Food and Agriculture Organization of the United Nations

GLOSOLAN
Soil spectroscopy training workshops

Soil spectroscopy from the Danish perspective

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Online webinars

GLOBAL SOIL PARTNERSHIP

OUTLINE

- **AGRO, AU**
- NIRS instrumentation
- Soil Spectral Library (SSL)
- Examples of SSL application
- Teaching

AGROECOLOGY, AARHUS UNIVERSITY

Core activity

- Research
- Policy support
- Education
- International collaboration

Staff

AGRO 270

SOIL 40/8

Foulum, Blichers Alle 20, 8830 Tjele, DK

RESEARCH SECTIONS

- Agricultural Systems and Sustainability
- Climate and Water
- Crop Health
- Crop Genetics and Biotechnology
- Enthomology and Plant Pathology
- Soil Fertility
- Soil Physics and Hydropedology (**SOIL**)

Soil spectroscopy

- NIRS, MIR, LIBS

- group (3 MSCs, 2 PhD, 2 Postdoc)

WHY NIRS?

- Growing need for more soil data (national, regional, local/farm scale)
- Need for improved estimation of soil properties
- Need to better account for infield variability
- Lack of soil data in remote areas

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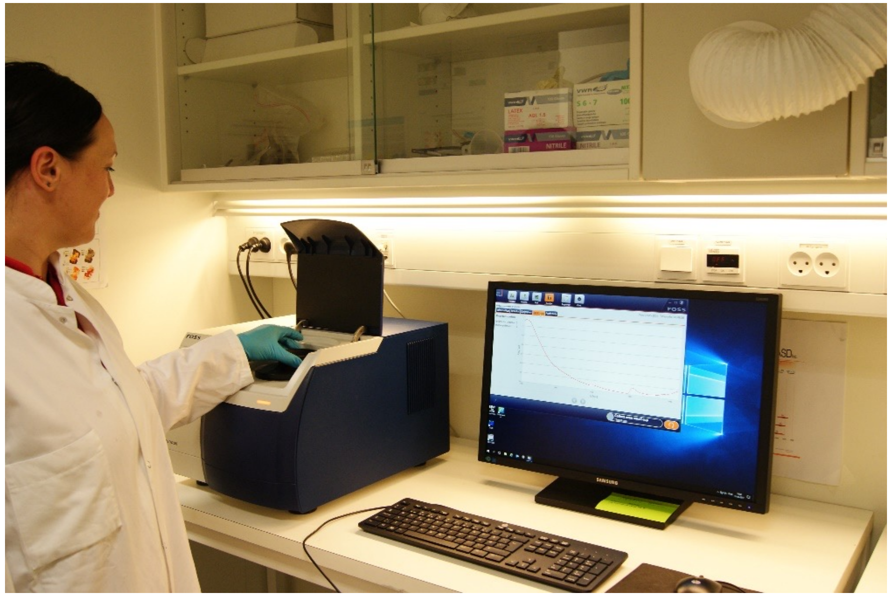


INSTRUMENTATION

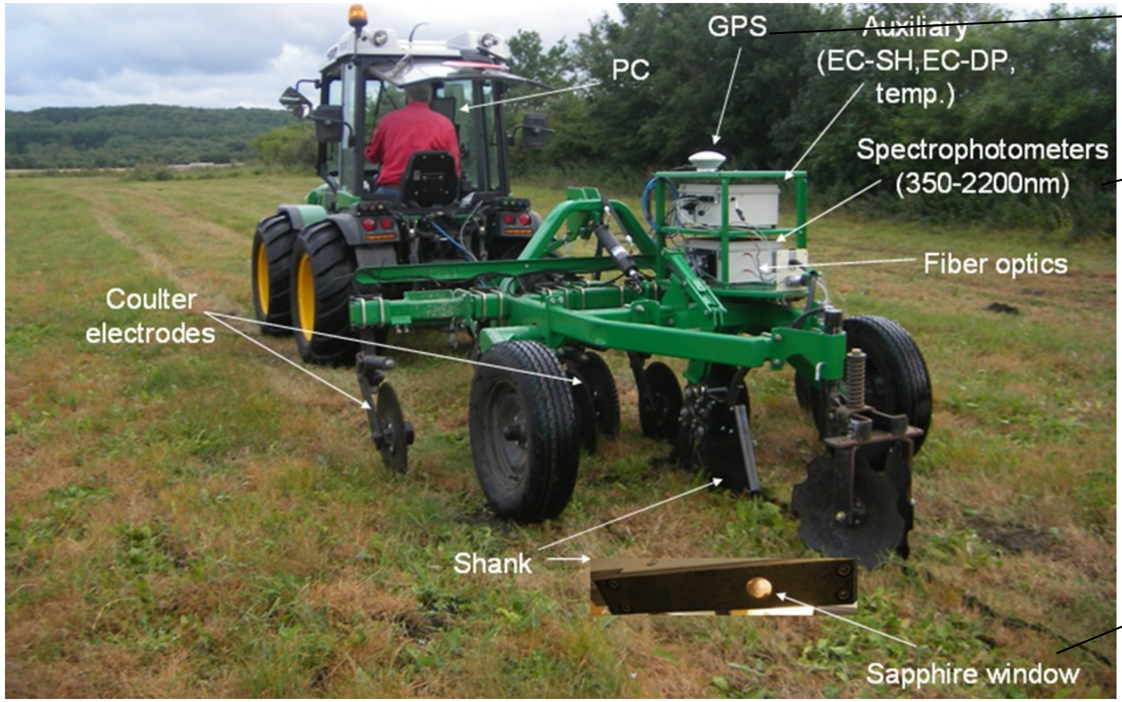
Laboratory

DS2500 (FOSS, DK)

ASD Labspec 5100

INSTRUMENTATION

Field (on-the-go and in-situ)



Veris shank and profiler systems

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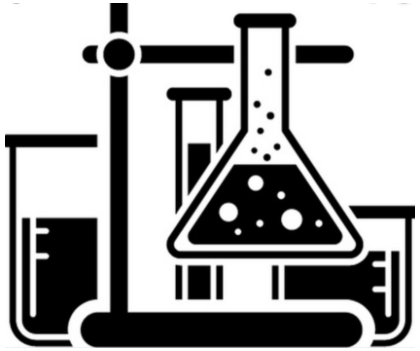
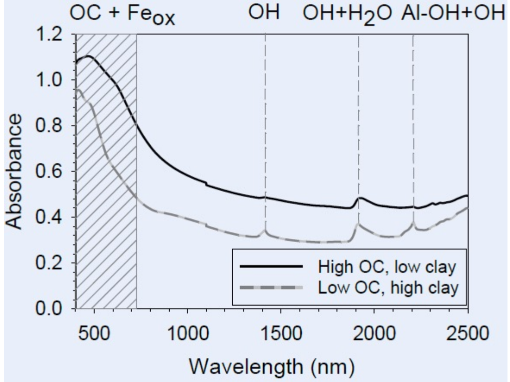
SOIL SPECTRAL LIBRARY (SSL) – the beginning

