Imaging NOTES

Summer 2010
Vol. 25 » No.3

EARTH REMOTE SENSING FOR SECURITY ENERGY AND THE ENVIRONMENT

Community Remote Sensing

Lawrie Jordan of ESRI

LBx JOURNAL
ON LOCATION INTELLIGENCE

CORAL REEF MAPPING

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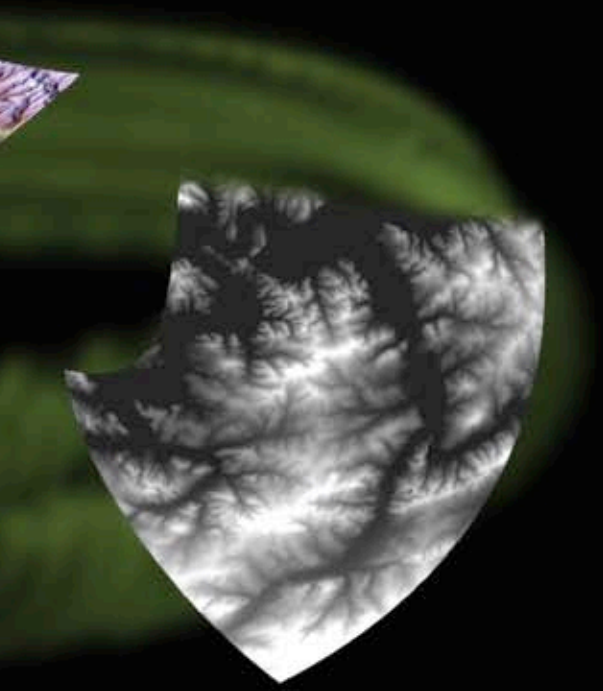

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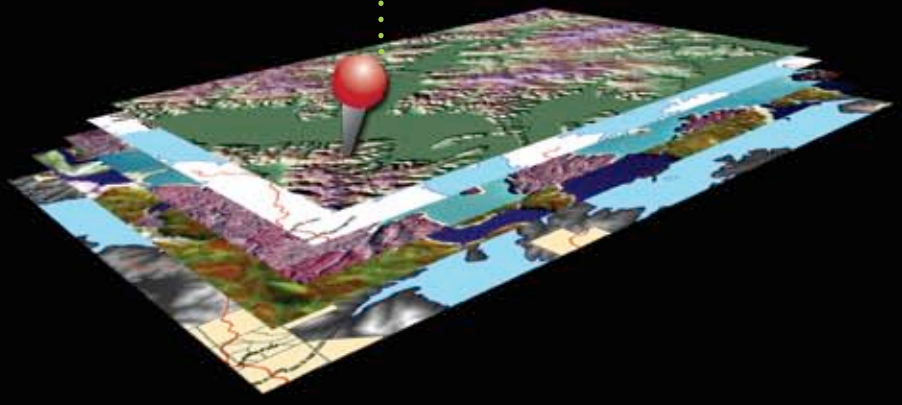

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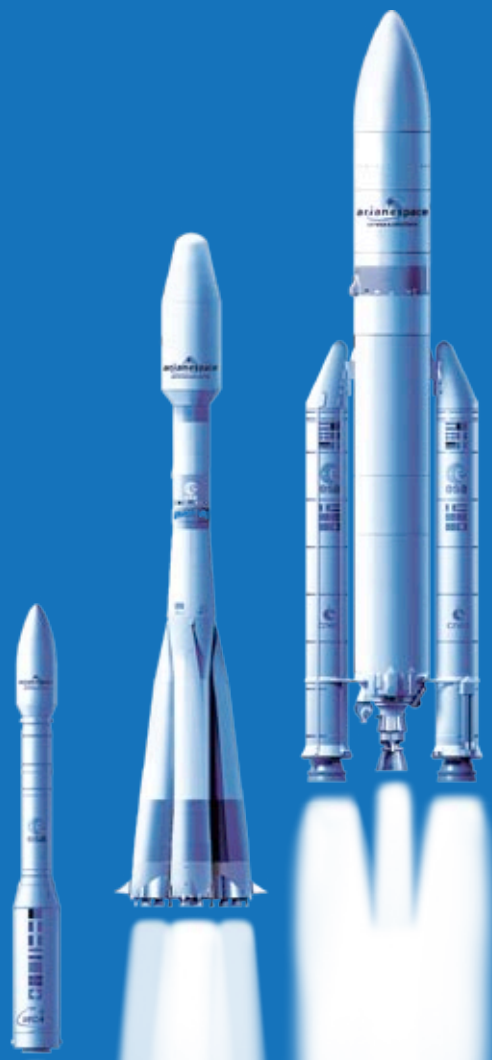

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Imaging NOTES

Summer 2010

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Aswan High Dam, Egypt

COVER IMAGE

The Aswan High Dam, situated across the Nile River in Aswan, Egypt, is one of the largest embankment dams in the world and produces the world's third largest reservoir, Lake Nasser. The capacity of Lake Nasser is 5.97 trillion cubic feet, which is nearly five times the size of the Hoover Dam in the U.S.

Completed in 1970, the Aswan High Dam was built to control the annual flooding of the Nile River, to provide water storage for agriculture and to generate electricity. For years, the Nile River overflowed its banks annually, depositing tons of nutrients on the valley floor, and creating a very productive and fertile farmland in the middle of the desert. However, during those years when the flooding did not take place, the area experienced widespread drought and famine.

The Aswan High Dam is now used to control the flooding by capturing water in the rainy seasons and releasing it in the dry seasons, but it is also producing several negative side effects, including the relocation of 90,000 Egyptians and the loss of the nutrient-rich silt that once fertilized the land. The fertility of Egypt's farmland has decreased so much that now more than half of Egypt's soil is rated medium to poor.

Aswan High Dam is shown in natural color, at 2.5-meter resolution. The image was taken by the Spot 5 satellite on Dec. 24, 2006. It was orthorectified using Reference3D and mosaicked using Pixel Factory, which are products sold by Spot Image. Image Copyright: 2006 CNES. Distribution Spot Image Corporation, U.S.A. All rights reserved.

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Our Mission

Imaging Notes is the premier publication for commercial, government and academic remote sensing professionals around the world. It provides objective exclusive in-depth reporting that demonstrates how remote sensing technologies and spatial information illuminate the urgent interrelated issues of the environment, energy and security.

Imaging Notes has a partnership with Secure World Foundation (www.secureworldfoundation.org).

Imaging Notes is affiliated with the Alliance for Earth Observations, a program of The Institute for Global Environmental Strategies (www.strategies.org).

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Monday, November 1

PRECONFERENCE LEARNING & TECHNOLOGY TRACKS

USGIF is providing two concurrent tracks on Monday, November 1, from 10:00 a.m. to 4 p.m.

One track will focus on Academia and Education with an overview on the USGIF Accreditation and Certification Program for colleges and universities; presentations from the NGA University Research Initiative (NURI); and a service academy roundtable discussion.

The second track focuses on innovation and technology with an IC S&T discussion lead by NGA's InnoVision directorate; an Activity-Based Intelligence tutorial; and a Worldwide Incidents Tracking System (WITS) overview and demonstration by NCTC.

Defense Intelligence Information Enterprise (DIIE)

Wednesday, November 3

AN ENTIRE DAY DEDICATED TO DIIE!

A keynote from Lt. Gen. John C. Koziol kicks off the day. Following this, attendees will hear from panelists Kevin Meiners and Dawn Meyerriecks for discussions on how airborne ISR must be capable of providing U.S. and coalition combat forces at the lowest echelons access to all relevant intelligence data and analysis, while simultaneously providing intelligence from fielded forces to higher-level organizations and regional intelligence centers.

Several breakouts on topics ranging from emerging sensors and platforms to Multi-INT integration, will also take place in the afternoon.

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Community Remote Sensing Offers Serious Potential

EARTH OBSERVATIONS EMPHASIS RISES

Earth Observations Sessions Added

Conferences continue to be a key focus for us as more organizations begin to understand more fully the value and potential of Earth Observations. In recent years, major gatherings such as Geospatial World Forum in India (formerly Map World Forum) and World Satellite Business Week in Paris, have been adding Earth Observations Symposia within their meetings. These inclusions demonstrate that finally Earth Observations are getting the attention they deserve, in recognition of their potential, ultimately, to increase the capabilities for using the data to save Earth, save homes, save livelihoods and save lives.

Community Remote Sensing at IGARSS

One of the emerging fields helping to increase these capabilities is Community Remote Sensing (CRS), or citizen science/citizen mapping, or to use a more casual term, crowdsourcing, of data. Bill Gail of Microsoft points out on page 54 that the data gap is being filled by contributions from the community – people who enter data for certain projects from their cell phones. Ray Williamson writes about the potential impact of CRS on page 10, and we profile two projects using CRS on page 15.

The 30th Anniversary meeting of IGARSS in Hawaii in late July will include sessions on CRS as well. The keynote will be given by two leaders of the U.S. Office of Science and Technology Policy (OSTP): Aneesh Chopra, President Obama's Chief Technology Officer, and Shere Abbott, Associate Director for Environment. They are quite interested in the CRS theme and the potential for the community to build a broader program around the theme. This address will be followed by a panel session with representatives from major space agencies discussing the impact of CRS on their activities.

