Regional delineation of potential source areas and runout distances of rockfalls as a planning basis for detailed assessments

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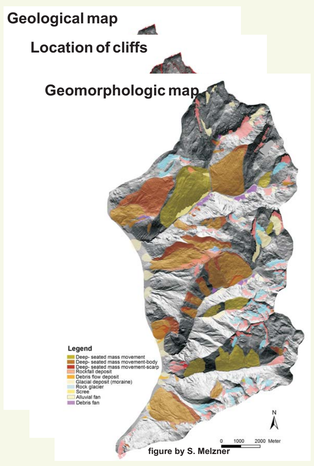
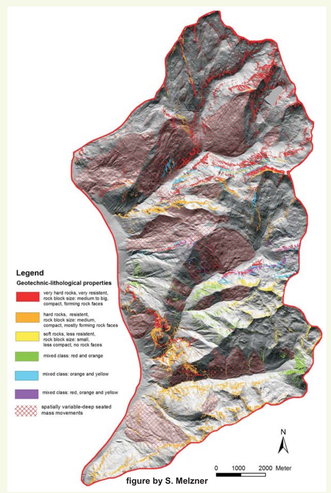
INTERPRAEVENT International Research Society

12th CONGRESS INTERPRAEVENT 2012
23rd to 26th April
Grenoble - France

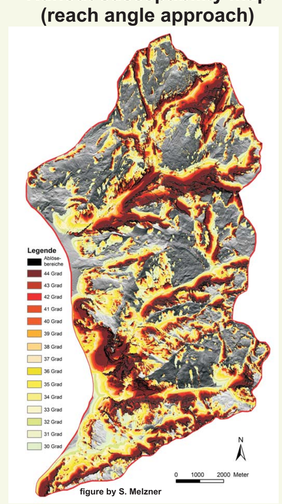
Regional scale



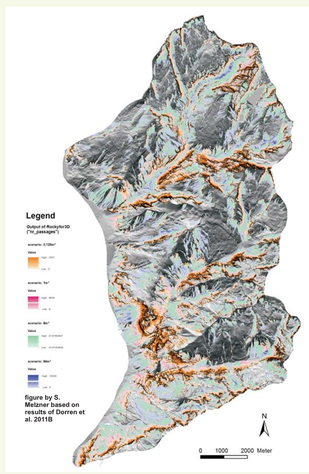
(see Melzner et al. 2011A for details)



(see Melzner et al. 2011A, Melzner et al.2012 for details)



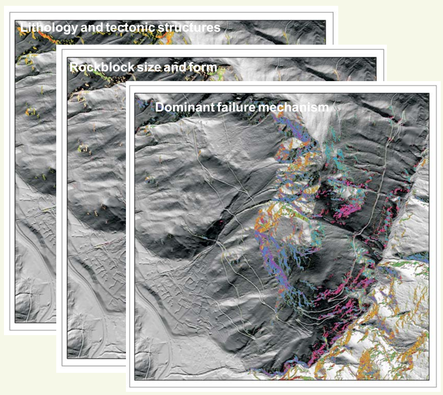
(see Melzner et al. 2011A, Melzner et al.2012 for details)



(see Dorren et al. 2011A, 2011 B for details)

Local scale

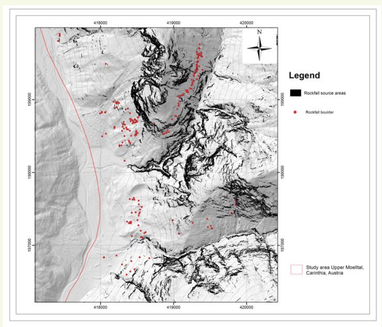
Onset susceptibility



(see Melzner et al. 2011A & B, Melzner et al. 2012 for details)

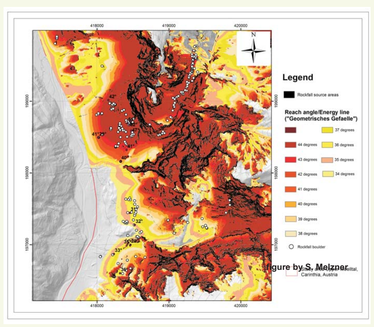
Runout susceptibility maps

Mapped boulders (local scale)



