World Soil Information

Expansion of the ISRIC – World Soil Reference Collection 2010-2013

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Introduction

ISRIC - World Soil Information has the mandate to create and increase the awareness and understanding of the role of soils in major global issues. As an international institution we inform a wide audience about the multiple roles of soils in our daily lives. This allows informed decisions to be taken by policymakers, the private sector and civil society organisations.

One of the main assets of the institute is the world soil reference collection. It consists of more than 1100 soil monoliths representing the major soils of the world. All soils have a comprehensive set of analytical data. A selection of the monoliths is on display in the World Soil Museum.

An expansion of the collection is planned to cater for soil types or regions that are currently under-represented. The expansion program will involve clustered collection of new soil profile information — profiles, site and soil description, soil analytical and physical analysis, also spectral analyses, and necessary supporting information (e.g. high resolution photographs and soil survey reports).

The work will be implemented in close collaboration with selected partner institutes worldwide, with regional soil-related mandates, to optimize efficiency of time and resources. The proposed project partners include researchers and field pedologists in Africa, Asia, Europe and South America; the project comprises both science-oriented and capacity building sub-components. The full field and laboratory program, which includes the development of a soil information system for storing the data and web-services for distribution of the newly collated data, will require three and a half years from team mobilization.

Upon project completion, a suite of tools/databases, with full instructions on how to use them, will be available from a single web site hosted by ISRIC – World Soil Information, the ICSU World Data Centre for Soils since 1989. All data collected, including imagery, will be freely accessible to the international scientific community, and other specialist user groups, upon completion of the project. The newly collected reference data, and data derived from them, may be used, for example, in support of studies on reducing soil degradation, world food supply, mitigation of greenhouse gas emissions from soils at national and global scale, thereby creating opportunities for new internationally funded projects. They will also be used to strengthen ISRIC's educational program through new thematic displays in the World Soil Museum.

Reference soil profiles and samples

Requirements for soil profiles to be part of the ISRIC World Reference Collection are:

- Complete site and morphological description, including accurate location;
- A good soil monolith with adequate accompanying sample material to permit additional research — in some instances, where monoliths for similar soil units are already on display in the World Soil Museum, these may be replaced by high resolution, digital imagery as a cost-effective solution

- Analytical data (*from a certified, reference laboratory*) enabling correct characterization and evaluation;
- Characteristic for one of the soil units of the FAO-UNESCO *Soil Map of the World*, or its successor the digital *Harmonized World Soil Database*[1], and important for the country/region. Conversely, they may be illustrative of a specific theme such as catenas or chronosequences, cultural-historical (*Terra Preta do Indio* from Brazil; set from Italy illustrating the effects of deforestation in the Mediterranean since Roman times), biological activity (termitaria), land use and land management aspects (effects of manual and mechanical forest clearing), or soil formation on specific parent materials.

Soil samples are collected to characterise the various layers, or horizons, in a soil. Consistent guidelines for soil description[2] and sampling underlie the reference collection; soil analytical analyses are carried out according to defined reference methods[3], in accordance with Good Laboratory Practice[4].

As standard, the reference samples are analyzed for particle-size distribution, reaction (pH in water and KCl), electrical conductivity, organic carbon and nitrogen, available Phosphorus, exchangeable bases and cation-exchange capacity; for selected samples clay mineralogy by X-ray diffraction. Depending on *specific* soil properties, additional analyses are: for calcareous samples, carbonates; for gypsiferous samples, gypsum; for acid samples (pH-water less than 5) exchangeable acidity and aluminium; for volcanic samples, oxalate-extractable silica, iron and aluminium, phosphate-retention and bulk density; for tropical soils, citrate-dithionite-extractable iron; for Podzols, pyrophosphate-extractable iron and carbon; for saline soils, readily soluble salts; for acid sulphate soils, sulphur; for shrink-swell soils, the coefficient of linear extensibility. Similarly, depending on soil acidity (pH) different types of soil analytical procedure will be needed for the determination of available P (e.g., P-Bray versus P-Olsen).

