THEME 1

GlobalSoilMap for Soil Organic Carbon Mapping and Modeling

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INTRODUCTION

The demand for information on functional soil properties is high and has increased over time. This is especially true for soil organic carbon (SOC) due to its major role in climate change mitigation and adaptation and in maintaining and enhancing many soil ecosystem services, among which is food production.

OBJECTIVES

The *GlobalSoilMap* project aims to produce a digital soil map of the world. The ultimate objective of the project is to build a free downloadable database of a common set of key soil properties at 3 arc-second resolution with a defined spatial entity, specified depth increments and uncertainty calculations (Arrouays *et al.*, 2014).

METHODOLOGY

How maps are produced:

Many countries have abundant legacy soil data that includes soil maps at a variety of scales, soil point data collected over decades, environmental covariate information and a network of partners that have contributed to building the soil information over many years. In addition, many have some additional soil sites sampled for soil carbon stock and baseline assessment. The majority of the data needed to produce *GlobalSoilMap* soil property maps will, at least for the first generation, come mainly from archived soil legacy data, which could include polygon soil maps and point pedon data and from available covariates such as climatic data, remote sensing information, geological data, and other forms of environmental information.

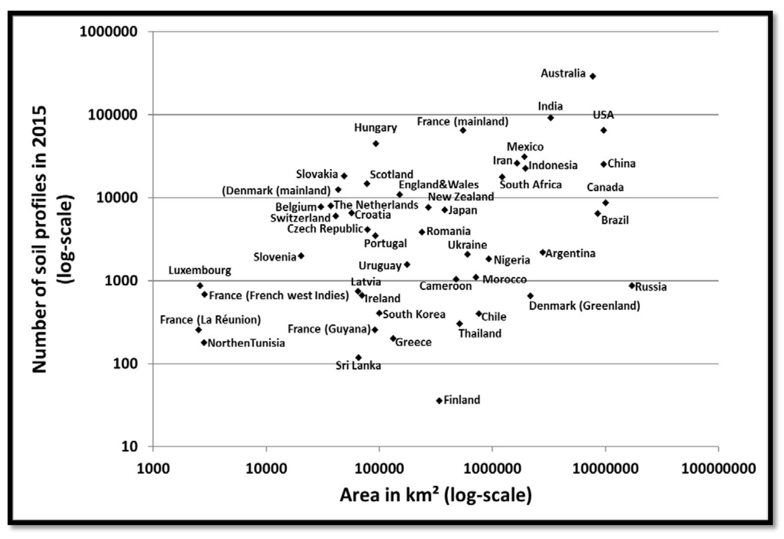

Fig. 1: Log-Log scatterplot of countries areas versus number of soil profiles for selected countries (Arrouays *et al.*, submitted)

The specifications and the products

The *GlobalSoilMap* specifications require the estimation of soil property values along with their uncertainty at each of six specified depth increments (0-5, 5-15, 15-30, 30-60, 60-100 and 100-200 cm) for the following soil properties: SOC, clay, silt, sand and coarse fragment contents, pH, ECEC, soil depth and available depth to rooting, bulk density (whole soil and fine earth fraction), and available water capacity.

As many methods may have been used to measure the soil properties included in the minimum data set they have to be translated to a standard method and the specifications provide guidance on how to do this. The spline function and similar methods are used to transform horizon data into continuous depth functions of soil properties.

