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National scale soil sealing monitoring data as a new explanatory variable for landslide susceptibility models

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It is widely known that human activities can negatively affect the equilibrium of slope systems, triggering or predisposing to landslides. In Italy, ISPRA (Italian Institute for Environmental Protection Research) uses remote sensing techniques to monitor the expansion of artificialization of the territory and releases every year an updated map of soil sealing, which is defined as the destruction or covering of natural soils by totally or partially impermeable artificial material. The soil sealing map covers the entire national territory and has a fine spatial resolution (10 m).

In this work, for the first time, soil sealing indicators are used as explanatory variables in a landslide susceptibility assessment. Three new parameters were derived from the raw soil sealing map: “soil sealing aggregation” (continuous variable expressing the percentage of sealed soil within each mapping unit), “soil sealing” (categorical variable expressing if a mapping unit is mainly natural or sealed), “urbanization” (categorical variable subdividing each unit into natural, semi-urbanized, or urbanized).

These parameters were added to a set of state-of-the-art explanatory variables in a random forest landslide susceptibility model. In particular, the parameters derived from soil sealing were compared with two state-of-the-art parameters widely used to account for human disturbance: land cover/land use (as derived from a CORINE land cover map) and road network.

Results were compared in terms of AUC (area under receiver operating characteristics curve, expressing the overall effectiveness of the configurations tested) and out-of-bag-error (used to quantify the relative importance of each variable). We found that the parameter “soil sealing aggregation” significantly enhanced the model performances. The results open new perspectives for the use of data derived from soil sealing monitoring programs to improve landslide hazard studies.