EGU21-4700, updated on 28 May 2022
https://doi.org/10.5194/egusphere-egu21-4700
EGU General Assembly 2021

A comparison of soil organic carbon concentration maps of Great Britain

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Soil organic carbon (SOC) is the largest reservoir of organic carbon in the terrestrial biosphere and is the main constituent of soil organic matter, which underpins key soil functions such as storage and filtration of water, and nutrient cycling. SOC concentrations are controlled by several dynamic variables, ranging from micro-scale properties like particle aggregation, to larger-scale drivers such as climate and land cover. Hence, soils are vulnerable to climate change and human disturbances, with implications for ecosystem services such as agriculture and global warming mitigation. Recent decades have seen greater efforts to monitor SOC dynamics, such as the UKCEH Countryside Survey, and to predict concentrations of SOC where we have no measurements, using geostatistics or machine learning approaches. Yet, there is still much to be understood about what controls spatial patterns of SOC, and how effectively different modelling approaches can capture this. Here, we compare predictions by nine maps of the spatial distribution of topsoil SOC in Great Britain. We found broad similarities in SOC concentrations predicted by all maps, which each showed right-skewed distributions with similar median values (43 to 97 g kg^{-1}). The greatest differences between maps occur at higher latitudes and are reflected in the upper ends of the SOC distributions. While the maps generally exhibit a sharp rise in SOC concentrations with increasing latitude from ~54^{o}N, values predicted by the ISRIC-2017 and FAO-GSOC maps show weaker increases with increasing latitude, and peak at lower values of 332 g kg^{-1} and 354 g kg^{-1}, respectively. We demonstrate that most of the maps, regardless of the modelling approach taken or the underlying data used, produced similar estimates of SOC concentration, including broad spatial patterns. This work will form the basis of more detailed future assessments of the sensitivity of SOC mapping to analytical methods versus the data used to drive these methods, and will be used to assess the importance of using stratified random field survey approaches for generating more accurate predictions of areas that cannot be sampled. Exploration of why and where different and coincident SOC predictions occur between maps should shed light on the utility of different modelling techniques and machine-learning meta-analyses of driving variables currently used to map SOC. Understanding how SOC predictions differ across all current national scale GB maps is a first step in improving modelling and assessment of SOC stock and change.