GEOLOGICAL AND GEOHAZARD APPLICATIONS OF RADARSAT-2

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ABSTRACT

In this paper, we will present the results of several case studies focusing on RADARSAT-2 InSAR monitoring of several different types of landslides and the uses of enhanced RADARSAT-2 polarimetric composites for surficial geological and terrain mapping in Canada. InSAR techniques are increasingly being used in slope stability assessment [1, 2 3]. Our research has shown that both differential InSAR and PS InSAR techniques using field corner reflectors are useful to monitor landslide activity along strategic transportation and energy corridors. These case studies include:

InSAR monitoring of landslides in permafrost terrains along the Mackenzie valley pipeline route: 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 [4]. 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. RADARSAT-2 InSAR monitoring techniques are providing the high resolution rapid revisit capabilities needed to continuously monitor these active slopes along these strategic pipeline corridors [5]. On these active slopes, corner reflectors are being used to continuously monitor the slope motion... Thirty five RADARSAT-2 InSAR images using PS InSAR techniques indicate the different level of activity of the slopes during different periods of the year. This information will establish a baseline motion for retroactive thaw slides in permafrost areas.

InSAR monitoring of small rotational failures along the Alaska highway and pipeline corridor
Several rotational failures along moderately steep sparsely vegetated slopes are affecting the Alaska highway and nearby gas transmission lines. These displacements originate from gradual movement of the underlying soils. The rotational failures and groundwater seeps produce water ponds in depressions above the pipeline. The pipeline company has installed several inclinometer casings along this segment of pipe to depths of 30-50 m to monitor slope motion affecting the pipeline. Over the last two years, surface movements relative to the bottom of the casings show movements of up to 5 cm/year... Fifteen corner reflectors were installed on the vegetated slopes and stable areas to complement the inclinometer measurements. PS InSAR analysis of our corner reflectors shows that the failure is more widespread and dewatering techniques are considered to prevent the future failure affecting the pipeline below.

InSAR monitoring of coastal landslides Coastal erosion produced by intensity and frequency of storm events are triggering several landslides on Canada's east coast in Newfoundland and Quebec. We have used both differential and PS InSAR analysis of installed corner reflectors to monitor these coastal landslides that are affecting our strategic highways and railways. This InSAR monitoring is ongoing, but our results to date has shown that the InSAR data are assisting in understanding the complex motion behaviour that are related to the stratigraphic units of these coastal sediments.

Enhanced polarimetric composites for surficial geologic mapping: In this case study we have used RADARSAT -2 ultra-fine image fusion techniques and polarimetric composites to characterized several surficial geological materials along the Mackenzie valley pipeline corridor. These polarimetric composites have assisted in finding construction aggregates for the Mackenzie valley pipeline The characteristic surface roughness and angularity the surficial sediments have produced a characteristic polarimetric signature that allows us to improve our surficial and lithological mapping in these northern terrains.

Keywords: RADARSAT-2, InSAR, landslides, polarimetric signatures, surficial materials.

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