Masterclasses Wageningen Soil Conference 2019

We proudly present here 30 masterclasses that will be organised during the afternoons of the Wageningen Soil Conference 2019. The masterclasses vary from field trips, to classroom discussions and demonstrations to hands-on laboratory or computer tutorials.

Please find below a tentative schedule of the various masterclasses. Clicking on the title of the masterclass will bring you to a more detailed description of it.

There will be a maximum space associated with each masterclass, so please confirm when registering for the conference which are your preferred masterclasses and we will where possible try to allocate you to your preferred masterclasses.

Theme 1: Society and Management	Theme 2: Methods to measure soil functions	Theme 3: Modelling & mapping soil functions	Theme 4: Synergies & trade-offs		
Tuesday 27 August	2019	Γ	Γ		
M1: Applying a participatory approach in understanding soil functions	M3: Soil structure and soil biodiversity	M6: Field description, classification and interpretation of the soil profile	M9: Qualitative multi-attribute decision modelling in soil science		
M2: How microplastics pollution in soil is perceived by the society	M4: Morphological characterization of arbuscular mycorrhizal fungi	M7: Bayesian networks and soil functions: integrating uncertainty and multi- functionality	M10: Soil biodiversity assessments at a global scale		
	M5: Soil Biological Quality Index (QBS-ar), a different way to look at soil	M8: Ensuring reliability and comparability of soil data			
Wednesday 28 August 2019					
M11: Integrated Soil Management on Sandy Soils for Sustainable Agriculture*	M14: Calibrating an electromagnetic ground conductance meter for mapping stored soil moisture	M17: Knowledge discovery and data mining in soil science	M20: Understanding the functional capacity of our soils – case studies from around the world		

Tentative schedule

M12: Soil Management for Regenerative Agriculture**	M15: Soil fertilization with micronutrients and inspiring practical tests with chelates to prove their function	M18: Mapping rootable depth and plant- available soil water & nutrients to evaluate soil functioning in terms of agricultural productivity	M21: Sustainability assessment of soil management: hands-on training	
M13: "Escape from Brussels"	M16: An introduction to identifying the feeding groups of nematodes	M19: Proximal soil sensing for soil data acquisition		
Thursday 29 August 2019				
M22: Interactive Augmented	M24: Getting a grip on soil	M27: Machine Learning for soil	M29: Challenges in assessing the	
for managing soil functions	biotul bation rates	парріну	of local subsurface water	
for managing soil functions M23: The future of European agricultural soil management	M25: A tool for identifying biological indicators of soil functions	M28: Spectral libraries for field predictions	of local subsurface water M30: Designing soil models	

* This is a field trip – you will not be back in time in Wageningen for the evening program.

** This is a field trip involving extra costs for transportation (expected ~25 eu p.p.) and you will not be back in time in Wageningen for the evening program.

M1: Applying a participatory approach in understanding soil functions

<u>Organisers</u>: Francesca Bampa^a, Lilian O'Sullivan^b, Julie Ingram^c, Jane Mills^c ^aWUR, Soil Biology Group, The Netherlands ^bTEAGASC, Johnstown Castle, Ireland ^cUniversity of Gloucestershire, UK

Scientists are increasingly seeing the need to: 1) involve stakeholders (from farmers and advisors to policy makers and citizens) in face-to-face discussions from the start of their research, 2) be interdisciplinary and communicate interactively with stakeholders; 3) be knowledge brokers. But how? This masterclass will give hands-on examples of the application of participatory approaches with stakeholders at different levels. The session draws on the experiences of a number of EU projects (LANDMARK, RECARE, SoilCare, VALERIE, SmartSOIL). The Catchment Challenge method in relation to soil functioning and land management will be demonstrated, along with co-innovation techniques, social network data collection and analysis.



M2: How microplastics pollution in soil is perceived by the society

<u>Organisers</u>: Violette Geissen^a, Esperanza Huerta Lwanga^a ^a WUR, Soil Physics and Land Management Group, The Netherlands

Every person in the world is aware of the plastic pollution in the ocean, but really few of them know about the microplastic pollution inside the soil. The purpose of this master class is to show the problem, how some of the soil functions are affected with the presence of soil microplastic pollution and to recognize some technics of plastic identification in soil.



