InSAR MONITORING of LANDSLIDES using RADARSAT and ALOS

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ABSTRACT

In this paper we report on the results of InSAR monitoring of several landslides using RADARDAT, and ALOS satellites. InSAR techniques are increasingly being used in slope stability assessment. Our research has shown that differential InSAR and coherent target monitoring techniques using field corner reflectors are useful to monitor landslide activity along strategic transportation and energy corridors. The Mackenzie Valley in northern Canada is experiencing one of the highest rates on mean annual air temperature for any region in Canada, thereby triggering melting in the permafrost, which results in active layer detachment slides. There are approximately 2000 landslides along the proposed Mackenzie Valley pipeline route. .The Mackenzie valley pipeline will traverse a 1300 km corridor, aimed at delivering natural gas to markets in southern Canada and United States. The pipeline - when completed - is estimated to cost $ 7 billion. In addition, the Trans Canada Highway in the Canadian Rockies are affected by several rock avalanches and slow retrogressive slides.

Our investigation has shown that differential InSAR and CTM techniques provide a useful monitoring technique for landslide activity under different slope, moisture and lithological conditions. On vegetated slopes, corner reflectors are being used to continuously monitor large active slopes. The series of RADARSAT-1 InSAR images indicate the different level of activity of the slopes (large and small) during different periods of the year. RADARSAT-2 is providing the high resolution rapid revisit capabilities needed to continuously monitor these active slopes along Canadian strategic energy and transportation corridors.

ALOS PALSAR InSAR results show that we can observe deformation on both vegetated and exposed rock areas on the Little Smokey slide and the Frank Slide. The Frank Slide, a 30 x 10^6 m^3 rockslide-avalanche of Paleozoic limestone, occurred in April 1903 on the east face of Turtle Mountain of southern Alberta, Canada. Seventy fatalities were recorded. This slide is still active. Several investigations have focused on monitoring and understanding post failure mechanism and mobility. Factors contributing to the slide have been identified as the geological structure of the mountain, subsidence from coal mining at the toe of the mountain, blast induced seismicity, above-average precipitation in years prior to the slide, and freeze-thaw cycles. In 2001, 6,000 tons of rock fell from the north slope of the Frank Slide which led to our InSAR investigation. The Government of Alberta has installed GPS stations and several in-situ instruments to monitor post-slide activity at specific locations. In this study, we compare differential InSAR results from RADARSAT and ALOS PALSAR images over the near same time period during summer 2006.

The RADARSAT-1 InSAR results show that Frank Slide is relatively stable except for a small area on the North Slope. The ALOS data show a larger area of rock deformation on the same area. The ALOS PALSAR data show deformation not only on the exposed rocky surfaces but also on the vegetated South Peak of Frank Slide. This is particularly interesting since the South Peak is extensively monitored by in-situ sensors and does show gradual motion. At Little Smokey our D-INSAR results show gradual motion during the summer of 08 on the vegetated slopes. This motion were not observed from RADARSAT indicating that L band InSAR are more suitable to monitor landslide motion on vegetated slopes
The information produced by our InSAR activity maps on various landslides are used to realign the pipeline route in sensitive permafrost areas, and to install slope stability measures along the Trans-Canada and Provincial Highways. Using these different satellites we are able to develop guidelines for more reliable uses of these SAR missions

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