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 set of maps covering topsoil physical properties, documented in "*Mapping topsoil physical properties at European scale using the LUCAS database*" [Geoderma, 261 (2016): 110-123].

The content of the aforementioned publication, following the Global Soil Map orientations and the Soil Thematic Strategy of EU for soil protection, can be assumed as an interesting and useful exercise at European scale to be integrated in a global scale, giving a broad picture on soil texture and some derived soil properties at continental scale. It also shows the importance of generating and interpreting spatial resolution soil maps and emphasizes the need for harmonized methodologies at European and national level and can be considered a good basis for the development of similar actions at national level to promote soil protection and sustainable soil management. However, it should be emphasized that topsoil mapping may be in some cases insufficient for soil functioning assessment, as it could be strongly influenced by the behavior of soil subsurface layers.

Nevertheless, as recognized in a similar paper, regarding the organic carbon content in the topsoil, 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 the 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. Predicted values, as shown in the proposed maps, may lead to a country or region labeling and create conditions to take them as representative for the country, leading to oversimplified and misleading conclusions, hindering local factors responsible for spatial variability, which is inadequate for purposes at national level. For instance, the variability is discussed considering large regions such as Scandinavian countries and Baltic States, Mediterranean Basin or large mountainous systems, and including broad factors (e.g. European geological history). In conclusion, several factors influence the degree of accuracy needed in national mapping and a defined spatial resolution may not give rise problems in some countries but be inadequate in others, with a more diverse geological, pedological and/or climatic background.

Some general considerations regarding the methodological approach arise along with the paper content. Firstly, the sampling size (that is, volume) of each sample is not specified, neither is there indication of the coarse fraction considered. According to our experience, the 500 g composite sample (used for the analysis) does not represent the whole coarse fraction (e.g. fine, medium and coarse gravel, stones) content existing in the soil; that is, to obtain statistically accurate rock fragment content existing in field conditions, a larger amount of soil material is needed to be sieved and weighed. Such accuracy regarding coarse fragments is essential to express the coarse fractions in a volume basis, in order to obtain the right soil fine fraction, indispensable to obtain a volume basis for stock determinations.

Finally, we consider that a common approach with respect to harmonization of particle size classes within the fine soil fraction (<2 mm) should be developed in order to achieve the desired comparability. For instance, in Portugal the ISSS system is widely used, while in LUCAS the USDA system has been used.

The criteria supporting the different interval classes of soil texture, namely the contents regarding coarse fragments, clay, silt and sand fractions are not clear and apparently some of these interval classes are not useful for land management in our specific conditions. For example, what is the advantage of considering narrow intervals (e.g. 8-9% or 10-12%) for coarse fragment content, as compared to that of 25-76%? Similar consideration can be developed for the intervals regarding clay, silt and sand fractions. Such interval classes seem to be inadequate to reveal the wide variability occurring along the country, as in the case of silt and coarse fragments (from the second to the seventh class the variation interval is only of 1-2%). Limits or thresholds already used in global soil classification systems, or in land capability and suitability evaluation could have been used also in this mapping.

The information regarding soil texture within mainland Portugal suggests a doubtful mapping discrimination, possibly because the distribution of sampling points is not sufficiently representative of different landscape units or geologic units and respective landforms. Accordingly with Figure 10 of the paper, soil texture in Portugal is loam and sandy loam, which does not agree with the texture diversity of soil at our country's level (not reproduced in the figure).

Although textural classes may be generally stable in a long time span, it is doubtful that in our conditions bulk density could be mapped as a relative stable soil property. Furthermore, soil physical constitution and land cover strongly varies with land use and management practices and can show wide variations within a short time, needing to be monitored for soil quality assessment and ecosystem services. A mapping of bulk density as proposed by LUCAS may lead to a wrong perception on this crucial soil property, as it depends on several factors. That is, apparently usefulness to get the respective values derived from "packing density" and clay content. It should be highlighted the low values reported for some coastal areas, which do not agree with the existing coarse textured soils (e.g. Podzols, Arenosols).

Figure 11, shows that topsoil available water capacity (AWC) for Portugal mostly includes the classes <0.07, 0.07-0.08 and 0.08-0.09, which do not match with the wide soil textural diversity (coarse to fine) and therefore the wide soil AWC which has been determined at national level. We assume that AWC was assessed from sieved (< 2 mm) disturbed samples (which is an obsolete methodology) and not from undisturbed samples, thus not reflecting the actual situation. It should be emphasized that in coarse textured soils the AWC is mostly assessed by the difference between soil moisture content at -10 kPa and -1500 kPa. We suggest, in Figure 11, the use of only one class (0.07-0.10) for AWC instead of three classes (0.07-0.08, 0.08-0.09 and 0.09-0.10) since they are not justified.

We emphasize that “Western Iberia” (not named in the document) is a significant region in the European context, in terms of geological and landscape diversity that should merit a much better evaluation, both in terms of cartographical units and diagnosis criteria for the parameters considered in the document. In fact, the highest landscape diversity in EU was recorded for Member States such as Portugal, Slovenia, Austria and Luxembourg, which feature mountainous or hilly areas associated with a relatively high degree of variation in their land cover, and with a Shannon evenness index of more than 0.75 (in 2012), higher than the EU-27 average. In these countries, this index is higher than that reported for countries with large forest cover with relatively homogeneous landscapes and lower degrees of diversity (e.g., Estonia, Finland), or countries with low levels of landscape diversity (indices of less than 0.65) and land cover predominately corresponding to grassland, cropland or abandoned farmland (e.g. Ireland, Hungary, Romania, United Kingdom).

The Shannon evenness indices for NUTS 2 regions, as opposed to national averages, are shown in Map 1 covering 261 different regions across the EU-27 Member States. There were 12 regions where the Shannon evenness index was at least 0.80 in 2012 (as shown by the darkest shade in the map). They were spread across eight different EU Member States: the following section focuses on two of these — Portugal and Austria — providing an indication of the changing landscapes that may be encountered within particular regions. In:

http://ec.europa.eu/eurostat/statistics-explained/index.php/Land_cover_and_land_use_%28LUCAS%29_statistics

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The Technical-Scientific Panel of the Portuguese Soil Partnership