
Oribatiid mite from a soil sample.

Spotlight on SOILS

2015 is the International Year of Soils. It's not the most glamorous area of science, but it's vital to just about every aspect of our lives – as Janet Moxley and Nicole Archer explain.

To many people soil might not seem to offer much to celebrate. After all isn't it just a load of dirt? Or perhaps something that's important to farmers and gardeners, but not much use to anyone else. However, when you ask 'What have soils ever done for us?' the list gets quite long!

Perhaps the most obvious thing that soils do is allow plants to grow, but they also soak up rainwater, store carbon, filter out pollutants, hold up buildings, help regulate greenhouse gas emissions, protect archaeological remains and are home to a diverse community of animals. NERC scientists are helping us understand many of these functions.

Five factors control how soil forms: climate, topography, vegetation, time and the kind of rock that lies beneath. UK soils are relatively young – in geological terms, at least – because glaciers 10,000 years ago scraped away older soils, and new ones formed more recently from the underlying geological parent material.

The UK's rich geological diversity generates over 1,800 types of soil, each with its own different chemistry and layer pattern or 'profile'. Since the late 1960s scientists at the British Geological Survey (BGS) have measured the soil environment to understand the distribution and movement of chemical elements at the Earth's surface.

This has led to the development of G-Base, a database providing geochemical baseline data for the whole UK. It is used for applications such as mineral exploration, mapping environmental change, supporting policy and environmental regulators, and studies into possible environmental causes of human health and agricultural problems.

The UK's cool, damp climate means our soils are very good at storing carbon. Plant material takes a long time to decompose, so carbon from plants builds up in the soil. If soils lose this carbon again, it may be released into the atmosphere as carbon dioxide or methane – greenhouse gases that cause climate change. Peatlands, traditionally regarded as unproductive bogs, are particularly important carbon stores. Although they cover less than 3 per cent of the global land surface, they are thought to contain twice as much carbon as all the world's forests.

BGS staff have been improving our understanding of where these sensitive peat soils are, and how deep they go. They use both traditional field survey methods of mapping and measuring peat depths and new remote-sensing technologies to study the variations in soil across the landscape, which tell us whether peat is building up or being lost. Meanwhile colleagues at the Centre for Ecology & Hydrology (CEH) have been studying how peatlands respond to pressures such as climate change, drainage and pollution. This knowledge will let us manage these areas better to make sure the carbon stays in the soil, and where possible increase soil carbon stocks.

Carbon dioxide and methane are not the only greenhouse gases that can be released from soils. Nitrogen compounds that are naturally present in soils but are also added in fertilisers and manures can break down to give nitrous oxide, a very powerful greenhouse gas. Research at CEH has looked at how agricultural practices influence nitrous oxide emissions from soils in the UK and abroad.

Soil and water

As well as storing carbon and helping regulate climate, soil properties can also affect how rainwater flows into rivers. All soils consist of three components – solid, water and air. How water behaves within the soil influences run-off and flood risk. Clay soil, for example, can store more water than sandy soil. Wetting these clay soils can make them swell, while drying can lead to cracking. These changes can contribute to building subsidence and landslides.

Scientists at BGS and CEH are working to find out more about how soil and water interact so we can develop better models to assess the risk of flooding, landslides and subsidence; this information helps BGS to maintain the National Landslide Database. This is mainly used by local authorities, companies and private landowners to assess landslide risks for road construction, town planning, building regulation and land-use management.

