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Improving the performance of a dynamic slope stability model (TRIGRS) with integrated spatio-temporal precipitation data

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Most shallow landslides are triggered by prolonged or short intense precipitation events. In dynamic physically-based model approaches for landslide susceptibility assessment, the input precipitation data is often derived from a single or a small number of rain gauges. However, precipitation patterns show a high variance in their spatial distribution that is insufficiently captured by standard rain gauge networks, particularly if inter-station distances are large. Spatially distributed weather radar-derived rainfall products have been used as input for physically-based landslide models to overcome the shortcomings of interpolated station measurements. However, the use of weather radar precipitation in physically-based modelling is not straightforward, since it represents an indirect measurement and thus requires pre-processing steps. With this in regard, the Integrated Nowcasting through Comprehensive Analysis (INCA) system (publicly released by GeoSphere Austria) provides historical (from 2011) hourly precipitation data at a 1 x 1 km resolution that combines weather radar data, station data and elevation data for the inclusion of elevation effects. The result is a pre-processed dataset that integrates the quantitative accuracy of station data with the spatial information provided by the radar data.

In this study, we investigate whether the use of INCA precipitation data leads to improved model performance of TRIGRS compared to a conventional set-up using station data. We model slope stability in a 53 km^2 sub-catchment located in South Tyrol (Italy) for an event that occurred in August 2016 with the INCA data and with precipitation data derived from a single station. The study compares the performances of the two model set-ups and their required parameter calibrations. First tests indicate that the model set-up using INCA data outperforms the station data set-up, as the spatial trend present in the INCA dataset of the modelled storm event follows the spatial trend present in the landslide inventory. In earlier studies and in a preliminary comparison with station data from South Tyrol, the historical INCA data was also shown to underestimate higher precipitation intensities, indicating that the two model set-ups require separate parameter calibrations. In future research, the calibrated model using the historical INCA dataset could be used with the nowcasting datasets from INCA to investigate if and how the INCA

dataset can be used for landslide early warning systems.

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