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Modeling soil organic carbon stocks and changes in Spain using the GEFSOC system

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Currently, there is little information about soil organic carbon (SOC) stocks in Spain. To date the effects of land-use and soil management on SOC stocks in Spain have been evaluated in experimental fields under certain soil and climate conditions. However, these field experiments do not account for the spatial variability in management, cropping systems and soil and climate characteristics that exist in the whole territory. More realistic approaches like ecosystem-level dynamic simulation systems linked to geographic information systems (GIS) allow better assessments of SOC stocks at a regional or national level. The Global Environmental Facility Soil Organic Carbon (GEFSOC) system was recently built for this purpose (Milne et al., 2007) and it incorporates three widely used models for estimating SOC dynamics: (a) the Century ecosystem model; (b) the RothC soil C decomposition model; and (c) the Intergovernmental Panel on Climate Change (IPCC) method for assessing soil C at regional scales. We modeled 9.5 Mha in northeast Spain using the GEFSOC system to predict SOC stocks and changes comprising: pasture, forest, cereal-fallow, cereal monoculture, orchards, rice, irrigated land and grapes and olives. The spatial distribution of the different land use categories and their change over time was obtained from the European Corine database and from Spanish census data on land use from 1926 to 2007. At the same time, current and historical management information was collected from different sources in order to have a fairly well picture of changes in land use and management for this area. Soil parameters needed by the system were obtained from the European soil map (1 km x 1 km) and climate data was produced by the Meteorology State Agency (Ministry of the Environment and Rural and Marine Environs of Spain). The SOC stocks simulated were validated with SOC values from the European SOC map and from other national studies. Modeled SOC results suggested that spatial-based approaches are crucial for quantify SOC stocks and changes in Spain.