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# Enhancing Maps with Satellite Imagery

Dr. Clive Farquhar discusses the technology that enables the enhancement of the mapping process

It is a fundamental human trait to seek knowledge about our surroundings. Maps are a permanent record of such information which can be transferred between individuals.

Traditionally maps were based on collating observations by individuals. In recent years, the use of technology such as aerial photography and satellite imagery has become essential, providing valuable information to enhance the mapping process.

## A Satellite's Global Reach

In the past, satellite imagery was often used only as a backdrop to a map, creating some visual interest. Now, satellite imagery is quickly becoming a valuable source of mapping information. The sensors used to capture imagery from satellites offer distinct advantages to professionals across industries who create maps, including the unique ability to monitor very large geographic areas, and coverage of virtually the entire globe with revisit times as short as a single day. In addition to wide area coverage, such sensors also have the potential to record in spectra outside the visible range, meaning they can supplement information collected by traditional methods. For example, satellite imagery updated every fifteen minutes was used to track the movement of the ash cloud from the Eyjafjallajökull volcano in Iceland, which helped authorities determine areas safe for aircraft travel. To do this with traditional means such as simple human observations would have posed technical and potentially dangerous challenges.

One of the strongest advantages of satellite imagery is regular global coverage. Satellite imagery is perhaps the only viable method for the regular monitoring required by global environmental organizations, such as the Kyoto Protocol on Climate Change. Satellite remote sensing is particularly suited to fulfilling Kyoto's requirements to track climate change, including systematic observations of land cover, establishing a carbon stock baseline, and quantifying changes in both land cover and above-ground biomass. Other examples of how

satellite imagery has helped in global studies include mapping Amazonian rainforest destruction and monitoring changes in sea ice extent.

## Creating a Better Map

Satellite-based sensors are also highly suited for mapping at national and regional scales. Within Europe the EU's Global Monitoring for Environment and Security (GMES) program uses a range of satellite imagery for a variety of applications, including land, marine and atmospheric monitoring, climate change modelling, and various emergency response and security-related projects. Examples of maps created with the help of satellite imagery include the CORINE series, which recorded the land cover of EU countries in 1990, 2000 and 2006. By using information from satellite imagery, analysts can detect change over time by comparing the maps, thus determining crucial developments in a certain land area, such as the rate of city expansion or the number of commercial buildings. The regular mapping of such a large area could only be achieved using information from satellite imagery, a capability which is essential when examining changes in both the natural and man-made environments of those regions.

It is at the local scale that there has been the greatest increase in the use of satellite imagery for a variety of mapping applications. Within the last decade, numerous sensors have been launched with sub-meter spatial resolution, providing professionals with a high level of detail about a geographic area that previously could only be achieved using airborne surveying. The ability to map individual urban elements such as buildings, trees and cars has opened up the possibility of creating maps that include geospatial information to a wide range of users, including civil engineers, urban planners, logistical companies and municipal governments. Imagery can now be used to update and complement existing GIS layers by using a new generation of image analysis technology, such as automated tools found in ENVI image analysis software from ITT.

Examples of capabilities include automated tools that make it easier to achieve expert level image analysis results, such as object-based classification tools for extracting features of interest from an overall image scene.

The ability of a satellite-based sensor to quickly revisit a location make them ideal for the rapid mapping that is required when time is critical, such as after a natural or man-made disaster that has affected a specific geographic area. Remote sensing has become a major component in post-disaster relief efforts and has been used in recent disasters such as the Haiti and China earthquakes, flooding in northern England and the 2004 Indian Ocean tsunami. Maps that included information from satellite imagery, along with ENVI, were used in a number of crucial relief efforts, including locating and quantifying damage extent and determine safe access routes to essential services such as hospitals and police stations.

## The Future of Imagery in Mapping

Expected advances in remote sensing technology will further aid both the quality of mapping from space and increase the range of applications of such maps. Both the number of satellites in orbit and their constantly improving monitoring abilities will increase the range and usefulness of imagery. For example, the satellite GeoEye-2 provides a 25cm resolution, meaning that remarkably small features, such as road markings, can be identified from space and that information added to a map for use in many applications. In addition, improvements in image processing technology such as the development of additional automation by software packages like ENVI will mean the improved production of standardised map products from remote sensing imagery.

In scenarios across the world and throughout many disciplines and industries, satellite imagery is becoming a crucial part of the mapping process. From disaster relief to security and city management, more and more professionals will continue to use imagery for the rich information it provides about their surroundings.

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