GLOSOLAN-Spec

Eyal Ben-Dor, Remote Sensing Laboratory, School of Environmental and Earth Science
Faculty of Exact Science
Tel Aviv University
General

The GLOSOLAN Initiative on Soil Spectroscopy (GLOSOLAN-Spec) was launched in April 2020 at the purpose of building the capacity of soil laboratories on the use of this technology by bringing together institutions and experts from all around the world on the topic to foster best of practices utilization.
## WG Steering Committee

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<tr>
<th>Name</th>
<th>Country</th>
<th>Affiliate</th>
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7th Meeting of the **Global Soil Laboratory Network** (GLOSLAN) | 21-23 November 2023
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<td>Christian Omuto</td>
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<td>GSP expert on spectroscopy</td>
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<td>Christian Resch</td>
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<td>Soil and Water Management &amp; Crop</td>
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<td>Leonardo Ramirez-Lopez</td>
<td>Switzerland</td>
<td>BUCHI Labotechnik AG</td>
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76 active members

28 Countries

5 continents
Vlasimsky, Magdeline (NSLD) Coordinator of GLOSOLAN-Spec – Quitted Beginning of 2023

The new management of GSP recognized our previous efforts in GLOSOLAN-Spec and invited Yi Peng a former coordinator and the founder of GLSOLAN -Spec to rejoin FAO/GSP and continue management the group at full time

Wellcome back Yi
Regional Champions on Soil Spectroscopy

11 regional champion laboratories on soil spectroscopy

• EUROPE and the Mediterranean Basin
• AFRICA
• NEAR EAST AND NORTH AFRICA
• LATIN AMERICA AND THE CARIBBEAN
• NORTH AMERICA
• ASIA

7th Meeting of the Global Soil Laboratory Network (GLOSOLAN) | 21-23 November 2023

GLOSOLAN-Spec achievements 2022-2023

Main conclusions

- Collaborating with IEEE SA P4005 to form a standard and protocol to measure soil spectra in both laboratory and field
- Preforming two summer Scholls with academic credit
- Performing a training activity
- Building a spectral calibration library under an agreed standard and protocol scheme and a modeling capacity.
- Generating a worldwide collaboration to share SSLs and exploit the world data archive by all
P4005™ Draft for Standard Protocol and Scheme for Measuring Soil Spectroscopy. Subgroup1: Laboratory protocol 400-2500 nm

Developed by the P4005

Stage 3: Field – Ongoing
Soil spectroscopy Summer School iii (Tel Aviv, June 2023)

Moderators: Prof Jose Dematte, Prof Eyal Ben Dor
Invited lectures: Prof. Bo Stenberg, Prof. Maira Kendal
Students from 4 countries
Soil spectroscopy Summer School ii (Marrakesh, August 2023)

Soil Spectroscopy: Measurements and Analyses
Summer School program August 2023
Morocco, UMSM

Day 1 – Arrival to UMSM meeting with Bruno, Mohamed, and Spectral lab staff
Visiting the SSL physical archive and setting down the visiting program
Setting all infrastructural issues for the visit (spectrometers, electronics, measurement area, etc)
Lecture 1: Introduction to soil spectroscopy (SEMIRAN)

Day 2: Laboratory standard and protocol – theory (SEMIRAN)

Soil Spectroscopy: Measurements and Analyses
Summer School program August 2023
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Lecture 1: Introduction to soil spectroscopy (SEMIRAN)

Day 2: Laboratory standard and protocol – theory (SEMIRAN)
Laboratory protocol – exploiting the R13 PIXRS protocol (EXPERT)
Laboratory measurement – GIS/ GI Measurement in the lab – setting up the measurement environment
First Measurements and Data analysis – archiving the information

Day 3 – Soil Spectral Libraries utilisation (SEMIRAN)
Chemical inspection and quality assessment – methods and parameters
Spectral assignment: theory (EXPERT)
Building an analyzing archive for AI

SSL Measurements

Day 4: Applying AI to the data (Theory) (SEMIRAN)
Supervised and unsupervised analyses
Field and laboratory – problem and solution (EXPERT)
Future Notes and further work
Continue with SSL measurements

Meeting of the Global Soil Laboratory Network (GLOSOLAN) | 21-23 November 2023
Soil spectroscopy training material

Planned for 2022
To be held 2024?

A primer on soil analysis using visible and near-infrared (vis-NIR) and mid-infrared (MIR) spectroscopy

1. Background
Visible and near infrared (vis-NIR) and mid-infrared (MIR) reflectance spectroscopy has emerged and developed in the past three decades as an important method for quantitative soil analysis in the lab (Baumgardner et al., 1985; Chang et al., 2001; Viscarra Rossel et al., 2006; Reeves III, 2010). Many researchers believe that vis-NIR and MIR can become an alternative to the conventional laboratory-based, wet-chemistry methods for soil analysis (Janik et al., 1998; Nocita et al., 2015). Various modern applications require large amounts for high-resolution (both in space and time), quantitative soil data. One example is precision agriculture, where soil samples are collected from the field (e.g., in a grid pattern) and analyzed in the lab to generate soil property maps. These soil property maps then become baseline maps to generate geographic maps or to guide variable rate applications of fertilizer, water,

- Six sessions
- Soil spectral modelling in R
- Expected to be online in 2022
- R codes

Yufeng Ge
University of Nebraska

Yi Peng
FAO/GSP

Alexandre Wadoux
University of Sydney

7th Meeting of the Global Soil Laboratory Network (GLOSOLAN) | 21-23 November 2023
The group aims to:

1. Develop the capacities of at least one soil spectroscopy institution/laboratory per country that will thereafter join SoilSpecNet; and
2. Under the auspices of GLOSOLAN, support the development of the Global Soil Information System (GloSIS) and the National Soil Information Systems by providing estimated soil property data to the International Network of Soil Information Institutions (INSII) for soil mapping and modelling purposes.