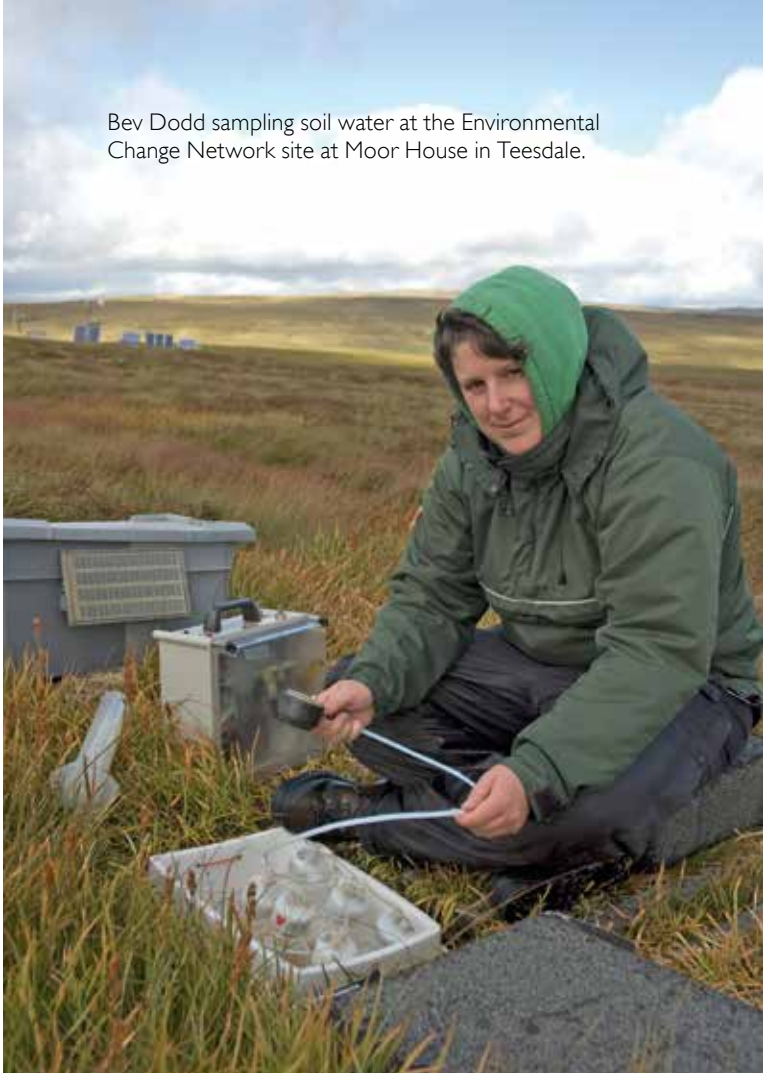
Plant roots are also part of the soil system, and can create pathways that transport water to deeper soil layers. Vegetation (particularly trees) helps water to soak into the ground and decreases water run off along the surface. This stops rainwater reaching rivers too quickly, making flooding less likely.

BGS scientists have measured how water moves through soils in forests more than a century old, and have found that they have the highest infiltration rates regardless of soil type and absorb heavy rainfall, whereas heavily grazed clay soils have low infiltration rates so heavy rainfall flows over the land surface rather than seeping into the soil. This can cause hotspots for flooding.

At CEH, meanwhile, scientists have found that when peaty soils dry out in summer droughts they become difficult to rewet as the soil particles become water repellent. This could increase flood risk if climate change means there are longer dry spells followed by heavy downpours. Preventing peaty soils from drying out during droughts by blocking drains and encouraging the growth of water-retaining plants such as sphagnum moss could help reduce this risk.

Soils are home to a huge range of animals, fungi and bacteria – everything from moles and earthworms to microbes. Just a teaspoon of healthy soil contains more living organisms than there are people on the planet. Identifying all of them with a microscope would take far too long, but fortunately sophisticated DNA fingerprinting techniques being used at CEH are giving us a better understanding of soil organisms than ever before.

Autochambers to measure gas exchanges from peatland at Auchencorth, Midlothian.



Bev Dodd sampling soil water at the Environmental Change Network site at Moor House in Teesdale.

CEH carries out the UK Countryside Survey roughly once a decade. Scientists visit over 600 sites across Great Britain to assess vegetation cover and take soil samples. Countryside Survey data show how soil properties, including carbon and nitrogen stocks, concentrations of metals, and soil animals, are changing over time.

Information on NERC-supported work on soils has recently been gathered together on the UK Soils Observatory website at www.ukso.org. This includes maps showing soil characteristics, information on the network of soil monitoring sites and mobile phone apps to find out more about the soils around you. The My Soil app developed by CEH and BGS gives you access to a comprehensive soil properties map, as well as allowing you to upload information to improve future mapping.

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UK Soils Observatory: www.ukso.org