SUSCEPTIBILITY MAPS IN SPATIAL PLANNING

BENEFITS AND CHALLENGES

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INTRODUCTION

The mapping of natural hazards in Norway builds on three levels: susceptibility, hazard and risk maps. Susceptibility maps are largely utilized by municipalities to mark potentially hazardous areas when planning new development.
The Norwegian Water Resources and Energy Directorate (NVE) was given the national responsibility for managing landslides and avalanches in January 2009. The government saw the need for better coordination and strengthened governmental action and support to municipalities. NVE was chosen as the leading government authority for this task based on NVE's experience in managing flood risk in a holistic way. This holistic model includes five main topics:

- Mapping
- Spatial planning
- Protection
- Monitoring and early warning
- Emergency preparedness and crisis management

The elements are well known from the risk management cycle and similar models. A national program for compiling susceptibility maps for landslide and avalanche hazards was started by the Norwegian Geological Survey (NGU) in 2007, since 2009 continued under NVE management.

SPATIAL PLANNING AND SUSCEPTIBILITY MAPS

The Planning and Building Act sets minimum safety standards by defining three levels of acceptable hazard for different types of building and infrastructure. The annual probability of being hit by a natural event is the only criterion used for the definition of acceptable hazard. NVE also develops guidelines explaining how to meet these standards at the different planning levels. NVE offers assistance to municipalities and can object if plans do not take proper account of natural hazards.
Spatial planning is a key to prevent new development in hazard areas. Susceptibility maps are used at the Municipal Plan level to identify areas potentially prone to natural hazards and to decide if more detailed hazard studies for development plans and building applications are necessary. Susceptibility maps should therefore cover the whole country, all relevant natural hazards (landslides and rock falls, avalanches, floods) and be relatively conservative in order not to "miss" hazardous areas.
Susceptibility maps for rock fall and snow avalanches have recently been compiled. A digital terrain model is used to identify potential release areas based on slope only, while GIS-implemented statistical-empiric methods are used to compute runout areas. The new susceptibility maps have been in use for about a year and have been received with a mixed response from municipalities. Although the spatial resolution of the utilized terrain model (25 m) makes it difficult to catch minor release areas, the main drawback of the automatically generated maps seems to be that they are too conservative (Fig.1). This has at least two causes: 1) the automatic identification of release areas does not consider local factors that can prevent release or reduce the extent of release areas (dense forest) or make major avalanches very unlikely (climate, slope aspect); 2) The runout distances are calculated

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without considering the form of each avalanche path or whether the path runs on open slopes or is channelized.

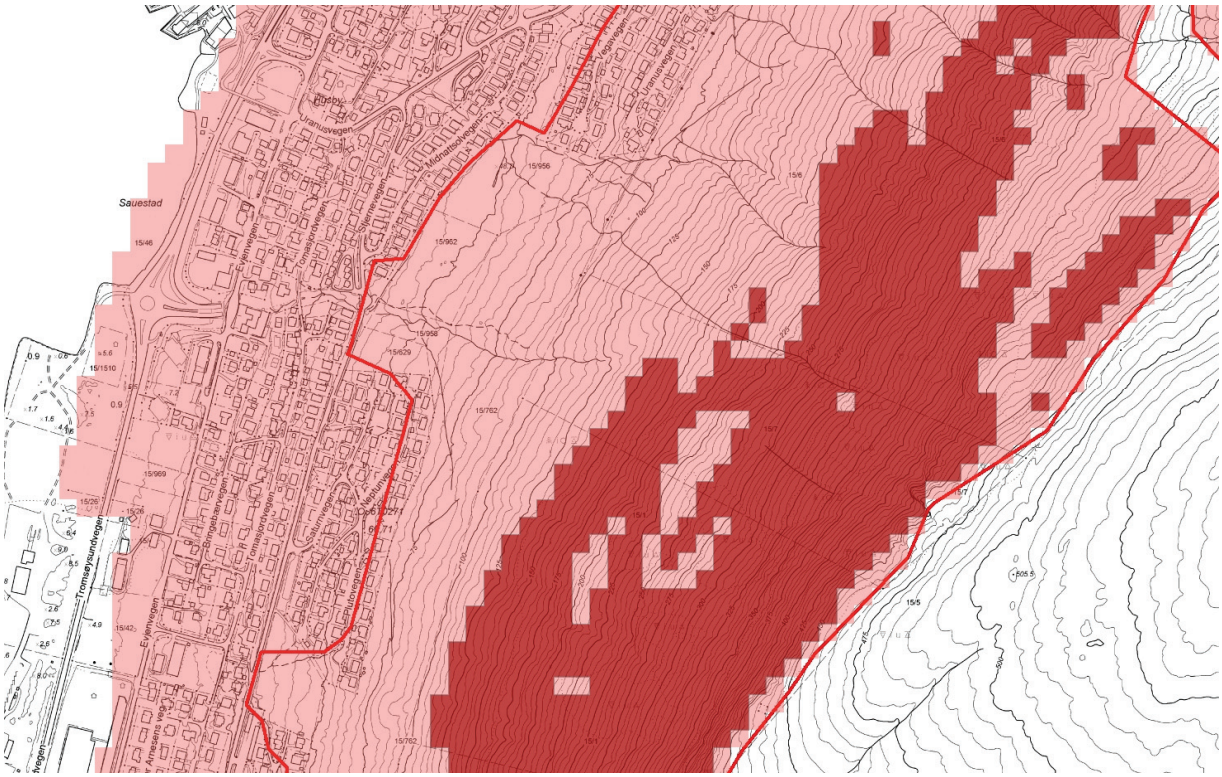

Fig.1 Excerpt from the susceptibility map for snow avalanches for Tromsø in Northern Norway. Potential release and runout areas are shown in filled colour (red and pink, respectively). Red line= avalanche with 1000 years return period from hazard map.

As the example in figure 1 shows, the automatic generated susceptibility map provides a way too conservative picture of the local hazard when compared with the maximum runout assessed by avalanche experts

Work is currently going on to assess the possibility of improving map accuracy by including local factors and tuning the algorithms for calculation of the runout distances to different terrain profiles.

Both technical and user-aspects of existing and future susceptibility maps have been discussed in workshops during spring 2011. The possibility of including more parameters in the model, such as local topographic and climatic factors, as well as the related risk of over- or underestimation of runout distance will be investigated by a project group through 2011.

Current use of the maps illustrates the dilemma: No further investigation of the hazard is required before development is granted outside the potential hazardous areas. This suggests that maps should be conservative. Susceptibility maps that underestimate the hazard may in the worst case endanger lives. On the other hand NVE as governmental authority objects to development in areas shown as potential hazard areas. Too conservative maps will result in the need for detailed analyses in areas not at risk, i.e. “unnecessary” costs. The confidence the general public has in hazard maps may also be undermined and contribute to a ‘laissez-faire’ attitude. This raises the issue whether this type of automatically generated maps should only be advisory to stimulate a dialogue on potential hazard areas and the need for further investigation.

Keywords: susceptibility maps, spatial planning