M3: Soil structure and soil biodiversity

<u>Organisers</u>: Amandine Erktan^a ^a University of Göttingen, J.F. Blumenbach Institute of Zoology and Anthropology, Germany

This masterclass aims at highlighting (i) how soil structure is influenced by soil organisms, taken alone or in interaction, and (ii) how soil structure is crucial to better understand the co-existence of diverse soil organism communities. Concepts and methods from soil ecology and soil physics will be discussed to initiate interdisciplinary exchanges. A demo of soil macroaggregate stability measurement (Method LeBissonnais, 1996), a simple index to account for soil structure, will be provided. To facilitate mutual brainstorming, a 3D model transparent soil, with soil organisms will be used to visualize the complex interplay between soil structure and soil biodiversity.

Wageningen | Netherlands | 27- 30 August 2019

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M4: Morphological characterization of arbuscular mycorrhizal fungi

<u>Organisers</u>: Isabelle Trinsoutrot-Gattin^a, Babacar Thioye^a ^a UniLaSalle, France

The detection and quantification of arbuscular mycorrhizal fungi (AMF) in roots and rhizospheric soil are essential in mycorrhizal research. The objective of this training is to provide the basic steps for spore extraction, root staining and observation of the intraradical structures of the AM symbiosis. The activity will be subdivided into two parts. The first is to observe and identify the different AMF structures developing within the roots by cleaning and staining the roots. The second is to extract and to identify the spores from soil based on their morphology.



M5: Soil Biological Quality Index (QBS-ar), a different way to look at soil

<u>Organisers</u>: Christina Menta^a, Fabio Gatti^a ^a University of Parma, Italy

Soil functions essentially depend on the high and still partially unknown biodiversity. The capability of soil to perform its functions is often referred to soil quality. The QBS-ar index, based on soil microarthropod community, was developed combining two important aspects: 1) soil microarthropods biodiversity; 2) soil microarthropod adaptation to soil conditions. This index, to date applied at international scale, allows to evaluate the suffering state of soils. It is an expeditious tool to evaluate soil biological quality in degraded lands and recovery areas.



M6: Field description, classification and interpretation of the soil profile

Organisers: Stephan Mantel^a, Erika Michéli^b

- ^a ISRIC Worls Soil Information, WUR, The Netherlands
- ^b Szent István University, Hungary

The masterclass will provide a short introduction and exercise to site-, and profile description and classification of soils. Participants will learn the horizon designations according to the FAO guidelines and practice the recognition of diagnostic units (horizons, properties and materials) and application of the classification key to determine the Reference Soil Groups of the WRB soil classification system. Description and classification will be followed by interpretation of soil genesis, soil functions and derived information relevant for land use and management. The field exercise will take place in the vicinity of Wageningen.



M7: Bayesian networks and soil functions: integrating uncertainty and multi-functionality

Organisers: Dirk Vrebos^a

^a Ecosystem Management Research Group, University of Antwerp, Belgium

In this masterclass we will learn about Bayesian Networks (BN) and how they can be useful for modelling a diverse suite of soil functions (SF). BNs make it possible to incorporate uncertainties and to complement empirical data with expert knowledge. This allows us to incorporate spatial heterogeneity, present in soils and land management practices, in SF assessments. In a practical exercise, you can build and test your own expert-knowledge Bayesian belief network. A short demonstration will be given how these networks can be used to map different SFs.



M8: Ensuring reliability and comparability of soil data

<u>Organisers</u>: Winnie van Vark^a ^a WUR, Chemical and Biological Soil Laboratory, The Netherlands

Data are very important in understanding soil functions, climate change, nutrient cycling etc. But are you sure the data provided to you are reliable? Are they comparable with data produced somewhere else in the world? WEPAL (Wageningen Evaluating Programmes for Analytical Laboratories) helps laboratories to harmonize the results with other laboratories worldwide by organising proficiency tests in soil and soil related materials to improve the quality of data for mapping, modelling and monitoring; nutrients (fertility and over-fertilization), trace metals (deficiency and contaminations), organic contaminants etc.

