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A data-drive model for the assessment of shallow landslides hazard with the integration of satellite soil moisture and rainfall data

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Rainfall-induced shallow landslides are very dangerous phenomena, widespread all over the world, which could provoke significant damages to buildings, roads, facilities, cultivations and, sometimes, loss of human lives. For these reasons, it is necessary assessing the most prone zones in a territory which is particularly susceptible to these phenomena and the frequency of the triggering events, according to the return time of them, which generally correspond to intense and concentrated rainfalls. The most adopted methodologies for the determination of the susceptibility and hazard of a territory are physically-based models, that quantify the hydrological and the mechanical responses of the slopes according to particular rainfall scenarios. Whereas, these methodologies could be applied in a reliable way in little catchments, where geotechnical and hydrological features of the materials affected by shallow failures are homogeneous. Data-driven models could constraints these, even if they are generally built up taking into only the predisposing factors of shallow instabilities, allowing to estimate only the susceptibility of a territory, without considering the frequency of the triggering events. It is then required to consider also triggering factors of shallow landslides to allow these methods to estimate also the probability of occurrence and, then, the hazard. This work presents the development and the implementation of data-driven model able to asses the spatio-temporal probability of occurrence of shallow landslides in large areas by means of a data-driven technique. The model is based on Multivariate Adaptive Regression Technique (MARS), that links geomorphological, hydrological, geological and land use predisposing factors to triggering factors of shallow failures. These triggering factors correspond to soil saturation degree and rainfall amounts, which are available for entire a study area thanks to satellite measures. The methodological approach is testing in 30-40 km² wide catchments of Oltrepò Pavese hilly area (northern Italy), where detailed inventories of shallow landslides occurred during past triggering events and corresponding satellite soil moisture and rainfall maps are available. This work was made in the frame of the ANDROMEDA project, funded by Fondazione Cariplo.