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Susceptibility assessment of shallow landslides occurrence in the Mt. Nerone district (central Apennines, Italy)

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Rainfall-induced shallow landslides are among the most common gravitational mass movements on natural and artificial slopes. In addition, these events are also responsible for severe consequences on ecosystem services provided by forests and rural landscapes, and on human lives, activities and infrastructures. Considering that the frequency of critical rainfall events is expected to increase in the future due to climate change, the development and application of physically-based models for assessing hydrogeological instability are necessary to monitor the potential occurrence of such landslide events and to suggest possible adaptive forest management. SlideforMAP, a software developed by the ecorisQ international association (ecorisq.org), is a physically-based model that quantifies the slope failure probability and tree roots' contribution to preventing soil mass movement. In this study, SlideforMAP was applied in the Mt. Nerone district (central Apennines, Italy) to asses the local landslide susceptibility. According to the national landslide inventories, significant landslides occurred in this area in the past. However, recent land-use changes that promoted forest recolonization on abandoned fields and grasslands, have substantially reduced the frequency of these critical events. This process enhanced the contribution of root reinforcement to landslide occurrence prevention. In fact, the historical landslides (covering about 14% of the entire Mt. Nerone area) are currently located on new forests previously used as agro-pastoral lands like in most of the study district. The SlideforMAP analysis detected potentially susceptible areas using factors such as morphology and related effects on water flow directions, soil type, and forest cover. We reconstructed some scenarios based on different rainfall return periods and forest cover, allowing for a pre-assessment of the potential hazard and risk levels in the investigated area. We found that the urban settlements and infrastructures are exposed to significant damage and that forested areas could play a primary protection role against shallow landslides. In detail, 17% and 32% of the total forest area in Mt. Nerone can potentially assume a primary function of direct protection of structures and infrastructures, respectively. The forest types more involved in this role are hop hornbeam-manna ash, turkey and downy oak, and beech forests, whereas 18% of the surface area subjected to risk of infrastructure damage is on pasture lands. Moreover, we were able to detect the forest areas with a substantial mitigation role and those where functional improvement is recommended. Finally, we were able to determine the mitigation effect of the forest expansion on the reduction of landslide frequency and to assess the current landslide susceptibility of the Mt. Nerone district. This study confirms the relevance of physically-based models in supporting land and forest management decision-making, aiming to increase the provisioning of ecosystem services and guarantee the safety of local communities, preserving the integrity of related cultural heritages and landscapes.