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Mapping the Vegetation of a Peatland in Swedish Lapland by using Aerial Photography

Northern peatlands play an important role in the observation of global climate variations. Permafrost in the ground is melting slowly, because the earth becomes warmer. This tends to result in increasing methane gas emissions from the ground. The impact of degradation is visible in a changing land cover distribution at the peatlands, because the landscape faces a change into moister conditions. Understanding the relation to climate conditions of the future is a challenge. No accurate information about the particular vegetation of peatlands exists. More knowledge about the vegetation cover would help to understand the effects from loosing permafrost in peatlands. It is also a useful source for a long-term observation of landscape changes. In our work, the objective was to derive a map that shows a detailed vegetation distribution of a permafrost underlain area. This was done by a classification of an aerial photography.

Because Swedish Lapland is far from populated places, remote sensing is a welcome method to observe the ground vegetation from above. This is commonly done by interpreting photos taken by an aircraft. Our method involves an approach of object-based image analysis. We classify the information from an aircraft-taken image in a meaningful context into groups of vegetation covering the land surface. We produce a detailed vegetation map that helps to explore the vegetation and to observe changes.

Background

Remains from the last ice age characterize the subarctic landscape of Swedish Lapland. Large areas are still underlain by a constantly frozen ground, permafrost. The regions of permafrost exhibit wetlands that are often peatlands. We know that the permafrost ground layer is sensitive to changes in local climates. An obvious effect, the trend to warmer temperatures and to more rainfall, is that the landscape changes slowly by that. Landscape transformation is highly visible by ongoing ground degradation. This causes an increase in the disturbance of wetlands. The plant cover is affected, as vegetation pattern is connected to the conditions in the ground. In subarctic regions, the plant species distribution covering a peatland is defined by water access. The production of methane, a greenhouse gas, is also connected to water accessibility. Water covered permafrost drives the release of methane to the atmosphere. A better knowledge about ongoing processes within the peatland ecosystems and permafrost disappearance is important.

Study Site and Data

Northernmost Sweden, Lapland, is a region where peatlands are commonly found. We use an aerial photography that shows the area of a peatland that is underlain by permafrost. The digital image was taken during the growing season. Our study site, Stordalen, is a peatland close to the Abisko Scientific Research Station near lake Torneträsk. Stordalen is a peatland which has a frozen permafrost ground at different stages of degradation. Permafrost is already melting in some places, which suits the area for a closer observation. The used image has a high pixel resolution of 8 cm,

which is in higher resolution than other available data of the area. Such high resolution enables to identify a high level of details of the vegetation cover.

Image Classification
A classification based on aerial imagery is a common technique. Traditional methods are based on a classification of every single pixel the image contains, and hereby considering the spectral information only. But this approach may lead to some problems, as one plant growing naturally consists of more than one pixel in a high-resolution image, as ours. The imagination that most plants covering the ground, e.g. patches of mosses, are naturally larger than 8 cm helps to understand this. We used the approach of an object-based interpretation, which enables a deeper influence on the classification, on the other hand. By the help of parameters and rule setting, object-based allows to capture typical pixel values that form a plant. Our method of object creation enables to include structures of different and very small sizes, so the plant cover is described following the natural shape. Main plant species are collected in vegetation groups that describe the type of plants by their growth form. Such a group is based on common characteristics. This classification method proposes the comparability of the vegetation classes. Using objects also enables new possibilities to analyze the vegetation.

Results and Conclusions
A map showing the distribution of vegetation at Stordalen peatland was obtained from the image. The work included tests of different parameters, the adjustment of the object size, shape and location. Typically, a vegetation object was identified by the spectral response of the plant surface in the image. A visual inspection, based on field knowledge, helped to determine the best parameters. The evaluation was done by comparing information from a field survey to the classification results. It was possible to produce a map that contains vegetation classes that follow the natural growth. Therefore, the combination of an object-based image analysis with high resolution data is of use to map the vegetation of a peatland. More knowledge about the actual vegetation, to evaluate the classification result, could improve future map results.

Key words: Physical Geography and Ecosystem Analysis, Object-Based Image Analysis, OBIA, Vegetation Classification, Permafrost, Arctic Peatland, Remote Sensing, Aerial Photography, Environmental Monitoring, Landscape Analysis

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