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The central role of digital landscapes in virtual field reconnaissance for geological surveying

J.R. Ford, B. Napier, P.R. Wilby, A.H. Cooper, A.J.M. Barron, and L.B. Bateson
British Geological Survey, Geology and Landscape, Nottingham, United Kingdom (jford@bgs.ac.uk)

'Landscape literacy', or the ability to interpret features on the ground surface in terms of their origin and underlying composition is an essential skill in geological surveying. Map and 3D conceptual geological model production at the British Geological Survey (BGS) relies on this skill to characterise the impact, interaction and legacy of geological, geomorphological and anthropogenic processes. Central to the BGS strategy for geological mapping is the concept of 'virtual field reconnaissance': the application of high resolution digital elevation models (DEMs) to create an enhanced digital landscape in which conventional 'literacy' skills can be used.

Field-based observation of the landscape is often restricted to 'line of sight' and limited by inaccessible terrain or logistical constraints. Hence, direct observation is often complemented by the interpretation of remotely-sensed data, including DEMs. Conventional remote-sensing techniques offer many benefits; however conventional techniques can present geologists with particular challenges, including fixed and unfamiliar (i.e. vertical) perspectives, and the need to learn complex software.

The recent deployment of intuitive 3D landscape visualisation software at the British Geological Survey (BGS) is providing geologists with unprecedented access to DEMs and interaction with a range of spatial data. Based on 3D gaming technology and developed by Virtalis and BGS, GeoVisionary recreates the landscape in a context-rich environment that can be observed and interpreted from any perspective. Freedom of movement, rapid streaming of full-resolution DEMs, real-time adjustments to scene illumination and vertical scaling allow the user to optimise the scene as they digitise their interpretation directly onto the landscape. The integration of diverse surface and subsurface data provides the basis for consistent and confident interpretations.

Case studies from recent geological surveys demonstrate the effectiveness of virtual field reconnaissance using GeoVisionary. The North York Moors is one of the UK's largest moorland areas, its landscape and geology reflect a history of bedrock processes, glaciations, landslides and mining. Revision geological mapping was necessary to provide improved support for geological hazard assessment and natural resource management. GeoVisionary was used to appraise existing 19th Century geological mapping in the context of the digital landscape. This approach highlighted geometric inconsistencies and exceptions to the modern conceptual geological model, including significant deviations between landscape features and geological boundaries, extensive landslides and areas of mining disturbance. Anomalies were either re-interpreted in GeoVisionary or prioritised for ground-truthing. Fieldwork using tablet PCs allowed the GeoVisionary linework to be integrated with direct observations. This approach resulted in significant efficiency gains, the identification of previously unrecognised detail, and a greater certainty in the new interpretation.

This approach has been applied in a range of terrains and to a variety of DEMs, including concealed surfaces such as the modelled boundary between geological strata. Landscape literacy applied to subsurface analysis is providing a unique insight into the geometry of the Earth, allowing the interpretation of structural elements such as faults, folds, and palaegeographic reconstruction.