In all cases, the new samples will have to be analyzed for the relevant soil attributes. On average, soil profiles will be characterized by six samples.

Ideally, water retention characteristics and bulk density should be determined for all new reference soil samples (cores) as such data are under-represented in the reference collection (in view of cost of measurement) yet essential for a wide range of modelling applications (e.g. soil carbon stocks and changes; crop production; soil water retention). Available phosphorus will be measured on all samples seen its importance for soil fertility and ultimately food security[5].

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[1] http://www.iiasa.ac.at/Research/LUC/External-World-soil-database/HTML/

[2] ftp://ftp.fao.org/agl/agll/docs/guidel_soil_descr.pdf

[3] Van Reeuwijk, LP 2002. *Procedures for soil analysis (6th ed.)*. Technical Paper 9, ISRIC, Wageningen (http://www.isric.org/Isric/Webdocs/Docs/ISRIC_TechPap09_2002.pdf)

[4] van Reeuwijk LP 1998. *Guidelines for quality management in soil and plant laboratories*, FAO, Rome (http://www.fao.org/docrep/W7295E/W7295E00.htm)

[5] Smit AL, Bindraban PS, Schröder SJJ, Conijn JG and van der Meer HG, 2009. Phosphorus in agriculture: Global resources, trends and developments. Report to the Steering Committee Technology Assessment of the Ministry of Agriculture, Nature and Food Quality, The Netherlands. Report 282, Plant Research International in collaboration with the Nutrient Flow Task Group (NFTG), http://edepot.wur.nl/12571

Implementation

The program will support ongoing international, collaborative research projects as well as the development of ISRIC's new web-infrastructure. Inherently, upon completion and publication, all primary data will be made freely accessible to the global scientific community as well as other user groups through ISRIC's new web services and the ICSU World Data Centre System. Newly collected monoliths will be used also for thematic displays in the ISRIC – World Soil Museum, focussing on key global issues as outlined in ISRIC's Strategic Plan for 2009-2012.

The scope for sampling typical soil topo-sequences (catenas) for major climate - soil type - land use zones will get special attention. The collection of full reference profiles, with monoliths rather than only digital imagery, will concentrate on representative profiles depicting such catenas resp. effects of man-induced features. As stated in the founding advice of our Centre[6], "monoliths should also be collected to illustrate and study landscape sequences, influence of human activities, soil degradation features, etc." Strategic alliances for helping with site selection and the fieldwork will be established with internationally recognized institutes.

All new samples collated during the recovery program will be analysed according to consistent laboratory methods[7,8] to ensure the integrity of the ISRIC soil reference collection that is the inter-comparability of the analytical data obtained. By their nature, however, these conventional analytical methods are generally time consuming and thus relatively expensive. Nevertheless, they are essential for calibration and further development of less costly, new spectral analysis tools[9]. Within the recovery program, new reference sample materials will also be analysed by infra-red spectroscopic analysis to strengthen the World Spectral Reference Library.

All new reference materials will be handled and stored at the ISRIC premises in Wageningen for archiving purposes and future use by international research groups.

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[6] Report on the first meeting of the Advisory Panel of the International Museum of Soil Standards, a joint project of UNESCO and The Netherlands, 1967

[7] van Reeuwijk LP 2002. *Procedures for soil analysis (6th ed.)*. Technical Paper 9, ISRIC, Wageningen (http://www.isric.org/Isric/Webdocs/Docs/ISRIC_TechPap09_2002.pdf)

[8] USDA-NRCS 2004. *Soil Survey Laboratory Manual* Soil Survey Investigations Report 42 (ver. 4.0), USDA-National Resources Conservation Service, Washington (Available at: ftp://ftp-fc.sc.egov.usda.gov/NSSC/Lab_Methods_Manual/SSIR42_2004_view.pdf; Accessed: 5 December 2009)

[9] http://www.worldagroforestrycentre.org/sensingsoil/libraryapproach.html