

Members of the BGS Landslide Response Team undergoing BGS•SIGMAmobile training



Digital Field System for Landslides Research

An insight from the latest British Geological Survey (BGS) product development.

BGS•SIGMAmobile is a system that is used internationally, both as a stand-alone tool and also as part of fully implemented digital workflows that are revolutionising the way geoscientists collect and manipulate field data.

BGS•SIGMAmobile was developed by BGS to run on ruggedised Tablet PCs/laptops using code that heavily customises ESRI ArcGIS®, MS Access, and InfiNotes™. The result is an integrated field mapping system that provides a considered balance of graphical map interface tools, structured input using drop-down menus, free text and sketches. Built-in GPS aids location, while comments, symbolised points, lines and polygons can be drawn on the map face with ease. The depth of information traditionally recorded in a field notebook is collected in a relational database accessed by modular forms. Ancillary data such as digital photographs can be added in the field and sketched over or annotated as required.

Additional tools enable data to be manipulated on-the-fly. For example, structure contours can be quickly and easily produced in the field using a combination of dip/strike measurements and a DEM. This helps geoscientists to rapidly build a 3D model of the geology from rock outcrops and is integral to the map-making process.

The field system is free to download (www.bgs.ac.uk/research/technologies_epo.html), however other components of the workflow that enable visualisation, interpretation, modelling, map production and transfer to corporate databases were developed specifically to link to BGS bespoke systems, therefore they are not included in the free download. The integrated digital mapping workflow (SIGMA ~ System for Integrated Geoscience Mapping) won the ESRI GIS Excellence Award for Innovation in 2007 and BGS•SIGMAmobile was 'Highly Commended' in the same category by the AGI in the same year.

Each member of BGS field staff receives two days of training in the use of BGS•SIGMAmobile. The first day is spent in the office learning how to use the hardware and the software interface. The majority of the second day is spent in the field practising how to use the system (Figure 1). At the end of the second day the trainees are guided through the process of downloading and manipulating the field data they collected.

BGS•SIGMAmobile for landslides research

Whilst originally designed as a tool for standard geological mapping, other geoscientists are now taking full advantage. One such group of specialists, comprising geologists, geomorphologists and engineering geologists, is the BGS Landslides Team (www.bgs.ac.uk/landslides). To enhance their research in the field, these scientists routinely use BGS•SIGMAmobile (Figure 2) which has replaced the traditional paper *pro forma* in their workflow now that bespoke digital landslide forms have been incorporated into the system. Data is collected in the field to update the BGS Digital Geological Map of Great Britain and the BGS National Landslide Database (www.bgs.ac.uk/landslides/NLD.html). As well as regional studies where previously unknown landslides are mapped, the Landslides Team responds to new events in order to collect data and subsequently provide local advice.

For regional studies, BGS has a wealth of techniques that are used to investigate and map landslides. Prior to fieldwork, a desk-based interpretation is made using visualisation and photogrammetric software that enables a range of resources to be interrogated. These include geological and topographic maps (both historic and modern), airborne/satellite Earth Observation imagery and elevation models. BGS•SIGMAmobile enables the full range of raster and vector data to be taken into the field where the desk-based interpretations are validated and new data collected.

An example of application

When a new landslide occurs, the BGS Landslide Response Team needs to make best use of time. Printing maps and aerial photos of the area takes time that is avoided by using a dedicated Tablet PC that is ready with national maps and data. An example of where BGS•SIGMAmobile has been used was during the response to the 2007 and 2009 Rest and Be Thankful Debris Flow.

The Rest and Be Thankful pass on the A83 in Scotland is the main trunk route linking Glasgow to villages in southern Argyll. After a sustained period of heavy rain, a debris flow landslide occurred on the 28th October 2007, blocking the road for two weeks and causing a 55-mile detour. The Landslide Response Team visited the site and used BGS•SIGMAmobile to create a new map of the landslide and to collect field data about the event (Figure 3). Then on 8th September 2009, a second debris flow occurred in the same place, this time blocking the road for two days. Data, observations and photographic records collected in the 2007 survey (as well as other data including geological maps, DEMs, aerial photographs and topographic maps) were taken out in the field on BGS•SIGMAmobile which enabled the Landslide Response Teams to quickly see how the instability of the slope had changed. For more information on this landslide, see www.bgs.ac.uk/landslides/RABT_2009.html.

BGS Staff collecting digital field data at the Rest and Be Thankful landslide



The Rest and Be Thankful landslide investigations demonstrate how BGS•SIGMAmobile facilitated the field survey. This landslide took place on a very steep (33°) and exposed slope which, in bad weather, would have been extremely difficult to investigate using numerous paper maps, *pro formas* and handheld GPS. Having the data compiled in GIS format on a ruggedised Tablet PC is a clear advantage.

System highlights

The efficiency gains for the Landslide Response Team are evident both in the office and in the field. While BGS•SIGMAmobile can be used in isolation, BGS has a full digital workflow that makes best use of the digital field system. Prior to departure for the landslide, rapid mobilisation is achieved using routines that compile diverse data from corporate servers. In the field, integrated GPS significantly aids navigation, while capture of field observations is enabled via forms that were specifically designed with input from the field specialists. A combination of dropdown lists, free text and automatically-completed fields ensure systematic and comprehensive recording, and guarantee that mandatory data are not forgotten. On return to the office, the new data are automatically transferred directly to the National Landslide Database with additional automatic QA also applied at this stage of the process. This rapid transfer enables the data to be manipulated immediately for 3D modelling, visualisation and photogrammetry.

The transition to a new working practice can be difficult. The challenge that the BGS•SIGMAmobile development team set themselves was to produce a system that is fit-for-purpose, and eventually favoured over pen and paper. Involving the landslides experts from the very beginning, and especially in the testing stages, has ensured that their needs have been met and often exceeded.

BGS•SIGMAmobile is available at no cost from www.bgs.ac.uk/research/technologies_epo.html, and over 740 licenses have been downloaded globally to date. The second release (November 2010) saw major improvements including the upgrade to ArcGIS 9.3.1. Furthermore, the software size is smaller, it is easier to install, there is a new fully-attributed line-drawing tool, and we have added the

ability to produce MSWord reports from the data collected. The free releases are intended to encourage shared development of an integrated geoscience field data collection tool, therefore users must agree to send any upgrades or modifications to BGS for inclusion in future releases where appropriate.

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For further information on BGS and items in this article, please contact enquiries@bgs.ac.uk.

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