GIS for Brazil

ESRI

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ESRI Working for a Better World

Within the past decade, Brazil has been recognized by the United Nations as one of the fastest developing countries in the world. The dynamics of fast-paced development sometimes create a climate of uncertain change. Brazilian governments, businesses, and citizens are responding to maintain a steady balance and positive direction for the country. In its recent National Human Development Report to the United Nations, Brazil placed information and communication technology, as well as energy and environmental policy building, at the forefront of solutions for its own development.

The insight that the technology of geographic information system (GIS) software brings Brazil affects a myriad of industries, services, governments, and businesses. ESRI® software, business partners, and professional services groups are working with people throughout the country to make systems flow smoothly as well as to help solve some difficult problems.

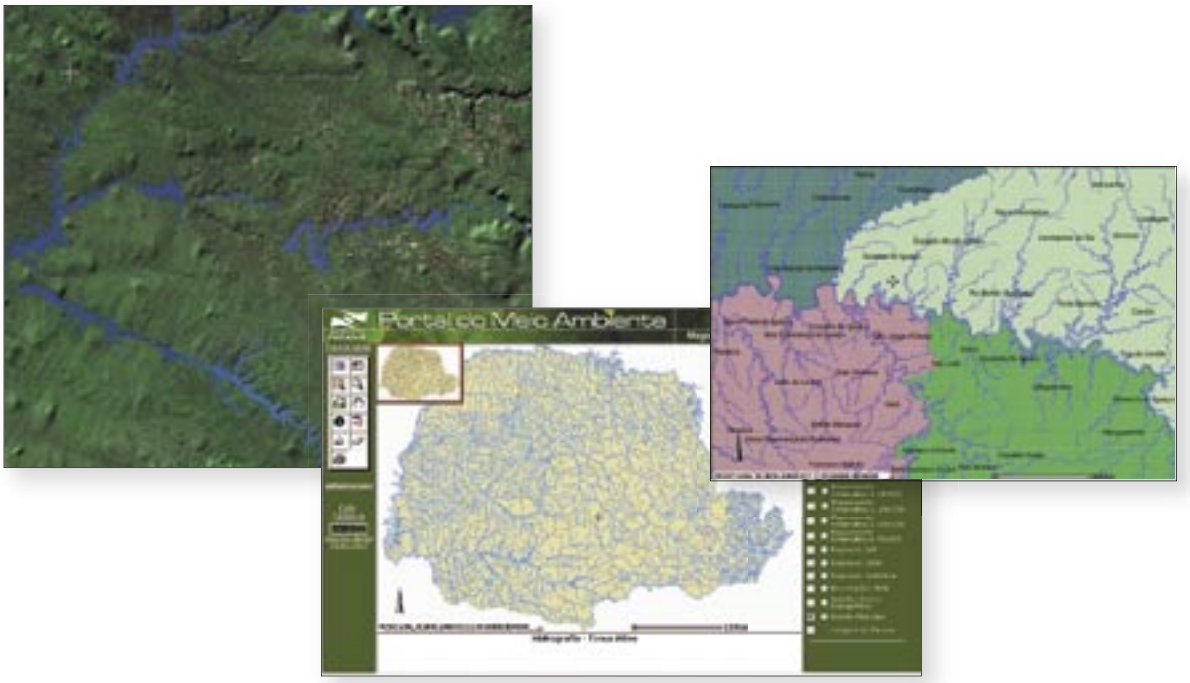
Meeting current needs while still planning for the future requires a clear understanding of both. GIS not only creates geographic representations but also performs accurate correlation analyses, which are important for forecasting and decision making. Legislators, administrators, policy makers, and engineers as well as many others use GIS technology to help them identify needs and best allocate resources to meet those needs.

Those who use GIS can view geography in addition to various combinations of data in relation to that geography. ESRI's ArcGIS® software combines digital mapping, image processing, and database management on one desktop computer. GIS can also be expanded to be used locally on a company's computer network or globally across the World Wide Web. Web-enabled GIS offers interactive applications, integrated databases, and real-time geographic representations. Since GIS has been accepted on nearly every front and in every country in the world, those who use it have been calling for consistency in industrial and international geographic data and technological standards. These common standards will allow GIS users to integrate an infinite number of geographic themes in open and interoperable environments.

Because Brazil is the most ecologically rich country in the world, Brazilians realize that the preservation and sustainability of their environment are essential to the larger global community. Sustainable development requires balancing economic development with the need to improve quality of life, conserve resources, and coexist in harmony with nature. Because geography is a basic element in this quest, GIS obviously plays a key role in creating sustainable environments. Brazil's environmental and agricultural policy makers increasingly rely on GIS technology to understand and maintain the ecological balance of their natural habitats, keeping in mind the socioeconomic stability of the country's 173 million inhabitants.

BRAZIL

GIS for Environmental Management



With its ability to pull spatial data from different sources into an integrated environment, GIS simplifies the process of preparing data for a multitude of environmental analysis possibilities. For example, GIS greatly extends the analytical power of hydraulic modeling. GIS can perform applications such as watershed delineation, topographic characteristic extraction, floodplain extent determination, and others to provide water resource professionals with an informed basis for making sound decisions.

The mission of Desenvolvimento dos Recursos Hídricos e Saneamento Ambiental do Paraná (Hydrological and Environmental Sanitation Resource Development of Paraná) is to develop environmental policy and oversee one of the largest ecological areas in the world. One of its directives is to establish the lines of direction for government in the areas of environment, hydrographic resources, forestry, mapping, and agrarian action as well as control of erosion and environmental sanitation. A core component in this directive is mapping, and intelligently mapping such a large domain requires a sophisticated GIS.

Desenvolvimento dos Recursos Hídricos e Saneamento Ambiental do Paraná has a pilot GIS project that is designed for environmental analysis for the state. The GIS is used for assessing and monitoring the Programa de Saneamento Ambiental da Região Metropolitana de Curitiba (the Environmental Sanitation Program of the Metropolitan Region of Curitiba), called PROSAM.

PROSAM's initial target is the hydrographic basin of the River Iguaçu. This river cuts through all of the Paranaense territory, impacting 100 cities and more than 50 percent of the population of the state. The basin is divided into three hydrographic subbasins (Low, Medium, and High Iguaçu). The High Iguaçu basin represents the largest index of environmental pollution because of the confluence of high urban development and the natural water sources (springs).

The initial focus of this project is on the management of hydrological resources in the High Iguaçu basin. The GIS computed a basemap by using data from land survey and aerial photogrammetry restitution. Converting available data to the GIS database and inputting new geodata were essential elements to building an accurate database. Database accuracy is crucial so that the GIS can build hydrographical models and query information.

The spatial representation and hydrological models that the GIS is creating are helping analysts determine how shared environments affect pollution. The pilot also serves to launch the Program Paranaense de Ambient Gestão, which is a civil society of the Association of Cities. This organization will join with other environmental partners to share the responsibility for improving the quality of life in and applying sustainable development principles for the region. GIS is an important player in bringing this group together to make sound environmental decisions.

The Desenvolvimento dos Recursos Hídricos e Saneamento Ambiental do Paraná has created a GIS Web site, www.pr.gov.br/sema/i_sema.shtml, that offers a thematic map of the environment for the state.

