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High-resolution terrestrial laser scanning of temporary small-scale terraces in a dynamic landscape – a pilot study at the Doren landslide

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Our pilot project aims at information gathering and geometric modelling of temporary, small-scale geomorphic features using high-resolution terrestrial laser scanning data. In this case we studied small seasonal terraces formed in the semi-artificial channel of a watercourse that drains a part of the lower section of the Doren landslide (Vorarlberg, Austria). These short-living forms typically tend to disappear very quickly because of two reasons: the landscape in which they are embedded is actively forming therefore on long-term superordinate processes determine their eventual fate. On the other hand, the active channel reacts to the discharge changes, due to the varying precipitation conditions and channel reorganization (e.g., beheading) of the upstream areas, causing interplay of incision, terrace formation and destruction. Because of their temporal character and small size, terrestrial laser scanning (combined with other photogrammetric techniques) is an optimal method to get and to extract topographic information of the features.

The three-dimensional recording of the shapes and volumes of the terraces in centimetre resolution using a Riegl LMS-Z420i terrestrial laser scanner enabled us to study the sequences of terraces. Using the overlapping parts and incisions of the various terrace generation we may bracket the formation phases, and in some extents the formation rate can also be implied. And last, but not least studying of this type of terrace formation with high geometric resolution helps us understanding the evolution of larger scale terraces in major river valleys. In the latter valleys settlements and built-up structures are situated on these terraces that can be endangered in case of centennial flood events reforming the terraces.

Using an algorithm originally developed for 3D city modelling, the surface model of the terraces was segmented into planar features. Statistical analysis of the geometrical parameters of these features led us to separate terrace planes, and terrace formation phases could be recognized.

Furthermore, deformation analysis of the whole slope has been carried out on behalf of multi-temporal laser scanning data sets. Together with the parameters of the terraces, we were able to determine how far the superordinated process of the landslide can cause deformation in this smaller scale.

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