

A preliminary study on infrared spectroscopy for soil physical quality in Irish tillage fields

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ICAERE 6th annual conference

08.05.2017



Introduction

Material & Methods

Results & Outlook

Overview

- Project: CTF Optimove, WP 5.1
- Main focus: soil compaction
- Goals
 - Calibration model for IR spectroscopic detection of soil compaction
 - Spatial distribution of soil compaction in the field
 - implementation in controlled traffic farming tools



Procedure

- Soil compaction indicators
- Calibration database (field/lab)
- Scan samples in IR
- Model calibration and validation
- Spatial variability
- Portable IR spectroscopy



Soil compaction



Most critical zones: headlands
2 types: topsoil and subsoil compaction

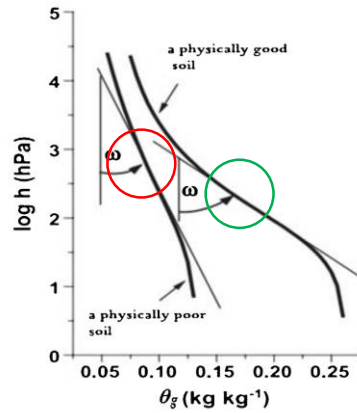
Topsoil

Subsoil



Soil compaction indicators (1)

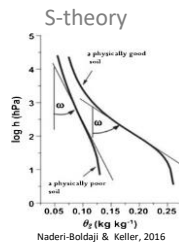
S-Theory



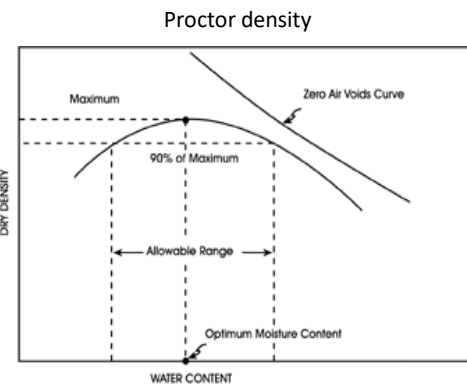
Naderi-Boldaji & Keller, 2016

Soil compaction indicators (2)

Reference density

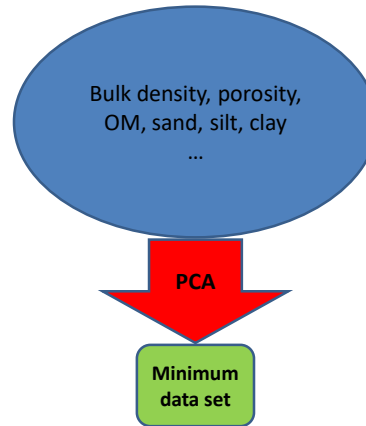
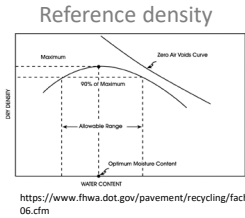
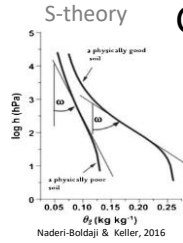


Naderi-Boldaji & Keller, 2016


<https://www.fhwa.dot.gov/pavement/recycling/fach06.cfm>

Soil compaction indicators (3)

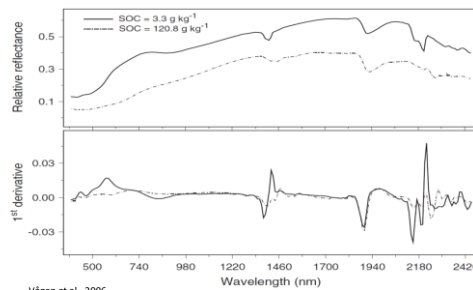
General Indicator of Soil Quality



Infrared spectroscopy

- Principle: Various components of soils absorb IR irradiation → characteristic spectra
- Analysis: Chemometrics

Region	Wavelength (nm)
NIR	780-2,500
MIR	2,500-50,000



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Fieldwork



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Labwork (1)

Particle size distribution

- Sieve pipette method
- Laser diffraction



Introduction

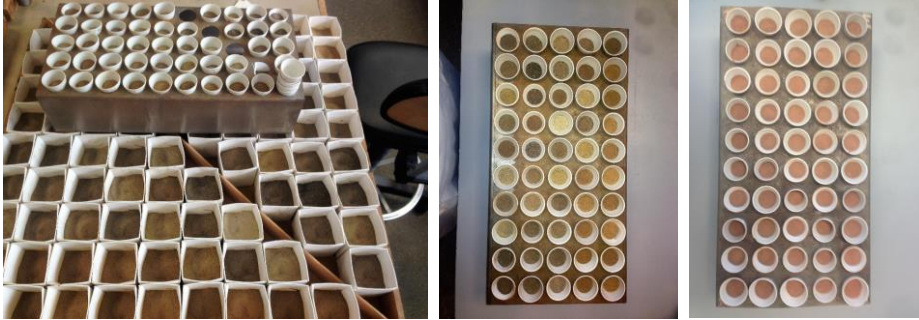
Material & Methods

Results & Outlook

Labwork (2)

Organic matter

- Loss on ignition



Introduction

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Results & Outlook

Labwork (3)

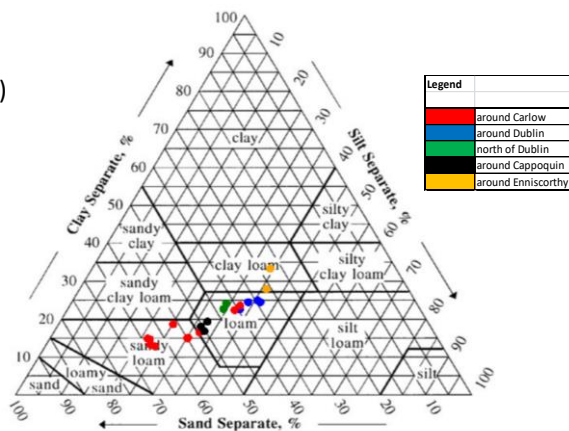
Others

- Bulk density (mass/volume)
- Moisture content
- pH/ lime requirement
- Nutrients (P, K, Mg, N)



Results

Particle size
distribution
(SPM, composite)



Procedure

- Soil compaction indicators (✓)
- Calibration database (field/lab) (✓)
 - Next: laser diffraction
- Scan samples in IR
- Model calibration and validation
- Spatial variability (GIS)
- Handheld IR spectroscopy



