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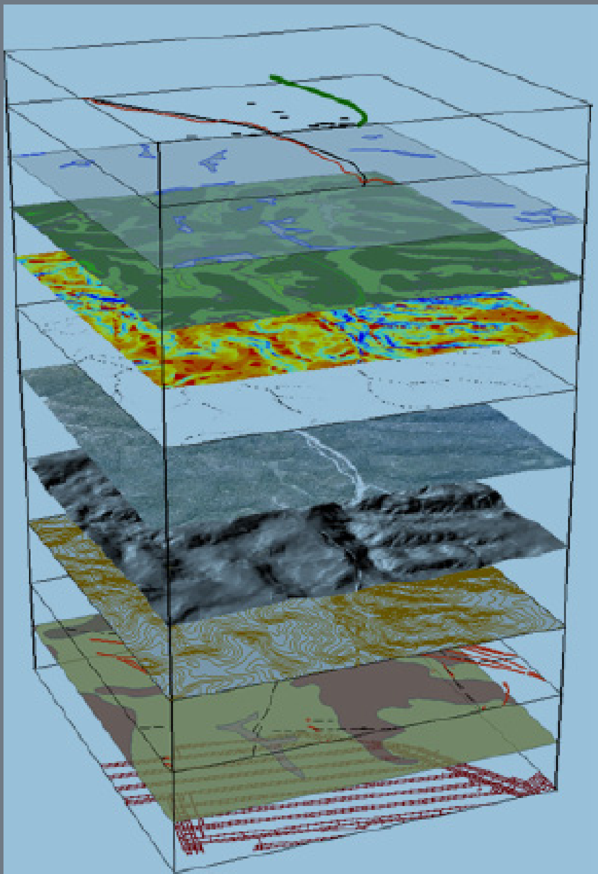
ACARP MATTERS

GEOGRAPHIC INFORMATION SYSTEM (GIS) TECHNOLOGY IMPROVES ON-SITE DECISION MAKING

Existing geographic information system (GIS) technology can be used to dramatically improve decision-making at all levels of the mining life cycle, from planning, impact assessment, approvals, start-up, operation, rehabilitation and mine closure, as well as mine subsidence impact assessment.

An Australian coal industry research project investigating practical methodology for assessing mining subsidence impacts on natural features has found that although many mines are using spatial data in a GIS, they could be using the technology more effectively across a wider spectrum of activities.



This example contains sample layers relevant to mine subsidence impact assessment, such as (from top to bottom), roads, swamps, vegetation, surface slope, drainage, aerial photography, DEM, contours, infrastructure, geology and mine workings. The overlay concept demonstrates how a GIS can manipulate and analyse incongruent data using the spatial attributes (ie. location), of the features within those datasets. All of these data layers contain different features, are in varied formats, and represent different physical objects. Despite these disparities, their common spatial characteristics allow the GIS to analyse a multitude of spatial relationships that may be found to exist between them.

Industry monitor Gary Brassington said the advantages of a geographic information system over other systems was that it enabled rapid, flexible assessments which yielded an easy-to-interpret visual product as an output – a digital or hardcopy map. It also provides data storage and maintenance within the system.

“This project demonstrated that existing technology could be used to solve unique mining problems, and the way GIS was used and trained to predict outcomes was very new for the mining industry,” he said.

“The use of GIS was prompted by the fact that the process of understanding and managing coal mine subsidence impacts is largely a spatial one and that many of the factors that are critical to the assessment of subsidence impacts have a strong spatial component, such as proximity to longwalls, terrain attributes (slope, relative height, valley shape and height), and the distribution of sensitive features.

“The project involved industry participants in demonstrating the best methods of adapting and using GIS technology; consequently, there has already been significant take up of the technology following on from this project.

“Successfully managing subsidence impacts is the key to unlocking access to future coking coal resources within the Southern Coalfield and is an integral part of underground mine planning.”

Assessing the Impacts of Mining Subsidence on Natural Features

As a result of this project, researchers were able to develop and demonstrate practical decision support methodology for assessing mining subsidence impacts on natural features. The decision support tools were developed within the flexibility of the GIS environment and case studies were used to demonstrate the usefulness of GIS tools. Through these case studies, researchers also demonstrated how the GIS could be used inappropriately and result in incorrect decision-making. This information was critical in developing industry guidelines for the use of GIS technology within the industry.

Researchers found five main roles for GIS in subsidence impact management:

1. The storage and management of spatial data related to mine workings (planned and existing) and the associated environment;
2. Site characterisation and identification and quantification of susceptible features, such as cliff lines and watercourses;
3. The assessment or prediction of the extent and magnitude of subsidence impacts;
4. Researching and understanding subsidence processes; and

5. 2D and 3D visualisation for communication and research purposes.

Two emerging methods for coal mine subsidence mapping were investigated during this project – synthetic aperture radar (SAR) data and airborne laser scan (ALS) data. SAR had a number of major limitations including the high degree of expertise required to process the data, high software and data costs, limited data availability, and coarse pixel sizes. Conversely, airborne laser scan (ALS) data showed a great deal of promise despite some current limitations. Two pre-mining surveys were compared in order to quantify the magnitude of expected errors intrinsic to the process of ALS surveying in rugged, heavily vegetated terrain. The results indicated that large errors (in excess of one metre) in surface height change mapping occur in areas of steep terrain such as along cliff lines or within drainage channels. A similar pattern of errors was evident when a post-mining ALS-derived surface was compared with a pre-mining surface. However, despite these errors the results generally matched the expected pattern of subsidence including the detection of relatively higher subsidence over multi-seam workings associated with past mining.

“The way the project used the GIS and trained it to predict outcomes was very new for the mining industry,” – Gary Brassington, Manager Environment, BHP Billiton Illawarra Coal.

Recommendations

The main recommendation to come from this research is that the coal mining industry as a whole should encourage and facilitate the development of subsidence impact databases, consisting of mapped and annotated impacts associated with past and current mining activities.

“Ultimately this will aid the decision-making process in relation to subsidence impact management assessment and GIS will become an increasingly important tool for the presentation and assimilation of relevant data, and the quantification of potential impacts for specific features for given subsidence scenarios,” the researchers said.

“GIS tools are available and useful. If you are not using them to assist your mine, you should be asking why,” – Gary Brassington, Manager Environment, BHP Billiton Illawarra Coal.

Gary Brassington said work on an industry subsidence impact database had commenced in the 1970s but it was only in recent years that the industry recognised the critical need for such data. With increased scrutiny and the need to respond to subsidence impacts becoming critical to the future of the industry these databases are now continually being developed and improved.

“There were significant improvements to the database in the late 1990s to early 2000s when computing technology improved dramatically and we continue to work on the database. The most recent developments link impacts to the environment with levels of subsidence movements. This ability to integrate subsidence movements with environmental outcomes was the missing link when this research was being undertaken,” he said.

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