

# Standard Protocol and Scheme for Measuring Soil Spectroscopy

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ESA Symposium on Earth Observation for Soil Protection and Restoration

# GLOBAL SOIL DATABASES

## Global soil spectral library (Viscarra-Rossel)

Whole word  
Not distributed  
No common standard and protocol

## LUCAS soil spectral library

European-wide 22,000 pts  
Download from the web  
All acquired with standard

## Brazilian soil spectral library (Dematte)

Brazil 60,000  
Not openly available

## Geocradle Mediterranean soil spectral library (Ben-Dor)

Easter Mediterranean 100 points

Harmonization is highly required  
Spectral Chemical



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A global spectral library to characterize the world's soil

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LUCAS Soil, the largest expandable soil dataset for Europe: a review

A. Orgiazzi<sup>✉</sup>, C. Ballabio, P. Panagos, A. Jones, O. Fernández-Ugalde

First published: 23 November 2017 | <https://doi.org/10.1111/ejss.12499> | Cited by: 22



systematic effect



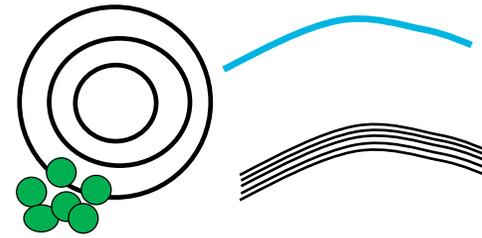
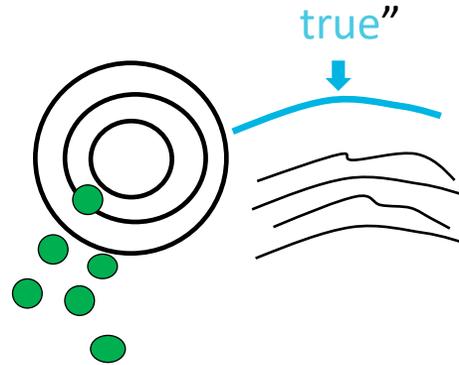
Precision



Non systematic effect



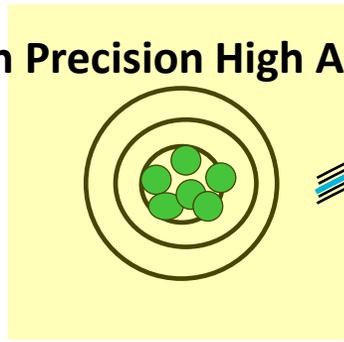
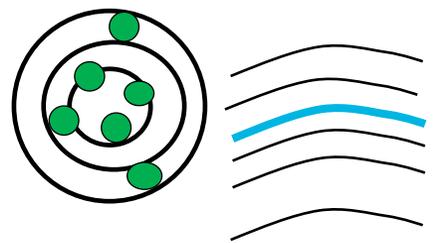
Accuracy



"true"  
Motherhood spectrum



High Precision High Accuracy



# STANDARD PROTOCOL AND SCHEME FOR MEASURING SOIL SPECTROSCOPY

2020-2024

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**SG-1 : Optical Operational Scheme (0.4-2.5 micron)**



## Programme Agenda

Day 1 - 02/07/2019

Room: Big Hall

Registration

Ben Dor, et al.

09:30

Session

Information derived from space-based EO systems  
for soil monitoring - part 2

3: New and potentially upcoming European space-based EO  
Systems relevant for Soil Monitoring

Session-4: Towards a soil monitoring systems

The Mediterranean Soil Spectral Library: An Example of an Effective Way to Exchange Soil Spectral Libraries  
Originated from Different Sources

# IEEE-SA P4005 WG

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## WELCOME TO P4005

**Sponsoring Society and Committee:** IEEE Geoscience and Remote Sensing Society/ Standards Committee (GRSS/SC)

**Title:** Standard Protocol and Scheme for Measuring Soil Spectroscopy

**Scope:** This Standard defines protocols and schemes for sensors and measurement methods when merging, comparing and utilizing Soil Spectral Libraries (SSLs) from many sources, including LUCAS SSL, GEO-CRADLE SSL, BRAZILIAN SSL and GLOBAL SSL, as well as monitoring their measurement scheme before performing data manipulation or quantitative analyses. Using the standard SSLs is an important stage while utilizing Hyperspectral (HSI) data for monitoring and mapping soils.

