Combining historic information and high resolution DTMs to improve the understanding of today's maximum possible landslide events and its relevance for hazard assessment

R. Bell[1], M. Röhrs[2], T. Glade[1] and A. Dix[2]

CONTEXT

Events of an exceptional magnitude often trigger natural disasters. After such disasters occurred, the question is raised whether this was an extreme and rare event or if it might occur again in the near future. Therefore, investigations of past conditions are absolutely necessary. One of the crucial questions is, if environmental conditions have been changing since the former occurrences, or if these conditions are comparable or even similar to current settings.
This research issue was addressed by the interdisciplinary project InterRISK (Integrative landslide risk analysis and evalution in the Swabian Alb, SW-Germany) funded by the German Science Foundation (DFG). Within the two subprojects InterRISK Analysis and InterRISK History, current landslide information was obtained from field investigations, GIS analyses and archive studies. It is often assumed, that the observed large landslides occurred in the Pleistocene, and just a few in the Holocene. Additionally it is suggested, that recent large landslides are reactivated Pleistocene landslides. These assumptions were analysed in detail.

METHODS

Within the geomorphic subproject InterRISK Analysis, landslide information was obtained from review of scientific literature, compilations of available landslide databases, interpretation of sets of aerial photographs, digitalisation of geological maps and mapping of features determined on high resolution digital terrain models (HRDTM). In particular the HRDTM provide an excellent basis for landslide mapping. The landslide age was approximated from the forms, e.g. landslides with distinct characteristics of head scars, cracks and depositional areas are younger than landslides with smoothed topography.
Historical archives from the period 15th to 20th century were carefully investigated in order to obtain information with respect to temporal and spatial distributions of former recorded landslide events by the subproject InterRISK History. In addition, old historic maps were analysed with respect to further landslide prone areas which are currently not known as susceptible to landsliding.

[1] Dept. of Geography and Regional Research, University of Vienna, Austria, rainer.bell@univie.ac.at
[2] Dept. of Geography, University of Bamberg, Germany

RESULTS

The surprisingly distinct and clear forms of numerous big landslides suggest an age of some landslides younger than Pleistocene. Also, numerous additional landslides were delineated in particular on the HRDTM. It is demonstrated, that it is absolutely crucial to investigate the original historical archives, because some interpretations of former findings can be questioned. It seems to be that often, the historical context at the recording time is not considered in the interpretations leading to some misinterpretation. In addition, the original sources often provide much more details of these former landslide events than ever expected and mentioned in secondary sources. This is also evident for reading the historic maps. A careful interpretation of the provided legends is crucial.

Combining the results from both the Analysis subproject and the History subproject, one landslide previously dated of Pleistocene age cannot be older than approximately 2800 BP, since historic protection walls (with such an maximum age) were damaged by this large landslide. Another landslide event was assumed to be at least a couple of hundreds years old but definitely occurred in the 19th century. In total 207 past landslides could be dated by historic analysis going back to 1416. Many more are still analysed in detail by the historians. Another important aspect is, that some very large historic landslides could be proved to be first time failures.

In 1983, the Mössingen landslide including a volume of 6 million m^3 occurred in the Swabian Alb. For landslides of such a magnitude a recurrence interval of 55 to 139 years (depending on the approach used) could be estimated.

CONCLUSION

The results indicate that the region has experienced much more and larger landslides in recent centuries than previously assumed. As a consequence such larger events might even occur today with a higher probability due to comparable environmental conditions.

It is evident, that these preliminary results need to be reassured by further research including in particular absolute dating. However, these new findings are important for any landslide risk management in the study area. It is suggested, that similar situations and conditions can be expected in other regions as well, including the Alpine chains.

Landslide, historic information, high resolution digital terrain model