GHENT UNIVERSITY

Course Specifications

Valid in the academic year 2023-2024

Environmental Soil Sensing (I002658)

Course size *(nominal values; actual values may depend on programme)*

Credits 4.0 **Study time 120 h**

Course offerings and teaching methods in academic year 2023-2024

A (semester 2)	English	Gent	lecture
			practical

Lecturers in academic year 2023-2024

De Smedt, Philippe	LA20	lecturer-in-charge
Mouazen, Abdul	LA20	co-lecturer

Offered in the following programmes in 2023-2024	**crdts**	**offering**
Master of Science in Bioscience Engineering: Land, Water and Climate	4	A
Exchange Programme in Bioscience Engineering: Environmental Technology (master's level)	4	A
Exchange Programme in Bioscience Engineering: Land and Forest management (master's level)	4	A

Teaching languages

English

Keywords

Soil survey, Soil mapping, Soil sensors, Near surface geophysics, geochemical prospection

Position of the course

This course provides theoretical and practical insights into near surface sensing methods to characterize, map and monitor variations in the shallow subsurface in space and time. The course focusses on geophysical and geochemical methods to acquire high-resolution continuous information on the pedosphere and its interface with the bio- and lithosphere. Emphasis of the course is on providing practical solutions in a broad range of environmental applications including pollution studies, utility mapping, precision agriculture, hydrological and forensic applications and heritage management. This includes the adaptive design of appropriate survey strategies and accompanying modelling methods and calibration/validation sampling.

Contents

THEORY:
1] Fundamental principles of sampling with sensors;
2] Introduction to geophysical soil properties and pedophysical modelling
3] Principles and applications of common near surface geophysical methods (electrical resistivity; ground penetrating radar; electromagnetic induction; magnetometry and environmental magnetism)
4] Introduction to optical sensing (geochemical soil sensing)
5] Principles and applications of multi-sensor data fusion

PRACTICE:
1] Field demonstration of common survey setups & introduction to invasive field sampling to complement soil sensor data;
2] Analysing and interpreting geophysical sensor data;
3] Analysing and interpreting geochemical & multi-sensor data.

Initial competences

Basic knowledge of (geo)statistics, soil science, soil physics and chemistry

Final competences

1 *develop adaptive survey approaches that integrate non-invasive and invasive techniques to support environmental research;*
2 *understand the operating principles of geophysical and geochemical sensors and their limitations for practical implementation;*
3 *understand the general principles for data processing and analysis for the different sensor discussed;*
4 *have insight into commonly used and commercially available instruments for non-invasive environmental surveying*

Conditions for credit contract

Access to this course unit via a credit contract is determined after successful competences assessment

Conditions for exam contract

This course unit cannot be taken via an exam contract

Teaching methods

Lecture, Practical

Extra information on the teaching methods

practicum: fieldwork, practicum and pc-exercises

Learning materials and price

Lecture slides and summary notes
Jupyter notebooks
Reading material:
1. Romero-Ruiz, Alejandro, Niklas Linde, Thomas Keller, and Dani Or. 'A Review of Geophysical Methods for Soil Structure Characterization'. Reviews of Geophysics 56, no. 4 (2018): 672–97.
2. Garré, Sarah, Guillaume Blanchy, David Caterina, Philippe De Smedt, Alejandro Romero-Ruiz, and Nataline Simon. "Geophysical Methods for Soil Applications." In Reference Module in Earth Systems and Environmental Sciences. Elsevier, 2022.
3. Shirzaditabar, Farzad, and Richard J. Heck. "Characterization of Soil Magnetic Susceptibility: A Review of Fundamental Concepts, Instrumentation, and Applications." Canadian Journal of Soil Science 102, no. 2 (June 2022): 231–51.
4. Mouazen, A.M.; Alexandridis, T.; Buddenbaum, H.; Cohen Y.; Moshou, D.; Mulla, D.; Nawar, S.; Sudduth, K.A., (2019) Chapter 2: MONITORING. In: A. Castrignanò et al. (Eds.), Agricultural Internet of Things and Decision Support for Precision Smart Farming. ACADEMIC PRESS, Elsevier, 36-138.

References

References to relevant (non-compulsory) literature is provided during the lectures, and made available via UFora.
These references include:
Evans, M.E., Heller, F., 2003. Environmental Magnetism. Principles and Applications of Enviromagnetics, Academic Press, California.
Jol, Harry M. *Ground Penetrating Radar: Theory and Applications.* Oxford: Elsevier, 2009.
Jordanova, N., 2017. Soil Magnetism. Applications in Pedology, Environmental Science and Agriculture, Academic Press, London, UK.;
Webster, R. & Lark, M. (2013). Field Sampling for Environmental Science andManagement. Oxon, United Kingdom: Routledge. ISBN: 978-1-84971-368-9
Telford, W. M., L. P. Geldart, and R. E. Sheriff. *Applied Geophysics.* Cambridge University Press, 1990.

Course content-related study coaching

Interactive discussion during lessons: questions before, during and after lecture. Individual (for extensive questioning): after appointment with lecturer or assistants. Support via Ufora (forum for students). Organisational announcements are made via Ufora.

Assessment moments

end-of-term and continuous assessment

Examination methods in case of periodic assessment during the first examination period

Participation, Written assessment, Assignment

Examination methods in case of periodic assessment during the second examination period

Written assessment

Examination methods in case of permanent assessment

Peer and/or self assessment, Assignment

Possibilities of retake in case of permanent assessment

not applicable

Extra information on the examination methods

Non-periodic: reporting on collected and processed field (sensor + soil sampling) data

Calculation of the examination mark

60% periodic evaluation
40% non-periodic evaluation