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EXPLORING FUNCTIONAL REGRESSION FOR DYNAMIC MODELING OF SHALLOW LANDSLIDES IN SOUTH TYROL, ITALY

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Shallow landslides are ubiquitous hazards in mountainous regions worldwide that arise from an interplay of static predisposing factors and dynamic preparatory and triggering conditions. Modeling shallow landslides at regional scales has leveraged data-driven approaches to separately investigate purely spatial landslide susceptibility and temporally varying conditions. Yet, the joint assessment of shallow landslides in space and time using data-driven methods remains challenging. Furthermore, dynamic factors have been typically included in data-driven landslide models as scalar predictors by employing aggregated descriptors over time (e.g., mean, maximum, or total precipitation over a defined time window), where many choices are possible for the considered time scales and aggregation operators. Therefore, incorporating the time-varying behavior of dynamic factors remains difficult.

This study addresses these challenges by exploring Functional Generalized Additive Models (FGAMs) to predict the occurrence of shallow landslides in space and time within the Italian province of South Tyrol (7,400 km^2). In contrast to conventional techniques, we test the benefits of using functional predictors to describe dynamic factors (e.g., precipitation and temperature) leading to landslide events. In other words, we evaluate dynamic factors as collections of measurements over time (i.e., time series). To do so, our approach uses a binomial FGAM to analyze the statistical associations between the static factors (scalar predictors), the dynamic weather conditions prior to a potential landslide occurrence (functional predictors), and the occurrence of shallow landslides in space and time.

Potential outcomes of this novel approach show an overview of the added value of using functional predictors for space and time shallow landslide modeling. These research findings are positioned within the context of the PROSLIDE project, which has received financial support from the Research Südtirol/Alto Adige 2019 research program of the Autonomous Province of Bozen/Bolzano – Südtirol/Alto Adige.