



Food and Agriculture  
Organization of the  
United Nations

21-23 November 2023

# GLOSOLAN-Spec

Eyal Ben-Dor, Remote Sensing Laboratory, School of  
Environmental and Earth Science

Faculty of Exact Science  
Tel Aviv University

7<sup>th</sup> Meeting of the  
**Global Soil  
Laboratory  
Network**  
(GLOSOLAN)



**GLOSOLAN**  
GLOBAL SOIL LABORATORY NETWORK



## *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

Name	Country	Affiliate
Bo Stenberg	Sweden	Swedish University of Agricultural
Cécile GOMEZ	France	Research Institute for Development
Sabine Chabrilat	Germany	GFZ German Research Center
Leigh Winowiecki	Kenya	Soil Plant Spectral Diagnostics Laboratory
Eyal Ben Dor	Israel	Tel Aviv University
Raphael VISCARRA ROSSEL	Australia	Curtin University
Jose Alexandre Melo Dematte	Brazil	University of São Paulo-ESALQ
Yufeng Ge	USA	University of Nebraska-Lincoln
Zhou Shi	China	Zhejiang University, China

1	Full name	country	Affiliation
2	Abdul Mouazen	Belgium	University
3	Adams Sadick	Ghana	Soil Research Institute
4		SENEGAL	Département de Physique
5			Institut de Technologie Nucléaire Ap
6			Faculté des Sciences et Techniques
7	Alessane Traore		Université Cheikh Anta Diop
8	Alex Mc Bratney	Australia	
9	Andrew Sila	Kenya	Soil Plant Spectral Diagnostics Laborat
10	Arwyn Jones	EC	JRC
11	ASHOK PATRA	India	ICAR-Indian Institute of Soil Science, I
12			Earth and Life Institute (ELI)
13			and Climate Research
14	Bas van Wesemael	Belgium	Belgium
15	Beata Tomczyk	Netherlands	AgroCares
16	Bo Stenberg	Sweden	Swedish University of Agricultural
17	Branislav Jović	Serbia	Faculty of Natural Sciences, University
18	Budiman Minasny	Australia	Sydney University
19	Cécile GOMEZ	France	Research Institute for Development
20	Christian Omuto	Kenya	GSP expert on spectroscopy
21	Christian Resch	Switzerland	Soil and Water Management & Crop Nt
22	Claudio Massimo Colom	Italy	Università del Molise
23	<a href="#">Curtis Monger</a>	USA	USDA
24	Daniel Shiley	USA	ASD compnay
25	Dave Hoover	USA	USDA
26	David Cizmar	UKZUZ Brno	<a href="#">Czech Republic</a>
27	Don Campbell	USA	ASD comppnay
28	Elvis Weullow	Kenya	Soil Plant Spectral Diagnostics Labc
29	Erick Towett	Kenya	Soil Plant Spectral Diagnostics Labc
30	Eyal Ben Dor	Israel	Tel Aviv University
31	Fabricio da Silva Terra	Brazil	Institute of Agricultural Sciences, Feder
32	Fassil Kebede	Morocco	CESFRA/UM6P
33	Fenny Van Egmond	Netherlands	ISRIC - WUR
34	Franck Albinet	FAO/IAEA	Soil and Water Management & Crop
35	George Zalidis	Greece	IBEC, Greece
36			
37	Gerd Dercon	FAO/IAEA	Soil and Water Management & Crop
38			Graduate Coordinator, Faculty of Agrici
39			Associate Professor, Department of En
40			Innovative Waste Management Program
41	Gordon Price	Canada	Dalhousie University, NS, Canada
42	Issam Bara	Morocco	CESFRA/UM6P, Morocco
43	Jean Robertson	UK	The James Hutton Institute, Scotland, U
44	Johanna Wetterlind	Sweden	Swedish University of Agricultural
45	Jonathan Sanderman	USA	Woodwell Climate Research Center
46	Jose Alexandre Melo Dem	Brazil	University of São Paulo-ESALQ
47	Kathe Todd Brown	USA	University of Florida, Dept of Environ
48	Keith Shepherd	Kenya	ICRAF, Kenya
49	Laura Schnee	Germany	University of Bremen
50	Leigh Winowiecki	Kenya	Soil Plant Spectral Diagnostics Labc
51	Leila Tajeddine	Morocco	CESFRA/UM6P, Morocco
52	Leonardo Ramirez-Lopez	Switzerland	BUCHI Labortechnik AG

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52	Leonardo Ramirez-Lopez	Switzerland	BUCHI Labortechnik AG
53	MAria Konyushkova	Russia	Soil Science faculty of the Lomonosov I
54	Maria Knadel	Denmark	Aarhus University/AGRO University labc
55	Martin Luft	Germany	Bruker company
56	Mila Luleva	Netherlands	AgroCares
57	Nicolai Bork	Denmark	FOSS company
58	Nopmanee Suvannang	Thailand	GLOSOLAN Chair
59	Nuwan Wijewardane	USA	University of Nebraska-Lincoln
60	Peter Wilson	Australia	CSIRO
61	Pradip Dey	India	ICAR-Indian Institute of Soil Science
62			
63	Raphael VISCARRA ROSS	Australia	Curtin University
64	Reza Haghi	Scotland, UK	The James Hutton Institute
65	Rich Ferguson	United States of America	USDA
66	Robert De Hayr	Australia	
67	Rong ZENG	China	Nanjing University of Information Scienc
68	Sabine Chabrilat	Germany	GFZ German Research Center
69	Sergio de los Santos Villal	Mexico	Laboratorio de Biotecnología del Recur
70	Stephen Haefele	UK	Rothamsted Research
71	Thomas Terhoeven-Urseln	Kenya	Cropnuts
72	Titia Mulder	Netherlands	Wageningen University & Research
73	Tomislav Hengl	Netherlands	The OpenGeoHub Foundation
74	Wenjun Ji	China	China Agricultural University
75	Yi Peng	China	GSP expert on spectroscopy
76	Yufeng Ge	USA	University of Nebraska-Lincoln