**Background:** For over 25 years, groups worldwide have been measuring soil reflectance spectra across the VIS–NIR–SWIR (0.4–2.5  $\mu\text{m}$ ) region in the laboratory, mainly for chemometric purposes. As a result, many soil spectral libraries (SSLs) have been generated with local to continental coverage, each making use of different sensors and protocols. As reflectance spectroscopy of soils is very sensitive to measurement geometry, illumination status, sensor output, sample preparation and more, merging or comparing SSLs remains a problematic issue. In addition, since hyperspectral (HSR) technology is entering a new and promising era (from both air and space domains), utilization of SSLs is becoming more and more attractive to users for direct implementation of SSL models on HSR data. Measuring soil reflectance by agreed standards and protocols should thus also be aligned with the HSR technology. Accordingly, the P4005 working group will work toward establishing a standard and protocol to measure reflectance spectroscopy of soil material.

- Activity start: KOM June 2020
- WG meeting every 6 weeks
- Strong involvement of the community (~50-60 participants)
- Next WG meeting #18 September 13th 15:00 CEST

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## WG OFFICERS

### Chair

Eyal Ben Dor, [benдор@tauex.tau.ac.il](mailto:benдор@tauex.tau.ac.il)

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### IEEE Program Manager

Vanessa Lalitte, [v.lalitte@ieee.org](mailto:v.lalitte@ieee.org)

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## LATEST NEWS

- [Meeting #4 invitation](#)
- [Calibration Transfer: A presentation by Mila Luleva](#)
- [Important Documents](#)

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## EVENTS CALENDAR

« APR 2021 »						
M	T	W	T	F	S	S
		31 •	1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22 •	23	24	25
26	27 •	28	29	30	1	2



