics (IBGE) census data, and variables were selected and spatially represented for each of São José dos Campos's 1073 census tracts. Socioeconomic indicators were taken into account for the SGeoVI proposal and categorized into five thematic groups: economic; educational; housing infrastructure; social dependency; e family structure. Based on the Socio-geoenvironmental vulnerability indicators, several neighborhoods in São José dos Campos, SP, were selected for a detailed SGeoVI assessment. In Pinheirinhos, a neighborhood situated in the southernmost part of São José dos Campo, the highest SGeoVI value reached to 0.91. In contrast, Jardim Apolo I, an established neighborhood located in the Central Region of São José dos Campos, exhibited a considerably lower SGeoVI value of only 0.04, for instance. The verification results of SGeoVI revealed socioeconomic disparities that align with geomorphological variations. The northern and southern parts of the municipality exhibit high susceptibility to landslides, coupled with low-income communities and inadequate housing structures, contributing to elevated socio-geoenvironmental vulnerability. In contrast, central regions feature flat terrain, reduced natural susceptibility, higher income levels, and improved access to housing infrastructure, resulting in lower vulnerability values. Given its ability to assess intra-municipal socio-geoenvironmental vulnerability, SGeoVI holds potential for extrapolation to other municipalities. Consequently, it can serve as a valuable tool for municipal authorities in formulating public policies aimed at landslide risk management.

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