76 active members

28 Countries

5 continents

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GLOBAL SOIL  
PARTNERSHIP

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

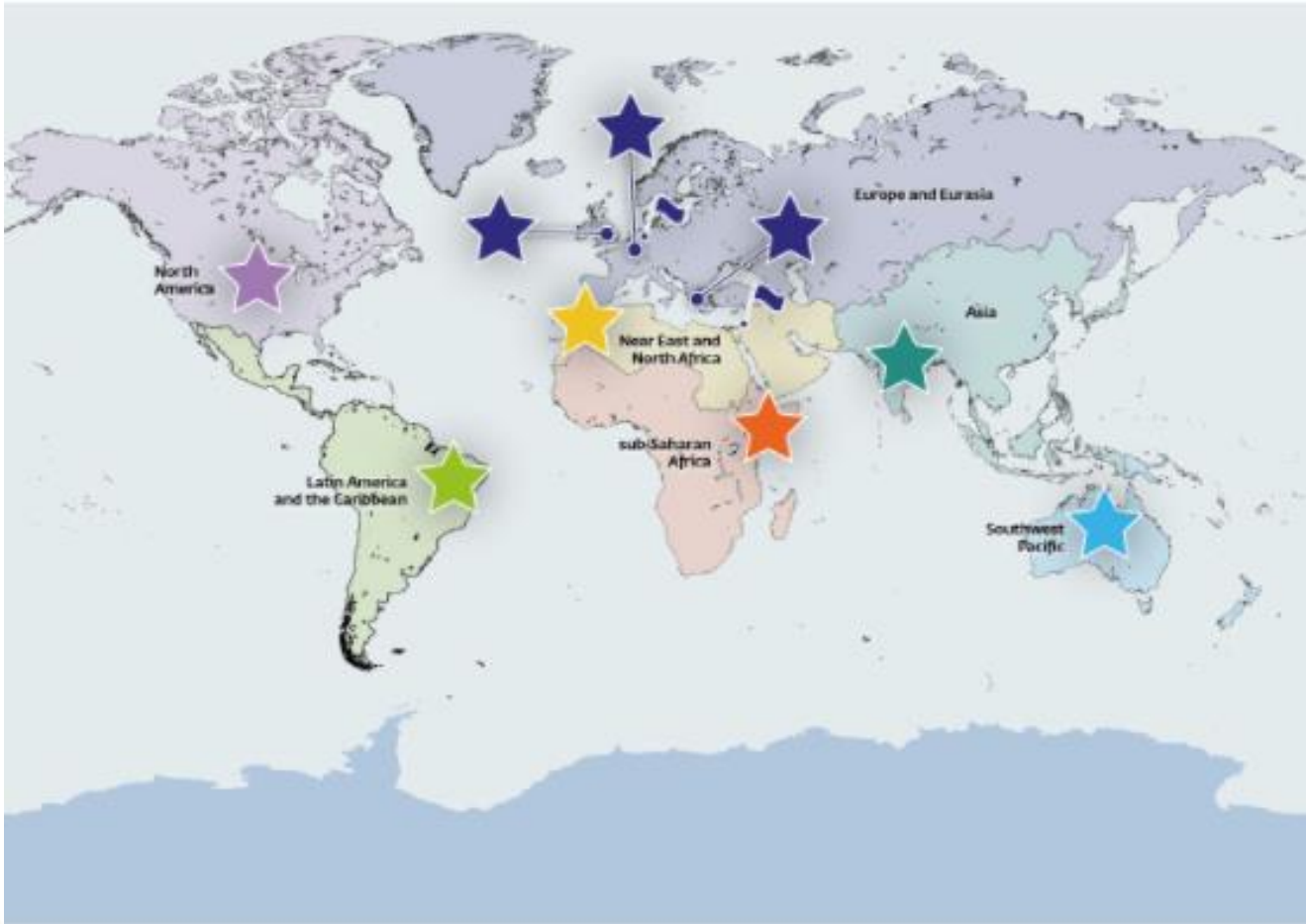
The new management of GSP recognized our previous efforts in GLOSOLAN-Spec and invited Yi Peng a former coordinator and the founder of GLSOLAN -Spec to rejoin FAO/GSP and continue management the group at full time

# Wellcome back Yi

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# Regional Champions on Soil Spectroscopy



