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INFRASTRUCTURE MONITORING IN REGIONS AFFECTED BY PERMAFROST USING HIGH RESOLUTION MULTI-FREQUENCY SAR DATA

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ABSTRACT:

Climate warming in recent decades has put a significant part of the Arctic permafrost at risk of thawing, threatening existing infrastructure such as roads, rail beds, runways, pipelines, and buildings that can shift the heat balance of underlying permafrost towards greater instability. Mitigation measures are needed to avoid permafrost thawing and degradation underneath and around the infrastructure to prevent gradual infrastructure destruction. Thus, there is a growing demand for monitoring permafrost stability around and underneath existing infrastructure.

This paper will present the intermediate results of an ongoing investigation of the synergistic potential of multi-frequency SAR data (C- and X- band) for monitoring of infrastructure in regions prone to permafrost degradation. Test sites located in different permafrost zones were selected, which show different thaw processes and deformation movements. The sites are monitored with TerraSAR-X and RADARSAT-2 at different incidence angles using their high resolution modes. The high temporal coverage of the SAR acquisitions shall help to analyze the complex dynamics in the permafrost and distinguish between temporal deformations due to frequent freeze/thaw cycles of the active layer and long-term deformations due to permafrost degradation as a result of global warming.

Results of a detailed analysis of the suitability and complementarity of X- versus C-band and the benefit or drawbacks of different spatial resolutions will be presented in this paper. This includes results of deformation measurements performed using InSAR techniques as well as the analysis of the performance of the new Staring SpotLight mode of TerraSAR-X for deformation monitoring and amplitude and coherence change detection methods, where the latter might provide an additional method for infrastructure monitoring.

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