Curious how this is done? Visit this masterclass given on location.



M9: Qualitative multi-attribute decision modelling in soil science

<u>Organisers</u>: Marko Debeljak^a, Aneta Trajanov^a ^a Jozef Stefan Institute, Department of knowledge technologies, Slovenia

Decision making in soil science is getting increasingly complex, therefore decision support modelling is becoming a useful methodology to make evaluation and selection of alternatives more transparent. In addition, decision models can be used for what-if analysis in the development of new theoretical or practical soil management solutions. This workshop will introduce the basics of qualitative multi-attribute decision modelling of soil functions. The participants will make their own decision models on selected case studies using the DEXi software. The participants will be able to apply the obtained knowledge on their own decision problems related to soil science.





M10: Soil biodiversity assessments at a global scale

<u>Organisers</u>: Kelly Ramirez^a, Stefan Geisen^a, Wim van der Putten^a ^a Netherlands Institute of Ecology (NIOO-KNAW), The Netherlands

Soils are a hotspot of biodiversity on earth that provide essential functions. However, most of this important belowground biodiversity remains unexplored and inadequately assessed, especially at a global scale. Here we will provide a consensus of current efforts to assess global soil biodiversity with the aim to develop the next-generation soil biodiversity initiatives.

In this masterclass we will review state of the art laboratory methods and mapping approaches, and give participants the ability to identify strengths and weaknesses of the many approaches. Participants will leave with resources to continue their own research.



M11: Integrated Soil Management on Sandy Soils for Sustainable Agriculture

<u>Organisers</u>: Janjo de Haan^a, Wijnand Sukkel^a, Leendert Molendijk^a ^a Wageningen Plant Research, Field crops, The Netherlands

Sandy soils in the South East of the Netherlands are generally very productive however difficult to manage from a sustainability point of view regarding e.g. water pollution, drought sensitivity and soil borne pathogens. At the experimental farm of Wageningen University & Research Field Crops, various soil management strategies are investigated e.g. crop rotation strategies, reduced tillage, organic matter management, chemical and non-chemical pest and disease control measures to reduce environmental impact, while maintaining financial yield. You will be shown long term experiments and introduced into the approach from fundamental research to knowledge transfer to farmers with demonstrations and discussions involving various stakeholders.

Note: This is a field trip; transportation costs for this masterclass are not included and need to be paid in advance (~25 eu per person). Depending on traffic, we will not be back in Wageningen on time for the evening program.



M12: Soil Management for Regenerative Agriculture

<u>Organisers</u>: Lijbert Brussaard^a, Mirjam Pulleman^a, Wijnand Sukkel^b ^a WUR, Soil Biology Group, The Netherlands ^b Wageningen Plant Research – Field crops, The Netherlands

<u>Topic</u>: What are the prospects for truly regenerative agriculture, i.e. restoring dwindling natural capital that agriculture relies on? <u>Activity</u>: We will visit the experimental setting of WUR-Applied Plant Research in one of the polders reclaimed from the sea. Here, different combinations of ecology-based technologies for soil and crop management are tried out and investigated regarding tillage & soil compaction control, green manure & organic matter management, strip & mixed cropping and agroforestry. You will be introduced to the approach and engage in on-site discussions with involved farmers and researchers on 5 spots that you will successively visit in the trial fields.

Note: This is a field trip; transportation costs are included but depending on traffic, we will not be back in Wageningen on time for the evening program.



Illustration: Fogelina Cuperus

M13: "Escape from Brussels"

<u>Organisers</u>: Rogier Schulte^a, Alan Matthews^a ^a WUR, Farming Systems Ecology Group, The Netherlands

"Escape from Brussels": an escape-room experience in contemporary EU policy making on sustainable land management.

