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VERTICAL MOVEMENTS OF FROST MOUNDS IN SUB-ARCTIC PERMAFROST REGIONS DETECTED USING GEODETIC SURVEY AND SATELLITE INTERFEROMETRY

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Permafrost-affected soils represent around 45% of Canada. These areas, especially the ones located in the discontinuous permafrost zone, belong to the most impacted environments on Earth under recorded climatic changes. Sever changes, such as surface subsidence and the degradation of frost mounds caused by the thawing permafrost, have already been observed at many places.
We surveyed three frost mounds (so-called lithalsa) by a high-precision differential Global Positioning System (d-GPS) during field campaigns in 2009, 2010 and 2011. Our study delivers detailed information about their thawing and freezing behavior on changing temperatures over the year. Seasonal pulsations of the frost mounds with differences depending on the degradation states and landcover were found. The most degraded lithalsa showed maximum amplitude of 0.19 m vertical movement over the three years, whereas the maximum movement over the lithalsa with less degradation was 1.24 m. In terms of the landcover, non- and sparse- vegetated patches showed remarkable fewer movements compared to grassed ones (average movement bare ground/ sparse vegetation: 0.17 m; grass: 0.56 m).
Additionally, differential interferometric (D-InSAR) analysis over the lithalsas was conducted with TerraSAR-X images acquired from April to October 2009 and from March to October 2010. Interferograms with baseline shorter than 200 m were computed revealing a generally very low interferometric coherence, however, phase unwrapping conducted for the most coherent interferograms indicates again maximum amplitude of vertical movements over the most degraded lithalsa.