Forum on Earth Observations 4 Report

I attended and wrote in eNews about the Forum on Earth Observations 4 (www.forumoneo4.com). The Alliance for Earth Observations brought together some key climate scientists, including Ralph Keeling of the Scripps Institute of Oceanography; Melinda Marquis and Monica Medina of NOAA; and The Honorable Alan Mollohan (D-WV), Chair, Subcommittee on Commerce, Science and Related Agencies, Committee on Appropriations, U.S. House of Representatives. Jigar Shah of the Carbon War Room brought to the room the subject of addressing climate with business ideas and economics.

Timing of this meeting was difficult because, to date, the BP oil spill disaster (I noticed that the Beltway politically correct way to refer to it is "Deepwater Horizon Incident") had yet to be stopped, and hearings were beginning on Capitol Hill. Read my summary of the meeting at www.imagingnotes.com/eNews.

Executive Interviews: Lawrie Jordan and Joel Campbell

We are privileged to include Executive Interviews with Lawrie Jordan (page 49), co-founder of ERDAS in the 1970s, now Director of Imagery at ESRI, and Joel Campbell (page 21), new President of ERDAS. Both companies are extremely professional and are focused primarily on their customers' needs in doing product development, which clearly speaks to their commitment to customer satisfaction.

Imaging Notes is fully committed to telling the stories of using remotely sensed and geospatial data – images, lidar, radar – and aerial data as well. As Lawrie Jordan notes, "*Imaging Notes* takes some of the science and mumbo-jumbo out of it and gets right to storytelling."

The Spring issue of *Imaging Notes* did not accurately identify the source of a few quotes in the story, "Radar Gets It Done." Kern in that story is Andreas Kern, who is Director of Business Development and Sales for Infoterra GmbH. I offer my deepest apologies for this omission.

Please follow us on Twitter and join our *Imaging Notes* groups on LinkedIn and Facebook, where you'll find photos from our travels.

–Myrna James Yoo
publisher@imagingnotes.com

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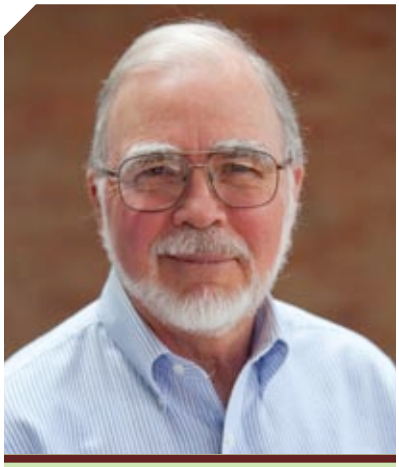
From Reality 2010 to Future Vision 2020

CRS POTENTIAL FOR DISASTER RESPONSE

SECURE WORLD FOUNDATION FORUM

Recently, I was asked to share my vision for the future of remote sensing and the response to natural disasters. Where could we be in 10 years? Where should we be? Are we even making effective use of what is available today? These questions are driven by the realization among the disaster response community that, despite all of the effort devoted to the use of remote sensing in response to the Chilean and Haiti earthquakes and European flooding, the effort still falls short of the potential.

A quick survey of today's space-based remote sensing data sources reveals an amazing variety. Some two dozen countries and at least a half dozen private companies own and operate electro-optical multispectral systems that provide data on an operational basis – in other words, customers of these systems can expect that the satellites collecting data will be replaced when they eventually fail to operate. Smaller numbers of companies and countries collect data from operational synthetic aperture RADAR (SAR) satellite systems. The field has clearly come a very long way from the first tentative steps with the Landsat program of the 1970s.



RAY A. WILLIAMSON, PhD, is editor of *Imaging Notes* and Executive Director of the Secure World Foundation, an organization devoted to the promotion of cooperative approaches to space security (www.SecureWorldFoundation.org).

Today's space systems provide data at varied resolutions, swath width and number and width of spectral bands. A few countries make data available free to all customers; others limit data distribution to select users. The private companies, of course, charge for data at competitive rates. In addition, a number of countries operate research satellites that are being used around the world in a quasi-operational basis to collect both surface and atmospheric data.

As space-based systems were being developed, airborne sensors and systems also followed right along. Now aircraft routinely carry a range of high-resolution electro-optical, RADAR and, most recently, LIDAR systems that can provide data on a contract basis for tasks where space-based systems cannot meet the scale or flexibility needs of the customer.

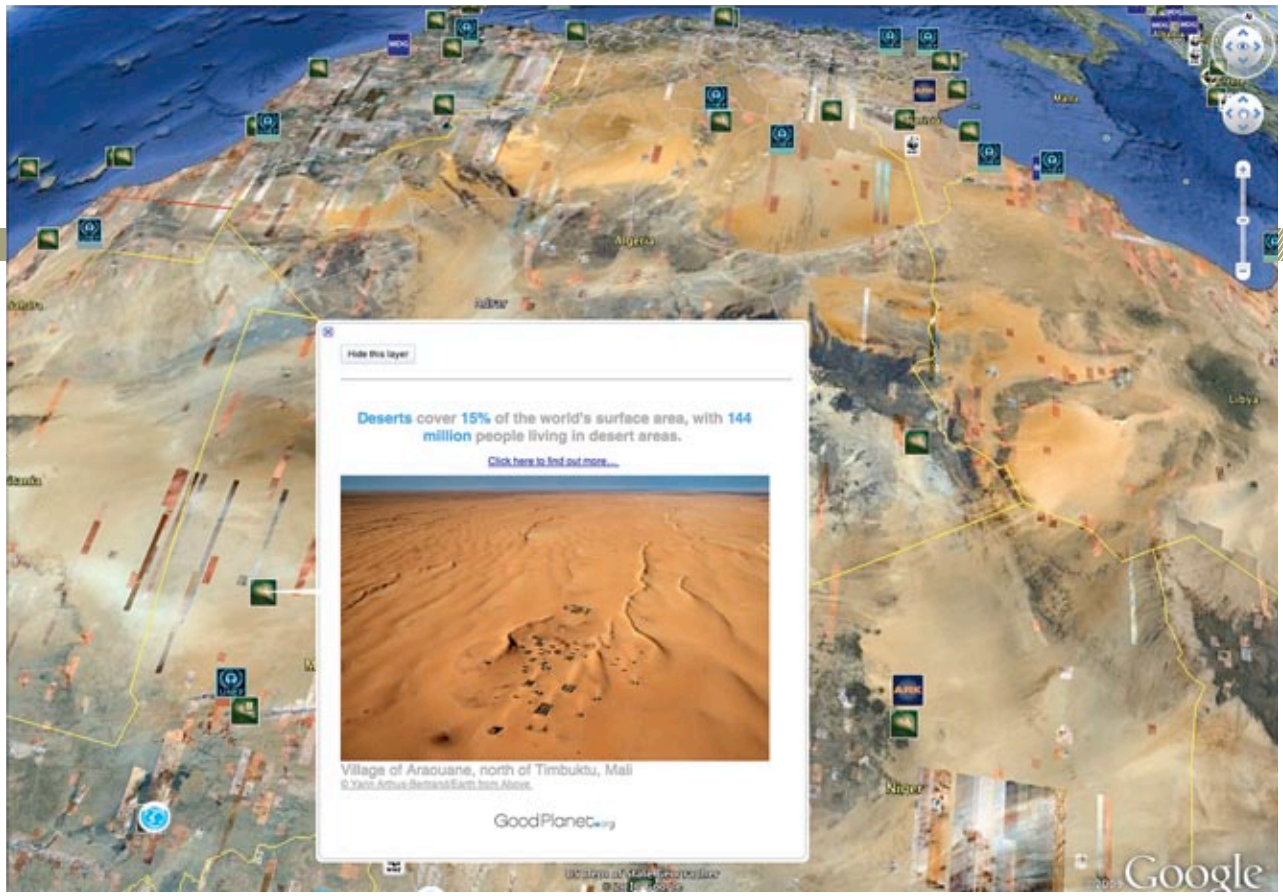
In short, a nearly bewildering set of data sources at different scales and characteristics is already available for the information needs of potential customers. In the near future, there will be many more. Thanks to the small-satellite revolution, many countries, including developing countries, are either building or considering the development of their own satellite systems. In addition, the past decade has also seen the development of powerful analytic tools.

Few doubt the utility of remote sensing for responding to natural disasters. The data provide an unparalleled synoptic view of the disaster scene at many scales. Yet how well are these systems put to use in the response and recovery? What innovations are needed? In our Spring 2010 issue, we provided one example from ImageCat on how GEO-CAN responded to the Haiti earthquake. Most natural disasters, such as hurricanes, earthquakes, floods and volcano eruptions, occur on a broad scale. Yet as far as the victims are concerned, the effects are local.

This then leads to my vision for the future and the innovations that I believe can and should take place in the response to natural disasters. For part of this I am indebted to Bill Gail, who pointed out recently that there exists a remote sensing "'scale gap' – the emerging demand for human-scale observations not readily supplied by traditional spaceborne and airborne remote sensing."[1] (See Bill Gail's editorial on page 54.)

I envision a world a decade from now in which everyday citizens have broad access to high-resolution space-derived data and information about their communities and in which they, wishing to contribute to their own well being, input local data into regional weather and climate models. It is a world where local environmental groups concerned about degradation of local waterways are empowered by technology and their own ingenuity to collect in-situ data on water quality and changing shorelines and to incorporate them into regional information collected from space platforms.

It is also a world where accurate and detailed information on local conditions reaches first responders within 24 hours after a disaster strikes, and where the affected population has the needed geospatial tools to guide their own recovery and reconstruction. In this world, the people hit by the disaster can also collect data on local conditions and report to assisting agencies.