## 11 regional champion laboratories on soil spectroscopy

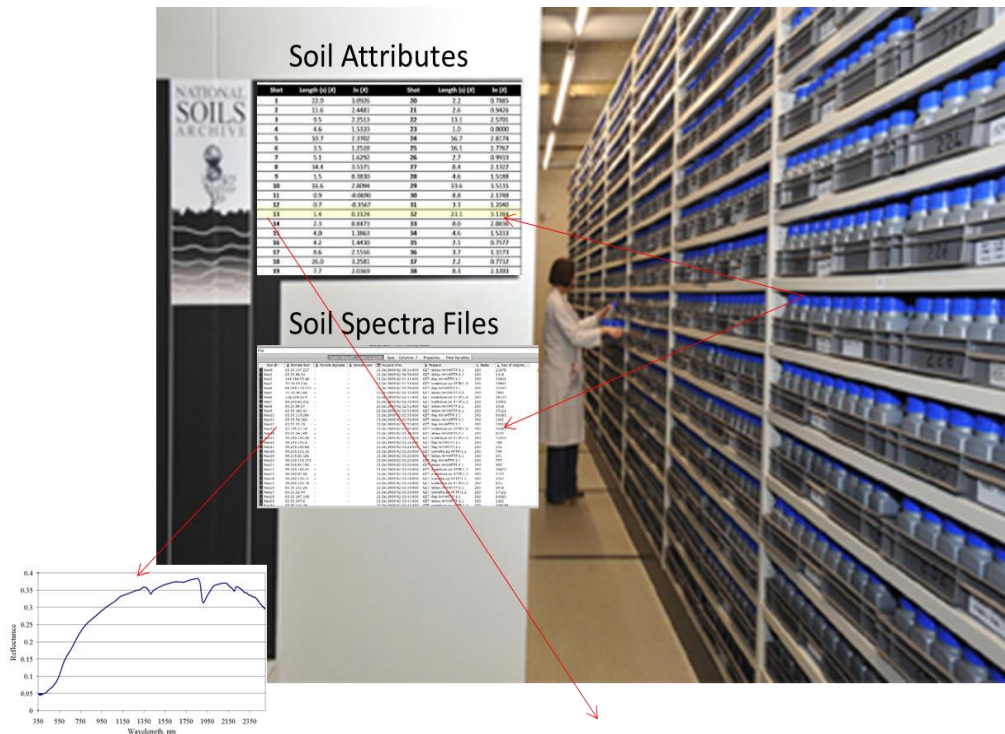
- EUROPE and the Mediterranean Basin
- AFRICA
- NEAR EAST AND NORTH AFRICA
- LATIN AMERICA AND THE CARIBBEAN
- NORTH AMERICA
- ASIA

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<https://www.fao.org/global-soil-partnership/glosolan/soil-analysis/dry-chemistry-spectroscopy/en/>



# 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
- Performing 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





# Soil spectroscopy Summer School ii (Tel Aviv, June 2023)

International course in precision agriculture at Tel Aviv University  
Porter School of Environment and Earth Sciences

*Soil Spectroscopy from Laboratory to Satellite to foster  
agriculture optimization*

Tel Aviv, June 2023

Academic Credit (Msc. BSc. Level): **2**

*Executer:* Prof. José Alexandre Demattê (Full Prof. Remote Sensing and Soils), University of São Paulo, Brazil  
Prof. Eyal Ben-Dor (Full Prof. Remote Sensing), University of Tel Aviv, Israel

**Eligible:** MSc. Students with a background in the course such as “introduction to remote sensing” or equivalent by the lectures permission  
The course will be opened to all Israeli universities (by a bilateral VATAT agreement) and to International students under agreement with TAU

**PERIOD:** June 2023; **26 hours** total

**DATES:** A weekly meeting, physical attendance - 14:00-18:00 hs

**DYNAMIC:** Each session – **2 hours** frontal lecture, 2 hours Exercise as provided

**Local:** Israel, Tel Aviv, Yad Avner, Zelig 10 Afeca, Room 013 **16-18**

**Final :** **Exam**

**Registration:** Send email to : [benador@post.tau.ac.il](mailto:benador@post.tau.ac.il) Re: “International Course”  
The number of students are limited, first come first serve .

**Guest lectures:** Prof Alex McBratney – University of Sydney, Australia  
Prof Bo Stenberg, Swedish University of Agricultural Sciences (SLU), Sweden  
Dr. Maria Knadel – Aarhus university , Denmark

**Open:** to MSc students with Introduction to Remote Sensing or equivalent background course.

**Duties:** Full attendees, Exam, and Exercise

## Course synopsis

The course will provide practical tools to utilize soil spectroscopy from laboratory, field, air, and space domains for precision agriculture applications. The course will be given by worldwide leaders in this field: Prof Dematte from the Faculty of Agriculture Sao Paulo University and Pro. Eyal Ben-Dor from Tel Aviv University. It will host three international lecturers and experts in both digital soil mapping and spectral modeling. The course will be divided into theoretical and practical stages: The theoretical part presents plenty of figures and years of experience in the indicated field. Understanding soil spectra will be the first step in highlighting its usefulness if spectral libraries exist to proximal wet attributes of the soil solely from spectroscopy. During the course, we will also indicate what are the basic fundamentals of other spectral regions such as gama, x-ray,

Moderators: Prof Jose Dematte, Prof Eyal Ben Dor

Invited lectures: Prof. Bo Stenberg, Prof. Maira Kendal

Students from 4 countries



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# Soil spectroscopy Summer School ii ( Marrakesh, August 2023)

## Soil Spectroscopy: Measurements and Analyses

### Summer School program August 2023

#### Morocco UM6P

Day 1 – Arrival to UM6P 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..ect)  
Lecture 1: Introduction to soil spectroscopy (SEMINAR)

Day 2- Laboratory standard and protocol – [theory](#) (SEMINAR)

## Soil Spectroscopy: Measurements and Analyses

### Summer School program August 2023

#### Morocco UM6P

Day 1 – Arrival to UM6P 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..ect)  
Lecture 1: Introduction to soil spectroscopy (SEMINAR)

Day 2- Laboratory standard and protocol – [theory](#) (SEMINAR)  
Laboratory [protocol](#):- exploring the IEEE P4005 protocol (EXPERT)  
Laboratory measurement – QA/ QI  
Measurement in the lab – setting up the measurement [environment](#)  
First Measurements and Data analysis – archiving the [information](#)

Day 3 – Soil Spectral [Libraries utilization](#) (SEMINAR)  
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](#) (SEMINAR)  
Supervise 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