Imagine you are a policy maker, working for the Ministry of Agriculture. For years you have relied on Brussels to set the rules for farmers, and your job was to implement these rules in your country. As of 2021, all of this is set to change. The European Commission has proposed "increased subsidiarity" for the Common Agricultural Policy. What they mean is that each country now has to develop its own Strategic Plan that addresses 9 challenges and delivers on a vibrant and sustainable rural environment...



M14: Calibrating an electromagnetic ground conductance meter for mapping stored soil moisture

Organisers: Timothy Weaver^a ^a CSIRO Agriculture and Food, Australia

Electromagnetic surveys have been utilised for years to map soil variability across various landscapes/fields. Establishing a relationship between soil conductivity and soil chemical properties can prove difficult. The masterclass will investigate one attribute, profile water content, and the relationship that has been developed with soil conductivity. The procedure to develop a calibration using an EM38-Mk II (Geonics) with profile water content from soil cores across a field will be taught producing variability maps. The masterclass will provide a hands-on experience learning the process of using an EM38-Mk II to build a calibration with profile water content including data logging (geo-referencing) and mapping field variability.



M15: Soil fertilization with micronutrients and inspiring practical tests with chelates to prove their function

Organisers: Marcel Bugter^a, Arjen Reichwein^a, Walter Schenkeveld^b

^a Nouryon Micronutrients, The Netherlands

^b Copernicus Institute, Utrecht University, The Netherlands

Theory and practical illustrative tests will be mixed in this masterclass. Participants will learn:

- Which factors in the soil will determine the availability of micronutrients?
- How we can measure those?
- What do plants themselves to promote the uptake to avoid deficiencies?
- Conceptual possibilities to enlarge the availability of micronutrients,
- Ideal carriers to promote availability,
- Differences between iron chelates do you know why the ortho-ortho isomer so important is?

- Differences (visual and explained) between complexes, partly chelation and full chelation of metals, and

- Differences in adsorption of copper to peat soils.

What happens in the (soil)solution

Note: Plants drink, don't eat!



M16: An introduction to identifying the feeding groups of nematodes

<u>Organisers</u>: Tamas Salanki^a, Ron de Goede^a, Gerard Korthals^b, Roel Wagenaar^b ^a WUR, Soil Biology Group, The Netherlands ^b NIOO, Terrestrial Ecology, The Netherlands

When assessing soil health, a number of chemical, physical and biological indicators can be measured. Nematodes have proven to be valuable bio-indicators. They have a high diversity and abundance, are widespread and have known high and species-specific sensitivity to various environmental conditions. In this workshop we will discuss the application of nematodes as biological soil quality indicators through the online tool NINJA, and you will get an introductory hands-on training explaining the basic morphology of nematodes. At the end of the masterclass you will be able to use the NINJA tool and to classify nematodes into feeding groups.



M17: Knowledge discovery and data mining in soil science

<u>Organisers</u>: Marko Debeljak^a, Aneta Trajanov^a ^a Jozef Stefan Institute, Department of knowledge technologies, Slovenia

The amount data in soil science is increasing tremendously and therefore datamining is becoming a useful methodology to explore large datasets to get better knowledge about different soil functions and their synergies. In this masterclass, we will introduce the basics of data-mining for modelling and mapping of soil functions. The participants will make their own data-mining analyses on selected datasets using the data-mining suite WEKA. After the masterclass, the participants will be equipped with basic knowledge in data-mining for soil science and with practical experiences that will enable them to perform some basic datamining on their own data of interest.



M18: Mapping rootable depth and plant-available soil water & nutrients to evaluate soil functioning in terms of agricultural productivity

Organisers: Johan Leenaars^a

^a ISRIC World Soil Information, The Netherlands

This masterclass shows how maps of rootable depth and plant-available soil water and soil nutrients can be derived from maps of primary soil properties. The methodology relies strongly on pedotransfer functions and other rule-based inferences. The derived soil qualities support the evaluation of soil functions including the capability of the soil to provide for buffer against drought, agricultural produce and food security. We illustrate the mapping procedure with case studies from Africa and let participants derive soil functional maps themselves in several exercises.