▲ *Google Earth is a tool that allows users or groups of users to add their own data. Shown here is an aerial image inset of the desert in Mali, Africa, from GoodPlanet.org, which also embeds environmental data about the images.*

Little of this vision is an issue of lack of technology or data availability. Rather, it is much more a matter of developing access to the technologies that now exist and building the appropriate public and private institutions to provide accurate and timely analysis of conditions in the affected site. It is also about building the appropriate links among institutions to facilitate the use of the tools that exist.

Thanks initially to the efforts of Google Earth, the concept of citizen access to high-resolution data from space is no longer an exotic one, no longer a dream. Anyone with access to the Internet can now explore the view from space of their neighborhood. More important, they can add more detailed information to features that show up there. What these images provide is an awareness of surroundings and a sense of relationships that are not easy to envision from a view on the ground.

In that way, citizens are filling the scale gap with information that they and their neighbors on the Internet can use. They can, for example, provide information on local hazards to their neighbors. Now that smartphones and other Internet devices have proliferated widely, these remarkable devices can be used to provide that information to local authorities. This is what has been called Community Remote Sensing.

So, what do we need in order to achieve this vision for 2020? At a minimum, I think we need:

- A simple means for potential new data and information sources to navigate the confusing plethora of data sources: analytic software. Secure World Foundation is working with CRECTEALC of Mexico to develop a unique database tool for this purpose;
- User-friendly analytical tools to make it possible for non-experts to do their own basic analysis;
- Development of a set of smartphone applications to allow citizen input to remotely sensed data, whether they are part of a governmental function or a less formal local structure;
- Methods to ensure that damage and other information valuable for first responders reaches them within 24 hours of the natural disaster. «

Footnote 1. **Gail, William B., "Filling Remote Sensing's Scale Gap," Space News, March 22, 2010, reprinted in this issue on page 54.**

Climate Change Reality: Skeptics Versus Empirical Earth Science

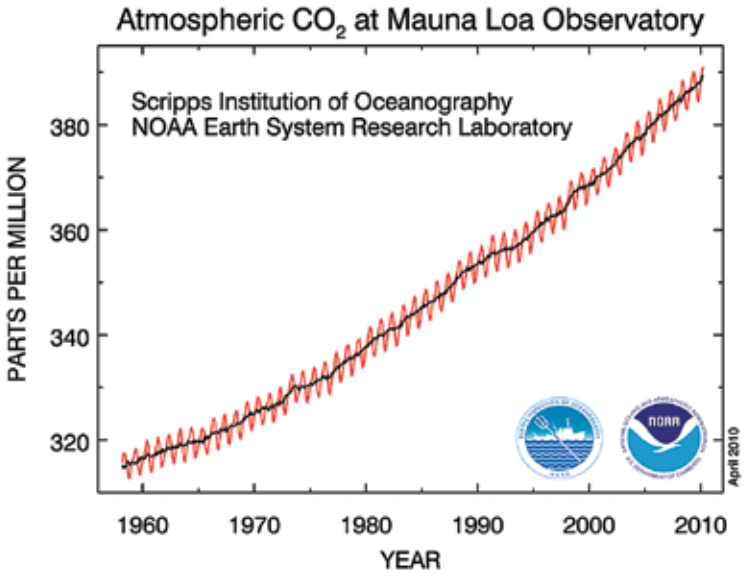
*The vast majority of good scientists today are comfort-*able with the current understanding of climate change, while recognizing that many complex components need continuous monitoring and measurements. At the same time, most scientists appreciate that basic knowledge of the physics of Earth's systems needs further refinement and that the biological components and feedback mechanisms of Earth's systems, though not fully known, play a significant role in climate change interactions and trends.

So what is the problem if a few scientists are not satisfied with knowledge of climate change science and do not agree with the consensus of the IPCC (www.ipcc.ch)? Fundamentally there is no problem. In fact, we should always cherish critical questioning of any hypotheses, data collection methods, or analyses of results. Unfortunately, a problem does arise when the empirical science of climate change has been whitewashed out of the public arena by climate change skeptic campaigns, many of which are financed by recalcitrant industries resisting environmental protection and Earth stewardship responsibilities.

Recent polling indicates that only about a third of our fellow citizens believe in climate change and in the links between fossil fuel, land use and the global climate phenomenon (www.pollingreport.com/enviro.htm). This proportion represents a precipitous drop in climate change awareness from just a few years ago. Such an appalling drop in citizen awareness of the scientific facts is disheartening to those of us who wish to focus our energy on issues of adaptation, mitigation, and soc-ietal transformation to obtain clean and renewable energy sources. The science of climate change is overwhelming. And that may be the problem. When people are overwhelmed, well, they simply cannot absorb the information. They turn off. This gap in citizen knowledge is being filled in with shock radio and biased television news programs that revel in their contrarian and conspiratorial disinformation campaigns.

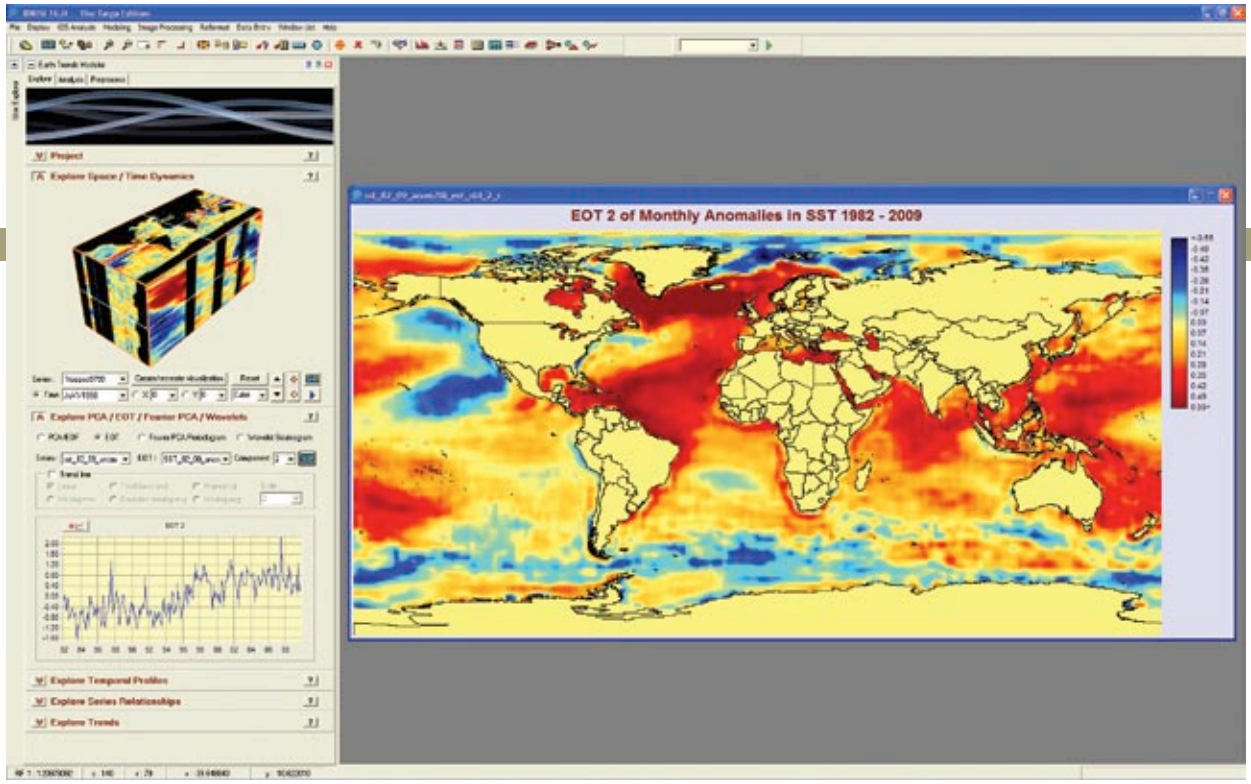
Fortunately, climate change science curricula have received a lot of attention and funding by federal agencies over the past few years (e.g., NASA, NOAA, NSF, and others) to build academic understanding and to promote resources for universities and K-12 schools. This summer, the American Meteorological Society, in partnership with NASA, is launching Climate Studies: Introduction to Climate Science (1st Ed 2010 AMS). A significant library of student and investigator guides now exists with excellent and accessible writings on climate change, ranging from Tim Flanner's *The Weather Makers*, to Jim Hansen's *Storms of My Grandchildren*. Science and citizen awareness can and should be promulgated in every school to focus on explaining the hard facts regarding shifts in the Earth's climate system, using visual Earth observation and field data.

A refreshing addition to the under-



▲ **FIGURE 1.** *Keeling Curve depicting the measurements of CO_2 in the atmosphere since 1958, which was named after the pioneering atmospheric scientist Dr. Charles David Keeling, who initiated the CO_2 measurement protocols and monitoring program. Courtesy of ESRL NOAA.*

DR. TIM FORESMAN is president of the International Center for Remote Sensing Education.