Planned for 2022

# Soil spectroscopy training material

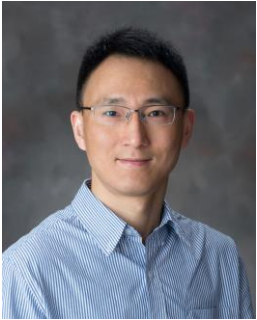
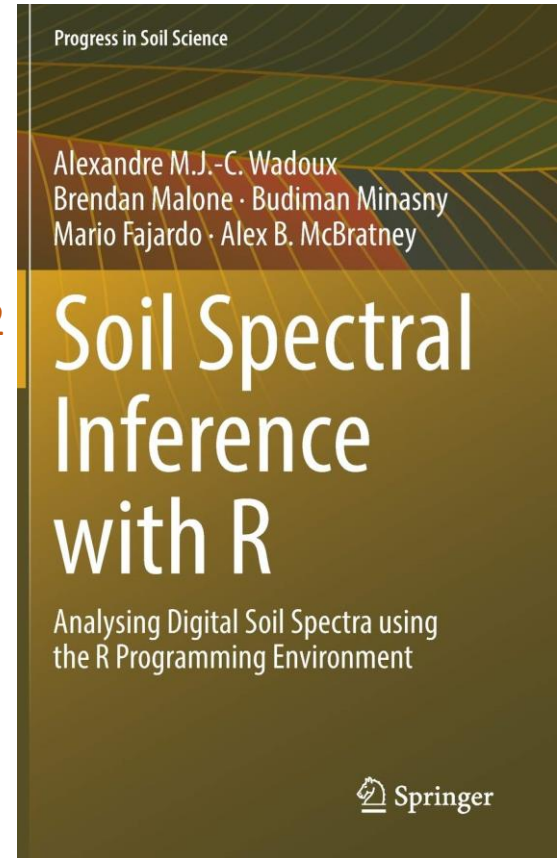
To be held 2024 ?

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 examples 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 management zones or to guide variable rate applications of fertilizers, 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

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Alexandre Wadoux

University of Sydney



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.

Two Webinars

Yi – Elaborate pls

Global Soil Partners

[Home](#) | 
 [Overview](#) | 
 [Partners](#) | 
 [Regions](#)

 
 back home

GLOSOLAN homepage

Soil Analysis

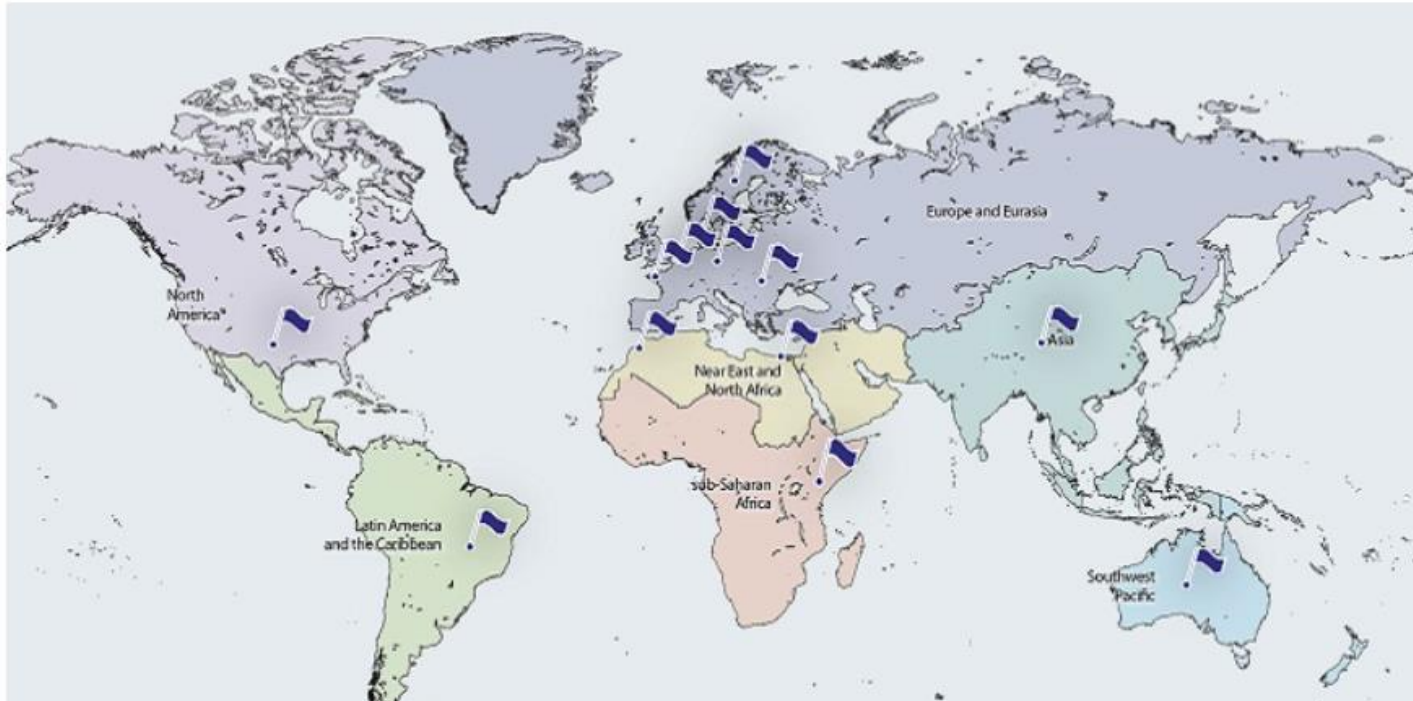
Standard Operating Procedures

Quality Assurance and Quality Control

Health and Safety

**Dry chemistry (spectroscopy)**

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.



