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Determination of Arctic land surface and soil properties with Synthetic Aperture Radar information from satellites

Permafrost is an essential climate variable and prone to change with future warming. Extensive permafrost degradation is likely to occur within this century. Currently stored carbon will potentially be mobilized effecting the global carbon cycle. Furthermore permafrost degradation will cause impacts on infrastructure and ecosystems. Permafrost monitoring is therefore essential and often challenging due to the fact that Arctic regions affected by permafrost are vast and often remote. Therefore Remote Sensing holds great potential due to continuous coverage.

As permafrost is a subsurface phenomenon it cannot be measured directly via satellite data. However its state can be indirectly derived and degradation impacts can be observed. This thesis focuses on the possibilities of synthetic aperture radar (SAR) for circumpolar monitoring. Relationships between SAR backscatter and arctic land cover as well as soil properties are explored, incorporating SAR data of different spatial scales and wavelengths as well as in situ data gathered during field campaigns.

In a first publication the influence of vegetation types of certain wetness regimes on C-band summer and winter backscatter is investigated in order to derive a circumpolar wetness map and subsequently to apply at site scale and medium resolution. Soil properties are further explored within a second paper, where the interrelations of arctic vegetation, soil moisture and active layer thickness are analyzed and connected to X-band backscatter as to delineate a continuous active layer map for a study site on the central Yamal Peninsula.

Within a third paper a simplified normalization approach is introduced by investigating land cover specific incidence angle dependencies for arctic regions.