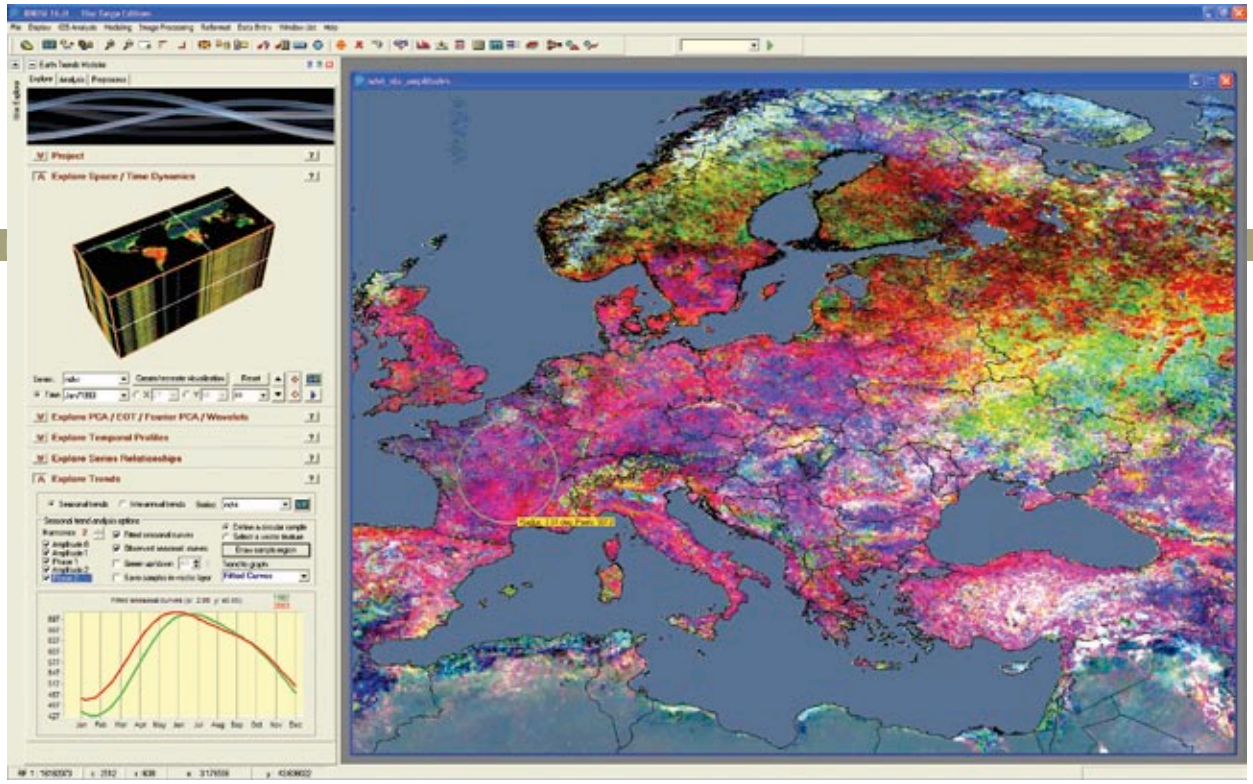
▲ **FIGURE 2.** *The climate system has a series of preferred patterns of variability called Teleconnections that have major implications for human activities. In an Empirical Orthogonal Teleconnection (EOT) analysis of anomalies in sea surface temperature (NOAA Optimally Interpolated Version 2) from 1982-2009, the second EOT (after the El Niño/Southern Oscillation phenomenon) correlates strongly with the Atlantic Multidecadal Oscillation (r = 0.70) – an approximately 70-year oscillation in northern hemisphere Atlantic sea surface temperatures. Note that during the limited period analyzed, Atlantic temperatures were uniformly increasing. Thus the analysis also probably includes a global warming component such as in the Indian and Pacific oceans. Courtesy of Clark Labs.*

standing of climate change and exposure to the science of shifting climate is evident in the work of Clark Labs, home of Idrisi remote sensing/GIS software. Clark Labs, directed by professor Ron Eastman, the 2010 winner of the Distinguished Career Award by the American Association of Geographers, is dedicated to getting climate change tools into the hands of citizens. Under Eastman's leadership, Idrisi has been used in over 180 countries, making image processing and modeling accessible to thousands of government and university researchers across the world. Two new Idrisi applications, the Land Change Modeler and the Earth Trends Modeler, are particularly helpful in documenting climate change trends (http://www.clarklabs.org/products/Earth-Trends-Modeler.cfm). Pedagogic use of these, or similar remote sensing tools, might represent a new approach to demonstrating the facts of climate change.

To begin with, an empirical approach to climate change, the facts collected over the past century, must be placed before the student. The student should be encouraged to question and challenge each presented fact. Hard evidence should never avoid serious enquiry. From the time of Svante Arrhenius to Charles David Keeling, a litany of empirical facts has been largely ignored or unknown to the public (and sadly to many scientists too). The Keeling Curve is one of the most visually compelling datasets of our time and should be central to the dialogue for bringing together the climate change science puzzle (***Figure 1***). This curve can serve as the basis for a single lecture or a semester-long course, such is its power for science comprehension and research.

The overarching question that needs to be asked of this curve: If CO_2 continues to fill our atmosphere as it is doing now, what will be the outcome? (The second question – What can we do about it? – is the more difficult to address due to political, economic, and societal challenges. Consider the December 2009 Copenhagen U.N. Climate Summit.) Regarding the first question, we can utilize the Idrisi tools to document empirical data from Earth observation satellites and can empower students and professors with direct, first-hand interaction with climate change science data. This kind of interaction creates a remarkable transformation in observer attitudes.

When we examine sea surface



▲ **FIGURE 3.** *A Seasonal Trend Analysis (STA) of Normalized Difference Vegetation Index (NDVI) data, 1982-2003, from the AVHRR instrument on the NOAA Polar Orbiter series. This series represents one of the longest Earth observational series available. The analysis indicates that most of Europe is experiencing the same seasonal trend – substantially higher vegetation productivity during the winter and spring, with a slight decline during the summer and a mild extension of the autumn. Graph provided by NASA GIMMS group, and courtesy of Clark Labs.*

Two new Idrisi applications, the Land Change Modeler and the Earth Trends Modeler, are particularly helpful in documenting climate change trends (www.clarklabs.org/products/Earth-Trends-Modeler.cfm). Pedagogic use of these, or similar remote sensing tools, might represent a new approach to demonstrating the facts of climate change.

temperatures over the period 1982 to 2006 using the Earth Trends Modeler (an unfortunate name, as it effectively documents empirical data versus "models") we can readily see that a warming trend is evident, notably in the northern hemisphere (***Figure 2***). Image time-series data are requisite to document global climate change and for exploring such global events as El Niño and related sea surface temperature anomalies and impacts.

The major challenge, however, is in isolating true change from measurement artifacts and normal environmental variability. A variety of techniques, including a coordinated suite of data mining tools for time series analysis, is needed to effectively document sea-surface and land-surface changes associated with climate change. These tools can be applied to demonstrating the seasons' shifts, such as the earlier onset of spring for regions such as Europe (***Figure 3***).

As students become more familiar with the empirical science and climate trends over the past couple of decades, they become better ambassadors for public awareness. We need a lot more ambassadors in this world if we hope to change the current polling trends and possibly convert media-bred skeptics into knowledgeable citizens. This conversion will require the widespread adoption of tools like Idrisi to upgrade our current school curricula and create a cadre of educated climate change ambassadors. «

CRS Impact

MYANMAR CYCLONE RELIEF AND CORAL REEF MONITORING

COMMUNITY REMOTE SENSING (CRS) IS AN EMERGING MOVEMENT MADE possible by technology advancement, public access to satellite imagery and the growing mass of technology-savvy citizens. It combines software, data and server-based systems to link experts and volunteers who contribute to collection of information for large-scale project areas. A priority watch activity of 2010 IEEE International Geoscience and Remote Sensing Symposium (IGARSS), CRS is characterized by application of location technology that ". . . combines remote sensing with citizen science, social networks, and crowd-sourcing to enhance the data obtained from traditional sources. It includes the collection, calibration, analysis, communication, or application of remotely sensed information by these community means." One form of CRS, crowd-sourcing is the use of cellular text messaging, Global Positioning Systems (GPS) and Twitter (San Francisco, Calif.) technology to report ground-level activities real-time and near-time for use in analysis.

Easy-to-access web-based collaboration tools have made possible a new era of distributed processing. This translates into the capacity to "…harness thousands of people around the world to do a tiny bit, a tiny little area each…," and to provide critical information in a useful timeframe,

EDITOR'S NOTE: Another article about coral reef mapping appears on page 20.

BY NATALIE CUTSFORTH
Writer and Geospatial Consultant
Denver, Colo.
http://nataliecutsforth.com/bio

▲ **FIGURE 6.** *Heron Island and Reef, Southern Great Barrier Reef, Australia. This image is from QuickBird-2, taken July 1, 2007. It is pan-sharpened multispectral. Copyright and courtesy of DigitalGlobe. Processed image data from the Center for Remote Sensing and Spatial Information Science, School of Geography, Planning and Architecture, University of Queensland.*

Widespread access to remotely sensed data has taken censorship out of the equation, so citizen organizations can proceed even when there is government resistance.

says Scott Madry, who is associate research professor of archaeology at University of North Carolina, Chapel Hill, a member of the faculty of the International Space University (Strasbourg, France), and president of Informatics International Incorporated, a Chapel Hill consulting firm. CRS is being used to acquire real-time weather data on private vehicles, ground-level data in agricultural settings and for disaster response, for local ecological and marine habitat monitoring, human rights watch information, and rapid peer-review of remote sensing work, and to advance the contributions of indigenous communities.

