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Complex landslide dynamics: establishing a monitoring setup to investigate sub-surface properties and displacements of a slow moving landslide system

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Quantitative data of the sub-surface properties and dynamics of recently active landslides spanning a temporal scale of more than a few years are still fairly rare. This is due to the fact that long-term landslide-monitoring setups are expensive regarding both financial and human resources as well as to install and maintain. Yet, a comprehensive understanding of potential landslide triggering thresholds is mandatory.
Apart from external triggers the internal hydrological, soil mechanical and geophysical properties of a hillslope determine its potential for displacement. The spatial distribution of groundwater levels and soil water contents as well as of the regolith material, resistance and depth define potential areas of activity. The internal structure of a landslide needs to be assessed in order to be able to evaluate magnitude and frequency as well as potential triggers of activity.

In this study, we present a long-term monitoring setup for the detection of sub-surface properties, structure and dynamics of the complex Hofermühle-landslide near Konradsheim in Lower Austria. A combination of direct (invasive) and indirect (non-invasive) methods is used. Direct methods include 1) dynamic probing to investigate sub-surface resistance and 2) the analysis of cores generated via drilling. Data analysis hereby focus on geotechnical parameters such as soil properties, regolith depth and resistance. To investigate hydrological properties data regarding 3) groundwater level using piezometers as well as 4) soil moisture using time domain reflectometry (TDR) probes are used. Data analysis focus on the spatio-temporal behaviour of soil moisture and groundwater level changes in order to assess sub-surface water pathways, water residence time and the connection to changes – regarding both input (precipitation) and output (evapotranspiration). Sub-surface movement rates and their position along vertical soil profiles are planned to be analysed using 5) inclinometer data. Direct methods are combined with non-invasive geophysical methods. As this monitoring setup will be maintained for a longer time period (>10a), the setup itself is assessed critically; challenges and issues of the installation, data transfer and analysis are discussed.

First results regarding the analysis of hydrological parameters indicate a heterogenic distribution of groundwater static level, soil water retention time after infiltration and flow paths. A first interpretation of the sediment core, dynamic probing as well as geophysical results support this heterogeneity. Sub-surface areas of potential activity could be presumed to be correlated with the

spatial distribution of surface displacements as these also show a heterogenic distribution.