Sustainable Development

Geography as a science and GIS as a technology can be seen as a framework for what many people call "sustainable development." Sustainability is a loosely defined concept associated with the ability to set up systems of human activity that can maintain themselves. This usually means economically, but more and more it includes strategies that have minimal impact on the environment and do not deplete the resources that support them.

The Mamirauá Sustainable Development Reserve (MSDR) is the largest protected area (1,124,000 hectares) in Brazil conserving flooded forests of any kind and the only functional area conserving the Várzea flooded forests that are found along many Amazon white water rivers. The MSDR has a high level of biodiversity and is the first Brazilian conservation area designed to integrate the preservation of fragile habitats with the sustainable development of local resident communities. Approximately 60 small Várzea communities have participated in research for monitoring extension and protection areas.

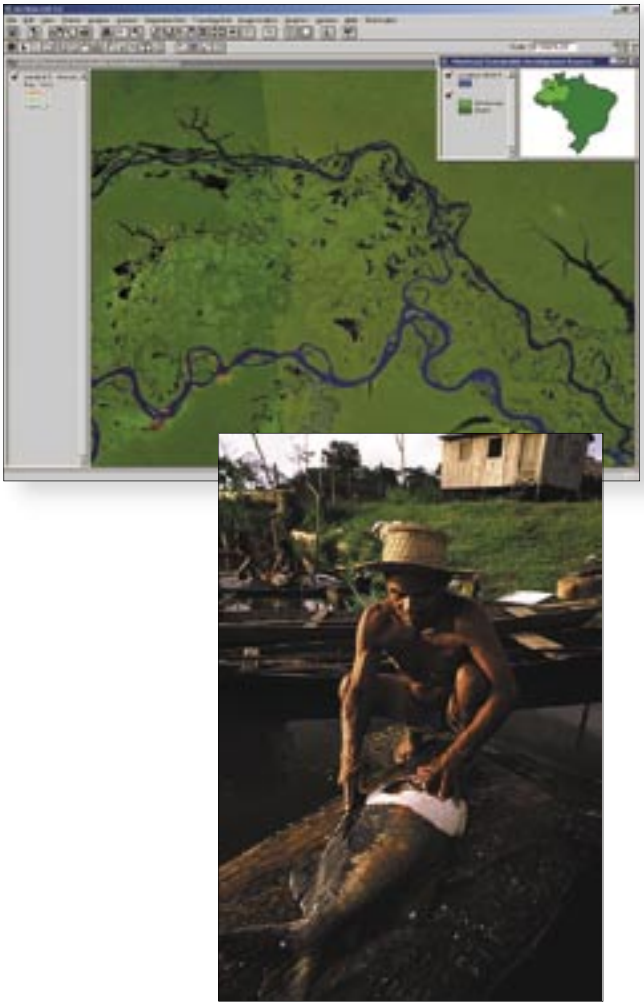
The continued presence of the local population requires a zoning system with adequate management rules to reduce conflicts between productive activities and biodiversity conservation, thereby increasing sustainability. The Mamirauá model proposes effective, low-cost environmental protection and reduction of the demand for natural resources by means of the development of new economic alternatives. These include a fisheries postharvest project, community forestry management, introduction of new crops adapted to Várzea environmental conditions, and so forth.

Monitoring systems were put in place to follow the expected changes in socioeconomic, key economic, and biological indicators. Zoning was established considering inputs from residents (people living within the reserve area); users (people living in the riverbanks outside the reserve who traditionally use the area); and researchers working with key economic and endangered species such as manatees, caimans, turtles, and others.

Economic alternative interventions were carried out to compensate for income losses resulting from restricted use of natural resources. For example, a fisheries program was initiated to organize the fishermen from an area of the reserve. Through this program, they received training to improve their fish processing techniques (salting, drying, icing, etc.), lessons in management, and support for marketing their products. The idea was to improve the quality of fisheries products, remove the middleman, and sell the products in more profitable markets. All fish marketed through the Fisheries Post-Harvest Program are recorded to provide biological and fishing effort information.

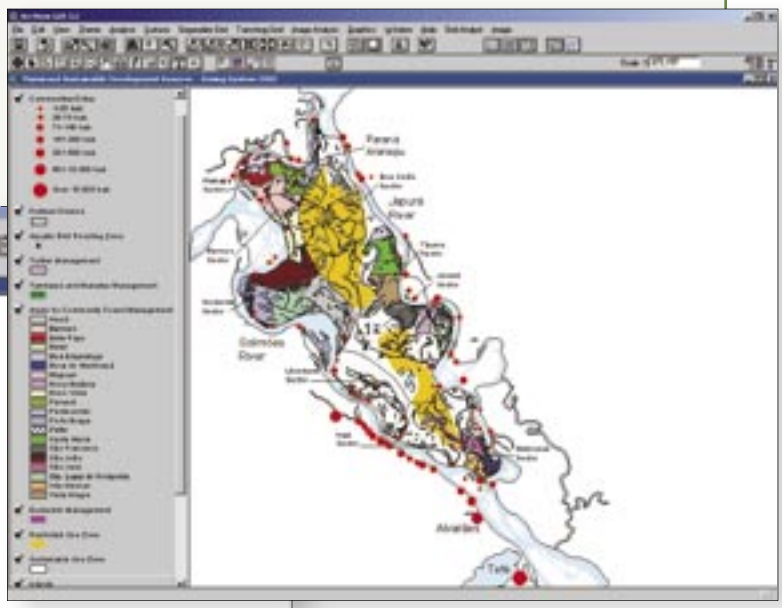
Stocks of the two major fish species of the area (the pirarucu [Arapaima gigas] and the tambaqui [Colossoma macropomum]) are also monitored through mark and capture experiments and other methods including a visual census in the case of pirarucu, which is an air-breathing species that comes regularly to the surface. Monitoring allows scientists to follow the expected changes in abundance. It is paramount that all information produced by the monitoring systems be readily available to back management decisions, and GIS is an extremely useful tool for achieving this. Project workers migrated more than 150 layers of information into the GIS. The zoning system and the location of human settlements easily show sustainable relationships.

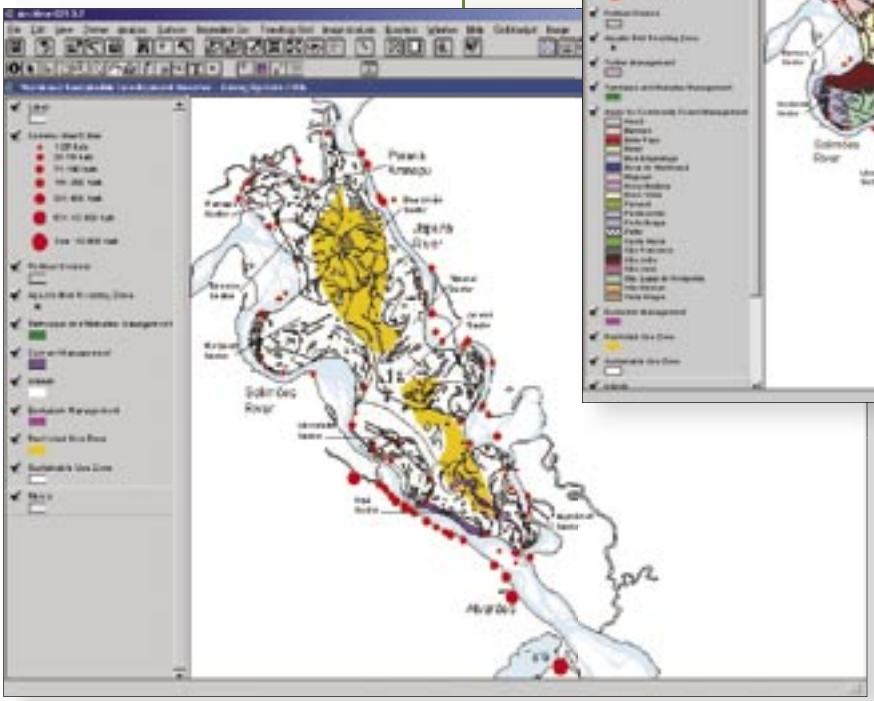
Because the MSDR is located between two floodplain lakes, the complex network of channels that connects these bodies is constantly changing. The map information needs constant revision. Satellite imagery is useful for updates.



