Parceria Portuguesa para o Solo

"Feedback on/validation of the soil-related maps derived with the help of LUCAS data"

This document is the Portuguese answer to the request of the Joint Research Centre (JRC) to have feedback on soil-related maps derived with the help of LUCAS data, taking into account the scope of answer proposed by JRC:

- The approach taken to derive such EU wide maps on the basis of LUCAS point soil data;
- The contents of the data in comparison with known data in your country for similar parameters.

Considerations on the map covering the topsoil organic carbon, documented in "A map of the topsoil carbon content of Europe generated by a generalized additive model" [European Journal of Soil Science, 66 (2015): 121-134].

Introduction

These considerations are based in the premise that the "*proposed European policy in the agricultural sector will place higher emphasis on soil organic carbon (SOC), despite detailed national SOC data sets, available in several European Union (EU) Member States, a consistent C stock estimation at EU scale remains problematic as data are often not directly comparable, and different methods have been used to obtain values (e.g. sampling, laboratory analysis) and access may be restricted*"[1].

The content of the aforementioned publication, following the Global Soil Map strategy and orientations, and the Soil Thematic Strategy of EU for soil protection, can be

[1] Emanuelle Lugato, Panos Panagos, Francesca Bamba, Arwyn Jones and Luca Montanrella - A New Baseline of Organic Carbon Stock in European Agricultural Soils Using a modelling approach - in Global Change Biology (2014) 20, 313-326.

considered a wide attempt to predict topsoil organic carbon content (**TOCC**) at European scale to be integrated in a global scale, taking advantage from the state of the art of digital soil mapping technologies, and using harmonized measurements, allowing soil scientists to provide spatially quantitative estimates and prediction of organic carbon content and model standard error.

Assuming that the aim of the publication was to analyze the LUCAS-topsoil carbon data, the supplied map of **TOCC** associates uncertainty and is an update in what regards a former approach, where a 30 cm soil depth was used. It shows and highlights the high influence and bias of land cover information on the estimation organic carbon content as compared to soil classes. This output requires and stimulates the need for the development of a similar approach at local and national level.

We fully agree with the paper conclusions, that the spatial information in the published maps shall not replace national or more detailed maps. Indeed, a better quality of information in these maps of bigger scale is required and the nature and relative influence of factors could be different, due to the refinement of the criteria applied or the accuracy of the spatial data. End-users must be aware of the uncertainty of predicted values and the need of a careful use and interpretation of the data provided by these European maps. In fact, in what concerns Portugal, soil organic carbon content on topsoil is extremely variable and is mostly associated not only with land cover, but also with land use, management practices, and soil properties (e.g. texture). Also, we may emphasize that in Portugal (or in Western Iberia) a wide variation of mean annual precipitation occurs (from less than 500 to 3000 mm). In fact, a correlation between the content and amount of soil organic carbon (corrected for coarse fragments) in the top soil (up to 20 cm depth) and mean annual precipitation was observed taking into account all land cover classes. In this context, the above mentioned maps at European scale should be a good basis to develop efforts aiming the assessment of factors associated with the spatial soil organic carbon variation and distribution at national level.

The document clearly clarifies that the map output is based on the organic carbon content in the soil fine fraction. The content of SOC measured on a soil volume approach could be different in areas where soils have high coarse fragment content.

In some regions as the case of Portugal (and Western Iberia), where large areas present soils with high stoniness it should be therefore useful to take into account an accurate content of coarse fragment in order to assess the stock of SOC on a volume based approach (e.g. the amount with soil depth).

The organic carbon content in the topsoil throughout the country, as shown in the map of predicted topsoil organic carbon content (Figure 7), seems to be exaggerated in some areas, especially in the central and Southern regions of Portugal. Apparently, there is a low mapping discrimination, possibly because the distribution of sampling points is not sufficiently representative of different landscape units or soil units and other aforementioned factors. The organic carbon map suggests a low differentiation throughout the country, which does not fully agree with trends that show a relationship between such content and the mean annual precipitation (it varies from less than 500 to about 3000 mm). Such a gradient is observable in the map with the organic carbon content of the sampling points [Figure 9 - Measured organic carbon content at LUCAS topsoil survey (2009)]. It is noteworthy that the gradient of spatial distribution of SOC content in the former map by *Jones et al.* (2005) reflected better the effect of precipitation. Such discrepancies may be associated with the fact that in Portugal different land cover types occur across the mean annual precipitation gradient.

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The Technical –Scientific Panel of the Portuguese Soil Partnership