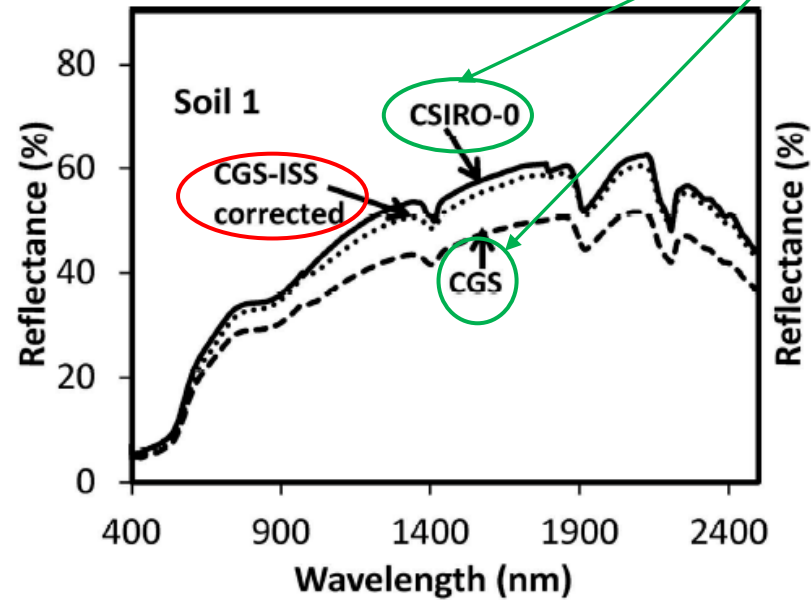
3 November 2023



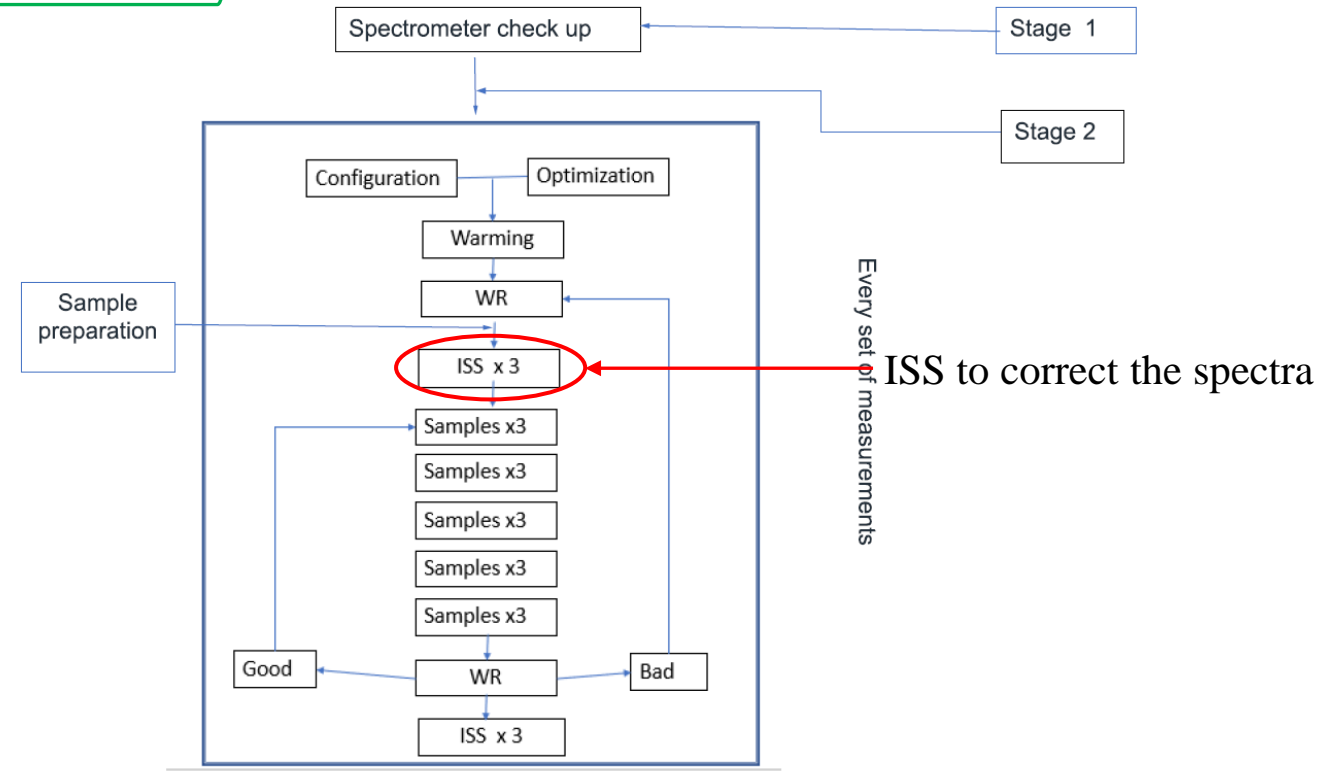
# Ring Trial with 70 samples from Senderman's collections 16 laboratories ( **check the IEEE SA P4005 Protocol** )

Marmar Sabetizadeh and Bas van Wseleman

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



V. KOPAČKOVÁ AND E. BEN-DOR, 2016



Protocol for soil scanning

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# World Soil Spectral Library: Sharing and Application