Plant-available water holding capacity (v%) of the soil fine earth over 2 m depth

M19: Proximal soil sensing for soil data acquisition

<u>Organisers</u>: Fenny van Egmond^a, Martin Knotters^b and Titia Mulder^c

^a ISRIC World Soil Information, The Netherlands

^b Wageningen Environmental Research, Soil Water and Land Use, The Netherlands

^c WUR, Soil, Geography and Landscape group, The Netherlands

At field, farm and/or regional scale several non-destructive proximal soil sensing techniques are available that can assist in soil data acquisition. Together with existing (open) data sources and new calibration point data they can have added value to answer information questions related to soil functions. We will discuss and practice how to define the additional data needs fitting contemporary research specific questions, how to choose which data acquisition methods are most suited (cost/accuracy/added value of information) and then how to analyse the collected data to answer the question at hand.



M20: Understanding the functional capacity of our soils – case studies from around the world

<u>Organisers</u>: Stephan Mantel^a, Rachel Creamer^b ^a ISRIC World Soil Information, The Netherlands

^b WUR, Soil Biology Group, The Netherlands

Based in the ISRIC World Soil Museum, we will visit 4 continents to provide case study examples of how to assess the functionality of our soils. Combining information from the ISRIC soil monoliths, interactive knowledge from the soil grids portal and case study video-blogs, we define the supply and demand of soil functions; primary productivity, water regulation, habitat for biodiversity, carbon management and climate regulation and nutrient cycling.

Groups of five members will be allocated to a map based case study and will be guided through the process of assessing supply and demand of soil functions and associated synergies/trade-offs.



M21: Sustainability assessment of soil management: hands-on training

Organisers: Carsten Paula

^a Leibniz Centre for Agricultural Landscape Research (ZALF), Germany

We offer a hands-on training on the use of a web-based toolbox for sustainability assessment of soil management methods. The toolbox and accompanying assessment guidelines have been developed within the BonaRes project (<u>www.bonares.de</u>) and are free to use. By means of a test case, we will jointly explore how to define system boundaries and how to select impact areas reflecting *resource use efficiency* and ecosystem services. Furthermore, we will present different methods for integrating results and for evaluating synergies and trade-offs.



M22: Interactive Augmented Reality Workshop for managing soil functions

Organisers: Lilian O' Sullivan^a ^a Teagasc Agriculture and Food Development Authority, Ireland

Participants will learn about augmented reality (AR) technology and apply it to landscape management for managing soil functions. Through the AR, participants will be transported to Mato Grosso in the Amazon Basin - one of the most rapidly-expanding and intensifying agricultural frontiers globally. We demonstrate how soil data can be utilised in tandem with AR technology in a process of stakeholder engagement to find solutions to complex challenges at a landscape scale. Participants will be challenged to take an integrated approach and to design a landscape that matches the supply with demand for soil functions in this region.



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M23: The future of European agricultural soil management

<u>Organisers</u>: Anja-Kristina Techen^a ^a Leibniz Centre for Agricultural Landscape Research (ZALF), Germany

Understanding, how agricultural soil management changes in the future, is crucial for soil research and actions. We will introduce European agricultural storylines for 2050, embedded in the Shared Socioeconomic Pathways of the climate research community (Eur-Agri-SSPs). They have been developed with a consortium of scientists from eight European countries and more than 50 European stakeholders. In a world café the participants will discuss how soil management may change within the setting of the framing scenarios of the Eur-Agri-SSPs. We want to give insights and raise awareness on the perspective of future soil management for work surrounding soil functions.



M24: Getting a grip on soil bioturbation rates

Organisers: Tony Reimann^a

^a WUR, Soil Geography and Landscape Group, The Netherlands

Tilling is widely used to improve soil structure and enhance yields. However, due to the drawbacks of tillage, e.g. inducement of soil erosion, reduction of the carbon sequestration potential, there is increased attention for natural processes mixing the upper soil layer – bioturbation by roots, tree fall and burrowing animals. Quantifying bioturbation rates is notoriously difficult, hampering assessment of bioturbation as nature based solution for improving soil quality and achieving land-degradation neutrality. In this masterclass, we will introduce novel luminescence-based methods for determining soil mixing rates. Activities of the workshop will include an introduction lecture, excursion to luminescence dating lab, and discussion on feasibility to use bioturbation in soil management.