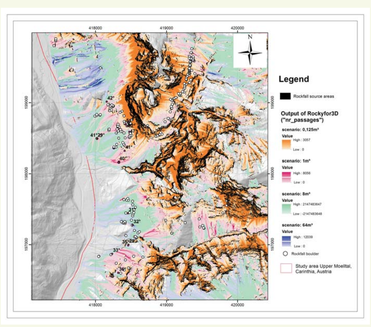
(see Melzner et al. 2011A, Melzner et al.2012 for details)

Comparison of reach angle results (regional scale) with mapped boulders (local scale)



(see Melzner et al. 2011A, Melzner et al.2012 for details)

Comparison of "Rockyfor3D" results (regional scale) with mapped boulders (local scale)

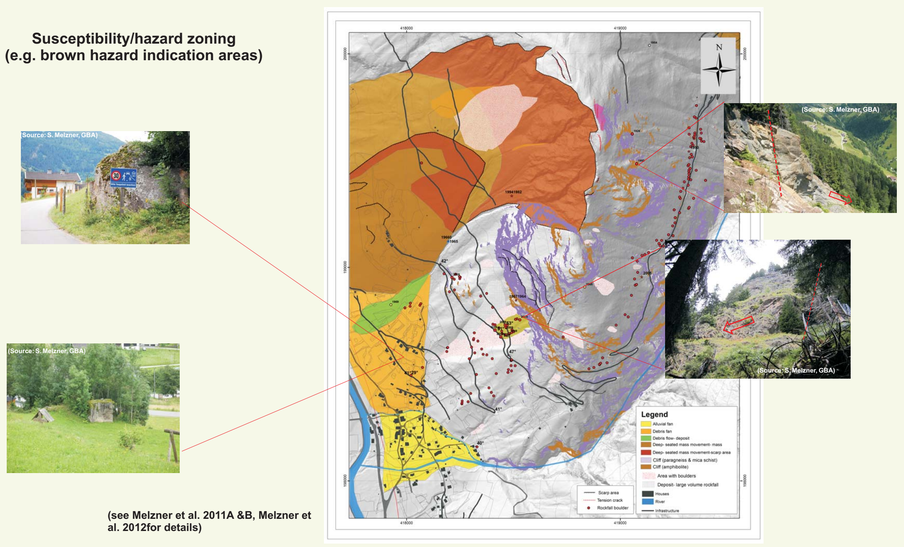


(see Melzner et al. 2011 A,B & Melzner et al. 2012 and Dorren et al. 2011B for details)

Slope scale

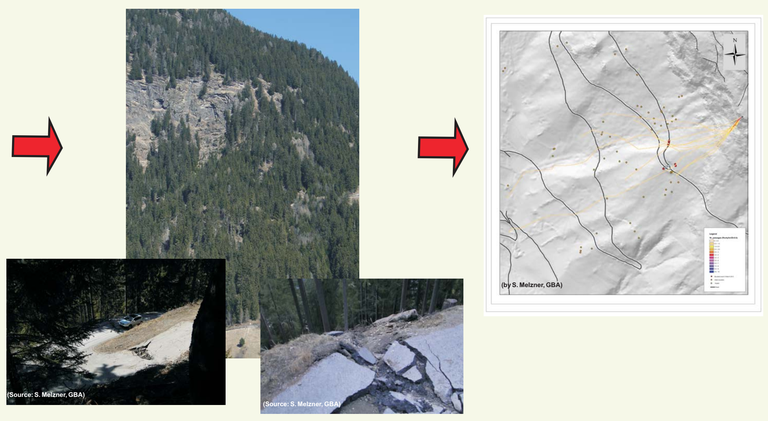
Planning of site-specific studies

Susceptibility/hazard zoning (e.g. brown hazard indication areas)



(see Melzner et al. 2011A &B, Melzner et al. 2012for details)

Rockfall event 5 March 2012



Introduction

Many regions in Austria and Italy are recurrently affected by rockfall processes which pose a significant hazard to settlements and infrastructure. Decision makers in the Federal State Governments/Local authorities are strongly dependent on methods/techniques and adequate data in order to delineate potentially endangered areas to plan more detailed investigations.
As part of the INTERREG IVA Project MASSMOVE (Project Code 1381-08-1) an area of approximately 120 km² in the Upper Moelltal (Carinthia, Austria) was investigated concerning potential rockfall susceptibility. Spatially continuous field mapping for such a large study area (regional study) is expensive and time-consuming. Hence the project applied and evaluated various methods at regional scale to identify potential conflict areas within the study region (Dorren et al. 2011B, Melzner et al. 2011A). For the selected regions a comprehensive, detailed assessment at local extent was carried out subsequently (Melzner et al. 2011A, Melzner et al. 2011C).

