Spectral based mapping and characterisation of salt effected ecosystems in a post-mining area near Halle (central Germany)

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Abstract

The substance output of mining dumps represents a landscape-ecological problem of global character. Tailing piles of potash salt processing underlie intense discharges causing azonal salinations of the environment. The resulting inland salt marshes often constitute important protective biotopes for the species conservation since they form the habitat of numerous endangered floral species. The inland salt marsh in the Weitzschke-depression near Halle (Central Germany) is a unique example with regard to its size and abundance of halophytes.

In classical CIR aerial image analyses the generally highly structured stocks of halophytes can only be limitedly and insufficiently identified. Therefore, time-consuming and cost-intensive field mapping has been the only solution heretofore. Thus new remote sensing methods are required to minimize costs and deliver fast results.

From 2009 to 2013 spectroscopic field measurements (ASD field spectrometer) were conducted in order to gather the spectral characteristics and the identifiability of halophytes and halophilic phytosociologies as well as their variance in different phenological stages. Halophytes of extreme locations (Salicornia europaea and Suaeda maritima) usually occur as mono or dominance stands and display specific spectral characteristics. Likewise, it becomes apparent that salty phytosociologies are distinguishable from ruderal and segetal communities, on account of their spectral behavior.

Based on these spectral peculiarities, an algorithm for the detection of halophytes was developed. This was accomplished by means of hyperspectral airborne imagery (HyMap). By the use of a decision tree classification with adapted and new developed vegetation indices salty phytosociologies could be determined. Due to the inclusion of modern methods of machine learning (SVM) the preciseness of the model could be further improved.

Additionally terrestrial hyperspectral imaging data (VNIR range from 450 to 1000 nm) could be collected from various stocks of halophytes captured by a Cubert UHD 285 camera. Due to the high spatial resolution of the terrestrial data variations within the plant associations could be investigated and evaluated, whereby the classification results of the airborne data can be further improved.

The combination of hyperspectral data analysis and classical panchromatic, true color or near-infrared airborne data interpretations result in a better understanding of complex and high structured post-mining landscape and allows an improved multitemporal analysis of high dynamic ecosystems like salt marshes.

The implementation of the algorithm for other areas could significantly facilitate the complex field work und would also enable a more cost-effective monitoring for inland salt marshes.