New Data Product Release from British Geological Survey

A Picture is Worth a Thousand Words, or a Thousand Hexagons

Data visualisation offers the opportunity to make huge amounts of complex data accessible and understandable – communicating patterns, succinctly and effectively, leveraging meaning behind data for the purpose of decision support, blending science and art.

The British Geological Survey (BGS) recently undertook a project to evaluate and explore the visual communication techniques for scientific data; hexagon grids proved to be one of the most popular results from this exercise.

The study focussed on delivering a set of easy to interpret, generalised outputs which would enable a broad audience to grasp scientific concepts. We explored seven of the current geohazard resources (see box out).

The resulting hexagon grids provide a visually striking yet simple mechanism, populated with a pared down version of existing complex geological data.

Why do Geohazards Matter?

Increasing demands on land use means that space is restricted not only by current infrastructure (e.g. buildings, pipes, cables, tunnels, foundations), but also by the natural geological hazards that co-exist.

There are also impacts on society, for example, geohazards such as landslides and mining related subsidence may result in loss of life, injury, significant financial loss or environmental damage.

Why use Hexagon Grids?

The geometry of a hexagon grid is simple, elegant and delivers an aesthetically pleasing output. Unlike the more familiar square grid scaling, grid orientation (horizontal [point up] or vertical [flat side up]) and cell referencing are not so clear cut. Hexagons provide a framework which delivers an understandable, comparable, visual interpretation.

How to Convert Existing Vector Data

A set of empty hexagon grids were generated using a 1km side length, a key criteria to make them scalable. Each geohazard dataset was translated from five hazard classes to three (low, medium or high) to simplify the output.

Statistical data was generated for each cell using dominant coverage (landslides, running sand and compressible ground) or worst-case score (for shrink swell, soluble rocks, collapsible deposits). These calculated values were transferred to the hexagon grid.

Different techniques were used based on the spatial size and distribution of the hazards to ensure that the representation was suitable.

For datasets with a wider spatial distribution a second processing stage was undertaken to populate a 5km hex grid using the dominant coverage for each hazard.

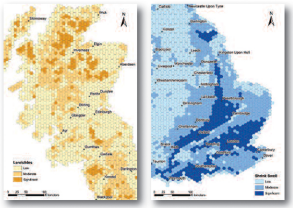
Each hazard was categorised in the following manner:

- Low: localised, small-scale mining may have occurred in the area.
- Moderate: small scale, underground mining may have occurred in the area.
- Significant: underground mining is known or considered likely to have occurred in the area.

Challenges using Hexagon Grids
Defining size parameters, hexagons can be scaled using area or side length. Using area produces a logical scale factor, however, side length maintains the visual impact between scales.

Summarising via spatial statistics may lead to over, or under, estimation of the extent of the hazard. Small features may disappear completely, this issue was highlighted when processing the mining hazard data.

Conversion to a hexagon grid generalises the data altering perception of the spatial distribution. Results of any analysis and subsequent interpretation should be viewed with care. Comparison with the underlying source data will reveal variations due to the generalisation process applied.



Left: Landslide susceptibility – showing a spatial distribution of a sporadic nature more prevalent in upland areas.

Right: Shrink Swell susceptibility – showing a more definite spatial distribution, directly linked to the underlying geology.

Do Hexagon Grids Promote the Creative Exploration of Data?

Geohazards are intrinsically linked to the underlying geology. A detailed understanding of the geological properties, associations between lithologies and their processes, is critical to identifying areas at potential risk. Varying levels of susceptibility occurs according to geological and morphological parameters.

The hex grids have been used as a method to clearly portray this information in an easy-to-use format. The outputs have been used to raise awareness of the potential hazards present across Great Britain.

Opportunity exists to combine the hexagon grids with other information (e.g. population to provide further valuable insight into potential risk). By exploiting this type of data, users can quickly create an overview of potential risk, according to asset or region, and identify areas on which to focus more detailed analyses.

Can Hex Grids be used to Visually Communicate Scientific Data?

Hexagons provide a good method to display data at a national or regional scale. In terms of GIS data for analysis, they lack the detail for useful analysis for resolutions greater than regional scale. However, generic, overview statistics or analysis can be carried out.

The regional impact overview that the hex grid provides can feed into national planning budgets, helping to identify where more detailed data analysis for hazard mitigation, preparation, etc., can be budgeted.

These Hex grids essentially draw a user's attention to where geohazards should be considered, suggesting that a picture is indeed worth a thousand words. We did this work in ArcGIS 10.3 to generate the Hexagon dataset.

The data can be found on the BGS website. Direct links are found here from GeoSure Hex (*www.bgs.ac.uk/products/geoSure/geoSureHex.html*) and Mining Hex (*www.bgs.ac.uk/products/geohazards/miningHazard/miningHazardHex.html*).

By Clive Cartwright, British Geological Survey

What are Geohazards?

Properties of Earth materials are important for all engineering projects and the classification of ground stability hazards.

Landslides (slope stability): Slope instability occurs when particular slope characteristics (such as geology, gradient, sources of water, drainage, or the actions of people) combine to make the slope unstable.

Shrink Swell potential: Swelling clays can change volume due to variation in moisture, this can cause ground movement, particularly in the upper two metres of the ground that may affect many foundations.

Soluble rocks (dissolution): Ground dissolution occurs when certain types of rocks, containing layers of soluble material, get wet and the soluble material dissolves. This can cause underground cavities to develop, leading to surface collapse.

Compressible ground: Some types of ground may contain layers of very soft materials like peat or some clays. These may compress if loaded by overlying structures or if the groundwater level changes.

Collapsible deposits: Some kinds of rocks and soils may collapse when a load (such as a building or road traffic) is placed on them, especially when they become saturated.

Running sand: Some rocks can contain loosely packed sandy layers that can become fluidised by water flowing through them. Such sands can 'run', potentially removing support from overlying buildings and causing damage.

Mining hazard: Provides essential information for planners and developers building in areas of former shallow underground mine workings.

Visit the BCS website at www.cartography.org.uk