Geophysical Research Abstracts,
Vol. 10, EGU2008-A-09399, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-09399
EGU General Assembly 2008

Landslide mapping in northern Norway using SBAS InSAR

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Being a mountainous country, with long steep fjords and valley sides, Norway is particularly susceptible to large rock avalanches. In the last 100 years, over 170 people have been killed by tsunamis in fjords caused by large rock avalanches. In each case, the rock avalanche was preceded by many years of slow movement, with acceleration prior to slope failure. At present, three similar unstable areas have been identified in Norway, and are being monitored using extensive instrumentation. With several thousand kilometers of inhabited coastline and valleys, the challenge we currently face is the identification of similar hazards in an efficient manner.

The Geological Survey of Norway is responsible for landslide mapping throughout the country. Since 2005, we have been cooperating with Norut AS to establish a Norwegian facility for InSAR processing. The goal is to be able to systematically process SAR images from multiple satellites to assist in geohazard mapping. Once hazardous slopes are identified, continued monitoring using InSAR can be augmented with ground-based systems.

Over 700 ERS and ENVISAT scenes, covering 19 overlapping frames, are currently being processed using the SBAS algorithm. These scenes cover the area of northern Norway with highest topographic relief, stretching from the Lofoten islands in the southwest to Alta in the northeast. The first results, based on ERS scenes from 1992-1999 only, are from around the Lyngen peninsula, just east of the city of Tromsø.

Nordnesfjellet is one of the three sites currently being monitored. InSAR results clearly show the outline of the moving block, and velocity estimates are in agree-

ment with earlier GPS measurements, though the accuracy of the GPS measurements so far is somewhat questionable due to the short time series (yearly measurements since 2004 only). Numerous other areas within the processed area have downwards velocities of up to one centimeter per year. Extensive field checking in 2007 has identified active fracture systems with evidence of movement in each of these areas. In at least one case, differential movement across multiple fault scarps is shown by different movement rates of the sub-blocks.

InSAR analysis of the almost two decades long time series available in the ERS and ENVISAT archives enables rapid identification of landslides within a large region, allowing us to focus field mapping in areas with known hazards. Without the use of such remote sensing tools, it would take decades to map the same area.