Sustainable Community Forest Management

As the work for the implementation of the management plan progresses, new economic alternatives are being introduced in the Mamirauá Reserve. In the case of forestry, for example, areas in the sustainable use zone were identified and delimited for the management of wood species. So far, 17 communities are participating, but other communities will extend this initiative in response to demand. People from the participating communities are being trained in stock assessment techniques and are receiving support for the elaboration of management plans and also for the establishment of associations through which these plans will be marketed. This is a requirement of the state and federal environmental authorities to grant permits for community forest management. GIS is used to analyze forestry changes and support management decisions.





Information for this article was provided by João Paulo Viana, Geyson Mattos, and José Márcio Ayres. Photography was provided by L.C. Marigo (www.lcmarigo.com.br). For more information, please contact João Paulo Viana at ***joao.paulo@mamiraua.org.br.***

Treetop Highway for Golden Lion Monkey

The golden lion monkey (Leontopithecus rosalia) is a species of primate endemic to the lower region of Mata Atlântica on the coast of the state of Rio de Janeiro. Much of the monkey's ancient habitat has been devastated. Today what remains of the once vast forests is but meager, isolated fragments. The monkey lives and travels along canopies of forest, but these areas have been diminished by pastures and farms. Isolation of communities limits genetic diversity, resulting in weaknesses caused by inbreeding.

Naturalists estimate that approximately 1,200 golden lion monkeys live in the wild; their survival is much attributed to the efforts of a conservation program by the Mico-Leão-Dourado Association. Although its population has grown during the last decade, the golden lion monkey remains listed as an endangered species.

The Mico-Leão-Dourado Association monitors the monkeys carefully and has set a goal of increasing the population to 2,000 by the year 2025. The conservation program is attempting to gain 25,000 hectares of forests that will be protected by law; it has already acquired 10,000 hectares for this purpose.

One method of preserving the small primate is through a program called Programa de Implantação de Corredores Florestais (Implantation of Forest Corridors Program). By creating "treetop highways" that connect the declining forest habitats, naturalists hope to reduce the primates' isolation. Forest corridors allow monkeys to relocate to other primate communites.

The Implantation phase of the Forest Corridors Program is using GIS to analyze the planimetric data of the region and to perform correlations with ecological data and monkey habitats. The target ecological region for the species is currently restricted by seven cities. Satellite images of the region from Landsat 7 make it possible for scientists to georeference ecological changes by time and spatially depict these changes. The GIS also generates maps that include vegetation coverage among its series of thematic maps.

The architecture of the GIS is built on ArcView® software. The database consists of vector maps of land use and ground coverages. Field data is also included about the location of monkeys that have been reintroduced into the forest. The locations of various groups have been georeferenced using a global positioning system (GPS).

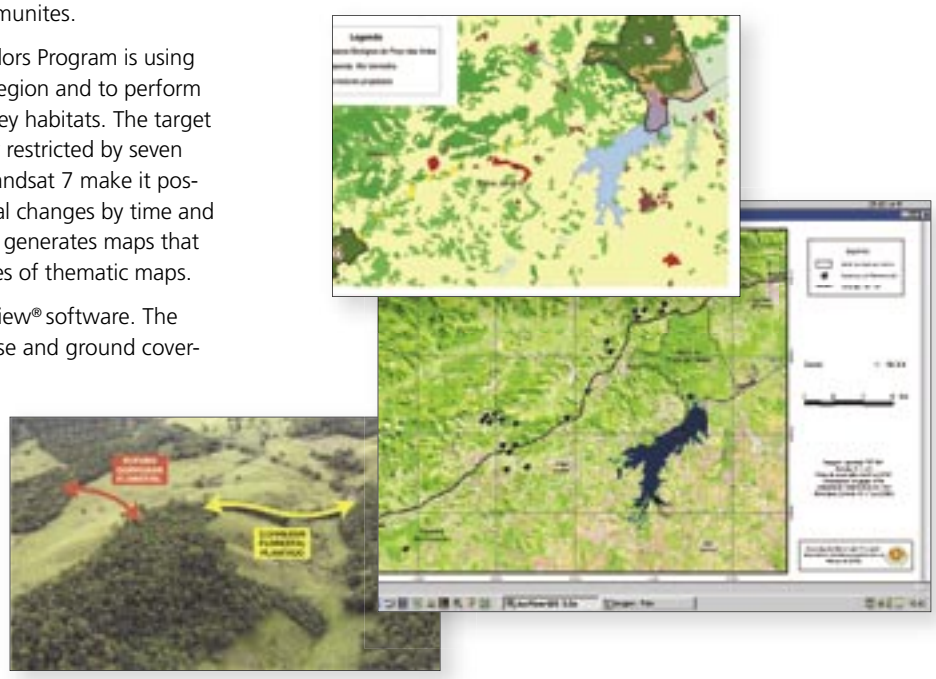
The information gained from these studies shows that golden lion monkeys do not live in areas higher than 500 meters and that the average area used by the species' community needs to be at least 40 hectares.

By inputting the most favorable conditions, size of forest, altitudes, and ground covers where the golden lion monkey thrives, the GIS created a map that indicates the best location and corridor routes for the primate. Findings show that the treetop corridors must be 10 percent of the value of the length (a minimum width of 30 meters) for primate travelers.

The GIS produced a map that correlates 14 fragmented areas that need to be linked, from the Well of the Tapirs biological reserve to the Red River Farm. Within this region are the greatest forest habitats for the golden lion monkey within the state of Rio de Janeiro. The corridors will link populations of monkeys: the wild monkey population of the Well of the Tapirs and the reintroduced monkeys at the Red River Farm.

In determining the best areas for planting the treetop corridors, scientists input other factors into the GIS. These include the ideal corridors, which are compared with the cadastre of country properties, areas of permanent preservation, and areas of legal reserves. This information will allow the planners to refine the tracing of corridors.

