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Possible reasons for widespread losses of carbon from soils across England and Wales

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The National Soil Inventory (NSI) of England and Wales showed widespread losses of carbon from soils across both countries between 1978 and 2003, and the rate of loss increased linearly with the soil carbon content. Furthermore, this trend is strongest in arable soils and weakest in non-agricultural soils. The fact that the carbon losses occurred across all land uses and in all regions suggest a link to climate change and a possible feedback loop between soil carbon emissions and future climate change. Here we fit simple mathematical models to the data in order to quantify the magnitudes of the drivers required to explain the losses and use the results to test three alternative explanations: 1) the soil carbon content develops towards a steady state, which is mainly determined by the current land use, 2) there is a consistent change in the decomposition rate of soil carbon, caused by, for example, changes in climate, and 3) there is a change in carbon input to the soil.

All three models could be satisfactorily fitted to the data. The results show that the required changes in the decomposition rate are far too big to be explained by a direct temperature effect. Changes in soil moisture may explain part of the losses in soil carbon if increased evapotranspiration has turned some permanently anaerobic soils to aerobic conditions, but this effect is unlikely in well-drained arable soils, which show the strongest trend of carbon losses. The results also show that any changes in carbon input alone are not sufficient to give the observed magnitude of the changes in soil carbon. On the contrary, the steady state level of soil carbon appears to be strongly dependent on the land use type, and historical changes in land use remain the possible

main explanation for the observed changes in soil carbon.