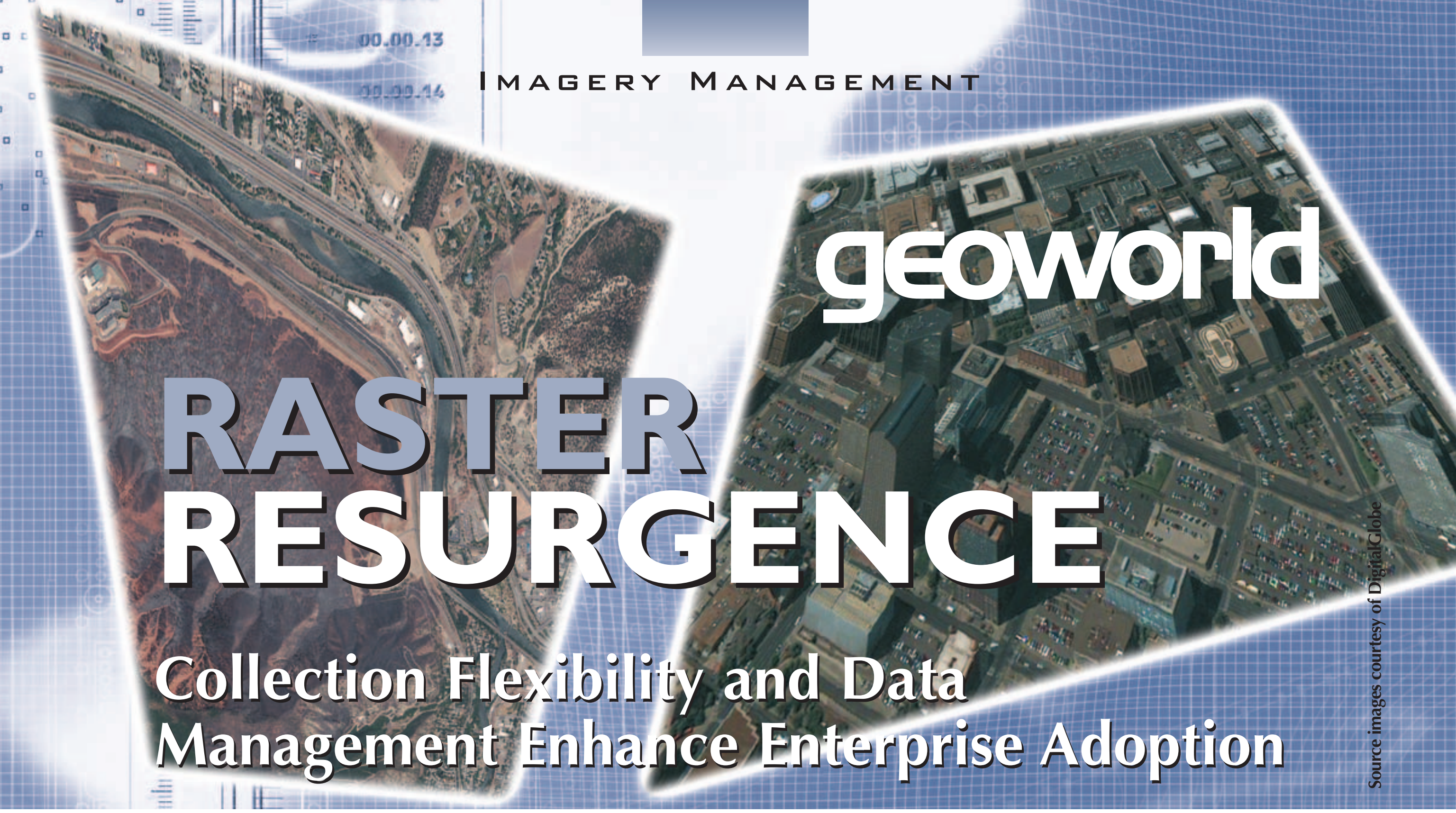

RASTER RESURGENCE

Collection Flexibility and Data Management Enhance Enterprise Adoption

Source images courtesy of DigitalGlobe

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The use of raster data evolved from classified applications in defense and intelligence agencies during the last 50 years to become a common tool in a wide range of applications. The following cases underscore the potential for raster imagery and grid-based data to increase the value of the enterprise repository when data are integrated with a comprehensive cross-section of core business data on location-enabled infrastructure.

Defense and Security

Problem

To detect threats to security and ascertain threat levels while managing an appropriate response matrix, friendly and unfriendly assets need to be tracked.

Context

Detecting changes over time on the ground is a prerequisite to effective planning and response.

Solution

Aerial and satellite remote-sensing platforms are tasked to generate images from an area of interest on a regular basis. Images are collected, georeferenced and loaded into a database as raster or gridded layers. Client tools are used to examine current images in association with historic images for the same surface coverage archived in the database. The current raster is mosaicked with surrounding images to create seamless coverage.

