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Assessment of soil organic carbon fluxes at the European scale

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European soils store around 73 to 79 Gt (billion tones) of carbon, which is about 50 times the total 2006 carbon emission in the European Union (1.5 billion tones; EEA, 2010). Soils are an important carbon stock: more than twice as much carbon is held in soils as compared to the storage in vegetation or the atmosphere. Soil organic carbon (SOC) stocks are dynamic and changes in land use, land management and climate all have significant impacts. Changes can result in rapid losses (i.e. instantly), whereas gains accumulate more slowly (i.e. over decades). Both the European Commission (EC) and the Intergovernmental Panel on Climate Change (IPCC) identify the decline of SOC worldwide as an environmental risk that undermines not only soil fertility and productivity and hence food security, but also the progressive stabilisation and subsequent reduction of atmospheric CO2 concentration levels. There are, however, large uncertainties in fluxes under different land uses.

The fluxes of organic carbon/matter to and from the soil across the EU are described and quantified for agriculture, forestry, pristine peatlands and the urban fabric using a coupled regional balance and soil organic matter model. Each of these land uses have an important influence on the organic matter production and loss per Member State. The production and loss of soil organic carbon is estimated using land use in combination with statistical data at several embedded layers of geographical detail: EU-27, Member States and NUTS2 administrative regions.

About 20% of the European soil organic carbon stock is located in peatlands. Carbon fluxes in peatlands were calculated using a gas balance and compared to estimates of organic carbon/matter production presented as humified organic carbon for agriculture, forestry and urban land uses. Despite the large regional differences, all peatlands will be turned to carbon sources in the coming two decades with carbon stock losses between 13 and 36%. It is necessary therefore to curb current land use conversion rates in order to safeguard the large carbon reserve of peatland soils.