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THE POTENTIAL AND LIMITATIONS OF ACTIVE LAYER THICKNESS ESTIMATION FROM SAR BACKSCATTER INTENSITY AND ITS RELATION TO SOIL ORGANIC CARBON

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Remotely sensed data, especially from optical sensors, is frequently used to estimate active layer thickness (ALT) in polar regions. The Normalized Difference Vegetation index ranges are associated with certain ALT ranges. It is expected that NDVI is related to the amount of biomass and indirectly underlying soil properties. NDVI can be however not universally directly translated into amount of shrubs in tundra.

Synthetic Aperture Radar data from satellites provide additional information on surface properties including surface roughness leading to diffuse scattering and biomass from volume scattering. This has been demonstrated for X-band (~3 cm) backscatter intensity values for shrubs (Widhalm et al. in press) and for C-band (5.6 cm) regarding roughness (Widhalm et al. 2015). Especially the latter has been shown previously to relate to soil properties (organic carbon content) in tundra environments (Bartsch et al. 2016a).

Active layer measurements from across the Arctic (CALM network) have been used to assess the potential of C-band SAR for this study. Analyses are complemented by X-band measurements at selected sites. C-band SAR data from ENVISAT ASAR GM have been preprocessed for the entire Arctic (several thousand of images) and statistics for early winter acquisitions (exclusion of liquid water impact on backscatter) derived.

In general low roughness corresponds to wetter sites which have shallow active layer thickness values (< 60 cm). Higher roughness represents drier sites with a larger range of ALT. Results are assessed with respect to the previously established relationship of C-band backscatter with SOC. Analyses shows that the approach is limited to sites without higher shrubs. The potential of inclusion of roughness information in traditional land cover maps (Bartsch et al. 2016b) within the framework of the ESA DUE GlobPermafrost project is eventually discussed.

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