Information provided by Fabiano Godoy, cartographer, and Rosan Fernandes, ecologist

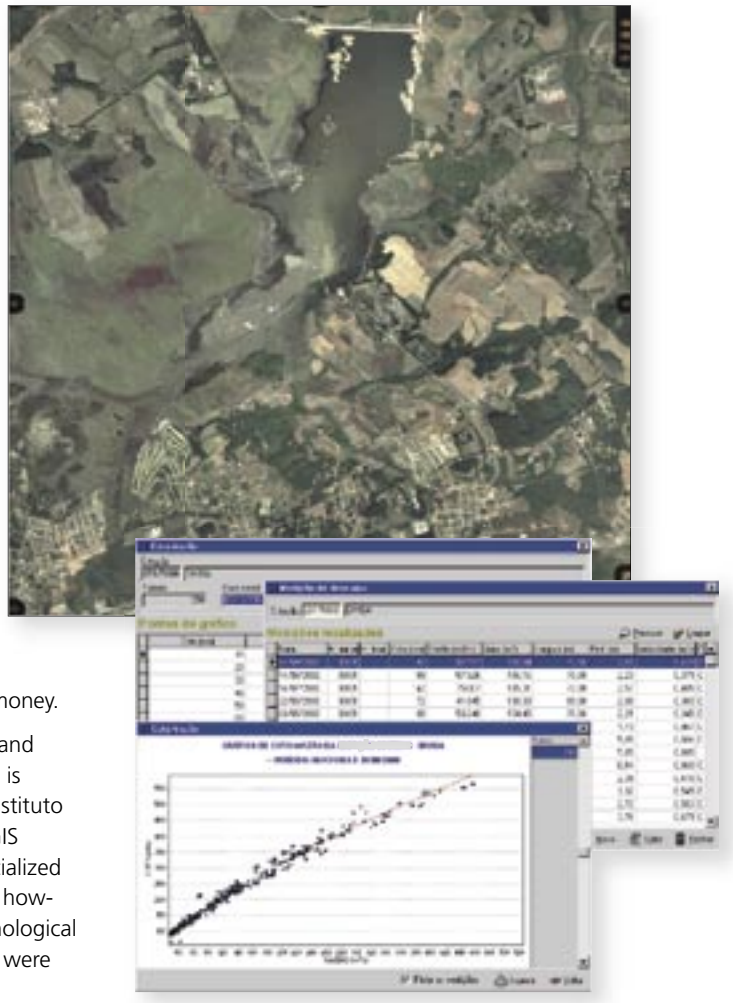


GIS for the Web

Agencies that share data expand their opportunities for service, work flow, research, and analysis. Web-enabled GIS technologies bring numerous advantages not only to national, state, and local governments but also to businesses and common citizens. State and local agencies share their geodatabases across the World Wide Web to manage parklands, study the environment, share administrative information, and much more.

GIS Web Technology Used by Secretary of the Environment

When Brazil's Secretary of the Environment (Secretaria do Meio Ambiente) learned about the potential of GIS technology, the agency implemented a GIS, Projeto de Preservação da Mata Atlântica (PPMA), which greatly increased the proficiency of various agency tasks. The GIS enables the agency to manage its 22,000 square kilometers enclosed in the valley of the Ribeira as well as the coast and part of the valley of the Paraíba, with a domain of 40 cities. The region also has 18 state parks and three ecological stations. The project uses GIS to improve its processes of inspection, environmental licensing procedures, and regional analysis. The Web technology component of the GIS project, Sistema Integrado de Comunicação e Informação (Sici), supports a network that is available to its own department and to other state agencies.



For example, the Web-enabled GIS has improved the agency's licensing process. With the manual system, the agent had to search the local database to determine if the applicant had any record of violation with that agency. The agent then searched the Forest Law Enforcement Service (Polícia Florestal) to determine if the applicant had violations documented by that department; last the agent searched the Forestry Institute (Instituto Florestal) geodatabase to determine if the area of request was within or adjacent to a designated conservation area. Using Web-enabled GIS technology, what was once a 90-day completion process has been reduced to a two-day response time because of the fast access to shared information. Agencies that use a network or the Internet to share data save time and, obviously, money.

The Sici geodatabase contains orthorectified aerial photographs and computer-aided design topographical mapping. This information is provided by the Brazilian Institute of Geography and Statistics (Instituto Brasileiro de Geografia e Estatística [IBGE]), which also uses ArcGIS software. The Secretary of the Environment once required a specialized technician to operate the technical system. The new GIS system, however, is easily operated and does not require a high level of technological expertise. Users were easily trained to use the new software and were quickly able to apply GIS to their daily tasks.

To find out more about the Projeto de Preservação da Mata Atlântica, visit www.ambiente.sp.gov.br.

GIS for Agriculture

GIS offers solutions for all levels of agronomy. GIS is valuable at the subfield level for analyzing crop yield information and understanding how features within the landscape interact. On a larger scale, GIS assists governmental organizations with a host of tasks such as risk analysis for insurance programs and field assessments for commodity subsidy programs. GIS helps agricultural decision makers optimize efficiency and improve economic returns.

In Search of the Wild Peanut

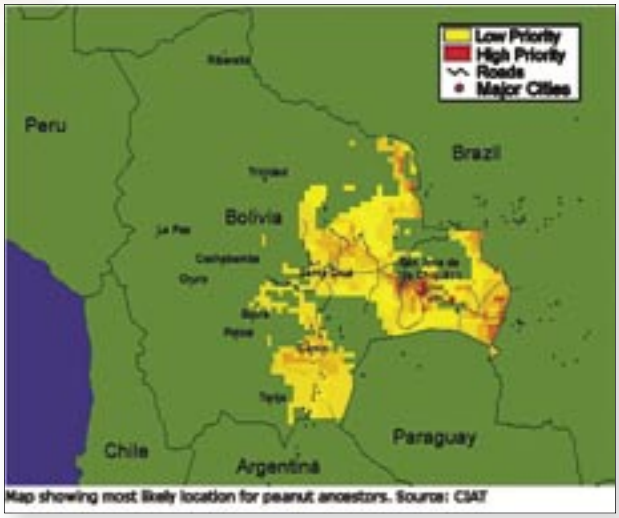
Peanuts are a staple in the diets of many peoples of the world. Peanuts are also an important commodity for many economies. The peanut's original home is believed to be the slopes of the Andes in Brazil and Peru. Portuguese traders, explorers, and missionaries transported the peanut to Africa and Spain. From Africa, peanuts traveled by ship to North America and were grown on farms in the southern British colonies.

Today's domesticated hybrids are a changed version of the original wild groundnuts of South America. These wild groundnuts are able to survive in more rugged conditions. In search of the peanut's origins, scientists hope to locate the hardy B-genome parents. They believe that enhancing today's peanut varieties with the B-genome of its ancestor would benefit farmers and consumers around the world, especially the poor. Today, there are 68 known wild peanut varieties.

Researcher David Williams is a plant explorer and ethnobotanist based in Cali, Colombia, at the Americas Office of the International Plant Genetic Resources Institute, a future harvest center of the Consultative Group on International Agricultural Research (CGIAR). Williams says, "The species we are looking for could eliminate much of the need for farmers to use pesticides and also help them cope with drought." Williams is using a GIS application called FloraMap to map the location, species, and habitat of various species in the regions of northwest Paraguay, southeast Bolivia, and southeast Brazil.

FloraMap was developed at the International Center for Tropical Agriculture (CIAT), another future harvest center of CGIAR. FloraMap links to agroclimatic and other databases, allowing biodiversity specialists to create maps showing the most likely distribution of wild species in nature. This application was built using ESRI's MapObjects® software.

Williams and CIAT researcher Andrew Jarvis recently mapped out the coordinates where the B-genome and other wild peanut species are most likely to be found. "We combined meteorological station data and a large global climate change model called Hadley with the geographic coordinates of the sites where wild species had been collected in the past," says Jarvis. "From there, we used FloraMap to map out and compare distribution patterns, both present and future, for each target species."



