Name of course: ELECTROMAGNETIC SOIL SENSORS – THEORY AND APPLICATIONS

ECTS credits: 5

Course parameters:
Language: English
Level of course: PhD course
Time of year: Q2 2027 (21-26 June 2027)
No. of contact hours/hours in total incl. preparation, assignment(s) or the like: 120
Capacity limits: 15

Objectives of the course: Over the past two decades, rapid advances in sensing technologies have revolutionised the way we observe, quantify, and model soil properties. Modern soil sensing systems now play a central role in complementing traditional, labour-intensive soil sampling approaches, offering unprecedented spatial and temporal insights into soil status and variability. These innovations have become fundamental to high-resolution soil mapping, enabling more sustainable and data-driven management of soil resources. At the same time, the integration of sensors with unmanned aerial vehicles (UAVs), robotic systems, and multi-sensor platforms has expanded the operational scope of soil sensing, allowing measurements at scales previously unattainable.

This course provides a comprehensive overview of recent developments in proximal and remote electromagnetic sensing technologies and their applications in soil science. Participants will gain hands-on experience in sensor-based data acquisition, calibration, and modelling workflows, linking theory with practice. Through selected case studies, the course will demonstrate how these technologies are advancing soil mapping and monitoring, with particular emphasis on applications in precision agriculture and the management of vulnerable ecosystems, such as peatlands.

Learning outcomes and competencies:
At the end of the course, the student **should be able to**:
- Comprehend the role of soil sensors in digital soil mapping
- Know the basics of georeferencing (GPS/GNSS)
- Understand the working principles of electromagnetic soil sensors
- Develop an intuition of what they measure
- Understand what soil properties can influence sensory measurements and model relationships
- Do fieldwork and data processing to a basic extent

Compulsory programme:
Lectures, exercises, field and laboratory measurements. Active participation in both lectures and group work is expected.

Course contents:
The course provides formal lectures introducing working principles, instrument configuration, applications, and hands-on experience for the following electromagnetic sensing techniques.
- Electromagnetic induction
- Ground penetrating radar
- Time-domain reflectometer
- Drones and Different cameras (visible, multispectral and thermal)
- Visible, near-infrared, and mid-infrared spectroscopy
- Gamma radiometric

Moreover, the participants will be introduced to georeferencing, working with spatial data, sensor-directed soil sampling, multi-sensor platforms and data fusion. The exercises will be mainly performed in groups and based on quality datasets available from the ongoing research projects.

Prerequisites: PhD students with a background in soil science, agronomy, digital soil mapping, precision agriculture and agricultural geophysics.

Name of lecturer[s]: John Triantafilis (University of Sydney, Australia), Fenny van Egmond (ISRIC – World Soil Information, The Netherlands), Sabine Chabrillat (GFZ-Potsdam, Germany), Mogens H. Greve, Davide Cammarano, Denys Grombacher, Maria Knadel, Lucas de Carvalho Gomes, Sebastian Gutierrez, Diana Vigah Adetsu, Rene Larsen, Henrik Nørgaard, Triven Koganti

Type of course/teaching methods:
The course will last for six days. Each day begins with a lecture session. The second half of the day will mainly involve hands-on measuring and modelling activities.

Literature: Obligatory reading before the start of the course. The material will be distributed to participants after signing up.

Course homepage: none

Course assessment: Individual student evaluation (pass/not pass) will be based on contribution to class discussions, group work, and presentation.

Provider: Department of Agroecology

Special comments on this course: The course fee is 600 Euros/4500 DKK (incl. meals). Participants are responsible for arranging their own accommodation and transportation to the campus.

Time: 21st – 26th June 2027

Place: Aarhus University Viborg, Blichers Alle 20, 8830 Tjele, Denmark

Registration: **Electromagnetic Soil Sensors - Eventværk**

The deadline for registration is the 1st of June. Details about the course schedule will be send out after the deadline. Please note the capacity limit (15 participants); the allotment will be based on a first-come, first-served basis.

If you have any questions, please contact Triven Koganti, e-mail: triven.koganti@agro.au.dk