Sustainable landslide mitigation strategies through long-term monitoring

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This PhD project aims to evaluate the effectiveness of hydrogeological simulations in the design of landslide mitigation solutions. Numerical hydrogeological modelling has been increasingly used to support the design of solutions to reduce the risk of slope instability areas. However, there is limited literature on the real opportunity to use hydrogeological models for the design of countermeasures to mitigate landslides. Therefore, it is planned to implement different 3D hydrogeological numerical models in two areas with high landslide risk to assess the effectiveness of hydrogeological simulations in designing landslide mitigation solutions. The two areas selected are Lamosano (BL) and Passo della Morte (UD) Italy, where large continuous monitoring networks have been installed by the Istituto di Ricerca per la Protezione Idrogeologica (CNR-IRPI) to collect data on various parameters, including inclinometers, Global Navigation Satellite System surveys, piezometers, rain gauges. The massive database recorded in decades-long monitoring campaigns offers an important resource for the implementation and calibration of hydrogeological numerical models. Furthermore, IRPI actively collaborates with local authorities for the realization of mitigation solutions. This fact creates the opportunity to be able to experimentally test the countermeasure design suggestions derived from hydrogeological numerical models. The first step in this project will be the reconstruction of the subsoil using available stratigraphy, followed by creating a conceptual hydrogeological model using literature information and available experimental data. This step will be useful for implementing 3D flow numerical models to reproduce the behavior of the hydrogeological system and the hydraulic head distribution in the area. The simulations will then be calibrated based on the available experimental piezometric measurements, and the models will be used for forecasting purposes. Specifically, the models will be able to reproduce the hydraulic head reduction of various mitigation solution proposals. Once countermeasure construction is completed, the effectiveness of the simulations will be evaluated by comparing the experimental hydraulic head with those provided by the models. Overall, this study will contribute to the limited literature on using hydrogeological models for designing landslide mitigation solutions and provide practical guidance for the construction of effective mitigation structures to reduce the risk of slope instability areas.