Map showing most likely location for peanut ancestors. Source: CIAT

Monitoring Agricultural Expansion Using Remote Sensing

Bahia

For centuries the western region of the state of Bahia has been used predominantly by cattle ranchers. But recent agricultural practices have brought notable changes to the environment. Within the past 15 years agricultural production has expanded to grains (soy and maize) and coffee. Technological and mechanical methods have further speeded the expansion of production. Today approximately 100,000 square kilometers have been affected by this dynamic land use.

The Brazilian Development Bank (BNDES) is concerned about these growing changes and contracted Embrapa Monitoramento por Satélite (Embrapa Satellite Monitoring) to construct an analysis of the region. Embrapa has been able to provide BNDES with information by using Landsat images integrated into GIS.

A multidisciplinary team of analysts was responsible for defining the classification system to be used in examining the images. ERDAS IMAGINE® software was used for the analysis of the images that were generated in ArcGIS, which helped with the manipulation of vectors and attributes. The team decided on the study procedures and necessary routines needed for the geospatial analysis.

To do this, the team first attained data about the region. Figure 1 illustrates the cartographic context of the study area and the necessary Landsat scenes for the mapping of land use. In particular, the team chose to focus on images from two years—1985 and 2000. This allowed them to compare and contrast the variations in the environment.

The team evaluated aerial and terrestrial passages of the entire study area. Using the GIS, they verified the precision and created map agreement for scale. The GIS produced cartographic depictions of weather patterns, vegetation covering, and land changes.

Findings

- Since 1985 (Figure 1), open pasture presented the biggest loss of area (21 percent).
- A significant loss of forested area was depicted for 2000 (Figure 2).
- The team analyzed agricultural expansion by agricultural type for 1985 and 2000 (Figure 3). Images indicated significant expansion within each classification: traditional 28.3 percent, modern 154.4 percent, and irrigated 526.0 percent.

The team predicts that agricultural expansion in the region will continue to grow at a rate of 18 percent each year. The images produced by the Embrapa Landsat and GIS, as well as the team's analysis of the data, are used to guide policy making about regional development by allowing legislators to see impacts on existing natural resources and environmental impacts. The integration of the data into the GIS increases the efficiency of monitoring these areas. It also will help agencies provide fast answers to financial agencies and local services.

Information provided by Mateus Batistella and Marcelo Guimarães of Embrapa Satellite Monitoring.

Figure 3

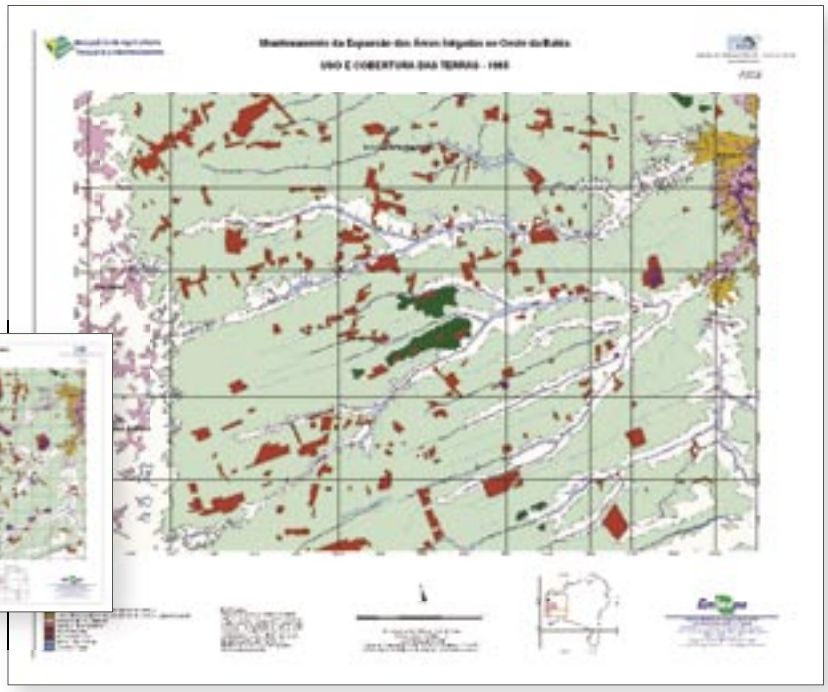


Figure 1

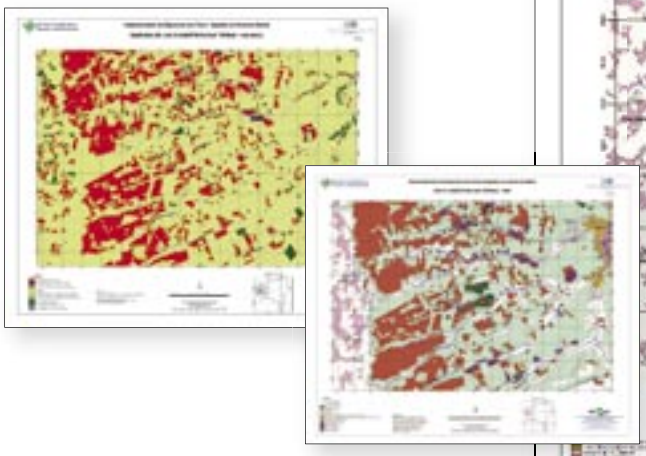


Figure 2

GIS for Government

Governmental policy makers use GIS to help them effectively respond to national needs such as defense, transportation, and health care. Today's GIS has the power to integrate geographic data from many agencies and groups such as civilian agencies, defense, and national security. Local governments use GIS as an essential municipal tool for cadastre, taxation, regulation, economic development, city planning, law enforcement, emergency response, community education, and much more. Whether interdepartmental, interagency, or international, ESRI's government enterprise solutions help governments build strong communities.

State Agency Processes Are Enhanced

State of Pernambuco

The Regional Council of Architecture, Engineering, and Agronomy (Os Conselhos Regionais de Arquitetura, Engenharia e Agronomia) is an inspection agency that oversees architecture for the state of Pernambuco. Its purpose is to ensure a prescribed level of quality in the region's architecture. In an effort to improve its services, the agency sought a new system that would function quickly throughout the enterprise. The council had become frustrated with an outdated system that was hard to use and sought to implement a GIS system that would be useful for the many tasks and services the agency provides.

For inspection purposes, the council divides the Região Metropolitana do Recife into four service sections. Inspectors gather building data and assess building code compliance. The council's old system contained a digital archive of inspection notifications. Although their operating system was able to generate some reports, the system was both difficult to learn and difficult to use. It was not only slow but also limited in the types of information it could produce.

The new inspection application enables inspectors to locate, classify, visualize, and print GIS maps of the sites they visit. Inspectors are also able to georeference the geodatabase with linked property images. By clicking on a map, workers can access photographs of the site, the building, costs, site data, and inspection information. The database is easy to update and maintain because GPS is used to gather and maintain geographic data for the GIS and provide accurate site coordinates.

Application tools have custom-designed features that address specific task needs. For example, the notification database tool was designed specifically for administrators who use it to evaluate the productivity of the inspectors. Another tool performs studies on business inspections and is used to analyze location and growth of construction. The CREA PH production tools support the system network, easing the interaction between management, engineers, consultants, and inspectors. CREA PH also generates various management reports including the public park, construction area, inspection, type of construction, and type of business reports.