GISCorps Volunteerism

One of the leading programs to apply CRS to large-scale international projects is GISCorps. They are a volunteer-based group formed in 2003 in Atlanta, Georgia, by Urban and Regional Information Systems Association (URISA) (Des Plaines, Ill.) GISCorps was formed with the intention of applying Geographic Information System (GIS) skills to make a positive impact on the world. The group mission supports humanitarian aid, community planning and development, health and education activities, human rights relief, environmental analysis, and economic development, as well as works to strengthen the local capacity to adopt and use information technology in disadvantaged areas. GISCorps relies on four types of supporters to complete their mission: committee members, volunteers, partner agencies and donors. They provide assistance with GIS projects in the form of:

- short-term onsite deployment of personnel who offer technology transfer and training or
- remote project team data creation from participants in locations around the world.

Cyclone Nargis Hits Myanmar

A specific incident that proved the impact of harnessing volunteers to collect massive amounts of data quickly was the response to cyclone Nargis, which hit Myanmar (Burma) beginning May 2, 2008. GISCorps was approached by UNOSAT, the UN Institute for Training and Research (UNITAR) Operational Satellite Applications Program, to coordinate volunteers with GIS and imagery analysis skills. A request was sent to GIS list serves for volunteers willing to provide immediate expertise to attribute features on pre- and post-cyclone imagery. GISCorps provided team members simple project area instructions and a Google Earth (Mountain View, Calif.) web mapping interface via a wiki, an interactive internet site that is not hierarchical and is easy to manipulate by all levels of project participants.

An understanding of local culture played a critical role in choosing the focus of data collection. The team collected typical features such as roads, bridges and towns, but also Buddhist monasteries. Monasteries are the heart of the Burmese communities, and therefore are the natural sites where people

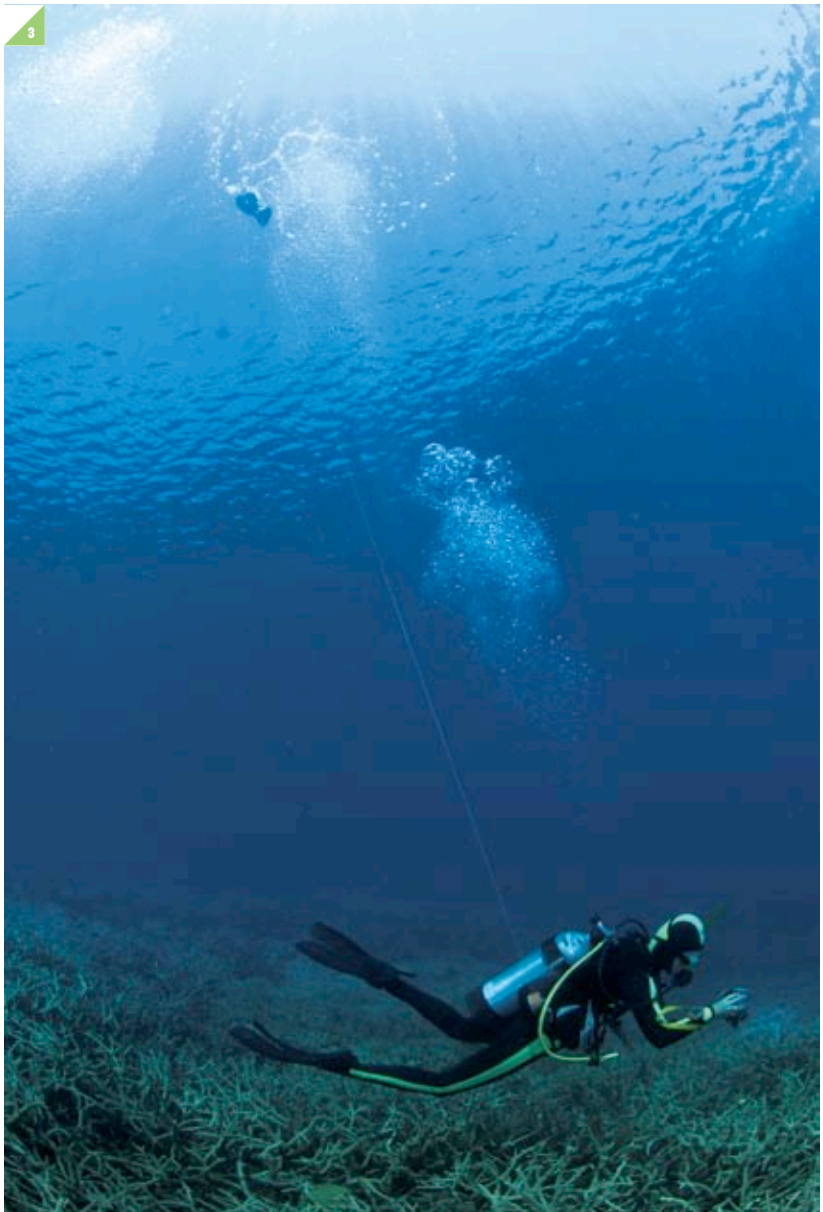


FIGURE 3. *A scuba diver collects digital imagery of coral reefs with a GPS unit buoyed to the surface.*

◀ **FIGURE 1.** *Satellite-based damage assessment for an affected unnamed village north of Tunggale village, Ngapudaw Township, Myanmar. Attributes created by GISCorps volunteers on 50-cm WorldView-1 satellite imagery (DigitalGlobe) acquired May 23, 2008 after cyclone Nargis impacted the region. Pre-cyclone Quickbird imagery (also DigitalGlobe) in Google Earth from Jan. 17, 2005 was also used for change detection. Processing by Pacific Disaster Center. Image courtesy of GISCorps, NGA, Respond/Keyobs.*

▲ **FIGURE 2.** *Overview of 18 villages affected by Myanmar cyclone, a final online deliverable made available to relief workers using a combination of remote sensing sources and attributes generated by GISCorps volunteers as a Landat Mosaic (ESRI-MDC). Damaged buildings have been identified with WorldView-1 satellite imagery (DigitalGlobe) acquired on May 6, 8, 10, 23 and 27, 2008 at a spatial resolution of 50 cm. Pre-cyclone Quickbird imagery from 2005 was also used for change detection. Processing by Pacific Disaster Center. Image courtesy of GISCorps, NGA, Respond/Keyobs.*

congregate in time of crisis. The first round of feature attribution used pre-disaster data and the second round used post-disaster data.

Citizen-Distributed Data Processing

All GISCorps volunteers worked from home and collaborated virtually via the online wiki community to receive assignments and produce as much data as possible outside of their normal working hours. Google Earth was used to attribute single points, lines and polygons on the satellite imagery backdrop. As team members completed assigned areas, they sent information to the project coordinator for review (***Figure 1***). The data were quality checked, then converted to an ESRI ArcGIS (Redlands, Calif.) software environment to add the power of a relational database. Attributes were then sent to UNOSAT, who completed the final cartographic product, providing it to relief workers through a web portal.

The government of Myanmar was initially not willing to allow international aid into the country, causing a delay in critical lifesaving efforts. This didn't stop the GISCorps project team of 33 volunteers from producing 1300 hours of work to identify 60,000 attributes on the map from May 9-21, 2008. When relief workers were finally allowed into the country, they had online access to the data they needed to prioritize response (***Figure 2***).

Widespread access to remotely sensed data has taken censorship out of the equation, so citizen organizations can proceed even when there is government resistance. Madry, who volunteered on the Myanmar cyclone GISCorps team, indicated, "The whole idea was speed and distributed processing in a very standardized way… Using a remote project team model reduces costs and increases the turnaround time on time-critical projects. Technologies such as Skype (Luxemburg), Google Earth and high-bandwidth internet have opened up a new way for volunteers to be effective from their own locations around the world."

Incidents such as the Myanmar cyclone have provided the opportunity to apply CRS and discover efficiencies that are being implemented in future projects. For example, the GISCorps team learned that attributes could have been collected

in a shorter period of time by identifying which regions had more dense data and assigning smaller areas to volunteers based on this knowledge. Madry suggested another route to improve response time would be to "…move datasets between volunteers around the planet based on waking/working time zones." Typically in emergency response scenarios, there is a high degree of volunteer burnout with people on the ground working 24/7 to reach victims. The power of CRS to distribute processing of critical data in manageable chunks relieves pressure on relief teams and reduces the situations when the data shows up too late to save human lives.

