Available online at www.sciencedirect.com

ScienceDirect

Procedia Earth and Planetary Science 16 (2016) 177 – 184

Procedia
Earth and Planetary Science

The Fourth Italian Workshop on Landslides

Evaluation of shallow landslides in the Northern Walgau (Austria) using morphometric analysis techniques

Elmar Schmaltz[a,*], Stefan Steger[a], Rainer Bell[a], Thomas Glade[a], Rens van Beek[b], Thom Bogaard[c], Di Wang[d], Markus Hollaus[d] & Norbert Pfeifer[d]

[a]*Department of Geography and Regional Research, University of Vienna, 1010 Vienna, Austria*
[b]*Faculty of Geoscience, University of Utrecht, The Netherlands*
[c]*Faculty of Civil Engineering and Geoscience, Delft University of Technology, The Netherlands*
[d]*Department of Geodesy and Geoinformation, TU Wien, 1010 Vienna, Austria*

Abstract

Landslides play a key role in landscape evolution in the Eastern Alps. These geomorphic phenomena are influenced by multiple interdependent and interacting natural and anthropogenic factors. An in-depth evaluation of the spatial distribution of existing landslides enables to gain first insights into potentially hazardous areas. Morphometric analysis techniques of mapped landslides as well as their date of occurrence allow to infer their activity and also potential impacts on affected areas. The prevalent slow moving landslides and inactive slipping areas were mapped and analysed via digital terrain models (DTM), shaded relief images of highly resolved airborne laserscanning (ALS) data and in-field observations. Orthophotos from aerial surveys and ALS data allowed a deferred-time analyses of past landslide occurrences including a record of recent slope movements. All mapped landslides were classified and analysed with geomorphometric indices. Pedological processes, the lithological setting and anthropogenic landscape transformationwere taken into account when interpreting the results. The geomorphometrical evaluation of the sliding areas determine the creation of a multitemporal landslide inventory in the Northern Walgau.

Peer-review under responsibility of the organizing committee of IWL 2015

Keywords: Shallow translational landslides, geomorphometry, morphometric indices, landslide inventory, Walgau.

* Corresponding author. Tel.: +43-1-4277-48752; fax: +43-1-4277-848752.
E-mail address: elmar.schmaltz@univie.ac.at

Peer-review under responsibility of the organizing committee of IWL 2015
doi:10.1016/j.proeps.2016.10.019

1. Introduction

Shallow translational landslides vary in their extent and dynamics. To interpret static or slow moving landslides accurately, it is important to determine the dispersion and the dimension of landslide features. Morphological analyses can help to understand the connection between appearances of landslips in reference to their immediate environment and the related triggering events. Especially for regions with less or no information about date of landslide occurrences, the quantification of landslide features can help to draw conclusions about mobility, impact on the landscape and material involved. Several techniques have been developed to analyse and quantify morphometric issues of landslides and to describe process-related properties of landslide dynamics[1-7]. An accurate interpretation of morphologic-process relationships appears to be elaborate in situ. The quantification of the relative landslide mobility is designated by the angle of reach[8], expressed by the connecting line between head of landslide source to the distal margin of the displaced mass[6]. Accordingly, the tangent of the reach angle depicts the equivalent coefficient of friction[1]. Several studies[1, 3, 9]explained the relation between the tangent of reach angle and volume of mass material that large landslides tend to develop longer angles of reach than small landslides and are thus more mobile. Whereas it was persisted[5] that the mobility of a landslide increases due to the height of fall. It was shown that a relation between landslide volume, reach angle and topographic constrains on the path that influence the mobility of a slide[6]. Hence, these studies have shown that accurate interpretation of morphologic-process relationships are strongly dependent on intrinsic properties of each landscape. However, morphometrical analysis techniques can help to understand the distribution and the diversity of landslide dynamics in an area.

Mapping of landslides and the development of landslide inventories was decisively simplified with the emerging use of light detection and ranging (LIDAR) to generate very detailed Digital Elevation Models (DTMs). Advantages of using these highly resolved DTMs to locate, delimit and characterise landslides were highlighted in earlier studies[7, 10-12]. Landslide inventories which were created by support of LIDAR are more accurate compared to landslide inventories purely based on observations from satellite images or field survey-based[13, 14]. However, most of these inventories do not consider morphology-process relationships, especially when they do not include temporal information. Hence, the quantification of different landslide features are able to upgrade the information content of a landslide inventory concerning morphometrical dimensions and process dynamics.The quantitative morphological analysis presented in this study is based on morphometrical indices, developed by Crozier[15]. These indices allow statements about the morphology-process-relationship due to their objectivity and significance[15] by using simple mathematical coherences. The primary intention of this study is the development of a multitemporal landslide inventory for the investigation area of the BioSLIDE-project in Vorarlberg, Austria. The combination of detailed airborne laserscanning data and aerial images from different dates of record can improve the temporal and spatial accuracy of the landslide inventory. Hence, the objective of this study is to upgrade the degree of information of this inventory by applying morphometric indices on the precisely delimited landslides from DTMs generated by laserscanning data. Moreover, a multitemporal landslide inventory shall be created for the whole Walgau area with additional information about the relationship of landslide morphology and landslide dynamic from the morphometric indices defined by Crozier[15].

Nomenclature

L	Total length of the landslide
L_x	Length of convex part
L_c	Length of concave part
L_f	Length of the bare surface on the displaced material
L_m	Length of displaced material
L_r	Length of surface of rupture
D_x	Thickness of convex part
D & D_c	Total depth of landslide or depth of concave part respectively
W_x	Width of the convex part
W_c	Width of the concave part