The hazard map groundwater of Nidwalden - against the unknown hazard from the underground

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INTRODUCTION

In Switzerland, hazard maps have been made available in most areas and in particular for the processes landslides, falls, floods and snow avalanches. For each of these hazardous processes the maps show the different areas at risk and thus represent an important instrument for regional planning. A hazard map is based on intensity maps which include the effects of a hazardous process at a specific location and with a certain return period. For the purpose of emergency planning, intensity maps also represent an excellent basis for an estimation of the consequences a process may have within an area. Therefore the consideration of hazard and intensity maps in regional (landuse) and emergency planning can not only save lives, but also help to reduce the extent of damage.

PROBLEM

Up to now the dangers emerging from groundwater have been neglected completed, primarily because groundwater processes are not considered as natural hazards in Swiss legislation. However, high groundwater levels and/or groundwater fluctuations may lead to buoyancy and water pressure which in turn can destroy structures, especially in the presence of cable networks and older buildings whose basements or foundations are not calculated to support water pressure and buoyancy. In addition, groundwater springs may lead to floods or at least increase surface flows. Therefore the canton of Nidwalden has started a pilot project to create a hazard map for groundwater.

MODELLING

One key difficulty encountered during its elaboration was the unsatisfactory database on groundwater levels during major precipitation events. As the observational network of groundwater has been densified only over the last few years, correlations between major precipitation events and their effects on groundwater remain only poorly documented. In a similar way, knowledge about processes lea- ding to significant changes in groundwater level fluctuations and system interrelationships remain quite unclear. In that sense, the quality of the information obtained will depend on the density of existing out- crops and the variability of the subsoil. Therefore, in a first step, the hydrological and hydrogeological baseline data had to be processed, refined and improved. Among other things an extension of heavy precipitation statistics to several stations has been necessary, Such that return intervals could be developed in the form of precipitation intensity graphs and areal precipitation statistics for the valley floor of Stans. In addition, analysis also focused on groundwater recharge processes in detail. Based on the areal precipitation statistics the groundwater formation rates were calculated for various precipitation events in the valley, taking into account soil sealing and urban drainage.

In this study, groundwater-specific feeds along the side of the valley represented boundary conditions for the groundwater model and had to be estimated considering the impacts of soil and rock storage and source outlets.

The improved databases were then integrated into an existing, three-dimensional, unsteady groundwater model. Based on the well-documented flood event of August 2005, it was also possible to calibrate the model and to test system response and sensitivity by varying the parameters used at different observation points. This analysis resulted in a map illustration water table depths for return periods of HQ30, HQ100, HQ300 as well as for EHQ, combined with rainfall durations of 48, 72, and 120 hours (Fig. 1).

RESULTS

Groundwater intensity maps are currently being developed and will be the basis of future groundwater hazard maps. For this purpose watertable depth maps are used in combination with floor structure daza and information on different permeability.

In the future, the groundwater hazard map could not only become a basis for regional and emergency planning, but also illustrate the expected effects of groundwater on new structures.

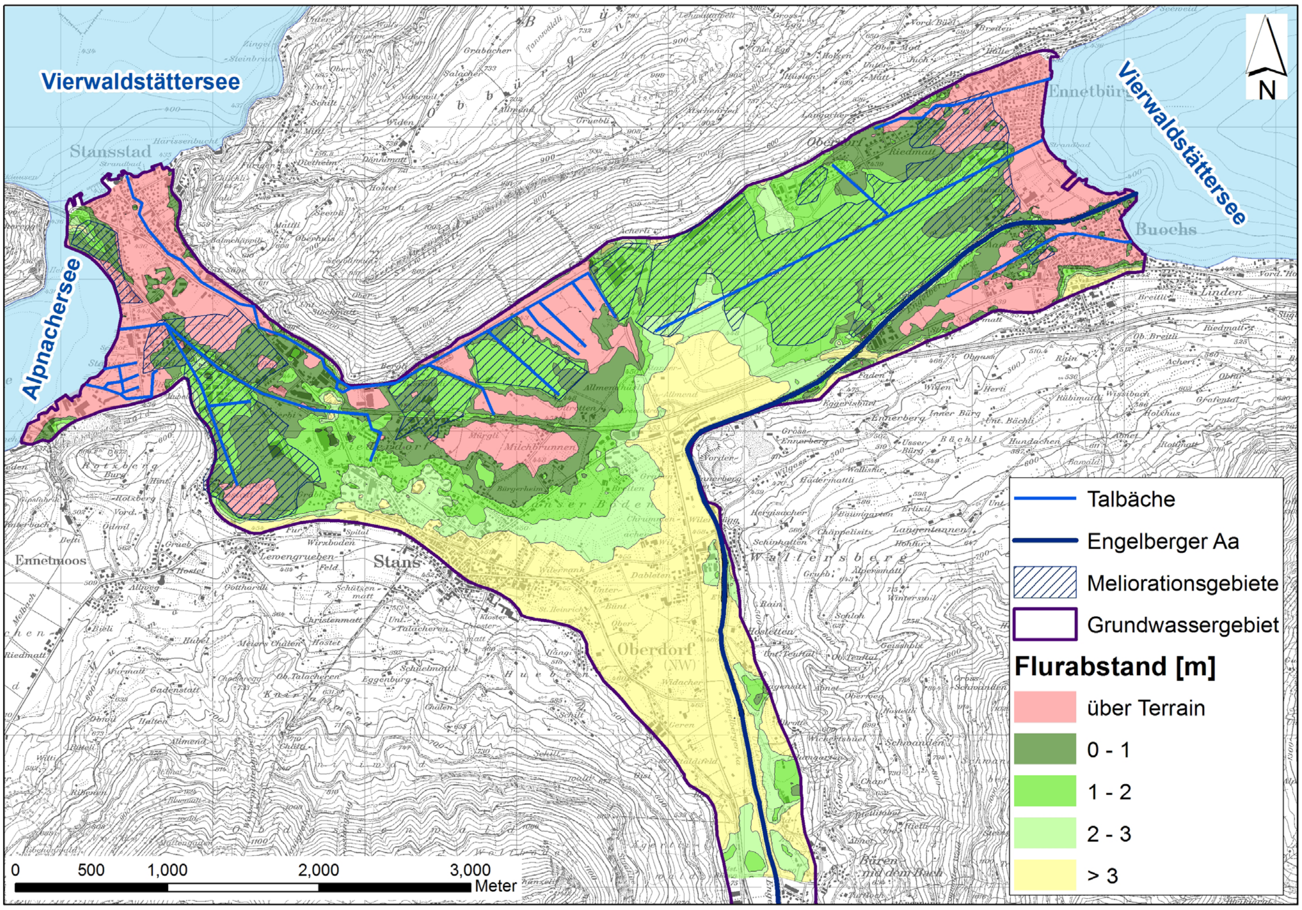

Figure 1. Watertable depth map for a return period of HQ100, combined with a rainfall duration of 72 hours

KEYWORDS

groundwater; hazard map

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