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Evolution of soil organic carbon distribution with depth in agricultural soils between 1960 and 2006 in Flanders (Belgium).

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Spatial and temporal studies of soil organic carbon (SOC) are essential for a better understanding of CO2 fluxes between terrestrial ecosystems and the atmosphere and sustainable management of the soil in the light of global climate change. In most studies only topsoil is taken into consideration. However, it has been shown that important amounts of relatively stable soil organic carbon (SOC) are also stored at greater depth. In this study we aim to quantify changes in SOC content as a function of depth in agricultural soils in north Belgium between 1960 and 2006. Therefore, a model which describes the distribution of SOC with depth was constructed and applied to SOC data from 1960 (database 'Aardewerk') and recent data (2006). In this model the depth distribution of SOC remains constant until the tillage depth is reached. Deeper on, SOC shows an exponential decline with depth. Inherently, the model estimates the tillage depth. Despites the great measurement errors by depth increment, the predicted values were close to the mean values and the model uncertainty is rather small, indicating that the model describes the identified system well. This temporal analysis was conducted under different land use, texture and drainage conditions. Changes in SOC distribution with depth by time within the same land use - soil type combination help to identify the effect of land management practices on the SOC contents. The results suggest that intensified land management practices seriously affect the SOC status. The increase in plough depth and a change in crop rotation result in a significant decrease of carbon near the surface for dry silt loam cropland soils, i.e. 1.02 $\pm$ 0.23 kg C m-2 in the top 0.3 m. A significant decrease of SOC in wet to extremely wet grassland topsoils, ranging from 3.99 $\pm$ 2.57 to 2.04 $\pm$ 2.08 kg C m-2 for the top 1 m depending on soil type, is detected and reveals a negative influence of intensive soil drainage on SOC stock. On the other hand, a not so well pronounced increase of SOC stock could be observed under dry to moderately wet grasslands at greater depths, varying between 0.65 $\pm$ 1.39 and 2.59 $\pm$ 6.49 kg C m-2 in the top 1 m. This finding can be related to increased livestock densities in the region.