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

**WorldSpectralLibrary**



## A global spectral library to characterize the world's soil



R.A. Viscarra Rossel<sup>a,\*</sup>, T. Behrens<sup>b</sup>, E. Ben-Dor<sup>c</sup>, D.J. Brown<sup>d</sup>, J.A.M. Demattê<sup>e</sup>, K.D. Shepherd<sup>f</sup>, Z. Shi<sup>g</sup>, B. Stenberg<sup>h</sup>, A. Stevens<sup>i</sup>, V. Adamchuk<sup>j</sup>, H. Aichi<sup>k</sup>, B.G. Barthès<sup>l</sup>, H.M. Bartholomeus<sup>m</sup>, A.D. Bayer<sup>n</sup>, M. Bernoux<sup>o</sup>, K. Böttcher<sup>o,p</sup>, L. Brodský<sup>q</sup>, C.W. Du<sup>r</sup>, A. Chappell<sup>s</sup>, Y. Fouad<sup>s</sup>, V. Genot<sup>t</sup>, C. Gomez<sup>u</sup>, S. Grunwald<sup>v</sup>, A. Gubler<sup>w</sup>, C. Guerrero<sup>x</sup>, C.B. Hedley<sup>y</sup>, M. Knadel<sup>z</sup>, H.J.M. Morrás<sup>aa</sup>, M. Nocita<sup>ab</sup>, L. Ramirez-Lopez<sup>ac</sup>, P. Roudier<sup>y</sup>, E.M. Rufasto Campos<sup>ad</sup>, P. Sanborn<sup>ae</sup>, V.M. Sellitto<sup>af</sup>, K.A. Sudduth<sup>ag</sup>, B.G. Rawlins<sup>ah</sup>, C. Walter<sup>s</sup>, L.A. Winowiecki<sup>f</sup>, S.Y. Hong<sup>ai</sup>, W. Ji<sup>a,g,j</sup>

<sup>a</sup> CSIRO Land and Water, PO Box 1666, Canberra, ACT 2601, Australia

<sup>b</sup> Institute of Geography, University of Tübingen, Germany

<sup>c</sup> The Remote Sensing and GIS laboratory Department of Geography, PO Box 39040, Tel-Aviv University, 69989, Israel

<sup>d</sup> Washington State University, USA

<sup>e</sup> Department of Soil Science, College of Agriculture Luiz de Queiroz, University of São Paulo, Piracicaba, São Paulo, Brazil

<sup>f</sup> World Agroforestry Centre, ICRAF, PO Box 30677-00100, Nairobi, Kenya

<sup>g</sup> Institute of Applied Remote Sensing and Information Technology, College of Environmental and Resource Sciences, Zhejiang University, 866 Yuhangtang Road, Hangzhou 310058, China

<sup>h</sup> Swedish University of Agricultural Sciences, Department of Soil and Environment, PO Box 234, 532 23 Skara, Sweden

<sup>i</sup> Georges Lemaitre Centre for Earth and Climate Research, Earth and Life Institute, UC Louvain, Louvain-la-Neuve, Belgium

<sup>j</sup> Bioresource Engineering Department, McGill University, Ste-Anne-de-Bellevue, Quebec, Canada

<sup>k</sup> Higher School of Agriculture, Mograne, Tunisia

<sup>l</sup> IRD, UMR EcoSols, SupAgro, 2 place Viala, 34060 Montpellier, France

<sup>m</sup> Laboratory of Geo-Information Science and Remote Sensing, Wageningen University, P.O. Box 47, 6700 AA Wageningen, The Netherlands

<sup>n</sup> Karlsruhe Institute of Technology (KIT), Institute of Meteorology and Climate Research, Atmospheric Environmental Research, Kreuzeckbahnstraße 19, 82467 Garmisch-Partenkirchen, Germany

<sup>o</sup> Joint Research Centre, Institute for Sustainability, Via E. Fermi 2749, 21027 Ispra, Italy

<sup>p</sup> Finnish Environment Institute, Merholinkatu 34 A 00751 Helsinki Finland