Coral Reef Monitoring

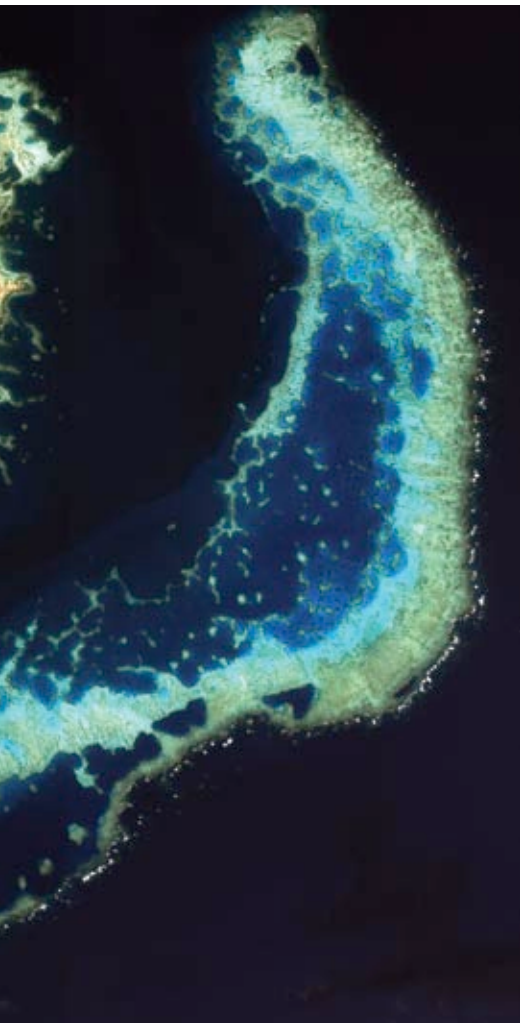
A less time-critical application of CRS is monitoring coral reef habitat in coastal regions. Historically, management of marine ecosystems has been localized and limited to specific study areas with rare species or economic value. Government, educational institutions and conservation groups employ experts to collect, compile and analyze the data used in management

▼ **FIGURE 4.** *Researchers performing field survey to monitor health of coral reef habitat.*

▲ **FIGURE 5.** *Kubulau Reef in Fiji, image taken by IKONOS in 2006, provided by Wildlife Conservation Society – Fij, and processed by University of Queensland.*

of coral reef benthic communities, organisms that live in and on the ocean floor. In an effort to expand human understanding of healthy coral reef habitat, a team led by the University of Queensland, Australia, school of Geography, in collaboration with the Wildlife Conservation Society, South Pacific Applied Geosciences Commission and University of South Pacific, all located in Suava, Fiji, has developed a toolset that local communities can easily use to collect and monitor coral reef habitat.

Regional participants in projects of this scale bring to bear critical first-hand



knowledge and expand the reach of traditional research environments. The Remote Sensing Working Group of Coral Reef Targeted Research (CRTR) and Capacity Building for Management Program created the Coastal Remote Sensing Toolkit (CRST) (www.gpem.uq.edu.au/crssis-rtoolkit) to monitor the health of benthic communities with remote sensing. In the process, they have developed coast-specific change detection methodologies that are applied for observation and management of biodiversity.

In the water, anyone with a GPS unit and underwater digital camera can collect data of a coral reef using the group's simple methodology. The GPS unit must be kept afloat with a buoy on the surface directly above the digital camera, and the data post-processed to provide accurate location of the photographs for use in a GIS. Participants swim transects of the coral reef in order to collect the necessary sampling of data. Once the data is in the hands of researchers, it is studied using satellite imagery, CRTR's unique coastal spectral signature library, and underwater plant database (***Figures 3-4***). The intent is to identify causes and provide solutions for coral bleaching and pollutants that may negatively affect the local habitat. More recently the data are also being used to monitor climate change.

A lead researcher on the CRTR project discussed how CRS is applied in the field with coral reef monitoring. "Locals can assist with gathering, calibration and validation of data; on top of that, they can help in creating maps. I worked together with local fisherman to create maps of reefs in Fiji," says Chris Roelfsema, Postdoctoral Research Fellow, Biophysical Remote Sensing Group, Centre for Spatial Environmental Research in the School of Geography, Planning and Environmental Management at The University of Queensland in Brisbane, Australia. Coastal ecosystems support local communities with tourism, food sources and recreation activities. Healthy coral reef ecosystems contribute to protection of the coastline from natural erosion. "The most powerful part of my work is turning a bird's eye view of a coral reef gathered by high tech sensor on a satellite, [combined] with basic skills and knowledge of local communities, into meaningful spatial information to manage these biologically and economically important resources," says Roelfsema.

Water clarity in tidal areas varies, limiting exclusive use of remote sensing data for analysis of coral reef health. Integration of satellite imagery sources with field survey data collected during the same time period results in further defining the spectral signatures for healthy benthic communities (***Figures 5-6*** on page 15). The underwater imagery collected with measurably accurate position helps validate features derived from satellite imagery. Remote sensing has been the only feasible way to measure significant large-scale change in coral reefs. By coupling science with the knowledge and broader participation of CRS in data collection, we take a leap in the direction of greater sustainability of global coastal resources.

By coupling science with the knowledge and broader participation of CRS in data collection, we take a leap in the direction of greater sustainability of global coastal resources.

The Future

CRS is an emerging application of earth observation technology with unlimited potential. Because it is nascent, we have a very limited understanding of the possible future evolution of this marriage between technology, humanity and the environment. Distributed processing, the leading edge of CRS, may be utilized to engage individuals around the world to contribute to our understanding of ecology, archeology, natural disasters and human behavior. As access to information expands, citizens are educated about the earth and shown more avenues for meaningful participation in society, whether through volunteerism, eco-tourism or conservation of resources in their local communities.

Caribbean Island Maps On- and Off-shore Habitats

BALANCING GROWTH WITH PRESERVATION

ON THE ISLAND OF SAINT LUCIA, WHERE TOURISM DRIVES THE ECONOMY, managing new development and protecting natural resources require a delicate balancing act. As it seeks economic growth, the tiny Caribbean nation is determined to avoid the mistakes of other island destinations by planning construction of future hotels and resorts to accommodate additional visitors without damaging its number one tourist attractions – the pristine coastline and lush mountain habitats.

"We realized that development along the coast impacts more than just the beaches," said Suzanna Aurelien, Senior Cartographer with the Saint Lucia Ministry of Physical Development and Environment. "So we needed a national GIS to help us in planning, development and environmental management."

In 2007, the Ministry envisioned a GIS capable of addressing issues unique to island nations. Rather than stopping at the water's edge, coverage of the system would extend from the highest interior mountain peak, across the white sandy beaches, and out into the ocean to a

▲ **FIGURE 6.** *Orthophotos off the coast of St. Lucia at 25-cm pixel resolution.*

EDITOR'S NOTE: An article about CRS in coral reef mapping also appears on page 15.

depth of 20 meters. Just three years later, Saint Lucia is on its way to developing a GIS that will enable it simultaneously to plan resort construction and agricultural programs while monitoring the health of its beaches, seagrasses and coral reefs.

Mapping the Coastal Zone

Saint Lucia is located among the Lesser Antilles Islands of the eastern Caribbean. Beach activities such as sunbathing, sport fishing and snorkeling are the primary attractions on this island, explained Peter Felix, Chief Surveyor for the Ministry of Physical Development. But the thousands of annual tourists are also drawn to the natural beauty of the island's interior rain forests, hot springs and 'drive-through' volcano.

A major challenge at the start of GIS development was the lack of existing geospatial data relating to these popular areas, or to any other parts of the island that 200,000 people call home. The only maps were in paper form and years old. The first order of business was to map the island from scratch. Because different funding sources were involved, the decision was made to perform the GIS base mapping as separate coastal

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▲ **FIGURE 1.** *St. Lucia's island-wide GIS now allows for integrated coastal resources management and smart planning to avoid urban sprawl and protect the island's pristine coastline.*

and land-based projects.

With Saint Lucia's banana-based agriculture industry attempting to diversify into other farming and business activities, its Banana Industry Trust (BIT) spearheaded the coastal mapping project. BIT selected Fugro GEOID of France to assemble the project team, which ultimately included Fugro EarthData in the U.S., and WS Atkins International and Envision, both of the U.K. Fugro GEOID handled ground control and geodatabase development, while the U.K. firms provided technical assistance in several capacities.

Fugro EarthData was assigned the role of acquiring and processing high-resolution digital imagery to create the coastal and benthic habitat basemap. BIT requested aerial image collection at 75-centimeter resolution and classification of multiple habitat types covering both the on- and offshore environments, including mangroves, marshes, sand beach, rocky shoreline, seagrasses and coral reefs (see ***Figure 1***). Following aerial acquisition, Envision and Fugro personnel filmed the benthic habitat with a GPS-enabled underwater video to identify the key classes (see ***Figure 2***).

"We had mapped benthic habitats before, but never to a depth of 20 meters," said Debbie Simerlink, Fugro EarthData Project Manager. "In fact, the aerial acquisition proved just as challenging as the processing of the image data itself."

Fugro EarthData deployed a twin-engine aircraft equipped with a Leica ADS40-SH52 digital camera to the island in fall 2008. Due to the irregular shape of the coastline, standard linear flight lines were drawn to cover almost the entire 620 square kilometers. During processing, the 170-square-mile coastal zone would be separated out from the other data. Although only three days of total flight time were needed, the actual deployment took much longer.

"In the tropical locale, the flight crew had to find openings in the cloud cover that coincided with relatively calm ocean conditions with as little turbidity as possible," said Simerlink. "On any given day, they could only capture small segments of flight lines, if they flew at all."

▶ **FIGURE 2.** *Image taken by the Fugro and Envision field verification crew in St. Lucia. Picture courtesy of Envision.*

The four-band image sets, comprised of natural-color and near-infrared data, were periodically delivered to Fugro EarthData's headquarters in Frederick, Maryland, for quality checking. If the subsurface images were not clear enough due to sediment in the water or rough surf, the lines were re-flown. Once the entire coastal area had been flown, the imagery was orthorectified in preparation for the coastal and benthic habitat mapping.

