Using geological data to answer environmental questions

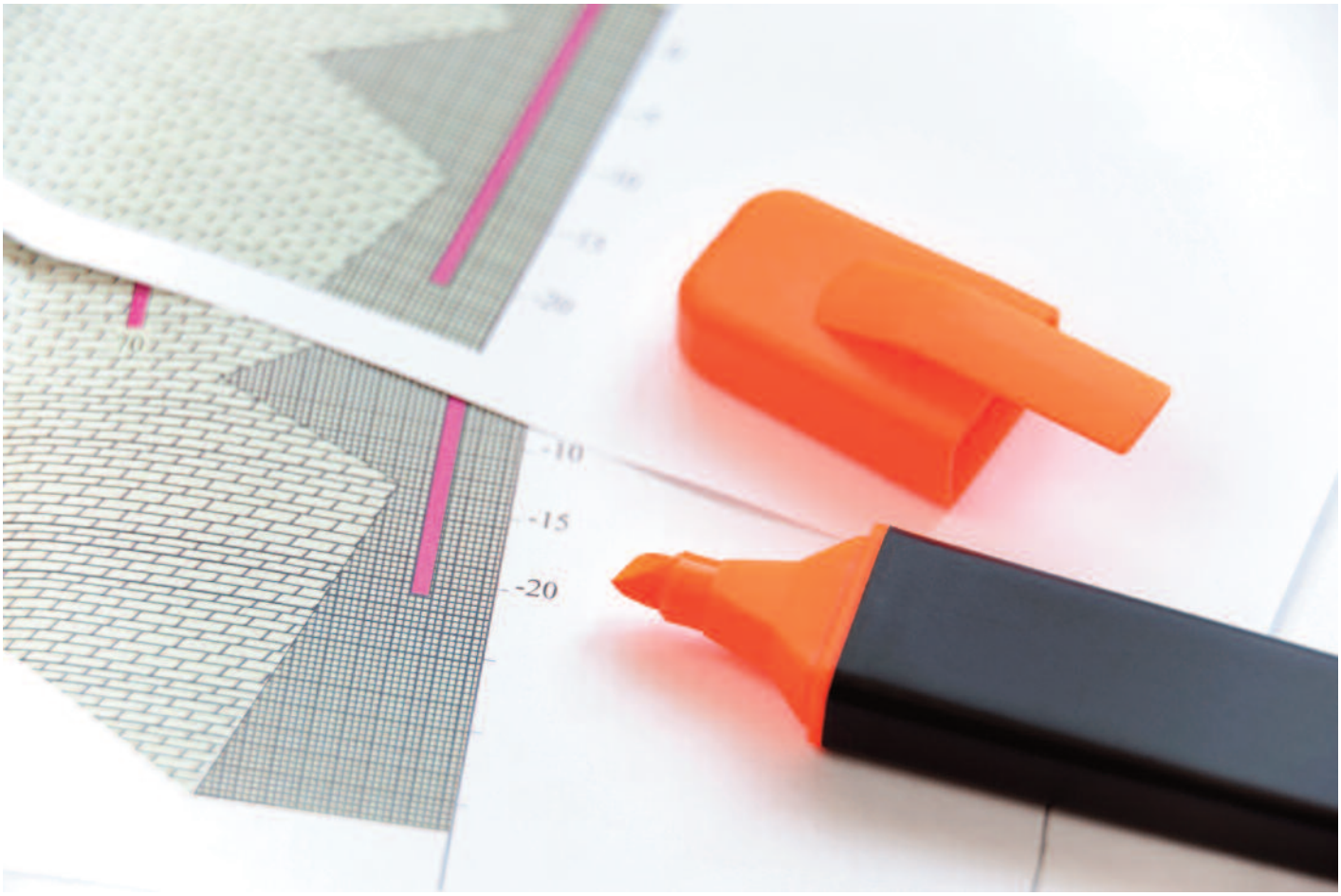
Kate Royse Director for Environmental Modelling at the British Geological Survey details how the types of geological data are changing in response to policy makers needing to answer ever more complex environmental questions...

Policy and decision makers today need geoscientists to answer what appear on the surface to be simple questions. Will we have enough drinking water in 50 to 100 years' time? How will changes in climate affect the frequency and magnitude of landslides? How vulnerable are our coastal communities? How resilient is our critical infrastructure from natural disasters? The geoscience community are finding that, in order to answer these 'what if' questions, we need to be able to improve our predictive modelling capabilities and work in partnership with many organisations in order to understand how the atmosphere, surface and subsurface behave under changing conditions. Put simply the environment is just too complex for us to reason through the needs of policy without models and data.

What does that mean in terms of the types of data and geospatial information that the British Geological Survey will be collecting in the future? In essence the Survey is going to be moving from concentrating on the solid subsurface to monitoring processes below the ground in real time (such as understanding how water moves through rocks). This will necessitate not just the instrumentation of subsurface boreholes but also the use of satellite measurements and real-time monitoring of natural hazards. The drive for this monitoring is to enable us to model, predict and mitigate the impacts of environmental change. To do this effectively we will need to look at novel ways to visualise and communicate our data to non-specialist users and combine our geological data with data from other sectors. Making use of mobile platforms and open data will provide us with many opportunities to achieve this, as well as some significant challenges.

We are going to see a huge increase in the amount of data that we will need to ingest and process. Big data will soon be the norm in the geoscience community as it is in the atmospheric sciences; the key challenge will be to be able to improve how we capture, ingest and model this data so that we are not drowned in a data deluge. Crucial to this will be the development of new technologies and architectures designed to extract value from large volumes of disparate data by enabling high velocity capture, discovery and or analysis. Currently the vast majority of data being generated is unstructured which means that more often than not we know very little about the data we are capturing unless it is somehow characterised or tagged. Metadata is not a new concept within the data information community but it is something that will need to become more prevalent if we are to make data useful i.e. 'smart'. Therefore the capacity for big data to change how we do research will be down to our ability to make data smarter.

Data based policy making has necessitated the need for decision makers to be able to argue their case to a much more data orientated public. To unleash the full impact of geoscience data to this community we not only need to model data, we also need to improve how we visualise data. Current advances in data interoperability are resulting in improvements in visualising time series, point cloud and satellite data are all essential for better modelling and manipulation of large-scale environmental datasets. 4D visualisations in real time will allow us to harness the potential of geospatial data to become much more predictive, improving our forecasting and scenario planning. Within the geoscience community the visualisation of geospatial data has so far been flat; in 2 dimensions, this is all about to change with a push to build whole earth models i.e. to integrate the subsurface with the surface.



We are already seeing a growing interest to include subsurface data within BIM systems and integrating subsurface and surface infrastructure within smart cities. In the next 5 years the ability of technology to visualise seamlessly the flow of geospatial data and information from the surface to the subsurface will open up possibilities for managing the life cycle of buildings and infrastructure, as well as monitoring and responding to the effects of environmental change and natural hazards within a virtual environment. This will enable scientists to engage more effectively with policy makers, responders and the general public, to provide effective and intelligent solutions to a wide range of problems and challenges.

The British Geological Survey will in the next 5 years, through the application of multi-disciplinary knowledge, instrumenting the earth and the development of integrated environmental models, be able to not only explain and explore but also predict the Earth's response to natural and human induced environmental change. By combining data, models and visualisation techniques in an integrated, flexible and reusable manner we will improve our understanding of how geological processes act in real time. We will use this to develop decision support systems and products that will better inform policy decisions and communicate environmental problems and solutions to society at large. ■

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