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The future of soil biochemistry and services in the UK under plausible climate, land use and land management scenarios

Dmitry Yumashev, Victoria Janes-Bassett, and **Jess Davies**

Pentland Centre for Sustainability in Business, Lancaster University, Lancaster, UK (d.yumashev@lancaster.ac.uk)

In this study, we explore plausible future states of soil organic matter, biomass, food production and soil greenhouse gas emissions across the UK under a range of climate, land use and land management scenarios. We use state-of-the-art soil biochemistry model, N14CP-Ag, combined with UKCP18 climate scenarios and ASSET land cover change and crop scenarios mapped onto a UK-wide grid with around 100,000 land parcels. Historic runs cover the period from the start of the Holocene interglacial (-12 kyr BP) to 2015; scenarios run from 2016 out to 2100. The results show variations of soil organic carbon (SOC) of around 10% between 2016 and 2100 relative to the simulated starting value of 1.4 Gton in 2015, with reductions of up to 7% under arable expansion scenarios and increases of up to 3% under grassland restoration scenarios. The effect of changing cropping patterns on UK-wide SOC is comparatively small. As climate scenarios move from lower to higher global emissions, the SOC reductions under arable expansion become more pronounced, while the SOC increases under grassland restoration diminish and eventually turn into losses. UK-wide crop yields show resilience to climate change and are maximised for the arable expansion scenario with protected sites of special scientific interest. Soil CO₂ and nitrogen emissions get progressively higher in warmer climates. The results of this study are expected to contribute to a future UK agricultural policy aimed at rewarding farmers for sustainable land management practices.