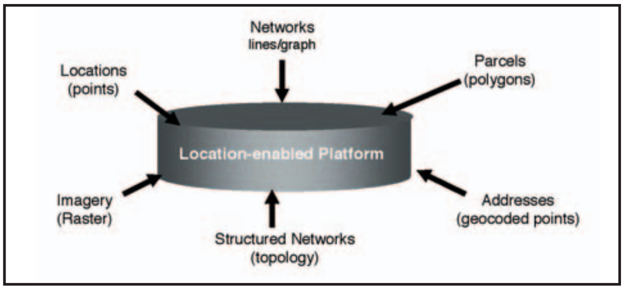
Critical Fact

Image data are the only geographic information that can be acquired in a scheduled/timely manner (tasked) for a specific locale, providing rapid access to current, accurate geodata.

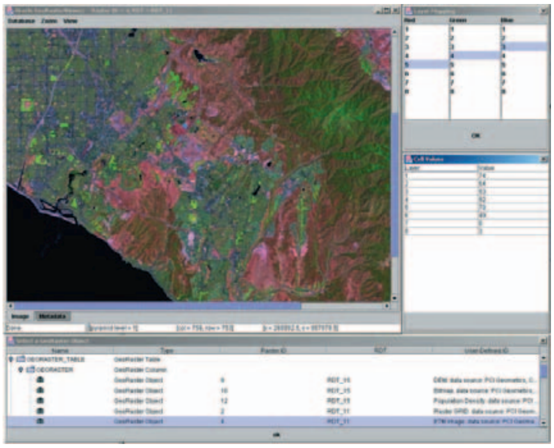
Emergency Response

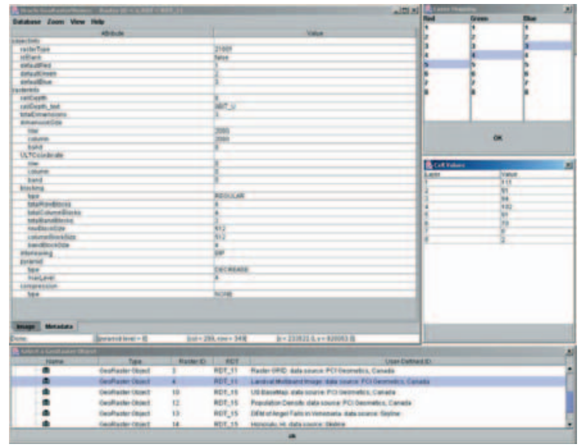
Problem

Assess on-the-ground damage and develop suitable response scenarios given damage to critical infrastructure.



Raster imagery is a component of core spatial information.





Complex raster images such as Landsat Thematic Mapper data (left) are complemented by comprehensive metadata (right).

Context

Making rapid damage assessments of infrastructure in the aftermath of a disaster is critical to timely response and mitigation.

Solution

Raster data from aerial and satellite remote-sensing platforms are used to compare "before and after" conditions on the ground. GeoRaster data are used in conjunction with associated vector data for continuous asset infrastructure (e.g., road, rail, power grid, gas, telco) to determine 1) damage 2) response scenario 3) viable corridors for first responders and 4) routing to appropriate facilities.

Critical Fact

Only raster data can provide the near-real-time data acquisition needed to accomplish damage assessments and meet the time-critical requirements of first responders. A raster data layer provides an ideal backdrop to display infrastructure data (e.g., pipelines, transmission lines, etc.) in a readily comprehensible form.

Support for large datasets, highly scaled environments and stringent security requirements supporting a broad community of users with differing roles suggest that commercial database technology can play a key role for producers and consumers of image data.

Enterprise Asset Management

Problem

Optimize preventative maintenance, field service and operations across a network of continuous and fixed assets (e.g., stations, substations and pipeline).

Context

Accomplish ongoing monitoring and management across a variety of assets to support normal preventative maintenance and operations.

Solution

Incorporate raster data from aerial photography into the existing geospatial data used to map assets under a single enterprise database-management system. Raster data used in conjunction with vector information representing property boundaries, lease zones and easements enable field-service personnel to save time and "wear and tear" on equipment, zeroing in on problem areas on the ground.

Critical Fact

Raster data increase the efficiency of resources in the field and drive down costs, making operations more efficient.

State and Local Government

Problem

State and local governments have limited resources to manage zoning, tax assessments, etc.

