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Coupling 3D GIS-based modelling and field methods to evaluate landslide hazard predisposition

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Recent decades have been marked by many disasters caused by natural hazards. Gravitational phenomena in particular have resulted in several deaths and extensive damage to infrastructure.
Nearly 10% of the Swiss territory is considered unstable. It therefore requires an effective methodology for the mapping of areas likely to be affected by this type of hazard.
The aim of this project is to establish the bedrock of a new methodology for the implementation of hazard maps related to landslides based on the evaluation of slope instability predisposition.
The first step of this methodology is a systematic field survey on a given study area. It needed the implementation of new field tests enabling to assess the properties of the formations during the mapping of the area. The information is organized by type (faults, dip, geological formations, fracturation, granulometry, plasticity, boreholes data, springs, streams, etc...) and then imported into a Geographical Information System (GIS) project to build a geodatabase.
Once these data interpolated and converted into a grid of points, we obtain on the one hand a three-dimensional geologi¬cal model (supplemented by geotechnical and hydrodynamic parameters measured in situ and extrapolated to the entire study area) and on the other hand an approximation of the gradient of hydraulic potential in the area. It is then possible to determine the properties of the slope and the stress inside of it; then, we could calculate a safety factor at each point of the model and assess the susceptibility of the slope to instabilities. After crossing this model with maps of moderating factors (altitude, aspect, vegetation, pre-existing mitigation tools) in order to take into account the context of the slopes and the map of phenomena, we used a bayesian probability model to obtain the final hazard map. Achieving it is thus automatic, quick and entirely transparent.
This methodology was already tested on nine sites in Switzerland (Les Clées, Travers, Hohberg, Fälli Hölli, Graitery, La Frasse, Villars-Chesières, Gondo, Les Avants) in several geological contexts (molasse, limestone, flysch and crystalline rocks); five of them could benefit from previous or actual detailed surveys, which enabled us to compare the results obtained with the proposed methodology and with the traditional one.
In a second phase, the geodatabase integrating the data collected on the field was used to contribute to the elaboration of indicative maps (at the scale 1:25'000), giving information about the properties of the geological formations in each region.