EGU22-9175
https://doi.org/10.5194/egusphere-egu22-9175
EGU General Assembly 2022

Space-time modeling of rainfall-induced shallow landslides in South Tyrol, Italy

Mateo Moreno[1,2], Stefan Steger[1], Luigi Lombardo[2], Alice Crespi[1], Peter James Zellner[1], Massimiliano Pittore[1], Volkmar Mair[3], and Cees van Westen[2]

[1]Eurac Research, Institute for Earth Observation, Bolzano-Bozen, Italy (mateo.morenozapata@eurac.edu)

[2]University of Twente, Faculty of Geo-Information Science and Earth Observation (ITC), Enschede, The Netherlands

[3]Office for Geology and Building Materials Testing, Autonomous Province of Bolzano-South Tyrol, Cardano-Kardaun, Italy

Shallow landslides of the slide-type movement represent potentially damaging events in mountain areas all over the world. These geomorphic processes are caused by a combination of predisposing factors (e.g., hillslope material), preparatory conditions (e.g., prolonged snow-melt), and triggers (e.g., heavy rainfall). Data-driven methods have been used to model shallow landslides at regional scales. Traditional approaches are mainly focused on the spatial dimension, whereas the space-time component remains a challenge.

This contribution is built upon data on past landslide occurrence from 2000 to 2020 events in the province of South Tyrol, Italy (7400 km²). The inventoried information systematically relates to damage-causing and infrastructure-threatening events. The methodical procedure included an initial delineation of slope units that were subsequently replicated in time (2000 to 2020) and randomly subsampled to generate balanced distributions of landslide presence/absence observations across space and time. Different spatial static factors and cumulative daily precipitation time windows were aggregated into the mapping units. A Generalized Additive Mixed Model (GAMM) was implemented to derive statistical relationships between the different static and dynamic factors and the occurrence in space-time of shallow landslides. The resulting predictions were validated from multiple perspectives and transferred into space for different combinations of dynamic factors (e.g., triggering and preparatory precipitation, seasonal effects).

The first results are promising. The exploratory analysis has revealed that from a temporal viewpoint, the best-performing model consists of a combination of preparatory and triggering factors while additionally accounting for seasonal effects. The further inclusion of the spatial static factors improved the modeling results. The developed approach shows the potential to integrate static and dynamic landslide factors for large areas by also accounting for the underlying data structure (e.g., repeated observations nested in space) and data limitations (e.g., accounting for spatial data incompleteness). The proposed method is expected to enhance the predictability of shallow landslides at multiple spatial and temporal scales and provide a better understanding of the role of the environmental processes. This study is framed within the PROSLIDE project, that has received funding from the research program Research Südtirol/Alto Adige 2019 of the

Autonomous Province of Bozen/Bolzano – Südtirol/Alto Adige.