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

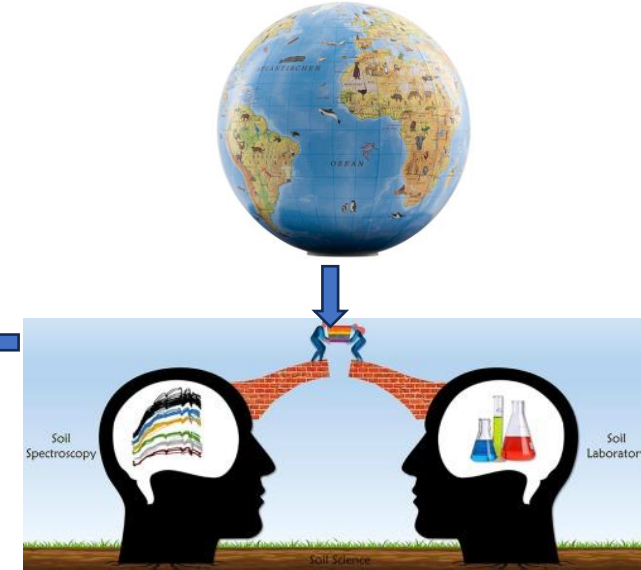
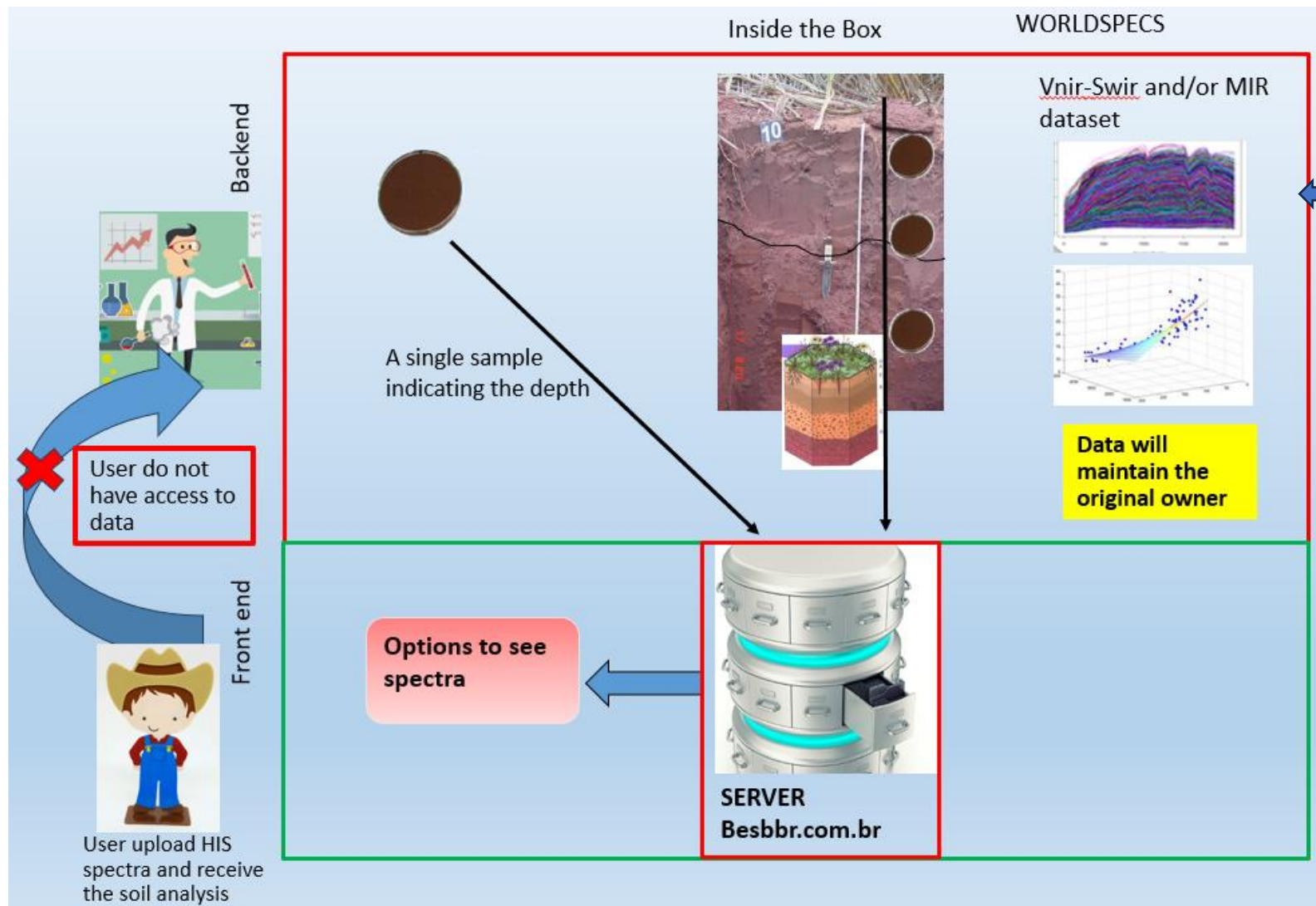


Project: The World Soil Spectral Service

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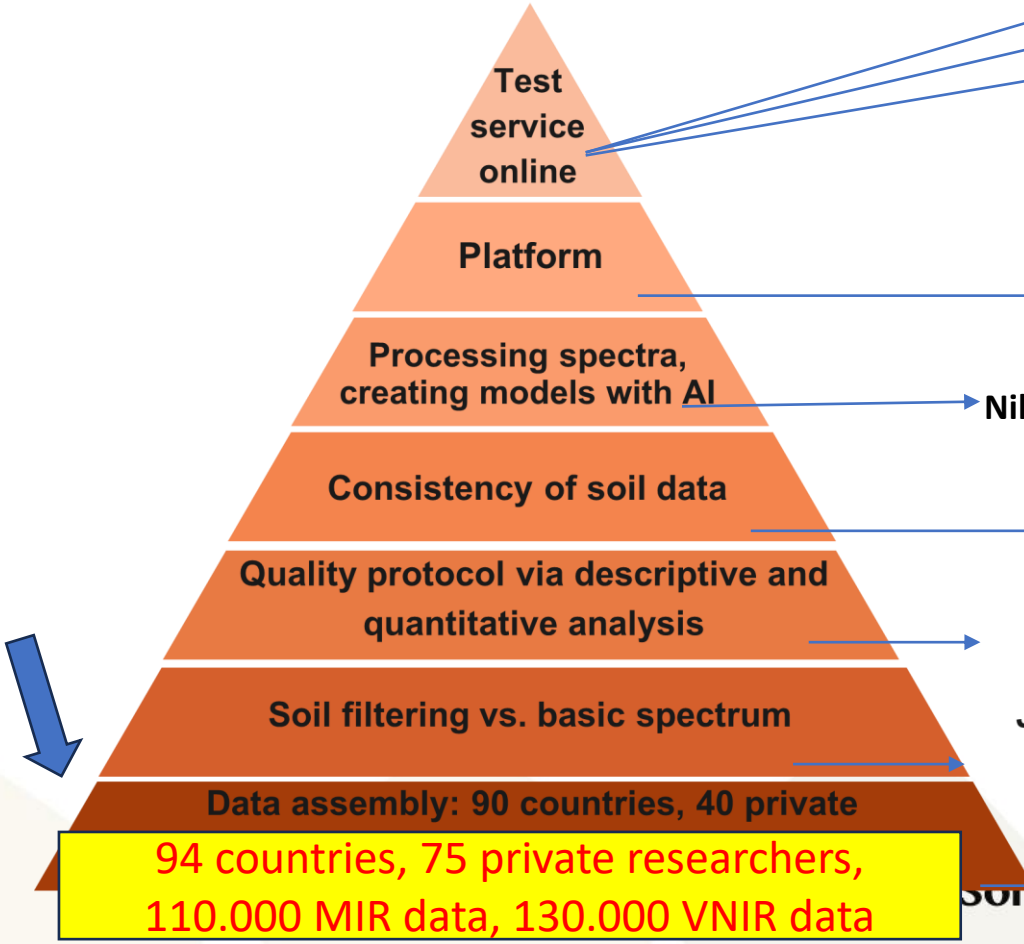
# Basic Schem