# Exploring the spectral variation between instruments for the ring trial

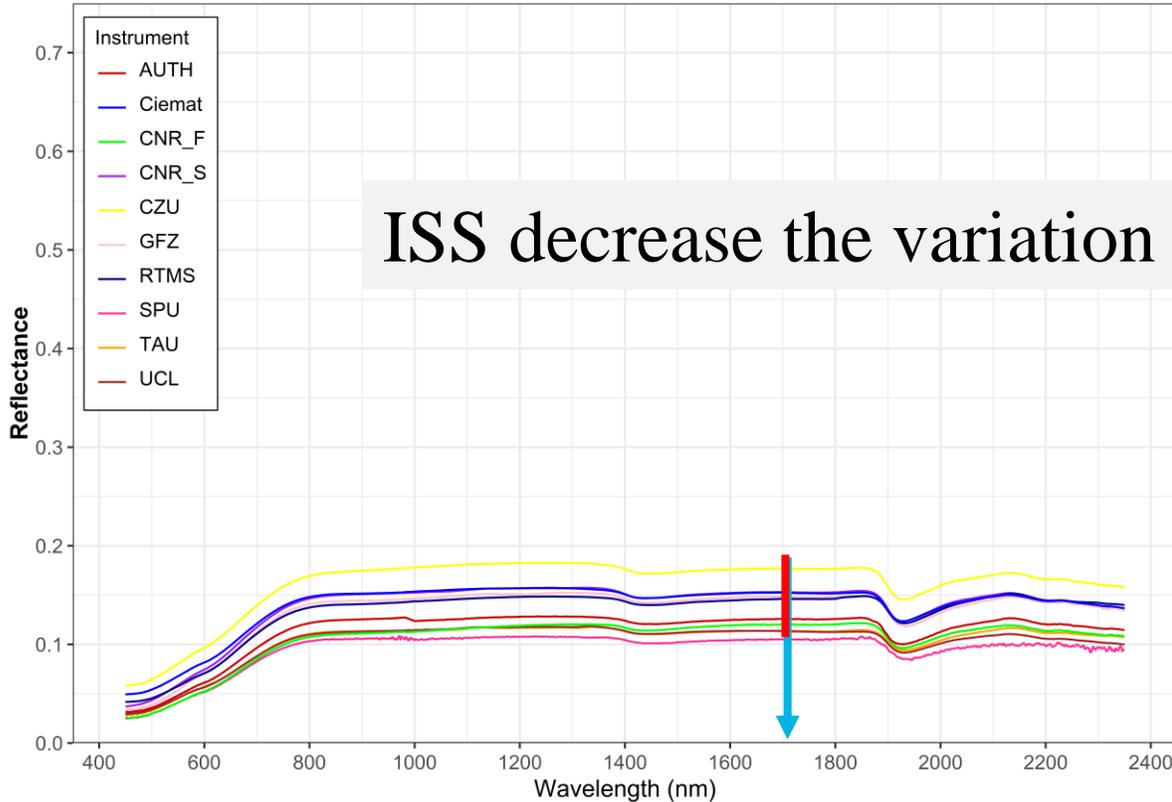


55 same Soils and 11 laboratories (A RING TRIAL TEST)  
With and Without Standardization

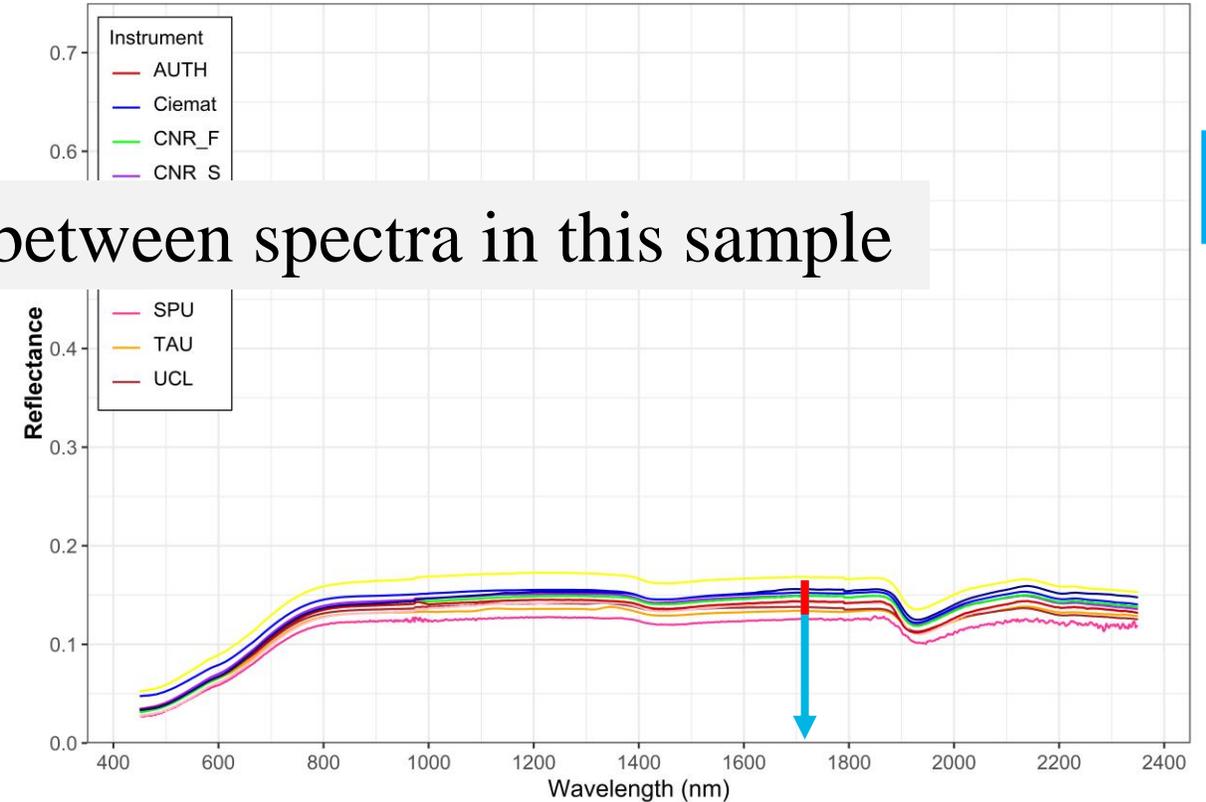
E.g. sample 9 with high SOC content (16.24%)



