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Retrieving freeze/thaw-cycles using Sentinel 1 data in Eastern Nunavik (Québec, Canada)

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In the terrestrial cryosphere, freeze/thaw (FT) state transitions play an important and measurable role for climatic, hydrological, ecological, and biogeochemical processes in permafrost landscapes. Satellite active and passive microwave remote sensing has shown its principal capacity to provide effective monitoring of landscape FT dynamics. Sentinel-1 continues to deliver high-resolution microwave remote sensing than ever before and has therefore a large potential of usage for monitoring. In light of this, the capability and responses of its radar backscatter to landscape FT processes in different surface soil depths should be examined to provide a thorough grounding for a robust application of the F/T retrieval algorithm.

This study presents a seasonal threshold approach, which examines the time series progression of remote sensing measurements relative to signatures acquired during seasonal reference frozen and thawed states. It is developed to estimate the FT-state from the Sentinel 1 database and applied and evaluated for the region of Eastern Nunavik (Québec, Canada). In this course, the FT state transitions derived from Sentinel 1 data are compared to temporally overlapping situ measurements of soil moisture from different depths within the top 20cm soil. This work allows to explore differences in the sensitivity of the Sentinel 1 at different surface soil depths in higher detail; this information is used to examine the penetration performance of the Sentinel 1 under different conditions of permafrost and permafrost-dominated landscapes.

This work is dedicated to providing more accurate data to capture the spatio-temporal heterogeneity of freeze/thaw transitions. As Sentinel-1 continues to deliver high-quality information, the provided threshold algorithm delivers an extended time series to analyze FT-states and improve our understanding of related processes in permafrost landscapes.