Measurement-based review of the land use/cover components of soil organic carbon estimates for Europe

D. de Brogniez (1,2), B. van Wesemael (2), R.J.A. Jones (3), R. Hiederer (1), O. Dewitte (4), G. Toth (1), and L. Montanarella (1)

(1) Joint Research Centre - European Commission, Institute for Environment and Sustainability, Ispra, Italy, (2) Georges Lemaître Centre for Earth and Climate Research, Earth and Life Institute, Université Catholique de Louvain, Place L. Pasteur 3, 1348 Louvain La Neuve, Belgium., (3) National Soil Resources Institute (NSRI), School of Applied Sciences, Cranfield University, MK43 0AL UK, (4) Ghent University, Department Geology and Soil Science, Ghent, Belgium

The decline of soil organic matter (SOM) was identified as one of the main soil threats in the European Union by the Thematic Strategy for Soil Protection adopted by the European Commission. In addition, the United Nations Framework Convention on Climate Change (UNFCCC) acknowledges the mitigation potential of soil organic carbon (SOC) and encourages its accounting in national greenhouse gas inventories. However, the lack of accurate and harmonised SOC data at European level has so far been an obstacle to producing reliable estimates at continental and regional scale.

The first attempt to calculate SOC contents at European level was made by Van Ranst et al. (1995), with the use of pedo-transfer rule (PTR) concept. The latter inferred SOC estimates from the relationship, identified through expert knowledge, of the scarce SOC data available at the time to soil type (classification, texture), land use and climatic variable (temperature). The above-mentioned PTR was revised by Jones et al. (2005) and applied to a 1km soil data set derived from the European Soil Database, CORINE land cover dataset, a digital elevation model and temperature data. The resulting SOC estimates available as a database were also presented as the first topsoil (0-30cm) organic carbon content map of Europe. The validation of the results, using measured OC data from sampling surveys on the ground in the UK and Italy, gave a coefficient of determination in excess of 0.9. However, the authors stressed the lack of geo-referenced and comprehensive SOC data at European scale and its probable effect on the applicability of their map at regional scale.

The Land Use/Land Cover Area Frame statistical Survey (LUCAS), launched in 2001, is a project that aims to estimate and monitor the changes in land use/cover at European Union (EU) level, based on the visual assessment of parameters relevant for agricultural policies. The survey uses a regular 2 x 2 km grid covering the EU-territory and is defined as the intersection of around 1 million geo-referenced points. Its methodology was tested in 2001 and 2003 and the first comprehensive dataset was obtained in 2006. In 2009, the LUCAS topsoil survey component was added to the general LUCAS exercise and implemented in 23 Member States of the European Union. About 21,000 soil samples were collected and analysed for basic soil properties, including particle size distribution, pH, organic carbon, carbonates, NPK, CEC and visible and near infrared diffuse reflectance. LUCAS-soil is the first harmonized survey conducted at EU level.

The present study aims at comparing the SOC values calculated by Jones et al. (2005), using expert knowledge-based PTR, against the SOC data collected during the LUCAS-soil 2009 ground survey. The comparison will be performed for the whole range of land use/cover types. Discrepancies in the modeled values will be interpreted taking land use/cover and soil properties components of SOC level determination into account. With the lessons learned from the current study improved, up-to-date, method for the calculation of organic carbon in the soils of Europe can be developed.

References
Jones, R.J.A., Hiederer, R., Rusco, E. & Montanarella, L. 2005. Estimating organic carbon in the soils of Europe for policy support. European Journal of Soil Science, 56, 655-671.
Van Ranst, E., Thomasson, A.J., Daroussin, J., Hollis, J.M., Jones, R.J.A. & Jamagne, M. 1995. Elaboration of an extended knowledge database to interpret the 1:1,000,000 EU Soil Map for environmental purposes. In: European Land Information Systems for Agro-Environmental Monitoring (eds D. King, R.J.A. Jones & A.J. Thomasson),