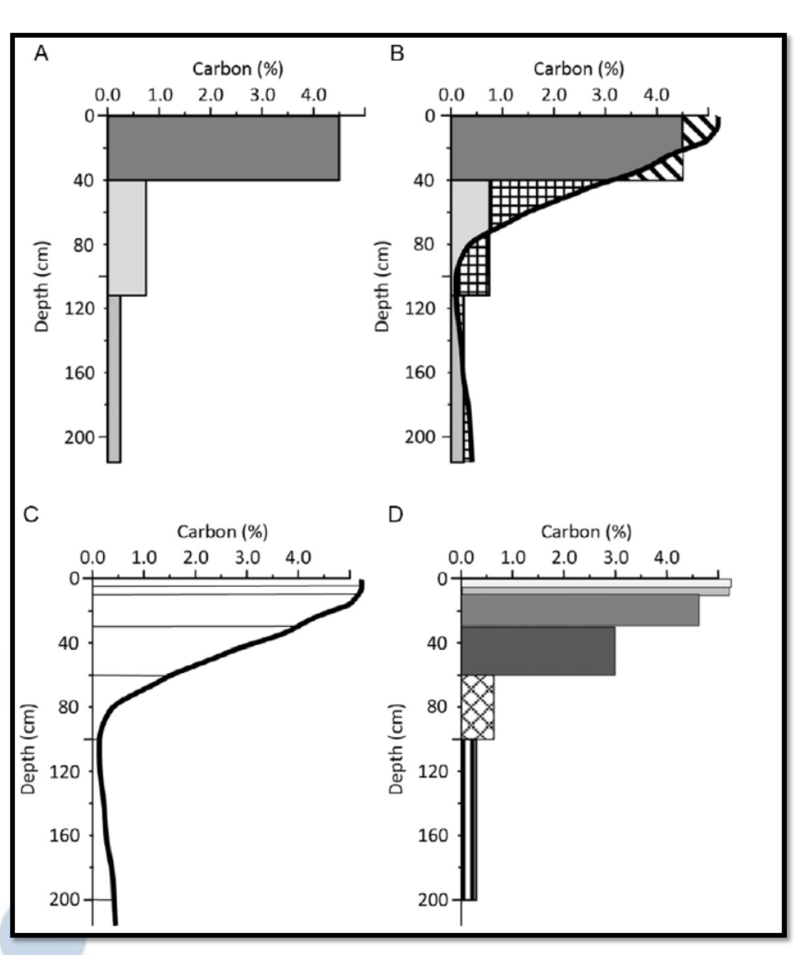

Fig. 2: The process for estimating depth functions from soil data relating to soil layers of horizons

MAIN RESULTS

The *GlobalSoilMap* specifications do not prescribe the methods of prediction, because of diverse soil legacy data situations in various countries. However, Minasny and McBratney (2010) provide a flow chart that outlines different models that can be applied.

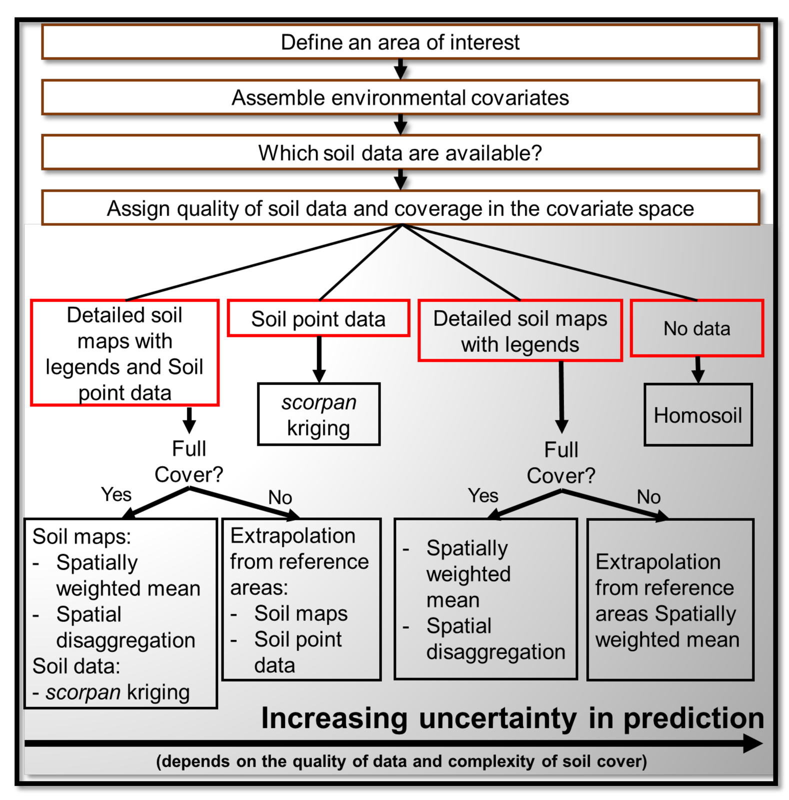

Fig. 3: A decision tree for digital soil mapping based on legacy data (from Minasny and McBratney, 2010)

The estimation of uncertainties is a unique feature but also a major challenge of this project. The uncertainties may determine, for example, whether the soil maps are sufficiently accurate for the intended use or where to conduct new surveys or additional soil sampling to obtain more accurate predictions of soil properties.