Soil archive at AGRO



Wet chemistry

ASD Labspec 5100

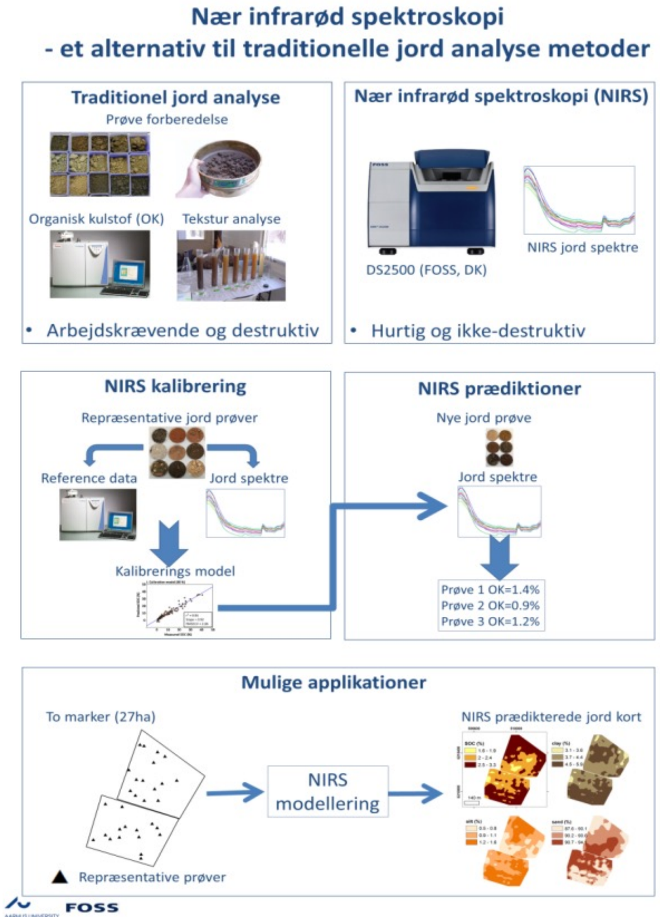


Soil spectra

SSL and collaboration with FOSS

Implementing soil spectra in the assessment of soil quality (SOIL-SPEC)

- **AU**: expertise and knowledge on soil and soil libraries
- **FOSS**: sensors based on spectroscopy
- **Patriotisk Selskab**: results dissemination to farmers & advisors

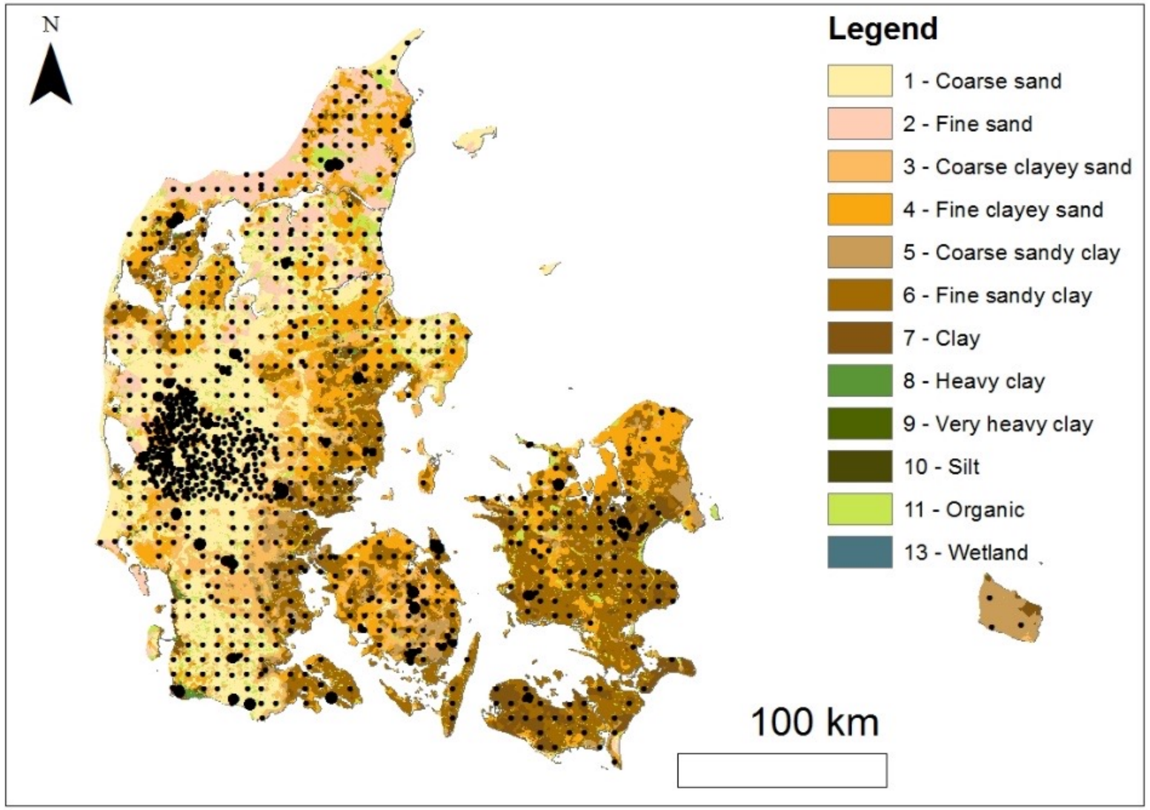


DS2500 demo & on-site predictions

SSL overview

- soil profile investigation (~3000)
- soil classification database (~ 660)
- lowland database (~ 1000)
- field investigations

  40 fields (~ 1600 samples)
- Greenland (~ 500)
- international samples (~ 200)