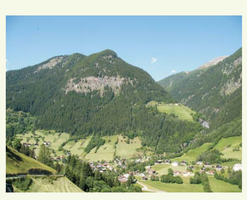
Assessment scales

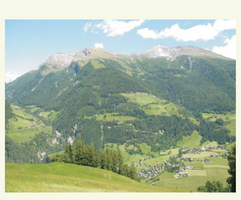
Source: MassMove handbook for rockfall

Analysis Scale	Scope	Type of maps	Indicative Map scale	Cell size
R: Regional	Recognition of potentially endangered areas	Inventory maps/ Susceptibility maps	1:50 000 - 1:10 000	</=30 m
L: Local (e.g. municipality)	Land use planning	Rockfall susceptibility maps /hazard map/hazard zone maps	1:10 000 - 1:5 000	</=5 m
S: Specific areas or slope-scale (site specific study)	Hazard and risk analysis, design of countermeasures	Hazard map/hazard zone maps	1:5 000 - 1:500	</=2m

Challenges of assessment

Large study area: impassible terrain conditions and remote areas
Tectonic and lithologic complexity: large variety of areas with different lithological and structural anisotropies
Large variety of potential source areas: cliffs, deep seated slope deformations, scree and glacial deposits
Available data: high quality data (e.g. Laserscan) versus low quality data in terms of scale (e.g. Geological map 1:50.000) and erroneous content (e.g. landuse map)





Study area

Size: ca. 120 km²
Location: Upper Carinthia, "Goldberggruppe"
Dimension:
- orogr. left slopes of the Upper Moellvalley
- tributaries Zirknitz, Asten und Kolmitzen

Communities:
- Großkirchheim
- Moertschach
- Winklern

Assessment strategy

Project phase 1: The identification of potential endangered areas within the whole study region (regional scale)
The initial stage of the project collected all existing datasets for the study region. The acquired data were incorporated into preliminary field investigations in order to define potential rockfall source areas. The lithological units were categorized according to their geotechnical behaviour. The main morphostructural features such as lineaments, deep-seated slope deformations, talus slopes etc. were manually mapped using the ALS data and verified in the field. Potential rockfall distances were determined by applying a simple empirical model and by undertaking a 3D simulation using Rockyfor3D. Overlaying these results with areas of habitations and infrastructure could identify potential endangered areas.

Goal: Definition of areas for detailed assessments at local scale

Project phase 2: The specification of rockfall susceptibility (local scale)
The second phase of the project used the areas identified as potentially endangered in order to undertake detailed investigations of existing rockfall susceptibility. In effect, this phase of the project examines the extent to which rockfall processes occured in the past and, thus, may reoccur in the future, thereby endangering settlements. This required on the one hand, an evaluation and analysis of the dominant lithological-structural characterists and, on the other hand, the mapping of the location of silent witnesses. Partially mapped information were interpolated to spatially- continuous parameter maps which were used for the susceptibility analysis.

Goal: Generation of data as basis for the planning of detailed investigations at slope scale

Project phase 3: The evaluation of rockfall susceptibility at local scale as basis for planning site-specific studies (slope scale)
Results at local scale were used to define areas that should be subject to further investigations at the slope scale. These site-specific studies should incorporate detailed spatially- continuous mapping (>1:5000) and the application of more quantitative assessment methods. Within the MassMove Project, the Austrian rockfall study area is much larger (120 km²) than the Italian study sites (a few km²). Consequently, site-specific studies at slope scale were undertaken by the colleagues in Italy.

Acknowledgments

- Italian project partners and rockfall experts
- M. Lotter, I. Baron, M. Linner, G. Pestal, R. Schuster, N. Tilch & J. Reitner (GBA, Vienna)
- Austrian Torrent and Avalanche Control (WLV), Section Upper Drautal und Moelltal, Villach
- M. Moelk (Austrian Service for Torrent and Avalanche Control, Geological Service, Innsbruck
- communities Großkirchheim, Moertschach & Winklern

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