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Simulating the effect of land use and climate change on upland soil carbon stock of Wales using ECOSSE

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Within Wales soils hold between 400-500 MtC, over half of this carbon is stored in organic and organo-mineral soil which cover less than 20% of the land area of Wales. It has been predicted that climate change will increasingly have an impact on the C stock of soils in Wales. Higher temperatures will increase the rate of decomposition of organic matter, leading to increased C losses. However increased net primary production (NPP), leading to increased inputs of organic matter, may offset this. Land use plays a major role in determining the level of soil C and the direction of change in status (soil as a source or sink). We present here an assessment of the effect of land use change and climate change on the upland soil carbon stock of Wales in 3 different catchments i.e. Migneint, Plynlimon and Pontbren using a process-based model of soil carbon and nitrogen dynamics, ECOSSE. The uncertainties introduced in the simulations by using only the data available at national scale are determined. The ECOSSE model (1,2) has been developed to simulate greenhouse gas emissions from both organic and mineral soils. ECOSSE was derived from RothC (3) and SUNDIAL (4,5) and predicts the impacts of changes in land use and climate on emissions and soil carbon stock. Simulated changes in soil C are dependent on the type of land use change, the soil type where the land use change is occurring, and the C content of soil under the initial and final land uses. At Migneint and Plynlimon, the major part of the losses occurs due to the conversion of semi-natural land to grassland. Reducing the land use change from semi-natural to grassland is the main measure needed to mitigate losses of soil C. At Pontbren, the model predicts a net gain in soil C with the predicted land use change, so there is no need to mitigate. Simulations of future changes in soil C to 2050 showed very small changes in soil C due to climate compared to changes due to land use change. At the selected catchments, changes in soil C due to the impacts of land use change were predicted to be up to 1000 times greater than the changes predicted due to climate change. This is encouraging, as it illustrates the great potential for C losses due to climate change to be mitigated by changing land use.

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