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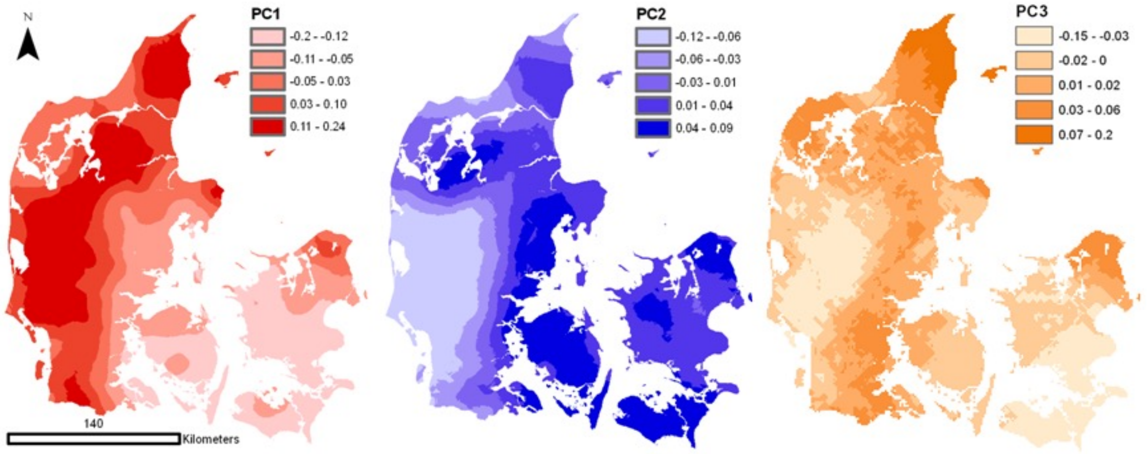
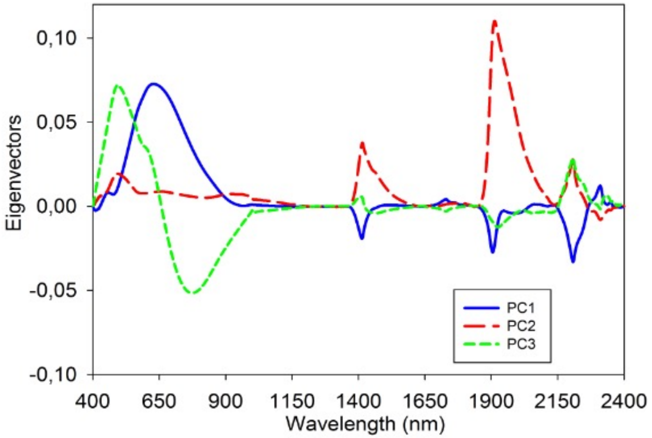
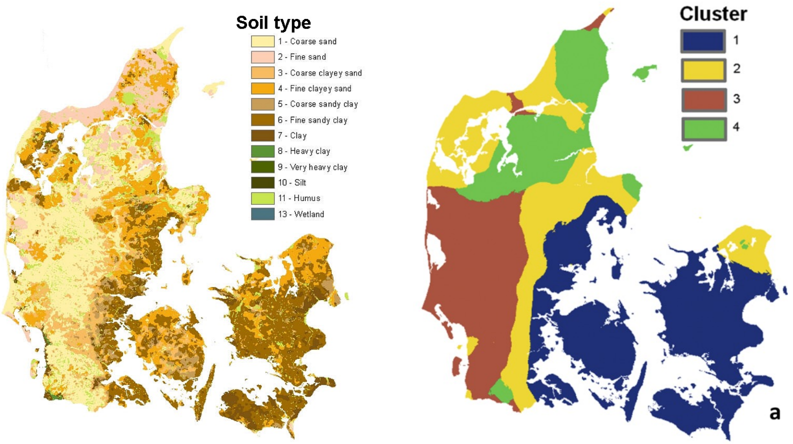
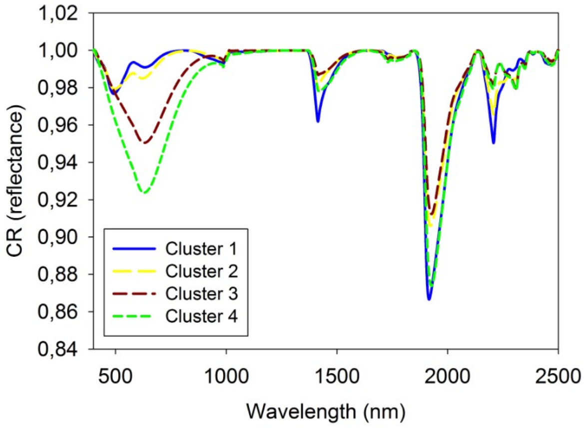
NIRS FOR SOIL CLASSIFICATION



