Food and Agriculture Organization of the United Nations

GLOBAL SOIL PARTNERSHIP

Global Capacity Development in Soil Spectroscopy

A Concept Note of the Global Soil Partnership

Prepared by the Steering Committee on Soil Spectroscopy
in the framework of the Global Soil Laboratory Network (GLOSOLAN)

Background

Many studies have demonstrated the potential of soil diffuse reflectance spectroscopy as a rapid and low-cost method for soil characterization (Janik et al., 1998; McBratney et al. 2006; Shepherd et al., 2007; Nocita et al. 2015). Numerous soil properties can be calibrated to near- and mid-infrared spectra owing to the fact that soil spectra respond to soils mineral and organic composition (Soriano-Disla et al. 2014; Wijewardane et al. 2018). Spectral technology is enabling soil analysis at scales that can support local to global digital soil mapping and precision agriculture, reduce the cost of soil testing services for farmers, assist in data based policy development and soil monitoring for climate adaptation and mitigation. However, a major constraint for wider uptake of soil spectroscopy is the lack of capacity of conventional soil laboratories in spectral methods and the lack of spectral calibration libraries for different soil types and geographies.

This proposal is to develop a capacity development initiative to support the effective application of soil spectroscopy under the Global Soil Partnership (GSP), implemented through the Global Soil Laboratory Network (GLOSOLAN). This includes development of guidelines, provision of advisory services on suitable instrumentation and standardization of sample preparation, spectral measurements, calibration, and estimation. The proposal is closely linked to the GLOSOLAN initiative “A Global Soil Spectral Calibration Library and Estimation Service”.

This effort is strengthened by the already ongoing efforts by GSP and its Soil Data Facility, currently hosted by ISRIC, to build a Global Soil Information System (GLOSIS) for soil (reference) data. GLOSIS is a distributed global soil information system that uses a harmonised soil data model (already under development), facilitates standardisation of soil data using SOPs and harmonisation rules developed by GLOSOLAN. It consists of local, national or regional nodes that together build the database and are accessible through one entry point. It is currently being built and is expected to be operational soon.

Objectives

Under the framework of GLOSOLAN, this project aims to:

1. Harmonize soil spectroscopy methods (including soil sample preparation, spectral measurement and quality assurance of data analysis);

2. Develop the capacity of countries and labs in the performance of lab-based soil spectroscopy measurements.

Beneficiaries

This proposal focuses on three main target groups:

- Local, national, regional and global researchers and advisers on soil, water, landscape, land use and agricultural production related topics;
- Decision makers on soil related topics such as agriculture, land use planning;
- National and other soil laboratories.

Expected results

Output 1. Guidelines and standard operating procedures for soil spectroscopy

Activity 1.1. Develop guidelines and standard operating procedures to help consistency and harmonization of soil spectral data globally

The Steering Committee on Soil Spectroscopy of GLOSOLAN of the Global Soil Partnership will develop guidelines to help consistency and harmonization of soil spectral data globally. The committee has already produced a first draft outline of the guidelines that should serve countries with already established laboratories as well as countries that have to provide samples to third parties. The guidelines will be completed in a modular format and circulated within the GLOSOLAN Spectroscopy Working Group for review and input.

The guidelines and standard operating procedures will cover an introduction to spectroscopy and its application in soils, instrumentation, sample preparation, sample presentation and reading, spectral quality assurance and control, calibration and estimation of soil properties, laboratory information and software systems, and application notes, for example the application of soil spectroscopy in digital soil mapping.

The results of both (wet chemistry and spectroscopy) harmonization efforts are also being used in the (distributed) Global Soil Information System GLOSIS under the Global Soil Partnership.

Output 2. Enhanced capacity of national soil laboratories on the use of soil spectroscopy analysis techniques

Activity 2.1. Train and assist national soil laboratories with sampling schemes for new sampling using geo-spatial covariates, for selection of samples from existing soil archives where reference or spectral data is available, and for archiving of soil samples.

Activity 2.2. Train laboratories on how to use spectral data and apply the spectral models in their soil samples. In this regard, tools for model applications will be developed by GLOSOLAN.

Activity 2.3. Train and assist national soil laboratories on: (a) the implementation of standard operating procedures for soil preparation and storage, and for spectral measurement, (b) the use of laboratory equipment and its maintenance, (c) spectral data collection, storage and quality control, (d) spectroscopy software tools, and (e) interpretation of results.

Activity 2.4. Establish regional nodes to support countries in applying GLOSOLAN guidelines and standard operating procedures, developing or re-calibrating regional calibration models, including collation of meta-data on the samples and harmonisation with GLOSIS standards and data entry.

Activity 2.5 Conduct regional training courses on GLOSOLAN guidelines and standard operating procedures for soil spectroscopy.

These activities will also support the linked GLOSOLAN proposal to provide a freely available, global soil calibration library and estimation service, and the GSP's GLOSIS initiative to develop a distributed global soil information system.

Conclusion

The proposed initiative on Global Capacity Development in Soil Spectroscopy will enhance the capacity of national soil laboratories through the provision of guidelines, standard operating procedures, advisory services, and organization of trainings, including delivery through regional nodes. The initiative will help the wider adoption and efficient application of soil spectroscopy, which will in turn help countries provide better soil information at lower cost to decision makers, planners, agricultural input providers, digital agriculture services and farmers. Better soil information will facilitate sustainable soil management, food security and nutrition, and climate adaptation and mitigation. Developing countries with limited laboratory resources stand to gain the most from this initiative.

References

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