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Changes in soil pH across England and Wales in response to decreased acid deposition

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In our recent analysis of data from the National Soil Inventory of England and Wales, we found widespread changes in soil pH across both countries between the two samplings of the Inventory. In general, soil pH increased – i.e. soils became less acid – under all land uses. The Inventory was first sampled in 1978-83 on a 5-km grid over the whole area. This yielded about 6,000 sites of which 5,662 could be sampled for soil. Roughly 40% of the sites were re-sampled at intervals from 12 to 25 years after the original sampling – in 1994/96 for agricultural land and in 2002/03 for non-agricultural. Exactly the same sampling and analytical protocols were used in the two samplings.

In arable soils, the increase in pH was right across the range, whereas in grassland soils the main increase was at the acid end of the scale (pH < 5.5) with a small increase above pH 7. Some part of the change is likely to have been due to changes in land management. This includes better targeting of agricultural lime on acid soils; changes in nitrogen fertilizer use; deeper ploughing bringing up more calcareous subsoil on soils on calcareous materials; and so forth. However a major driver appears to have been decreased acid deposition to land. The total amounts of nitrogen compounds deposited were relatively unchanged over the survey period, but the amounts of acidifying sulphur compounds decreased by approximately 50%.

We constructed a linear regression model to assess the relation between the rate of change in pH (normalised to an annual basis) and the rate of change in acid deposition, as modified by soil properties (pH, clay content, organic matter content), rainfall and past acid deposition. We used data on rainfall and acid deposition over the survey period on the same 5-km grid as the NSI data. We fitted the model separately for each land use category.

The results for arable land showed a significant effect of the change in rate of acid deposition, though a significant part of the increase in pH was not related to the change in acid deposition. At sites with a large historical acid deposition, the rate of change for a given change in deposition was greater than at those with smaller historical deposition; at sites with higher pH, the rate of change was less than at sites with lower pH; at sites with higher rainfall the rate of change was less than at sites with lower rainfall; soil clay content and carbon content did not affect the results. Similar results were obtained for grassland sites except that the average rainfall had no significant effect and the effect of change in acid deposition was only significant in interaction with the historical rate of deposition and the average pH at the site. It was difficult to determine significant effects in other land uses because of small sample sizes. The results have implications for rates of weathering of basic minerals in different soil types.