ArcExplorer™, a lightweight GIS data viewer by ESRI, was downloaded to all desktop computers so that everyone had at least minimal access to the GIS using the network. GIS inspection data is being disseminated; basemaps, attributes, and data are successfully being combined with full spatial representation; and maps are made accessible online. Because of this expanded access, new concepts, processes, and potentials of GIS are being explored and applied.

CREA PH brings the council an ability to assign work flow, obtain specific combinations of work information, and perform detailed tasks such as applying fines and penalties for noncompliant facilities violation. Accuracy, quality, and speed of production have all been enhanced.

GIS for Economic Development

City of Ipatinga

Municipalities use GIS to analyze transportation, infrastructure, education, workforce, tax incentives, and other factors that must be identified and emphasized. By centralizing all information about a community, GIS speeds the process of analyzing data and recognizing trends. The city of Ipatinga seeks economic development of the community to improve the quality of life for its citizens.

Ipatinga uses GIS in its municipal clerkships of finance, urban and environmental services, and health. GIS provides numerous solutions for these agencies. For example, those in education use GIS to determine the community distribution of children by age and residence. This helps administrators plan for schools and class sizes by grade. Community health services use GIS to map the spread of disease and to locate health sites. The GIS also provides a picture of the community family groups, which helps the family and health program target its services.

The city's cadastre was also brought into the system. ArcGIS completely integrates all major functions of a cadastral organization: mapping, ownership registration, and valuation in a scalable environment. This helps the staff locate new construction and remodeling efforts. The GIS generates maps for field inspectors about the parcels and provides inspectors with a route to get to sites.

ArcIMS® and ArcSDE® allow users to view and access maps on the Web. A Web site was created that provides employees with important data needed to complete their daily work tasks. Access to information is controlled. A public Web site is available to the community and provides information about services, cultural events, sports, leisure, traffic, demography, and location. This Web site also offers city budget information. Users can use the Web site as a resource for GIS location services.

The municipality's GIS is located in City Hall. Officials realized that implementing a GIS, which touched so many municipal services, would take teamwork. Because of the city's ability to collaborate, the project is a core tool used by city management and citizens alike.

City Workers Tap GIS

Curitiba

The city of Curitiba, Paraná, Brazil, has taken many innovative actions in city administration. For example, its public transport system has become so successful that it boasts providing 70 percent of the citizens' daily trips. Curitiba has also made significant improvements through its environmental policies. Its new Urban Spatial Order is a plan that incorporates the spatial distribution of activities and people as well as effectively determining sites of plants and services; Curitiba has been carrying out a town planning program for more than 30 years.

Success in a digital world has become the muscle of successful city administration. GIS serves the city government of Curitiba in its public administration and planning efforts. Curitiba's GIS has dramatically improved services such as lot identification, database interaction, parcel management, city planning, and policy development.

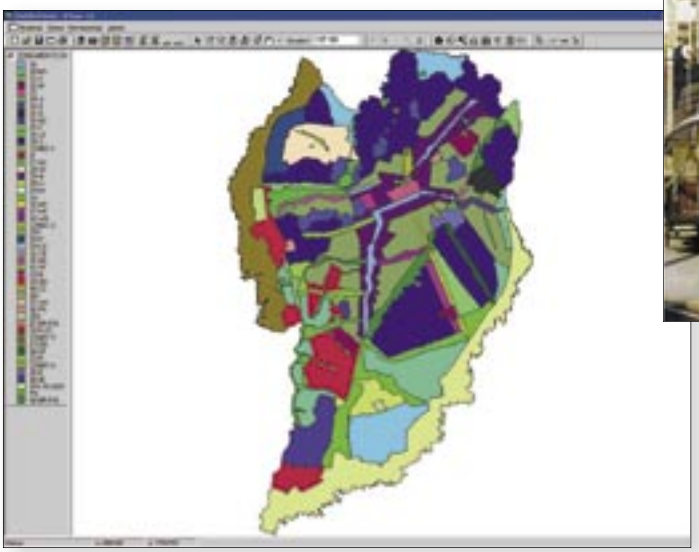
Through the Institute of Research and Urban Planning of Curitiba (IPPUC), the city created a GIS solution for geoprocessing municipal data. This geoprocessing included such GIS operations as geographic feature overlay, coverage selection and analysis, topology processing, and data conversion.

The city of Curitiba's GIS is built with ESRI's GIS software. The city chose this software because of its ability to work in many arenas, providing multiple solutions to a wide user base who all work within one system. This means that the GIS works across the entire enterprise and throughout many community government sectors.

The city converted its data to the GIS and served it on a Digital Alpha Server 4100 using Oracle and ESRI's ArcSDE to manage the database. Dissemination of spatial information was made possible through a high-speed fiber optics network that facilitated a heavy level of demand over a normal network system. The demand is high because Curitiba has 500 stations working on the system.

GIS was put into the hands of many employees. Equipment and training were given to diverse sectors of the city government, enabling them to perform routine tasks. Higher levels of training were given to a GIS team. This GIS team's tasks are to maintain the database, customize the GIS for specific tasks, provide specialized knowledge of application software, act as contact points for individual department support, and provide GIS research and publication expertise. This team has done an exceptional job of working with employees in the acceptance of GIS into their daily routines.

Employees now see GIS as an inherent tool to the city's administrative proceedings. The GIS team support ensures data continuity and maintenance quality.



GIS for Utilities

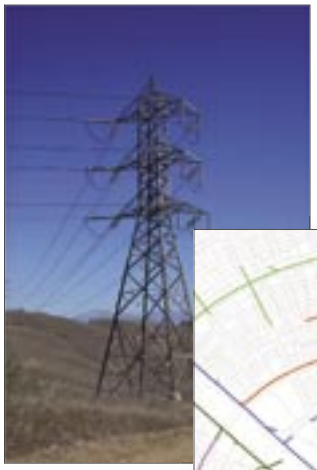
Successful utility services management relies on spatial representations for facilities design (placement of substations), asset management (utility poles and underground cables), customer service (setting up accounts and field service), outage management, and much more. GIS makes it possible for a utility company's various computer systems and departments to work together. Billing procedures, engineering design, work order management, and field routing all benefit from GIS with proven return on investment. Because of the many benefits GIS brings to power company facility management, the community's utility company often leads the way in developing the community's GIS.

Eletropaulo Uses GIS for Facilities Management

São Paulo

Eletropaulo, a leading electric utility based in São Paulo, provides power to 4.8 million customers. This company uses ArcGIS/ ArcFM™ to streamline asset management, improve and extend interdepartmental communications, and expand the reach and accessibility of enterprise-level data. The facilities management software, ArcFM (specifically designed for utilities by Miner & Miner), works hand-in-hand with ArcGIS. Because the software is easy to use and highly functional, more than 100 Eletropaulo employees use the GIS for their day-to-day work activities. The utility uses the GIS to create intelligent geographic databases that couple behavior and properties. By using ArcSDE technology, the utility uses the GIS to support versioning and long transactions in a standard relational database management system. This allows several users to work on a single database.

Eletropaulo is using the GIS for analysis and visualization functionality to support outage management and response. Using GIS and supporting technologies, the company will meet strict outage response criteria enforced by regulatory agencies.



