

Houses cracking or collapsing into holes, falling over eroding cliffs or being buried in debris; **Anthony Cooper** shows how BGS geohazard data can make us better prepared for a changing climate of more frequent extreme rainfall events and sea-level change that will increase the risk of these hazards.

Mapping UK hazards

The BGS has a 175-year history of mapping and recording geology including unstable land. However, public awareness of such potential problems was not awakened until the Aberfan disaster, 44 years ago, when a school was buried by a landslide from a coal spoil tip killing 144 people, including 116 children. Since that event BGS research into landslides and unstable land has increased and new techniques have been developed to measure, monitor and model them.



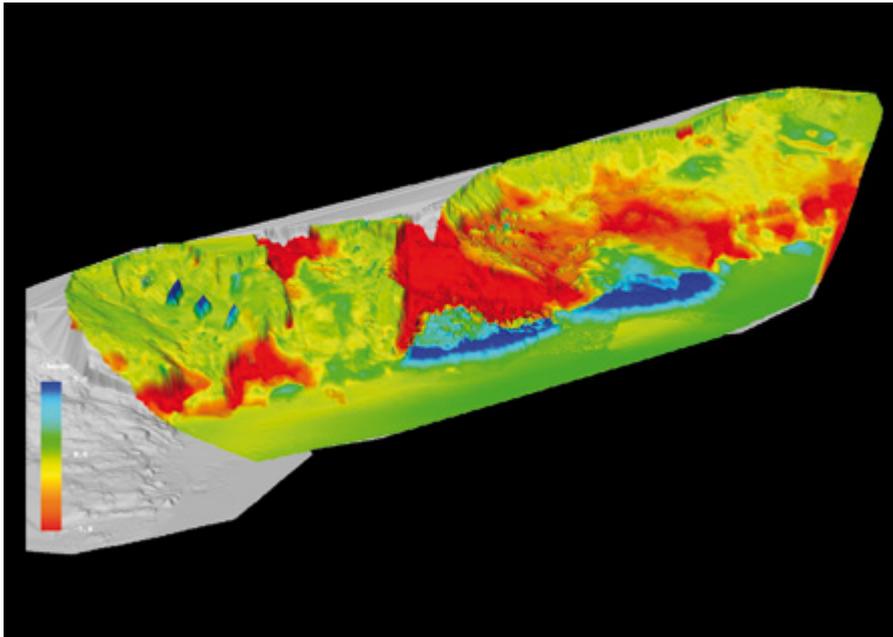
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Rock fall at Pennington Point, south-east Devon coast. This coast is well-known for its sequence of Triassic, Jurassic and Cretaceous rocks but also for its many large-scale landslides.

In most years heavy rainfall events trigger landslides which commonly affect roads and buildings. Data collection and research into landslides feeds into the BGS National Landslides Database. When an event occurs, the Landslides Response Team are available around the clock to map, monitor and advise on active landslide failures. They use BGS•SIGMA mobile tablet computers with built in GPS and a dedicated interface for landslide recording that allows direct upload of the digital data.

Laser scanning techniques now allow landslide research scientists to record the precise shape of landslides. When the scans are applied sequentially (on a six-monthly to annual basis), they allow the moved volumes of material to be measured and assessed, and the modelling of how the movement has occurred. Inland, this type of monitoring shows the downslope movement of the landslide. Applied on the coast, the sequential laser scanning technique quantifies coastal erosion and the associated landslide events. Understanding coastal landsliding and the interaction with coastal processes, will help our understanding of how rising sea-level change will affect coastal erosion.

Using a combination of scientific techniques, live monitoring of a landslide is now being undertaken at a site in Yorkshire. Geomorphological mapping and laser scanning surveys are being carried out in conjunction with geophysics. Arrays of electrical resistivity



Lidar-scanned change model over one year for landslides developed at Sidestrund, Norfolk; blue material gained (lobes), red material lost (slides).

Scanning a coastal landslide with a laser scanner to monitor landslide movement and coastal erosion.

and downhole movement sensors buried in the ground are relaying live information using wireless telemetry to the monitoring office (the BGS ALERT system).

As the climate changes, we can expect hotter, drier summers and warmer, wetter winters. Consequently some deposits, such as clays that are prone to shrinking and swelling, will change volume according to their moisture content. These volume changes can be enhanced by tree growth removing water from the ground or man-made disturbances causing a change to the drainage system. The results are that older properties (without special foundations) built on deposits such as the London Clay Formation can suffer large amounts of movement and damage. Laboratory tests and modelling of the results, along with information gathered for the Geotechnical Database combined with geological map information, allow the areas prone to such movements to be identified as an aid to construction and mitigation.

Soluble rocks in the UK, which include limestone, chalk, dolomite, gypsum and salt, also pose a problem. These rocks dissolve underground and extreme rainfall may cause the collapse of overlying material into cave systems and underground cavities. This situation can

be aggravated by inappropriate drainage, pipe leakage, pumping groundwater for drinking or for ground source heat pumps. BGS karst research and the database that details these collapses inform the modelling of the soluble rock problems.

With our knowledge, and databases allied with geological map information, we can now identify the areas susceptible to geological hazards. Our challenge for the future is to fully understand how climate change and pressures on the environment will affect the various hazards and help to mitigate the effects.

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Distribution landslides across Great Britain in the National Landslide Database.