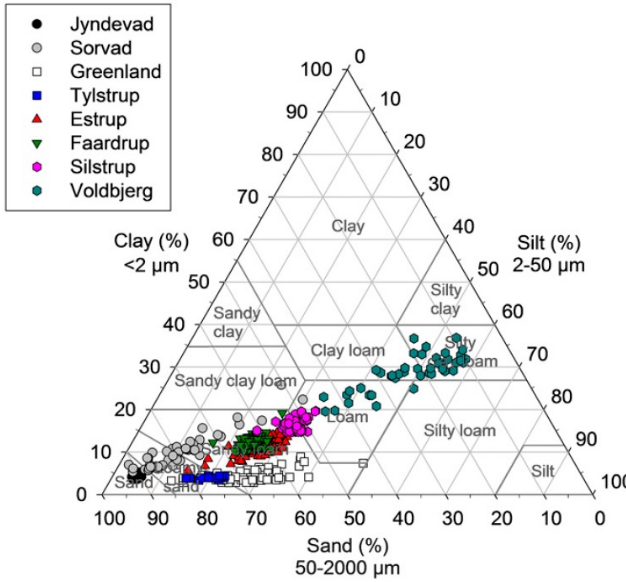






*1

NIRS FOR BASIC SOIL PROPERTIES

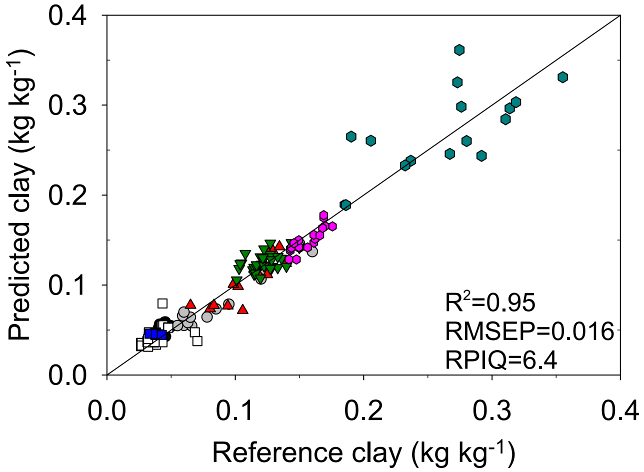


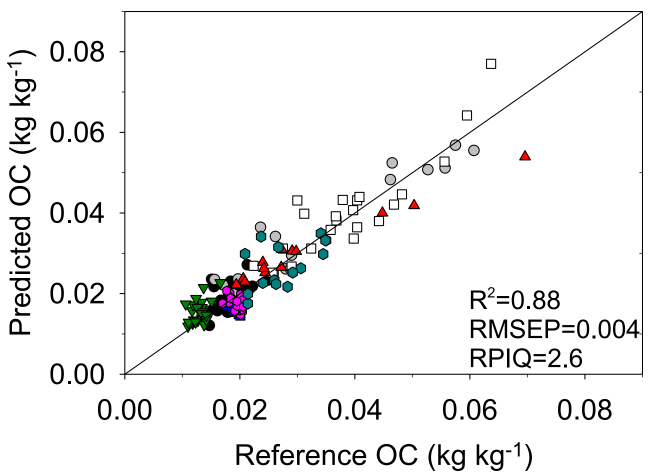
*2

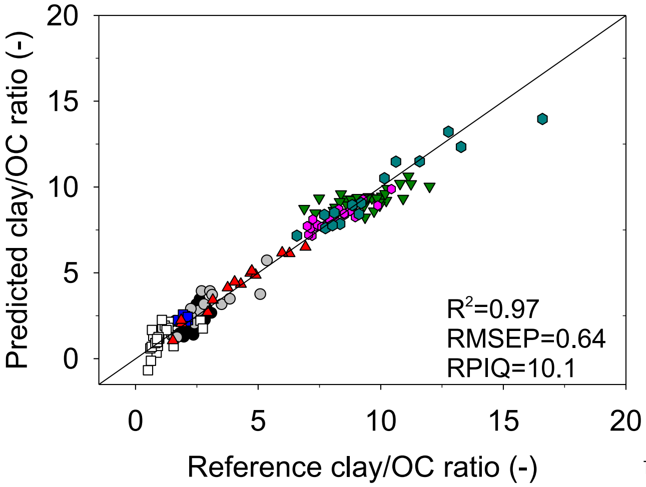
Dexter n = clay/OC:

8-10 g of clay complexes 1 g of OC

n < 10: non-complexed OC → good tilth conditions
n > 10: non-complexed clay → degraded soil structure







NIRS FOR FUNCTIONAL SOIL PROPERTIES

- **Structural**

Macroporosity, CT matrix (*3)

- **Surface**

Specific surface area (*4,5), water repellency (*6,7)

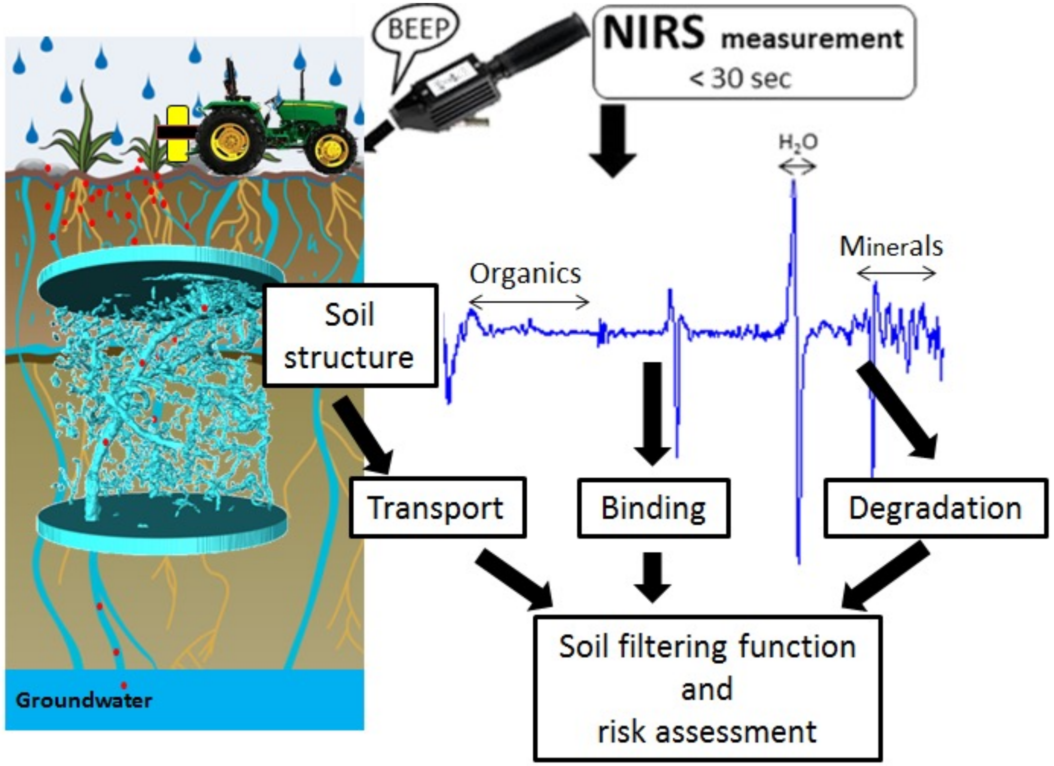
- **Transport**

Soil water retention curve (*8,9)

solute mass transport (*10)

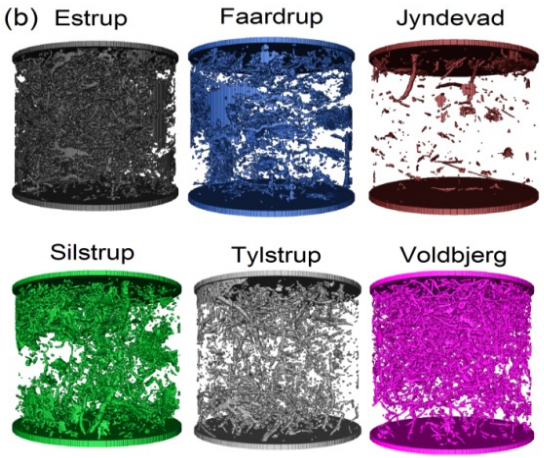
- **Binding**

Sorption coefficient (*11, 12)



