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The influence of hydro-meteorological conditions on landslide dynamics – an application to the Salcher landslide in Gresten, Lower Austria

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Understanding preparatory and triggering factors for landslide initiation is of particular interest in landslide research. In this regard the analysis of hydro-meteorological data – precipitation and spatio-temporal infiltration patterns (determined by groundwater-level, soil moisture content and groundwater flow) – in combination with data on landslide dynamics can give information about possible landslide initiation thresholds, their interrelations and dependencies.

This study focuses on the investigation of a small (approx. 4.000 m^2 active area/ 20.000 m^2 total area), shallow but complex rotational landslide with different sliding planes ($\sim$ 3 m depth/ 9 m depth). Due to relatively slow movement rates ($\sim$ cm/a), the landslide is part of a long term monitoring project since 2014 and is being investigated with a variety of different surface and sub-surface methods (Salcher landslide observatory – noeslide.at; Gresten/ Scheibbs district/ Lower Austria/ Austria). The activity of the un-forested, relatively gently inclined slope (between $\sim 5^\circ$ and 20°) is mainly due to both the pre-dispositioning factor of local geology and hydro-meteorological conditions. Being situated in the transition zone between the (Rhenodanubien) Flysch Zone (Penninic) and the Gresten Klippen Zone (Helvetic), the respective lithology mainly consist of very fine grained and deeply weathered materials (clays, clayey and marly shales, marly limestone, sandstones).

To investigate hydro-meteorological conditions and landslide dynamics as well as their interrelationship and patterns high-resolution precipitation data (logged every 1.5h), direct (TDR and piezometer sensors) and indirect (4D-geoelectric monitoring (ERT) installed and operated by the Geological Survey of Austria in the frame of the LAMOND-project funded by the Austrian Academy of Science); every 4h) information on hydrological subsurface conditions as well as data on landslide dynamics (inclinometer measurements; every 10min) were used and evaluated complementary. The data is statistically analyzed to find out i) how water infiltrates into the landslide body after precipitation events, ii) whether there are distinct patterns of infiltration and how these are spatio-temporally defined, and iii) if and how these patterns may be interrelated regarding landslide dynamics. The processing timesteps start one hour before a specific precipitation event and will be pursued 1h, 2h, 4h, 6h, 12h, 24h, 48h, 96h and 144h afterwards.

A combined analysis of the 4D-ERT data, precipitation data, the soil moisture and the groundwater level data indicate the interrelation of the parameters after a specific precipitation event. Distinct patterns in infiltration behavior within the Salcher landslide become apparent through correlation analysis. These findings emphasize the importance of high-resolution monitoring data to understand complex parameter interrelationships. How far and to what extent the infiltration patterns are linked to landslide dynamics will be shown by means of a principal component analyses.