Boa Vista Energia S.A. Implements GIS Solutions

Amazon

Boa Vista Energia South America, a subsidiary of Centrais Elétricas do Norte do Brasil–ELETRONORTE, is an electric utility with a service territory of 3,550 square miles.

The company's GIS, named Management Graphical System for Distribution Lines (SIGREDIS), was originally designed to create topographical surveys in the municipal district of Boa Vista and to survey the count and geographic location of the power poles. GPS technology produced an immediate result by reducing the time it took to survey power poles by 80 percent. Furthermore, geographic points can now be efficiently surveyed in the field. All the distribution lines are drawn using GIS, and the respective attribute data information is registered. This makes it easy to correctly complete the registration of each customer, quickly create up-to-date maps, and accurately develop new projects.

Simulation systems for primary and secondary lines were based on ArcInfo™ software on the UNIX® platform. ArcInfo made it possible to use vector data, maintain up-to-date records of customer registration, and analyze network continuity. Basic functions of capture, conversion, editing, storing, manipulation, analysis, consultation, and exposition/plotting of spatial data and attributes were developed as well as the creation of a linking topology.

SIGREDIS provides ELETRONORTE with the necessary speed for processing and consulting the database. It allows the utility to calculate technical and nontechnical losses, discover frauds, and simulate network performance analysis in just a few minutes.

For more information, visit www.eln.gov.br.

Power Company GIS Used for Cadastre Database and Environmental Studies

Paraná

The Companhia Paranaense de Energia (COPEL) has incorporated a GIS called HARPIA into its operating system to better serve its three million customers in the state of Paraná. HARPIA uses ArcGIS as its platform to produce the region's first integrated GIS. COPEL is using HARPIA in the construction of the Salto Caxia Hydroelectric Plant. GIS offers an analytical tool for studying hydrographical and ecological impacts. It is also being used to determine the accompanying infrastructure necessary for the dam including powerhouses, water, sewer, access highways, and the effects on the local power network.

It was important to have solid demographic and economic data for the program, so the GIS team created social environment GIS studies. These maps provided administrators and legislators with an understanding of social and environmental diversity in the region. The studies also offer citizens insight that allows them to participate in the sustainability of their own communities. HARPIA supplies information at a Web portal called Green Generation that offers public environmental education.

COPEL is using HARPIA to create a reliable cartographic and cadastral database. In addition, HARPIA also creates maps for the ZERE program, which manages residues generated by energy production. COPEL was recently recognized nationally by the Associação Brasileira dos Distribuidores de Energia, which presented the utility company with its prestigious award for better delivery of services.

GIS Offers Water Utility Solution

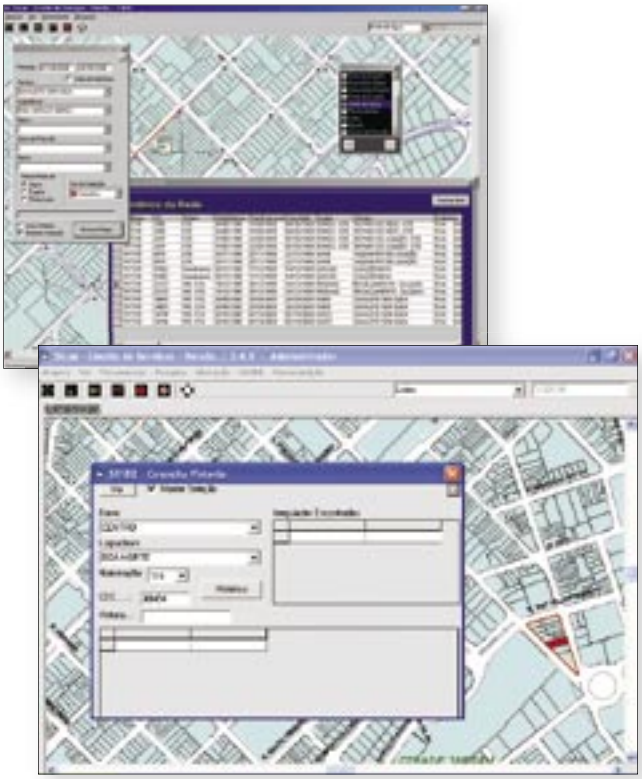
São Paulo

The city of Limeira in the state of São Paulo sought to expand the benefits it was reaping from its municipal GIS. Originally investing in GIS to produce digital cadastre maps, Limeira decided to expand the return on its GIS by improving the management of its water service department, Aguas de Limeira.

The city's GIS team digitized all the levels of information related to the sewer and water management of facilities. The digital information in the database was then integrated with the city's commercial cadastre, and applications were developed to meet the needs of end users. ArcView software is being used to draw resources from the digital database to create multiple map types for maintenance, customer service, and engineering.

The most expensive asset of a water utility is its underground water and sewer system. GIS helps Aguas de Limeira identify and focus action throughout the utility's 800 km of underground assets. For example, by correlating estimated population growth and water exchange sites, engineers are able to plan facilities based on projected customer need. The city's GIS database system stores highly useful data for the management of sewer service, the publication of Register of Administrative Orders, and the publication of the Cadastre Register. GIS also generates reports and maps for legal documentation.

At present, the entire field staff for water and sewer services uses GIS for everything from routine tasks to administrative analysis. The GIS plant maps have become a basic work tool. All water utility asset locations have been digitized into the GIS. This benefits the project area's 250,000 inhabitants.



GIS for Telecommunications

The telecommunications industry in Latin America is changing as quickly as it is growing. In such a dynamic market, telecommunication businesses need the power of GIS to stay ahead of their competition and give strong customer service. GIS provides wireless telephone companies with many solutions such as analyzing relationships among signal coverage, test results, trouble tickets, customer inquiries, revenues, and gap analysis. GIS also makes the design and development of wave propagation much easier.