Context

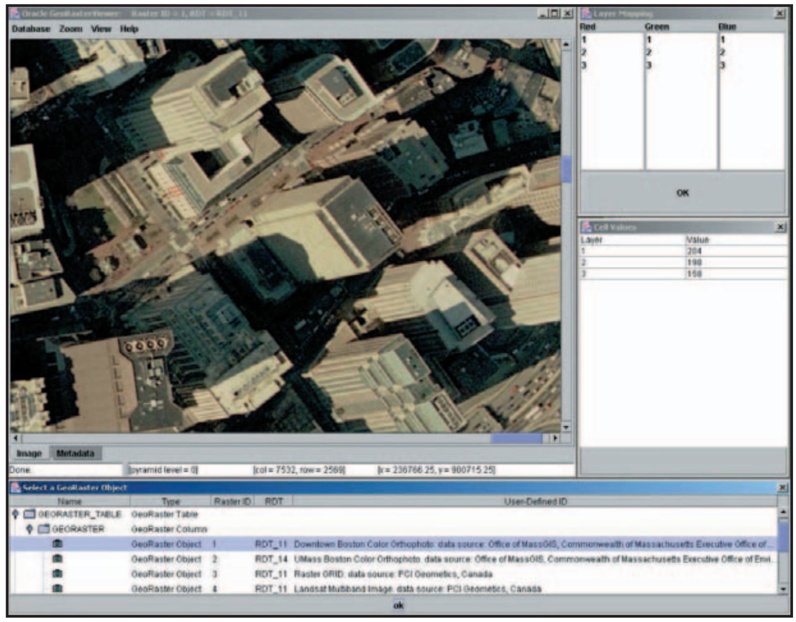
State and local government budgets are stretched like no time in recent memory. With the tax base often shrinking and public-service expenses increasing, local officials are compelled to improve efficiency and maximize coordination and communication among local government departments.

Solution

A base map of digital raster data (digital orthophoto quads or contracted photogrammetric products) provides a common frame of reference that can be used across multiple departments (Transportation, Tax Assessment, Zoning, School Administration, etc.) to support decision making as well as policy formulation and implementation.

Critical Fact

Raster data provide a common frame of reference that can be used across departments and state agencies.



Storing raster data in a common database provides infrastructure to core business applications and government departments.

Agriculture Monitoring

Problem

National agricultural agencies need to document and verify the land's agricultural use.

Context

Farmers often are required to report the land-use practices they employ and the crops they seed, allowing officials to project earnings based on yield. In addition, it's common under some circumstances to compensate farmers for land that's left fallow or unseeded.

Solution

Use of aerial image data acquired on an annual basis in conjunction with vector information from land-management agencies enables officials and local agriculturists to create an accurate record of acres in crop and fallow.

Critical Fact

Only image-based information acquired on an annual basis can provide the baseline information needed to make the assessments needed to support equitable taxation and remuneration.

Geographic Raster Data Management

In addition to traditional consumers of raster data, the insurance and real estate industries are increasing their use of georeferenced raster data, while entertainment, media and medical imaging users incorporate the data via local or non-Earth-based coordinate systems.

The basic types of data to be considered are grid-based and imagery data.

1. Grid data typically have a uniform grid in which each grid cell has specific attribute values measuring things such as elevation, frequency, concentration, etc. Given information about the grid's bounding coordinates, the location of each cell can be calculated. In this model, thematic information such as digital terrain elevation data; pollution concentrations; and land-use, land-cover, geological and rainfall information can be effectively used.

2. Raster imagery or pixel-based data created from optical or other sensors is collected using a variety of technologies such as satellite remote sensing, airborne photogrammetry and sonar. Digital orthophoto images and images composed of one or more bands measuring reflectance along the electromagnetic spectrum are popular for documenting the land base at a specific point in time, as a base for feature extraction or as a means of exploring complex relationships in the physical environment.

More is Better … and Bigger

A key feature associated with remotely sensed, raster data is the frequency with which the data are acquired. Typically, a satellite will orbit Earth several times a day. This means that the satellite can photograph the same portion of Earth at regular, predictable intervals, making it the most cost-effective way to digitally track changes on the ground.

The base sizes of individual images—and the fact that many applications look for changing patterns on the ground and require multiple images of the same area as a time series for comparison—ensure that the volume of raster data will accumulate at a rapid rate. For example, Space Imaging's IKONOS platform completes an orbit every 98 minutes (14 times a day), and it has produced more than 100 million square kilometers of imagery since it achieved orbit in 1999.

Image-based sensor devices produce large quantities of data, and image-based applications consume large quantities of data, creating requirements for ingesting, manipulating, storing and delivering large volumes of consistently changing information. To meet these requirements, vendors must create robust test suites and large datasets to validate scalability. For example, Oracle ran more than 100 separate tests against 1-, 3- and 220-band images ranging from 1GB to 400GB in size to help validate the scalability of its new GeoRaster data type. Test results indicated negligible effects on performance even when images approached a half terabyte in size.

Imagery and image-based applications present unique opportunities and specialized challenges to producers, publishers and consumers of digital data products. The structure of image data, the frequency of acquisition and the demand for products with increasingly higher resolution result in larger datasets.

In addition, time often becomes a multiplier, because the same portion of Earth is imaged multiple times to develop a time series for evaluation and analysis to understand changing conditions. Frequently, image data must exist in a highly secure, controlled environment to support emergency response and other secure applications. Many applications using imagery have a collaborative component that requires many users to access, use and, in some cases, modify the data.

Support for large datasets, highly scaled environments and stringent security requirements supporting a broad community of users with differing roles suggest that commercial database technology can play a key role for producers and consumers of image data.

Editor's Note: *This feature was excerpted from a paper delivered at the 2004 GeoTec Event. To learn more about the GeoRaster capability of the Oracle 10g platform, visit the feature archive on GeoPlace.com for additional material as well as a* GeoWorld *Industry Interview with Jim Farley.* **gw**

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