Applying Object-Oriented Classification

Mapping subsurface habitats with airborne multispectral imagery is a relatively new technique that Fugro EarthData played a major role in developing, in partnership with the National Oceanic and Atmospheric Administration (NOAA). The semi-automated methodology, referred to as an object-oriented image classification process, was originally developed by Fugro

EarthData in 2008 through a series of projects spearheaded by NOAA's Coastal Services Center to map seagrass beds along the Gulf Coast of Texas. Although the company had applied the process in other commercial projects since then, Saint Lucia again presented a special challenge due to the depth of mapping requested by BIT.

"The collection of field data with the underwater video proved critical in the analysis," said Chad Lopez, Senior Digital Imaging Analyst at Fugro EarthData. "The video allowed us to see that the appearance of identical habitats changed from shallow water to deep, and that meant their spectral signatures in the imagery would change as well."

In the first phase of analysis, Lopez masked the orthorectified coastal image at the water line into on- and off-shore data-sets. He then used Definiens software to segment the images into polygons (see ***Figure 3*** on page 24). Other than allowing Lopez to set parameters relating to the size and shape of the output polygons, the software ran in an automated fashion without inputs of classification training data.

2

It segmented the image data into discrete polygons comprised of multiple pixels, which were later classified, rather than classifying individual pixels by spectral value. The three visible bands and one infrared band were processed simultaneously. "The output was a vector dataset in which the polygons outlined the various habitats," said Lopez. "Training and classification came in the second phase."

Next, the analysts used commercially available statistical analysis software to classify the polygons in a technique referred to as Classification and Regression Tree (CART) analysis. CART utilized ground truth, or habitat training information, collected by the field teams onsite and extracted from the digital underwater video to create a set of rules for polygon classification. The analysis routine took into account a multitude of variables in establishing these rules, which ultimately generated an orthoimage layer with classes labeled according to the desired habitat schema.

"An advantage of the CART analysis is that you can quickly run several iterations to improve the overall classification accuracy," said Lopez. "From there, the CART-generated classes are joined to the image segments using ESRI's ArcGIS to produce classified polygons." (See ***Figures 4-5*** on page 24.)

Mapping subsurface habitats with airborne multispectral imagery is a relatively new technique that Fugro EarthData played a major role in developing, in partnership with the National Oceanic and Atmospheric Administration (NOAA).

Fugro GEOID has developed a multilayer geodatabase structure containing the coastal habitat classes for delivery to BIT. The database is designed for compatibility with the national GIS under development and will accommodate updated habitat information as the system evolves.

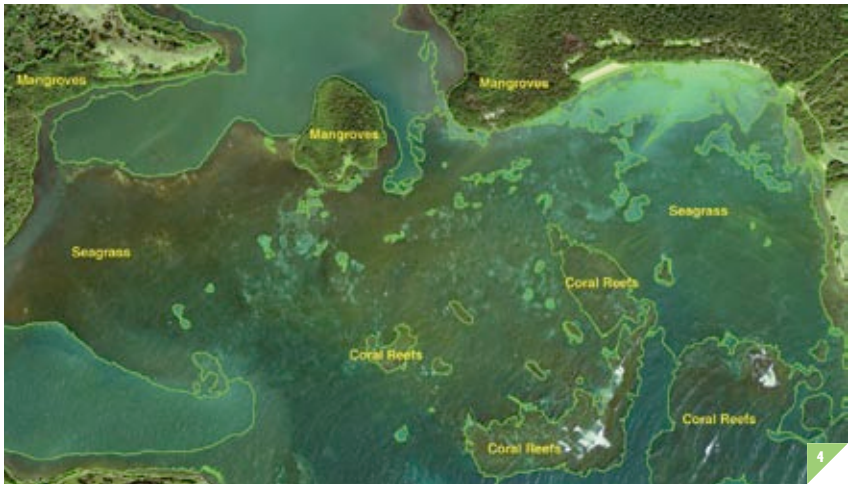
The decision to create the GIS came at an important time for Saint Lucia. Early examination of the imagery indicates there has already been damage inflicted upon the reefs and significant beach erosion near existing resorts.

Capturing the Land Base

The Ministry of Physical Development and Environment awarded a second contract directly to Fugro EarthData to create a high-resolution basemap of the entire island. This would serve as the primary digital land base for the nascent GIS. At the time of the contract award, the Maryland firm had already deployed its ADS40-equipped aircraft to Saint Lucia for the coastal mapping, and the same crew was able to alternate acquisitions for the two projects in late 2008 into early 2009.

"We had to fly the two projects separately because the Ministry requested much higher resolution for the land-based mapping, which required a lower altitude," said Simerlink.

An interesting aspect of the land-based acquisition was the additional request from the government to collect the terrestrial



▲ **FIGURE 3.** *Segmentation of the imagery using Definiens software resulting in polygons.*

▲ **FIGURE 4.** *The polygons are labeled using Classification and Regression Tree (CART) analysis.*

▲ **FIGURE 5.** *The final labeled polygons.*

imagery at two different spatial resolutions. The Ministry wanted the majority of the island mapped at 25-centimeter resolution (see ***Figure 6*** on page 20), while eleven populous urban areas would be collected at 12.5 centimeters. By taking advantage of the ADS40's extra detector array, which can be used to increase resolution without flying separate lines at different altitudes, Fugro was able to meet this requirement without significantly increasing the flying time and overall cost.

Through this technique, known as HiRES mode, the firm was able to produce orthoimages at the two resolution levels, generate digital elevation models and extract framework data layers (buildings, roads, etc.) at the required scale and accuracy.

The Saint Lucia land-based map was delivered to the Ministry in the form of an ArcGIS geodatabase file. It contained the orthoimagery, DEMs, contours and planimetrics that will serve as the foundation for the nationwide GIS.

Managing the Island Ecosystem

Fugro EarthData's Lopez believes the ability of digital airborne cameras to capture clear subsurface imagery and the development of processing techniques capable of generating habitat maps from those images have dramatically enhanced the value of GIS-based coastal zone management because they add details relating to an important part of the ecosystem.

"Benthic habitat mapping is a fundamental component of coastal management," said Lopez.

Without these new technologies, mapping offshore would have been more costly because the data would have to be collected manually, a process that could take years even on an island like Saint Lucia. Once its GIS is fully developed, the island's Ministry will have a complete picture of how activities on the land impact the sea and vice versa. The government hopes the GIS will assist it in devising strategies to prevent further habitat damage without stifling growth. ≪

LBx JOURNAL

LOCATION IN THE LANGUAGE OF BUSINESS

But my thinking was something that illustrated the sensor web concept...tentacles of devices transmitting data to a mother ship type of thing

the whole idea is that there are all these receiving and transmitting devices out there...cell phones, traffic sensors, bio hazard sensors, cameras--surveillance, etc, and they all transmit info back through the Internet (the mothership or the cloud if you will) and that then needs to be processed and retransmitted back in terms of information, reports, applications etc.

Building BI Bridges

NEXT-GEN DATA ANALYTICS // BY VICTOR HARRISON

BUSINESSES ARE AT VARIOUS LEVELS OF MATURITY RELATIVE TO INVESTMENTS in business intelligence data and systems. For the most part, Business Intelligence (BI) as an IT and data investment has been the domain of Fortune 500 companies. Advances in cloud computing and SaaS/managed services bring BI to small and mid-sized companies and offer compelling solutions to business users of large organizations that struggle with getting the information they need and want from their data and IT. In particular, what is increasingly becoming the norm is small and mid-sized companies that have big company data issues. (For an example, see sidebar on Stubb's Bar-B-Que.)

Location intelligence (LI) is the bridge between business intelligence and market intelligence, the bridge between the database analyst and the business user, and the bridge between the integration and correlation of various enterprise data systems such as CRM (Customer Relations Management), ERP (Enterprise Resource Planning), and BI. Location data has been the missing link in systems that allow companies to optimize and leverage their investments in data and to recognize the promises made by vendors that data analytics offer, in fact, a competitive advantage. BI is an analytical system that usually relies on data from transactional operational systems such as CRM and ERP. ***Figure 1*** illustrates the conversion required from transactional systems to analytical systems.

Location intelligence is more than just the ability to plot data on a map, although visualization is a big component. LI is the next evolution of business intelligence, because

- it provides BI with a value proposition beyond large companies and makes BI available to mid-market companies;
- it offers a cost-effective solution to complex data analytics;
- it extends the existing BI infrastructure and environment of companies that have already invested billions of dollars in these systems by making BI solutions scalable across the enterprise and down the food chain; and
- it brings the data closer to the user and makes it more actionable.

We spoke with four senior LI company executives from the field to gain their perspective on this subject: Tom Link, Owner/CTO, SpatialKey; Jim Pollock, President of Vertical Markets, aWhere; Jean-Sebastien Turcotte, Executive Vice President/CTO, KOREM, Inc.; and Luc Vaillancourt, CEO, Spatialytics. Their comments are included in this article. These companies provide consulting, strategic and integration services, as well as next-generation LI

THIS ARTICLE DISCUSSES

- **The difference between business intelligence (BI) and location intelligence (LI);**
- **Why location intelligence is an extension or subset of business intelligence;**
- **Why location intelligence is a cost-effective solution for small and mid-market companies ready to embrace data analytics and business intelligence;**
- **The options for integrating and purchasing an LI solution;**
- **How businesses tend to underestimate the cost of data, including the maintenance of the data.**

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tools, technologies and solutions with a focus on keeping LI simple for the customer.

