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Modelling potential soil carbon stocks across UK landscapes: Downscaling global models to the landscape scale using model emulation

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Global terrestrial carbon dynamics have witnessed significant changes over the last couple of centuries. This is mainly attributed to the historical changes in land use and the allied management systems in addition to the effect of climatological changes. Several biogeochemical models e.g., Dynamic Global Vegetation Models (DGVMs), have predicted the magnitude of undisturbed (equilibrium) carbon stocks at the global scale. However, the replication of DGVMs at the landscape scale requires the use of high resolution input datasets, including climatology, topography, biogeochemical data and data on the extent and magnitude of historical ecosystem disturbances, such as wildfires, land use/management decisions and levels of human induced atmospheric CO_2. Therefore, with the exception of climatological data and topography, the availability, resolution, accuracy and scale of the rest of the required dataset for running a DGVM to predict potential carbon stocks at the landscape level presents a major challenge because these datasets are not readily available at the appropriate time/space scale. This study overcomes this using model emulation based on neural network simulation of the relationship between the equilibrium terrestrial carbon responses of DGVMs at the global level and the driving climatology. The emulator is then used to simulate the potential carbon stocks at the landscape scale using high time/space resolution datasets for the UK.