

# The potential of mobile VIS/NIR measurements in TOC prediction and organic soils delineation in different field conditions

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## 1. Introduction

The current study represents the first attempt to apply the mobile shank-based VIS/NIR system to the mapping of organic soil in Denmark with the focus on investigating its potential as a rapid analytical method for real-time estimation of the spatial distribution of TOC. The crucial approach of this project is based on the hypothesis that VIS/NIR should be a lucid method for TOC estimation and organic soils delineation due to the organic nature of the majority bonds in this region. The possible effect of different field conditions on the spectral measurements will be investigated. As the main part of this work comparison of conventional mapping method to the new mobile VIS/NIR mapping was reported.

## Objectives

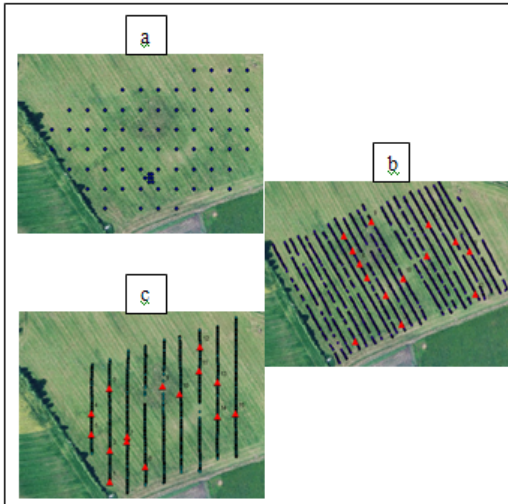
- > comparison of conventional mapping to the new mobile VIS/NIR mapping system
- > investigating the potential of VIS/NIRS as a rapid analytical method for estimating the spatial distribution of TOC of organic soils
- > testing the accuracy of the system in different field conditions

## 2. Method

Three different sampling methods:

- Manual sampling on a 25m grid
- Mobile VIS/NIR measurements in the wet field conditions
- Mobile VIS/NIR measurements in the dry field conditions

### Sampling methods



## Mobile shank-based VIS/NIR system

The system is developed for in-situ near surface measurements of soil carbon content. It measures diffuse reflectance in the 350-2200 nm region. Optical measurements are made through a sapphire window at the bottom of the shank, pulled at a depth of 7cm at a speed of 4-5 km/hr. The system also acquired soil Electrical conductivity (EC) for two soil depths: Shallow (0- 31 cm) and deep conductivity (0- 91 cm) together with the soil temperature

## Calibration

Calibration equations were acquired from TOC of 15 representative samples for both sampling campaigns

### Calibration models:

Calibrations of TOC from spectral data were developed using PLS regression, the segmented cross-validation method on centred data.

### Three types of calibration models were performed on:

- Spectra only
- EC data along with spectra
- EC and temperature along spectra data

### with six different pre-treatments using:

- only spectra, (2) Savitsky-Golay smoothing over 11 wavelength points and transformation to a (3) 1<sup>st</sup> and (4) 2<sup>nd</sup> Savitzky and Golay derivative algorithm with a derivative interval of 21 wavelength points, (5) with or (6) without outliers removal.



## Inference models

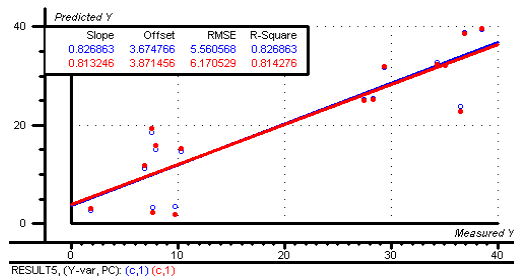
Determination of 15 representative sampling locations:

- > Spectra compression (PCA)
- > Outliers removal (more than 3 Std above or below the mean)
- > Clustering- within each cluster location with the min. spatial variability

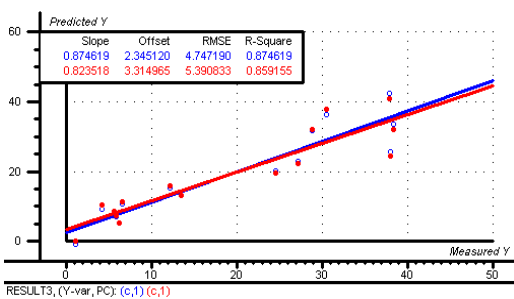
## 3. Results

### The best calibration models

In wet field conditions- using smoothed spectra with the 1<sup>st</sup> derivative and EC-DP

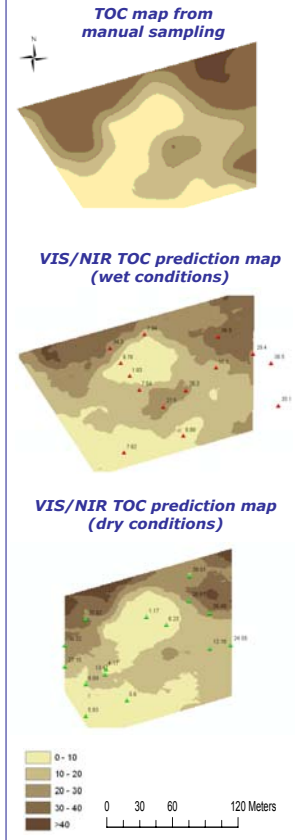


Dry field conditions- using smoothed spectra with the 1<sup>st</sup> derivative, EC-DP and temperature



Calibration equation was applied to the field spectra for TOC prediction

## Maps of TOC



## 4. Conclusion

VIS/NIR system:

- > Presented good estimates of spatial distribution of TOC
- > Performed well comparing to traditional soil sampling
- > Accurately selected sampling locations for calibration
- > From the prediction point of view the second calibration model with lower correlation in the higher TOC range is more suitable
- > Despite of small discrepancies between the two calibration models, wet and dry field conditions have not affected the prediction maps seriously and still correlate well with the reference map suggesting a minor effect of moisture content on spectral data.