**SoilSpecNet will be composed of**

1. Internationally recognized soil spectroscopy institutions and laboratories; and
2. Private sectors (e.g., manufacturers and private laboratories) specialized in soil spectroscopy that prove not to have any conflict of interest with GLOSOLAN and GLOSOLAN-Spec.

To learn more about the institutes and laboratories registered with SoilSpecNet and the type of support they can offer, please consult the interactive map below, by clicking on flags in the country or region of your choice.

3 November 2023
How to deal with variation in the spectra of same soil acquired from different instrument

Spectrometer check up
Stage 1

Sample preparation

ISS to correct the spectra

Stage 2

Every set of measurements

Protocol for soil scanning

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Viscarra Rossel:  Using Curies University Server and all the SSLs from 2016 and more - Still waiting for IP share solutions

WorldSpectralLibrary
WorldSoilService (Main Institute: University of São Paulo, Brazil (PI: Prof Jose Dematte)

Project: The World Soil Spectral Service

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Coordination: Dr. José Demattê
Research group: GeoCis (Geotechnologies on Soil Science)
Main Institution: University of São Paulo, Brazil
Server Institution: Embrapa Environmental Monitoring (Federal)
Partners: University of Florida, University of Tel-Aviv, Aristotle University of Thessaloniki

2-TEAM
Embrapa Agrotag-TI
- Luiz Vicente
- Nikos Tziolas and Nikos Tsakiridis

Dr José Demattê
- Eval Ben-Dor and team
- Jean Novais, Bruno Ferreira

3-BULLETS AND UPDATE
- (Creation of the site in server. Already made three meetings. In phase of structuring. Starts in January)
  - Processing: Will start January: script creation
  - Human Protocol evaluation: finished 90%
  - First Protocol finished for filtering: finished 90%
  - Wet Soil analysis consistency: 70% concluded
  - Mining data (open and private): 95% conclude
  - Receiving new data until 15 December

4-CRONOGRAM
- Online and paper: may/june 2024
- Test inside server: march/may 2024
- Test outside server: March 2024

WORLDSPECS TEAM

Test service online
- Platform
  - Processing spectra, creating models with AI
  - Consistency of soil data
  - Quality protocol via descriptive and quantitative analysis
  - Soil filtering vs. basic spectrum

Data assembly: 90 countries, 40 private

94 countries, 75 private researchers, 110,000 MIR data, 130,000 VNIR data
Programatic method processing: Convolution Neural Networks

- Deep learning architecture able to handle hyperspectral data, supporting also multi-output predictions;
- Exploits the **complementary information contained from hyperspectral sources** (*no need to find the best pre-treatment*) - maximize the spectral space;
- Localized learning using an adaptive error correction mechanism;
- Address the issue of interpretability.

7th Meeting of the **Global Soil Laboratory Network (GLOSOLAN)** | 21-23 November 2023
objectives of the GLOSOLAN-Spec as proposed in last Meeting

- To support the development of all types of soil spectroscopy at national, regional, and global levels.

Summer schools and training initiative

- To support countries in establishing their own soil spectral laboratories and national soil spectral libraries with standardized methods and decentralized estimation services.

Morocco as an example

- To support the development of standards and protocols for soil spectroscopy, including but not limited to soil sample preparation, measurement protocols, quality assurance, and data analysis and modelling.

IEEE SA P4005 – Phase 1 (laboratory standard- accomplished), Phase 1 (Field standard – on the way)

- To continuously support the development of the global spectral estimation services by encouraging countries to share part of existing national soil spectral libraries on a voluntary basis

WorldSoilService (Main Institute: University of São Paulo, Brazil (PI: Prof Jose Dematte)

WorldSpectralLibrary (Main Institute: Curties University, Austrelia (PI: Prof Viscorra Rossel)
Activity planes for GLOSOLAN-Spec 2022-3

• A ring samples tour: Sending 20-30 samples that are well known to several champion laboratories for QA comparison and check.
  Done

• Collaborating with P4005 IEEE SA WG on soil spectral standard and protocol
  Done

• Arranging summer schools for soil spectral measurements and data analyses
  Done

• Preparing a COST ACTION proposal
  Not Done

• Preparing an academic (credential) course with ranked experts on Soil Proximal Sensing
  Done
Activity planes for GLOSOLAN-Spec 2023-4

• Continue with World Soil Spectral Library: Archive and Utilization.
• Continue Collaborating with P4005 IEEE SA WG on soil spectral standard and protocol.
• Getting to more users and disseminate the technology to Africa and South America Arranging.
• Continue with summer schools for soil spectral measurements and data analyses.
• Conducting workshop, conference and special sessions (e.g. EGU, AGU, Soil Congress, PSSS at Ugent).
• More (will be decided at the next stirring committee meeting).
Thank You