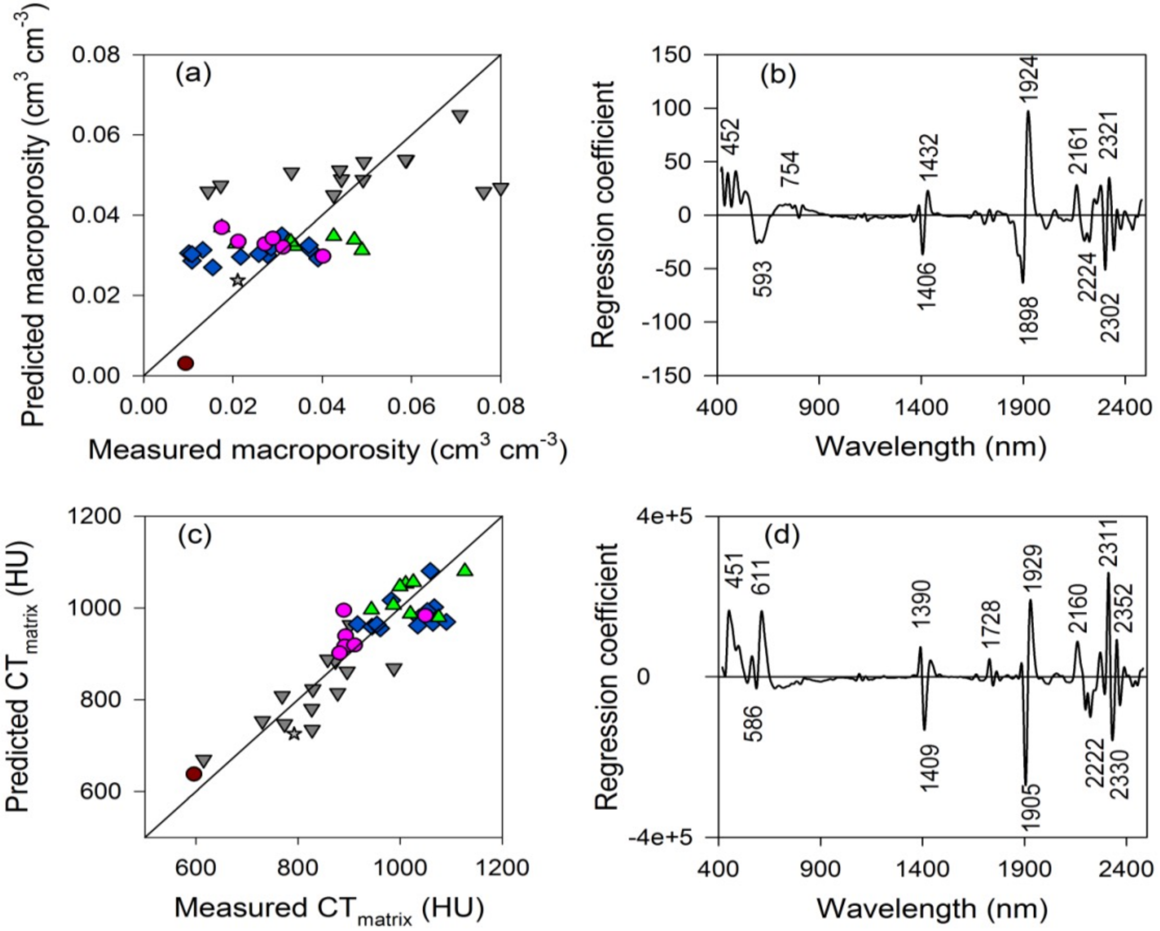
AARHUS UNIVERSITETS FORSKNINGSFOND
AARHUS UNIVERSITY RESEARCH FOUNDATION

STRUCTURAL PROPERTIES



Derived parameters:
CT_{matrix} (density of soil matrix)

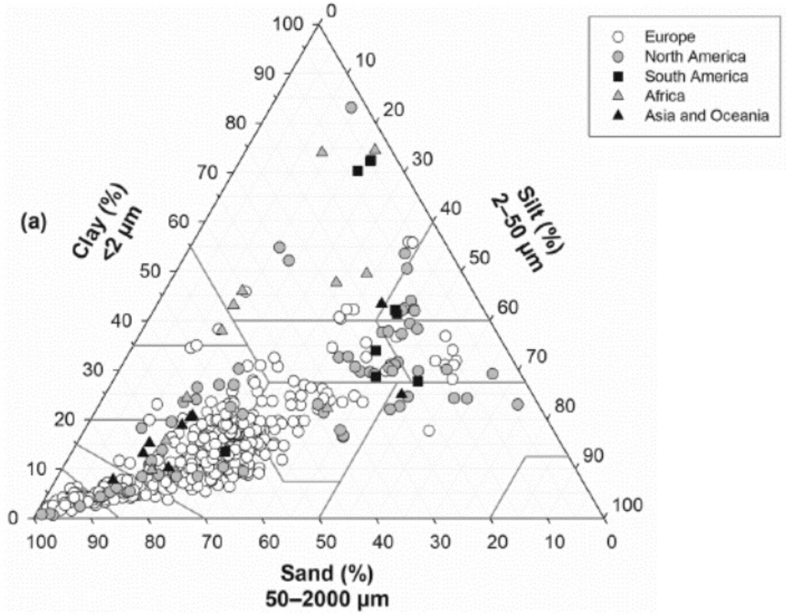
Macroporosity (pores > 1.2 mm in diameter)