Sample 9-Before correction



Sample 9-After correction



ISS decrease the variation between spectra in this sample

Marmar Sabetizadeh and Bas van Wesemael 2023

from Marmar Sabetizadeh and Bas van Wesemael

# ACTION

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- Approximately 50- 40 participants from around the world actively engage in monthly eMeetings for collaborative discussions.
- The group effectively oversees the coordination of measurements and experimental activities.
- Participants execute both laboratory and field exercises to ensure a comprehensive understanding of the subject matter.
- The collective effort aims at generating a comprehensive and standardized written protocol for the benefit of all involved stakeholders.
- Involvement with FAO through GLOSOLAN-Spec WG

# 1 P4005™ Draft for Standard Protocol 2 and Scheme for Measuring Soil 3 Spectroscopy

4 (laboratory protocol)

5 Developed by the

6  
7 **P4005**  
8 of the  
9 **IEEE SA**

10  
11 Approved <Date Approved>

12  
13 **IEEE SA Standards Board**

14  
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- The laboratory PROTOCOL contains 62 pages with Python codes and detailed instructions
- The field document is under preparation

# 1 Draft Standard Protocol and Scheme 2 for Measuring Soil Spectroscopy

## 3 1. Overview

4 The P4005 working group operates within the framework of the IEEE-Standards Association and is dedicated  
5 to the development of comprehensive standards and protocols in the realm of soil spectroscopy. This initiative  
6 stems from over two decades of active research by global scientific groups, exploring soil reflectance patterns  
7 across the visible, near-infrared, shortwave infrared, and thermal spectral regions. These efforts have yielded  
8 various soil spectral libraries with diverse coverage and data sources.

9 However, a significant challenge has emerged in the form of the need to merge or compare these SSLs  
10 effectively. This challenge arises from disparities in instrumentation and measurement protocols. In light of  
11 advancements in hyperspectral technology, there is a growing interest in leveraging SSLs for quantitatively  
12 assessing soil properties on a global scale.

13 The primary objective of the P4005 working group is to establish a protocol that achieves the harmonization  
14 of soil spectral libraries, and this protocol seeks to address the details of instrumentation and measurement  
15 methodologies, thereby ensuring uniform and comparable soil spectral measurements. The overarching aim  
16 is to establish compatibility and comparability among SSLs that originate from different sources, thereby  
17 facilitating a seamless merging and comparison of soil spectroscopy data.

18 The P4005 working group operates through subgroups that focus on specific facets of soil spectroscopy.  
19 These subgroups span topics such as laboratory and field measurements, data handling, spectral performance  
20 assessment, cross-calibration, and more. The expertise of these subgroups is drawn from a network of experts  
21 that support this effort for standard development including various experiments and trials that have been  
22 undertaken, ultimately leading to its validation and refinement. The release of the standard is anticipated to  
23 foster enhanced collaboration within the soil spectroscopy community, as well as promote advancements in  
24 soil science, remote sensing applications, and environmental monitoring. Furthermore, this protocol is set to  
25 contribute to the creation of a comprehensive global SSL, providing researchers with a powerful tool for  
26 modeling and mapping soil properties on a worldwide scale.

## 27 1.1 Word usage

28 <This subclause is mandatory and shall appear after the Scope and Purpose (if included).>

29 The word *shall* indicates mandatory requirements strictly to be followed in order to conform to the standard  
30 and from which no deviation is permitted (*shall equals is required to*).<sup>1,2</sup>

# CONCLUSIONS

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- The need for a soil spectral measurement protocol is paramount for the harmonization of global soil spectral libraries.

End-users are seeking for ISO approval

- The IEEE SA P4005 working group is actively addressing this gap by developing a reliable standard and protocol, facilitating harmonization of SSLs from their point of origin.
- We anticipate that the IEEE SA protocol will foster (and improve) collaboration among scientists and provide essential support for emerging initiatives in compiling SSLs under harmonization domain



# Thank You!



ESA Symposium on Earth Observation for Soil Protection and Restoration



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World Soil Information

UCLouvain



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