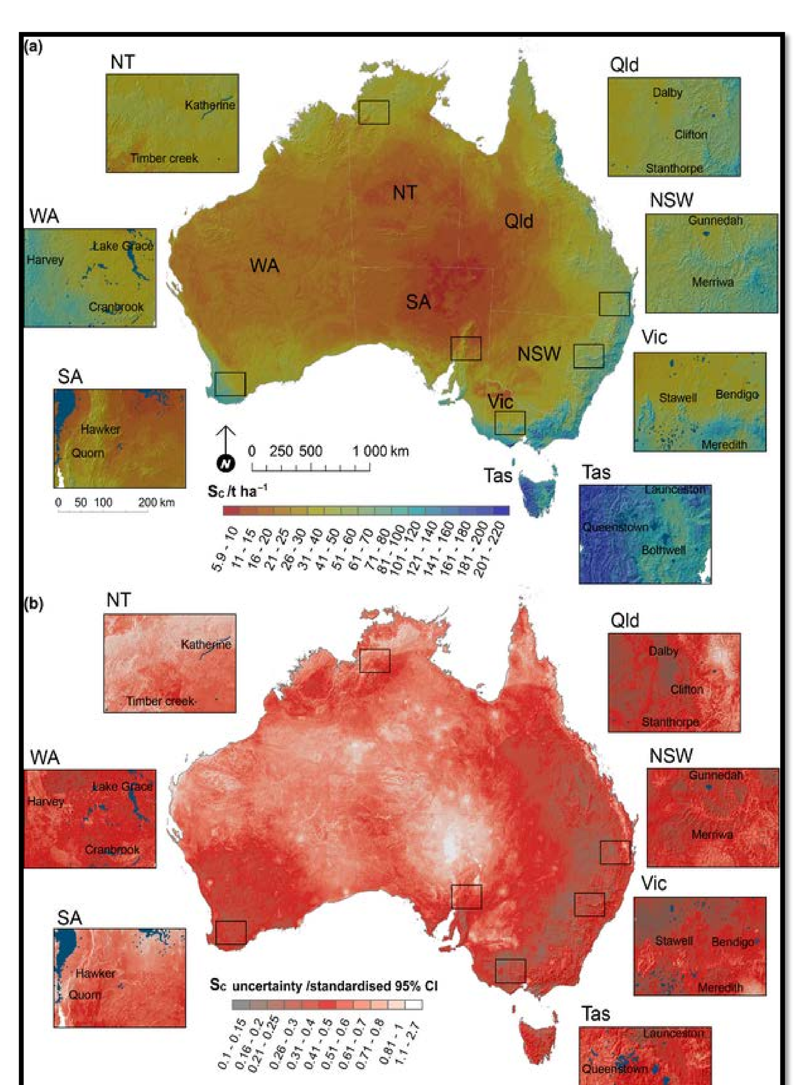

Fig. 4: Soil Organic Carbon and related uncertainties for Australia (Viscarra Rossel *et al.*, 2014)

A working Group "Global Soil Map" has been launched by the IUSS following an initiative coming from many organizations

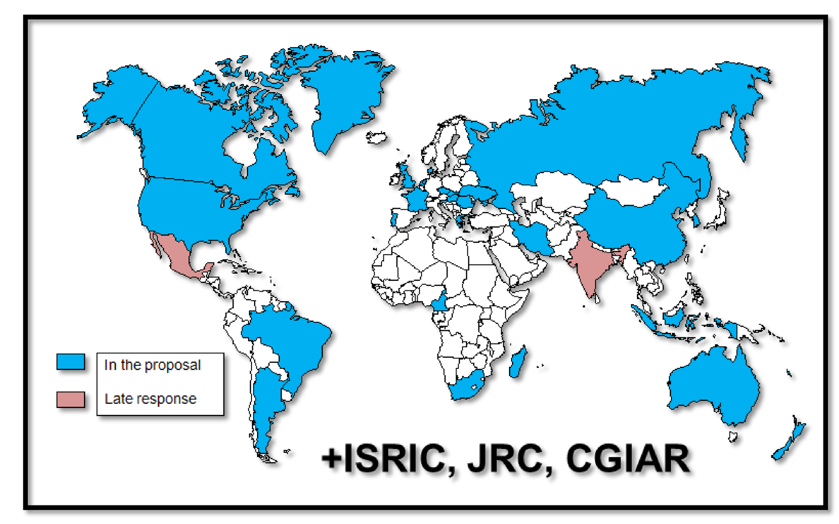

Fig. 5: Origin of the organizations proposing the IUSS WG on GlobalSoilMap

CONCLUSION

Functional soil property maps have been produced using digital soil mapping techniques and existing legacy information and made available to the user community for application. In addition, uncertainty has been provided as a 90% prediction interval based on estimated upper and lower class limits.

Main scientific challenges include time related and uncertainty issues. Combining local and global predictions should be the way forward both to enhance the quality of digital soil maps and their use, and to map the entire world. For this purpose both top-down and bottom-up approaches are necessary. Bottom-up products take full advantage of local data and knowledge, and of local soil distribution controlling factors. However, global models have a big advantage in that they avoid spatial gaps and may be a useful tool for harmonizing countries products.

We believe that *GlobalSoilMap* constitutes the best available framework and methodology to address global issues about SOC mapping.