Britain's landscape is a treasured resource in its own right, but also a dynamic system responding to environmental change. **Michael Ellis** and the **Landscape Group*** describe the importance of monitoring this system, both to understand its history and to forecast what lies ahead.

Unravelling the past, modelling the future

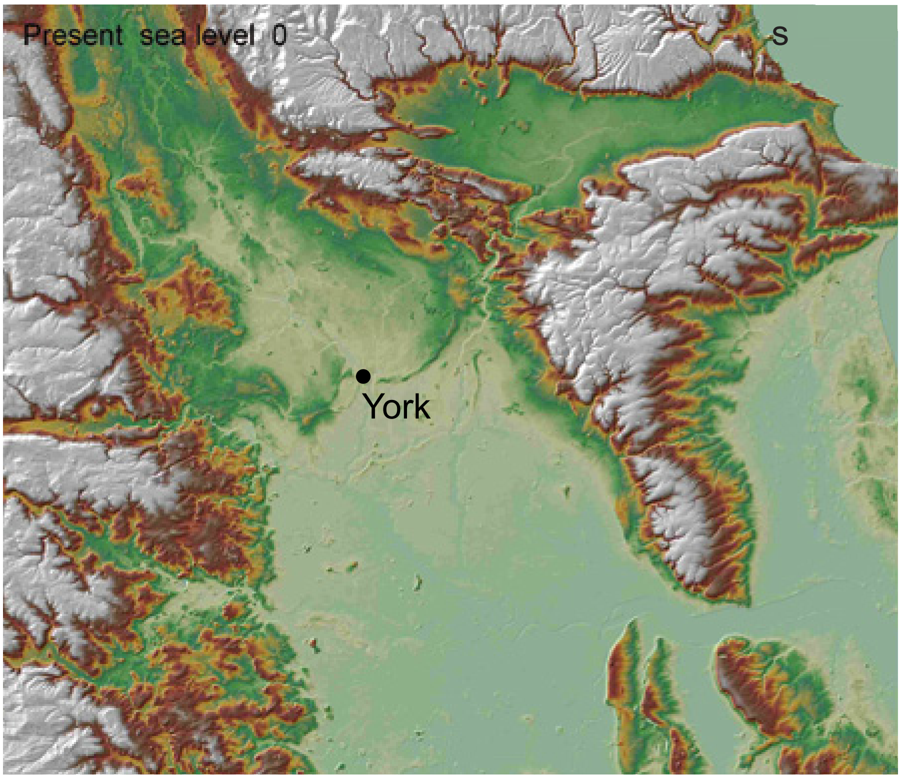
Britain's landscape provides our recreational space, has inspired poets and artists, and has taken up countless hours of BBC TV airtime. It has absorbed the blood of hundreds of battles over thousands of years. It conceals the treasures of our multicultural origins and the spoils of the Industrial Revolution. Now it must support a population of slightly more than 61 million people. For all its long history of human occupation, geologically speaking it is a young landscape, sculpted by the waxing and waning of multiple ice ages and changing sea levels over the past two million years. The last extensive ice cover receded almost 20 000 years ago, leaving in its wake a landscape further sculpted by rising sea levels, deforestation, and the inexorable propagation of urban environments. The pristine and manicured landscape — the British countryside — that we cherish today is a far more dynamic environment than we might at first realise.

Our scientists have contributed to the unravelling of the story of Britain's landscape. The history of Britain's last ice sheet has been rewritten through increasingly precise methods of absolute dating. Features of the glacial landscape can now be dated through the measurements of cosmogenic radionuclides, formed by the bombardment of cosmic rays on quartz-rich rocks and sediments. And where absolute dates are not available, we can unravel the intermittent action of glaciers by interpreting the unique landforms they generate through erosion and deposition. Glacial meltwaters eroded and redeposited large swaths of sediment and left undulating plains overwritten by a unique lexicon of landforms: long thin and undulating ridges of sediment (eskers), vast expanses of sand and gravel, cobbles and boulders (till and outwash), and small tear-drop shaped hills (drumlins).

In the wake of receding ice and mediated by our almost uniquely variable geology, Britain's landscape was significantly

Erosion along the Norfolk coast at Happisburgh.

* In alphabetical order: Peter Balson, Vanessa Banks, Tom Bradwell, Jonathon Chambers, Tony Cooper, David Gunn, Anna Harrison, Peter Hobbs, Chris Jackson, Jon Lee, Richard Ogilvy, Barry Rawlins, John Rees, Andy Tye, Chris Vane, Paul Wilkinson.



Topography of the Vale of York and surrounding region (S = Scarborough), showing the delicate legacy of ice-sheet erosion and deposition on the Yorkshire landscape.

modified by a complicated and constantly varying pattern of sea-level rise and isostatic readjustment. Isostatic readjustment is the vertical motion of the landscape surface in response to unloading of the ice cover. Some of this readjustment is elastic and so occurs immediately. But the underlying crust and upper mantle of the Earth also have a long-term response related to their viscous material properties, and this response continues to the present day, often at a rate that is comparable to the rate of sea-level rise. Much of the topographical relief in Britain's landscape is generated by rivers that attempt to erode to a once lower sea-level. The power to erode waxes and wanes as sea levels fall and rise, respectively, all the time mediated by the prevailing climate. As sea levels rose over the past 10 000 years (but especially between 10 000 and 6000 years ago), valleys were drowned and estuaries filled up, not with detritus from inland but largely from offshore materials. Coastlines owe their modern form and rate of renewal to this time of rapid environmental change. In turn, the rate of coastline change has dictated the evolution of Britain's inland landscape.

The rate of change of Britain's modern landscape is the sum of a continuing response to environmental changes over the past 20 000 years and to the increasing role of a burgeoning population and its concomitant need for resources. The consequences of these changes will inevitably modify the rate and impact of natural hazards, including flooding, landslides, the transport of pollutants, and the modification of riverine ecosystems. We now add to this mix the impact of inevitable climate change, likely to be more rapid than most in Earth's history, and our dynamic environment is potentially highly vulnerable.

There is, therefore, a critical need to quantitatively assess the sensitivity of landscapes to changes in external forcing. The BGS's prescient experience in monitoring environmental change (across the spectrum of surface and subsurface processes) is now paying unique dividends to the next step: the development of dynamic predictive models designed to assess the likelihood and magnitude of future changes. The value of long-term monitoring cannot be understated in the context of providing initial conditions to dynamic models of environmental sensitivity. And the value of developing dynamic models of environmental sensitivity is paramount in the face of population increase, resource depletion, and climate change.

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BGS scientists sampling quartz-rich glacially striated rocks for cosmogenic radionuclide analysis.