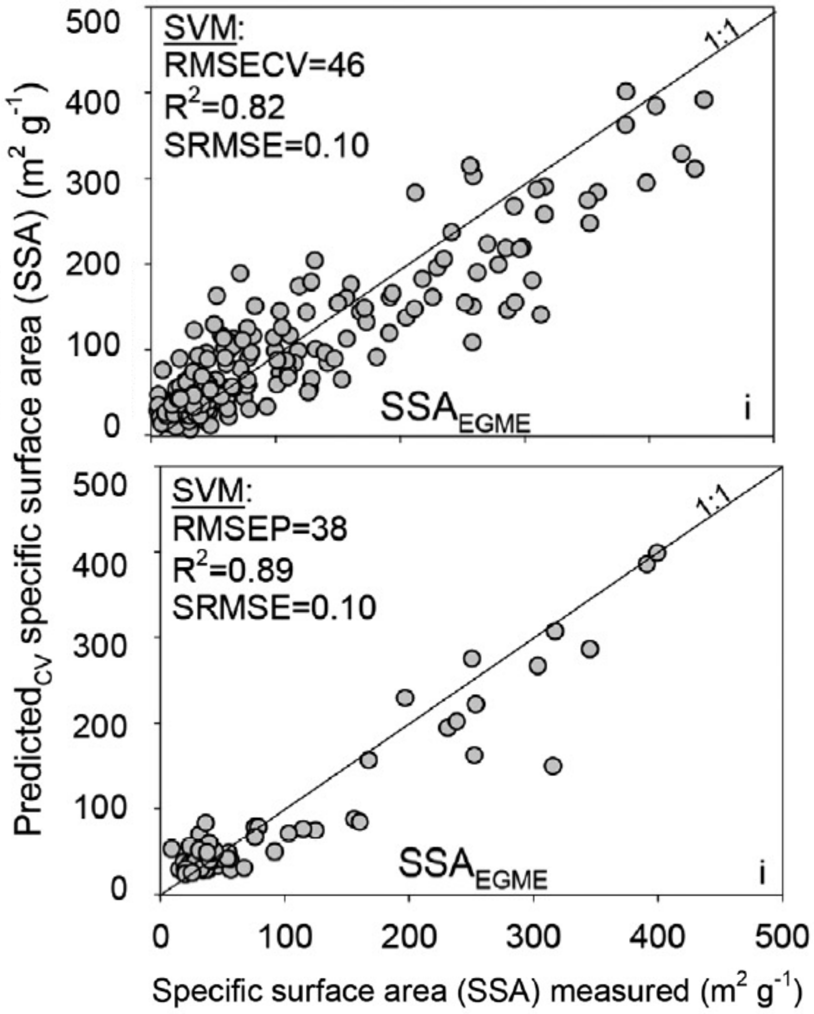


*3

SPECIFIC SURFACE AREA

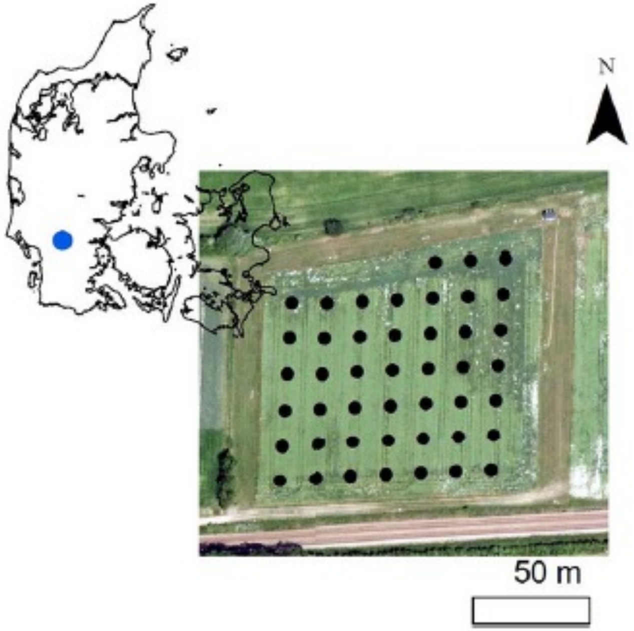
The SSA is expressed as surface area per unit mass of soil (m2/g)