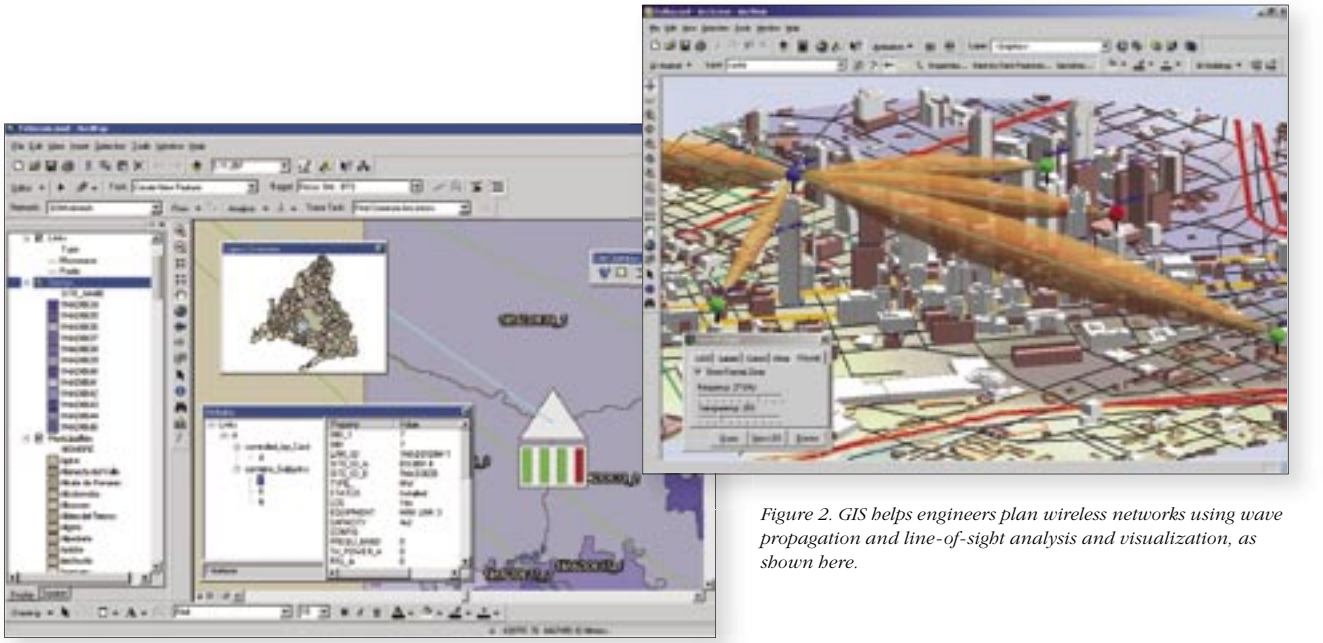


Figure 1. Operations support systems use GIS to monitor and evaluate network performance, dispatch service vehicles, and follow network testing.

Figure 2. GIS helps engineers plan wireless networks using wave propagation and line-of-sight analysis and visualization, as shown here.

Determining Telecommunications Demand

In 2001, Telecom Italia Mobile (TIM) acquired licenses for B- and D-band transmissions in Brazil, making it the first telecommunications business in the country to operate with this license. As it seeks to develop its Brazilian market for D- and E-band usage, TIM is using GIS to analyze a socioeconomically georeferenced data bank that will be useful in market analysis and business planning.

Using the geodatabase foundation, TIM uses GIS to identify the best options for actions and investments in the target municipalities, define the priority areas in each of the selected municipalities, and promote optimization of planning (engineering, marketing, and sales). GIS also offers competitive insight on how to improve services to each area while using cost-efficient strategies.

The project analysis outcome is a ranking of municipalities and surveyed sectors by market potential. The GIS also produced a market analysis database for each target group and has an activity index that ranks market data by potential (very high, high, medium, low, and very low). For example, the municipality of Rio Branco was identified as an area of high activity, and Cuzeiro do Sul was ranked as having medium activity. Most municipalities were classified as having very low activity areas. The models are open and allow for the inclusion and exclusion of variables as well as the modification of weighting in each index.

Cross-reference coverage maps combine attributes, which are useful for market comparisons. TIM's geographic segmentation model includes 45 physical, demographic, and economic variables. The database makes it possible to analyze the market potential of each region by district, municipality, and survey sector. Seeing the number of businesses in a sector helps in assessing an area's telecommunication needs. The correlations GIS brings to businesses support an understanding of the marketplace and direct intelligent planning strategies.

With GIS, providers can integrate their work flow based on the location of their assets, customers, sales territories, and coverage areas. As telecommunication networks grow more complex, the GIS applications providers use must become more sophisticated.

GIS for Learning Opportunities

Many schools are using GIS in their curriculums. From health epidemiology to agriculture precision farming, GIS is becoming an important part of Brazilian institutional teaching. Students use ArcView to learn wildlife analysis. They learn ArcView 3D Analyst™ in geology to study the topology of a mountainous region. They learn how to query, which helps them study "what-if" scenarios for analyzing an area's demographic changes.

As of 2003, more than 100 colleges and universities in Brazil offer GIS as part of their curriculum. Here are just a few: Instituto Brasileiro de Geografia do Rio de Janeiro, Universidade de São Paulo, Universidade de Campinas, Pontifícia Universidade Católica, Universidade de Brasília, Universidade Federal do Paraná, and Universidade Federal do Rio Grande.

ESRI knows that education and training are vital to every successful geographic information system implementation. Therefore, ESRI offers a variety of educational products covering topics related to GIS technology and applications as well as geographic information science.

Instructor-Led Courses

ESRI's instructor-led courses are ideal for those who need to learn the most in the shortest amount of time. Courses combine personal delivery, hands-on experience, and class participation to create a rich learning environment. Individual attention, direct peer interaction, professional networking, and the ability to get answers to questions on the spot are cornerstones to the effectiveness of instructor-led training. The contacts on the back cover of this brochure will direct you to GIS courses and seminars in your area. You can also go online to find a local distributor at **http://gis.esri.com/intldist/contactint.cfm**.

Web-Based Courses

The ESRI Virtual Campus offers Web-based courses in English over the Internet to motivated learners who want or need flexibility in their training schedule or location and for those who cannot afford the time away from work to attend traditional classes. Web-based courses combine hands-on experience, interactivity, and instructional support to create a dynamic learning environment. Accessibility, convenience, timeliness, and the ability to control one's own learning experience are the hallmarks of ESRI Virtual Campus courses. Visit the Virtual Campus at **http://campus.esri.com**.

ESRI Distributor-Led Courses

Brazilian ESRI solutions distributors offer classes and seminars for GIS students. See their contact information on the following page.

Self-Study Workbooks

ESRI's self-study workbooks, published by ESRI Press, are ideal for highly motivated learners who can independently complete work and apply what they have learned with little outside support. Workbooks are for those who would rather read than listen and who prefer to do their reading offline. They combine print delivery, hands-on experience, and a variety of printed and digital support materials to enhance the learning environment. Portability, accessibility, convenience, timeliness, and the ability to control one's own learning experience are keys to the popularity of ESRI workbooks. Workbooks are in English. ESRI Press books are available directly from ESRI by calling **1-800-447-9778** or ordering online at **www.esri.com/esripress**.

GIS BRASIL

GIS BRASIL is an annual conference enjoyed by GIS users who come from everywhere in the country. This event is attended by 4,000 participants who share in technical software sessions and network to learn how other people are using GIS in their daily business. The conference offers 30 business-oriented sessions that consistently receive excellent reviews from those who attend. GIS BRASIL provides a superior group of instructors who are knowledgeable about the latest technological updates. Demonstrations about GIS and GPS solutions are given, and GIS vendors demonstrate their latest software innovations. For information on upcoming GIS BRASIL dates, visit **www.gisbrasil.com.br**.

GEOBrasil International Conference

GEOBrasil is an annual international conference of Latin American GIS users who produce, integrate, and use geographic information. This conference is supported by the Geospatial Information and Technology Association (GITA). A GIS user community formed of many disciplines and industries presents conference sessions. GIS technology is demonstrated, and real-world users offer industry solution insights that are successfully integrated and functioning in their business systems. For information on upcoming GEOBrasil dates, visit **www.geobr.com.br**.

ESRI provides geographic information system software and related services to clients worldwide. Headquartered in Redlands, California, ESRI also has U.S. regional offices, overseas subsidiary companies, and distributors doing business in more than 189 countries. ESRI's flagship product, ArcInfo, a high-end GIS, has capabilities for the automation, modification, management, analysis, and display of geographic information. Several related products developed and marketed by ESRI include ArcView, an affordable geographic data query, display, and output tool for the desktop; ArcSDE, a gateway for GIS data in a database management system (DBMS); and MapObjects, embeddable GIS and mapping components for application developers.

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