**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

### WORLD SPECS TEAM



### 2-TEAM Embrapa Agrotag-TI

- Luiz Vicente Tziolas
- Nikos Tziolas and Nikos Tsakiridis
- Dr José Demattê
- Dr Eval Ben-Dor and team
- Geocis Group
- Jean Novais, Bruno Ferreira
- Dra Ariana Paiva

### 4-CRONOGRAM

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

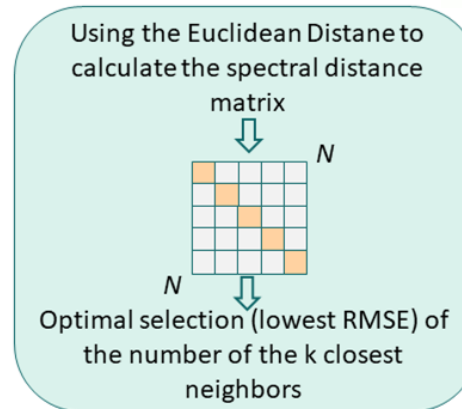
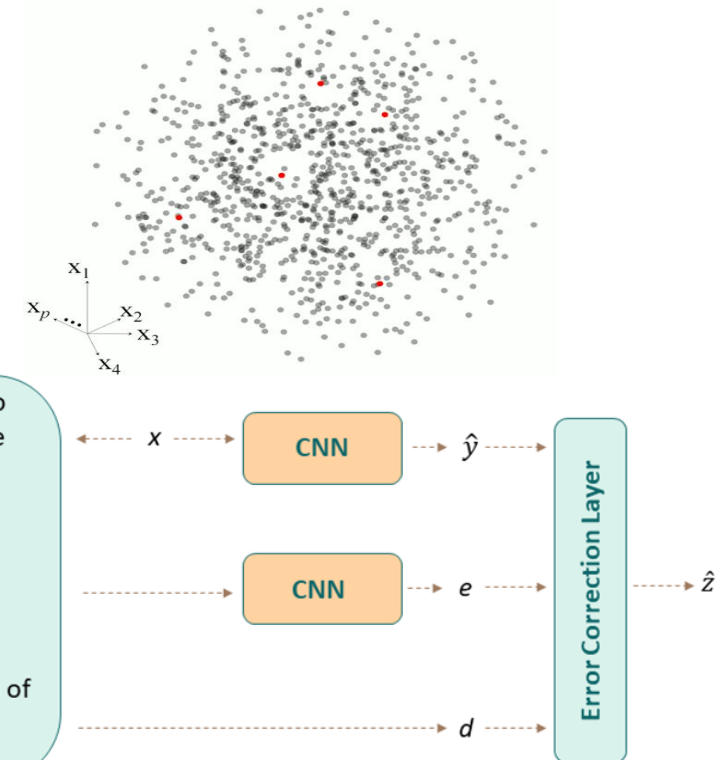
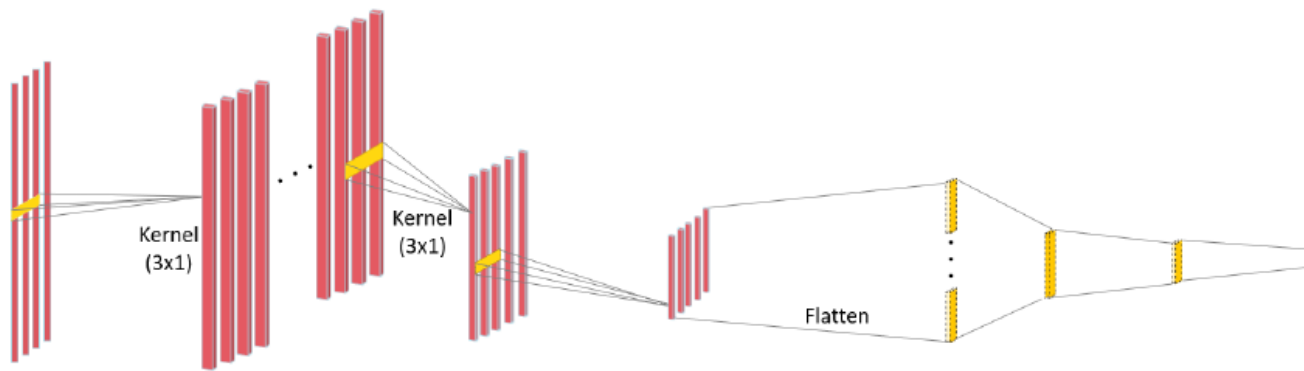
### 3-BULLETS AND UPDATE

- (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**

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# 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.

# 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)

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# 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

- 

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# 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 steering committee meeting)





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Thank You