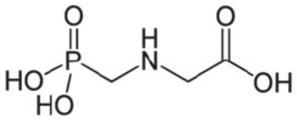




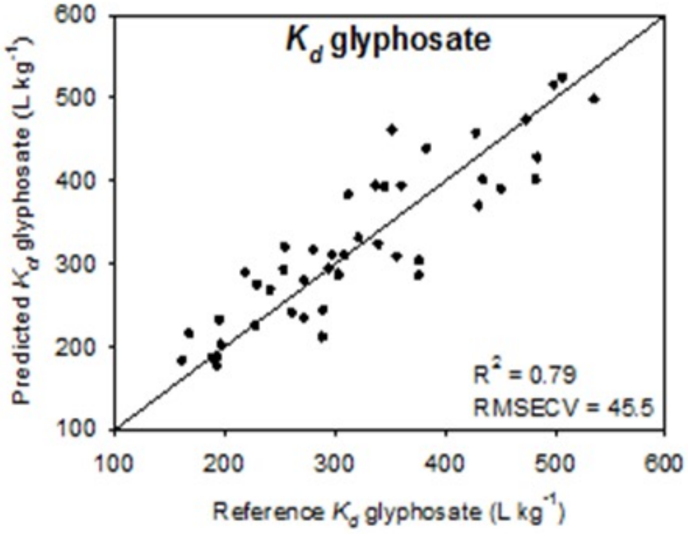
*4

CONTAMINANT BINDING

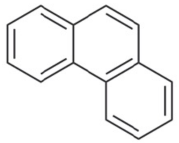




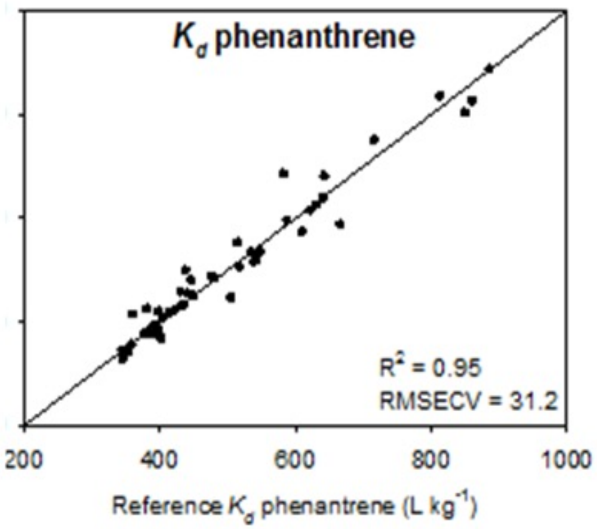
Herbicide



Binds to Fe, Al oxides and P



PAH from combustion

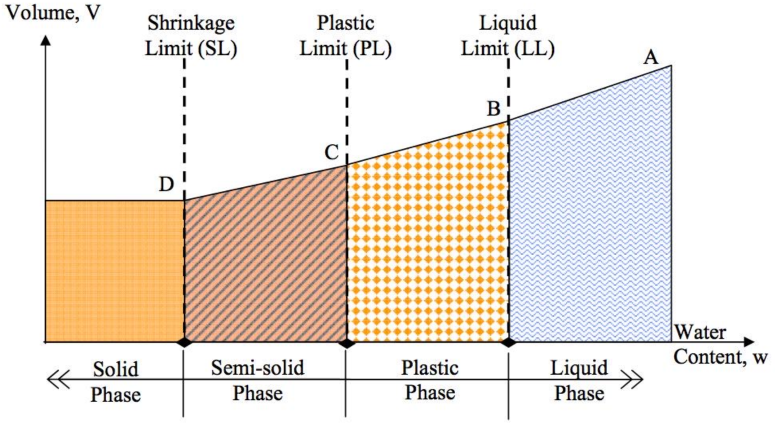


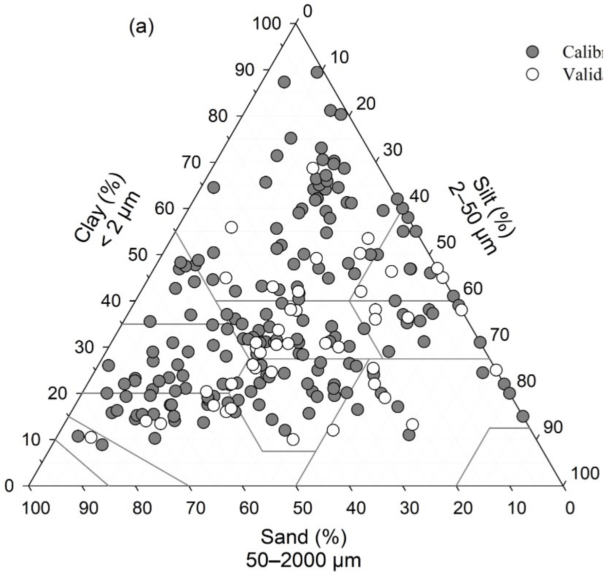
Binds to OM

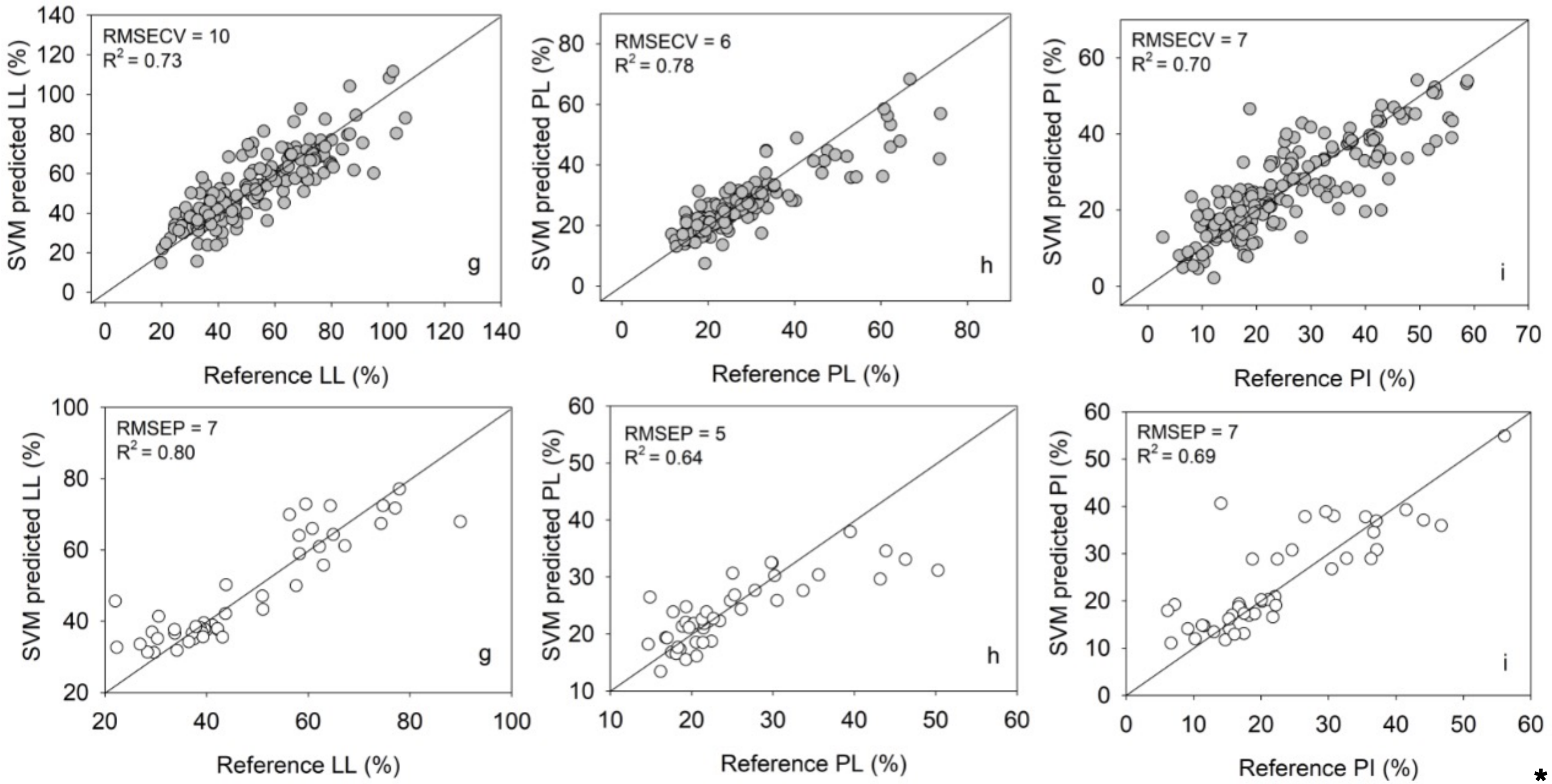
*11

ATTERBERG LIMITS

soil mechanical behavior concerning consistency limits:
plastic limit; **PL**, liquid limit; **LL**, and plasticity index; **PI**=LL-PL