M25: A tool for identifying biological indicators of soil functions

<u>Organisers</u>: Janna Barel^a, Giulia Bongiorno^a, Rachel Creamer^a ^a WUR, Soil Biology Group, The Netherlands

When we are considering indicators of soil quality or soil functions, we need to think about i) the information we wish to obtain (i.e. which soil function or soil threat) and ii) the scale at which we wish to assess (such as species specific, community based approach etc). This workshop will introduce you to a newly developed tool to help in selecting biological indicators to describe the capacity of our soils to perform a/(multiple) function/(s). We will discuss the approaches needed to identify the correct indicator and we will discuss the potentials and constraints of some of the indicators defined.



M26: Sensor technology for fast and on-site soil fertility diagnosis

<u>Organisers</u>: Christy van Beek^a ^a AgroCares and SoilCares Foundation, The Netherlands

NIR spectroscopy opens a new era of soil testing. With a simple device soil fertility status can be determined within a few minutes and on the spot. In this masterclass the advantages and disadvantages of soil sensor technologies are discussed. A life demonstration of the AgroCares soil Scanner is provided and participants are invited to bring their soil samples.



M27: Machine Learning for soil mapping

<u>Organisers</u>: Luis de Sousa^a ^a ISRIC World Soil Information, The Netherlands

This masterclass introduces methods and software for management, analysis and mapping of soil characteristics within the R environment for statistical computing. The focus is on digital soil mapping using supervised machine learning algorithms, such as random forest and gradient boosting. Methods are illustrated with case studies. Participants will also learn to apply the methods themselves in a computer practical, including methods to map soil functions from soil and land characteristics. The masterclass aims at soil and environmental scientists who wish to learn more about the theory and practice of digital soil mapping. Lecturers are experienced digital soil mappers and pedometricians.



M28: Spectral libraries for field predictions

<u>Organisers</u>: Fenny van Egmond^a, Titia Mulder^b ^a ISRIC World Soil Information, The Netherlands ^b WUR, Soil Geography and Landscape Group, The Netherlands

Infrared reflectance measurements in the field, lab and from remote-sensing imagery can be reliable predictors of soil properties such as soil organic carbon, clay and CaCO3 content, pH and others. In this masterclass, we will touch on the theory, perform measurements and practice with building, using and collating spectral libraries (NIR and MIR) for soil property estimation on newly collected spectra.



M29: Challenges in assessing the regional feasibility of local subsurface water

Organisers: Melle Nikkels^{a,b}

^a WUR, Water Resources Management Group, The Netherlands

b Aequator Groen & Ruimte, The Netherlands

Regional effects of local subsurface water storage are largely unknown. In this masterclass, participants discuss challenges in assessing the potential of local water storage. We start from the point of view that the focus must shift from storage 'potential', i.e. quantities of water that can be stored, to storage 'feasibility'. Storage feasibility depends on exploitability, purpose and interactions between storage alternatives. Spatial and temporal scale also influence feasibility. Finally, farmers' investment preferences are a factor, though these are shrouded in uncertainty. The discussion will be a first step to improving storage assessment tools and processes.

Link to podcast (in Dutch): <u>https://www.aequator.nl/2018/11/21/phd-podcast-over-elk-hoofdstuk-thesis-melle-nikkels/</u>



M30: Designing soil models

Organisers: Ed Rowe^a ^a Centre for Ecology and Hydrology, UK

Model design is primarily a social activity, since it involves summarising relevant science into mutually acceptable algorithms. If soil and ecosystem models are to incorporate the best science, this design process must be opened up to scientists who do not enjoy coding. Conversely, scientists who work mainly on measurement must appreciate the role of parsimonious models. Models can summarise and communicate knowledge, and ideally are used to apply this knowledge in socially-relevant contexts. Participants will develop their own dynamic model in a simple spreadsheet, thereby exploring methods for improving communication among model-focused and empirically focused scientists. Both are welcome.