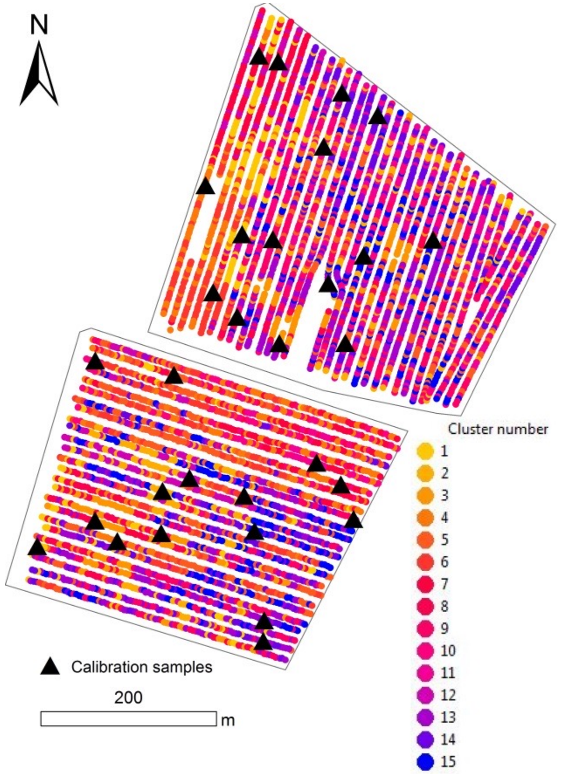


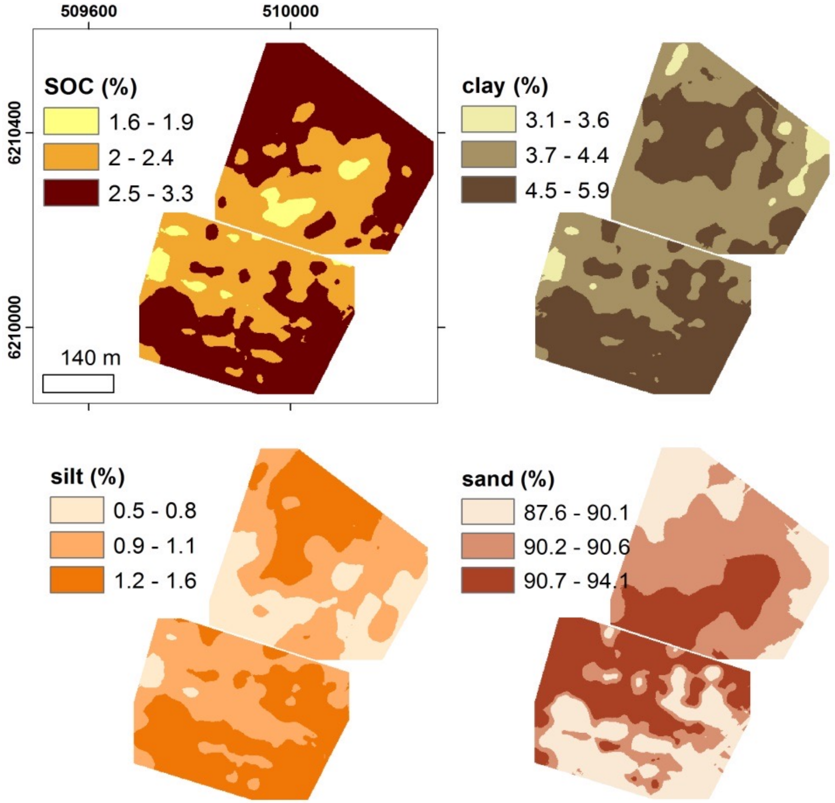




*13

FIELD APPLICATION





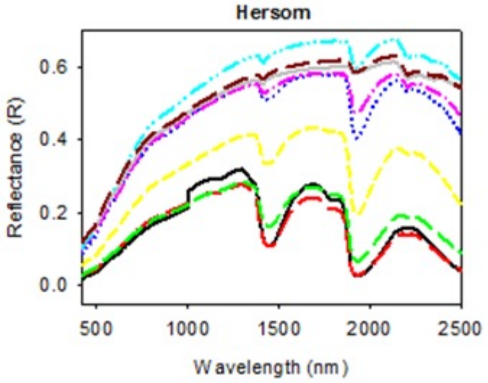
*14,15

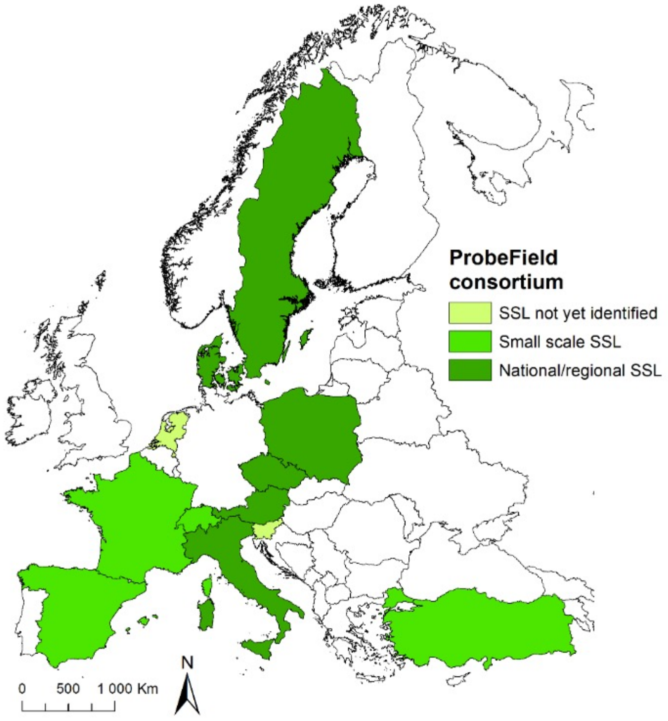
EJP SOIL

PROBEFIELD –A NOVEL PROTOCOL FOR ROBUST IN FIELD MONITORING OF CARBON STOCK AND SOIL FERTILITY BASED ON PROXIMAL SENSORS AND EXISTING SOIL SPECTRAL LIBRARIES

Lead: SLU, *Bo Stenberg,* Co-lead: AU, *Maria Knadel,* 12 countries, 14 partners

- Methodology for in-field spectral soil sampling
- Mathematical technique to remove in-field conditions
- Sensor fusion for point and 3D field estimations
- Protocol of the best practice





AARHUS UNIVERSITY
DEPARTMENT OF AGROECOLOGY

EJP SOIL has received funding from the European Union's Horizon 2020 research and innovation programme: Grant agreement No 862695

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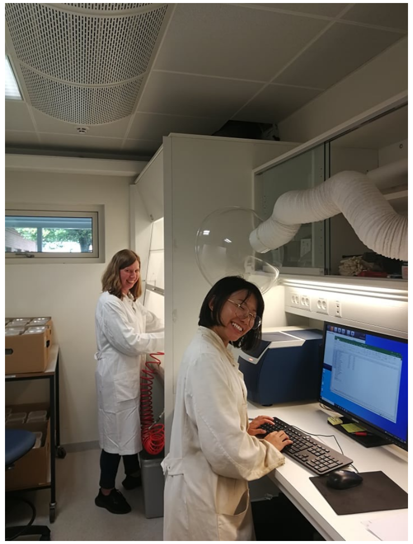
- **Teaching**

PHD - NIRS IN SOIL SCIENCE

- theoretical and practical knowledge of NIRS and its application to soil science
- ability to use NIRS sensors
- skills to analyse soil spectra and develop calibration models



Organizer - Maria Knadel (AU)
Lecturers:
- Bo Stenberg, Johanna Wetterlind (SLU)
- Maria Knadel, Cecilie Hermansen, Anders Møller (AU)
- Eyal Ben Dor (TAU)

LITERATURE

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Thank you for your attention!

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