LI and BI: The Differences, Advantages, and Options

All of those interviewed unanimously agreed that business data are already spatial because all businesses are place-based entities, and that LI is a subset of BI. Databases such as Oracle Spatial, Teradata 13, and Neteeza Spatial have now all made the storage and consolidation of location information across business data easily accessible. The main difference between LI and BI from a user perspective is the difference between the consumers and producers of data. Tom Link of SpatialKey explained, "the trend in BI has been to focus on the production of the data—the data warehouse, the database analyst, the cube, which often results in rigid reports that the business user has to figure out how to apply to day-to-day management. LI, on the other hand, is about the trend in visualization, usability, interactivity, and shareability of the information. The focus of LI is really on the person that has to consume and use the data to make decisions."

With a managed service such as aWhere or SpatialKey, a company can take advantage of the spatial/location analytics of the provider's location intelligence platform, and the company doesn't have to worry about the most important and expensive component of a location intelligence system, the data—the external third party data, including the mapping data.

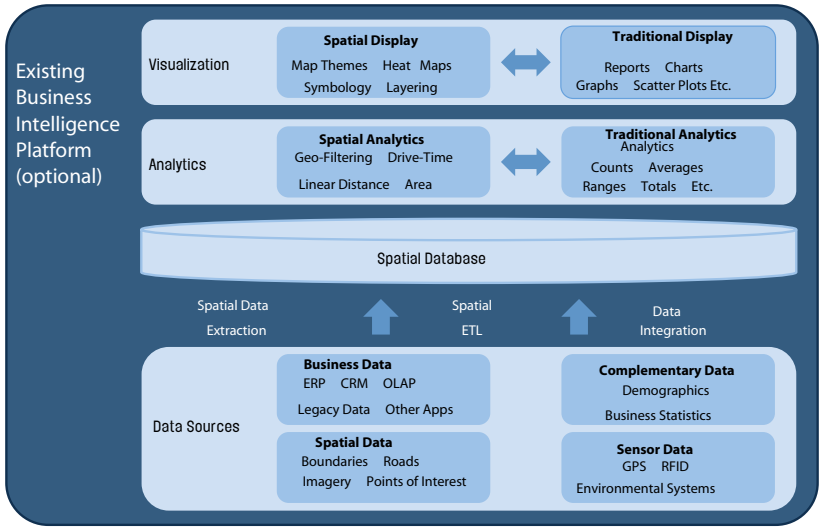
▲ **FIGURE 1.** *This figure is a technical illustration of what needs to happen behind the scenes (handled either by your IT department or by a managed service) to convert transactional data sources, such as stats, logs, CRM, ERP, etc., known as an OLTP (Online Transaction Processing) data model, to an analytical format that can then be used by an analyst, manager, or executive in the form of a data-mining or dashboard application. Transactional data must go through an ETL (Extract, Transform and Load) tool, which is able to properly feed a data warehouse in a specific OLAP data model. Graphic courtesy of Spatialytics.*

Many people confuse the map with location intelligence. The map is definitely in many cases a better way of visualizing data that is already in a BI system. See ***Figure 2*** on page 24. for the pattern recognition available from displaying tabular data on a map, which is unrivaled when geographic distribution of the data is in fact the insight. However, there is much more to LI than just plotting data on a map. ***Figure 3*** illustrates the data sources, analytics and technical platform required to deliver location intelligence.

It's All About the Correlation

The power of location intelligence is in the ability to correlate data down to,

▲ **FIGURE 2.** *This is a view of a Salesforce interactive location oriented dashboard that sales management can use to better understand factors, in this case, related to average deal size, and to understand trends that represent risks and opportunities. It provides an analysis of deals closed, looking at a number of dimensions of data including industry, lead source, status (won/lost), sales rep, geography, and close date. Graphic courtesy of SpatialKey.*



▲ **FIGURE 3.** *This figure illustrates how a business, with or without an existing business intelligence platform, can leverage the technical components and various sources of spatial data to develop a robust location intelligence platform. Graphic courtesy of KOREM.*

for instance, the location of a store, a customer, a medical clinic, etc., in relation to location influences such as weather, culture, socio-economics, or competition. "The real location intelligence is making use of great things that come out of GIS (geographic information systems) and bringing them into a BI workflow and being able to ask very sophisticated questions, such as, 'Where are my stores that are underperforming relative to competitors' stores?' as opposed to the simple sales question, 'Where are my stores performing or underperforming?'" said Tom Link of SpatialKey.

Jim Pollock adds, "Often, we discover hard-to-visualize similarities through mathematical spatial analysis. Conversely, we often see visual patterns in a map that are hard to do mathematically. Maps and numbers are great complements, not either/ors. Mapping is part of this,

An insurance company can leverage third-party 'cause-related' data to help predict severe weather patterns and conditions such as hail storms. They can then notify their 'at risk' customers in advance so they can adequately protect their family, vehicles, homes and other assets.

but just one more visual input. It helps to visualize patterns that emerge or do not emerge. If no pattern emerges, that could be a message, as well."

What Are the Options?

Traditional BI analytics are limited because they generally don't consider location. According to Jean-Sebastien Turcotte of KOREM, "The geographic dimension is often marginalized because traditional IT rarely assesses the value of geo at the beginning of the project."

Companies that wish to own their own system, therefore, have two options when it comes to LI, according to Luc Vaillancourt. "For new projects, they can develop a fully integrated GeoBI system that incorporates the geographic/location dimension from the beginning, or for existing legacy systems they can retrofit the system with a geospatial visualization component, and LI acts as a bridge to these existing data systems."

A third option is becoming increasingly important to small and mid-size companies with big data issues and small IT budgets, and for executives in big companies with big IT budgets who

"BI is an analytical way to look at business. Spatial BI is taking into account the fact that your business is affected by local variables such as weather, demographics, events, and topography. New LI tools expand this. LI is a component that often needs to be a part of your BI superset. The ratio depends upon the type of business you are in."

-Jim Pollock, aWhere

The good news for businesses today is that they create and have access to enormous amounts of stored and real-time data-based information or business intelligence (BI). In the past, it would often take large investments in technology and talent to effectively mine, convert, analyze and leverage one's BI. Today, location intelligence (LI), the 'seeing is believing' aspect of BI, can help to bridge this challenge by providing companies of all types and sizes with a new generation of tools and technologies, along with innovative business models and open platforms to affordably visualize and analyze their data.

"Businesses tend to buy lots of third-party data. It usually sits on a shelf because they don't know how to use that data. For example, a medical company buys demographic data to help to identify which hospitals to approach. What they get is a file that someone looks at for awhile but doesn't know how to integrate. LI is often a way to correlate different sets of data."

-Tom Link, SpatialKey

Is your data collecting dust on a shelf, and tucked away in a not-so-friendly knowledge management system? Managers can now fully take advantage of the investments in third party data. It's time to get closer to the data, to understand all its benefits and revelations. Data and systems that are easy to use, will be used.

"Whenever your problem is related to distance of distributors, markets or distribution of data, then you need to spatialize the data in order to discover the relationships. As soon as you exploit location information, you are doing LI; BI that is location aware is LI."

-Jean-Sebastien Turcotte, KOREM

Time and space are key correlating factors. Time has been managed relatively well in BI systems and not well in GIS systems. Space, on the other hand, has been well managed in GIS systems, but not BI systems. LI is the bridge. Today, the development and availability of scalable and affordable LI tools, technology, talent and services enable and expand access, allowing the small and medium business community to also leverage their data-based BI. These companies now have access to information a GIS department would ordinarily provide to enterprises, extending the BI value proposition that in the past was mostly the domain of large business.

are frustrated with the quality of the information they can extract from their systems. The third option is a managed service that is offered by companies like aWhere and SpatialKey. With a managed service, a company can take advantage of the spatial/location analytics of the provider's location intelligence platform, and the company doesn't have to worry about the most important and expensive component of a location intelligence system, the data—the external third party data, including the mapping data.

According to Turcotte, "Businesses always underestimate the costs associated with the data, which are typically 35-45% of the cost of an LI project. Also, 30-35% of the initial data investment needs to be factored for annual maintenance of the data. When we implement such projects, we can spend 20-50% of the time structuring the data to make it insightful, and when we go back a year later, we find that the company hasn't been maintaining the data; the data maintenance is the most critical component and is where most companies cut costs. Accuracy of the data is where the data costs rise; the more dynamic the data, the more often you have to update the information."

In today's highly competitive global marketplace, which is in a continuous state of transformation, possessing the ability to visualize and analyze BI quickly and affordably becomes a critical key to success. Now, companies of all types and sizes can leverage sophisticated LI in a predictive mode for planning and strategic purposes and can gain a better understanding of trends

and patterns from their data as well. For example, an insurance company can leverage third-party 'cause-related' data to help predict severe weather patterns and conditions such as hail storms. They can then notify their 'at risk' customers in advance so they can adequately protect their family, vehicles, homes and other assets. This LI can benefit all by increasing safety and reducing claims, while improving customer service and enhancing the overall customer experience. «

FOOD DISTRIBUTION: THE ART OF DEMAND ALLOCATION

Stubb's Bar-B-Q is a small but aggressive and fast-growing manufacturer of barbecue sauce in Austin, Texas. A key business challenge for Stubb's is demand allocation or cost-effective distribution and growth. "With 400,000 grocery and retail store opportunities out there, the question is, 'How do I pick and prioritize the right stores to distribute my product to in a powerful way?' Another associated problem for companies like Stubb's, which have to compete with Kraft and other multi-billion dollar brands, is that we can't afford to buy syndicated market data and we are too small for IT," said Chris West, Vice President of Sales for Stubb's.

To help address these business issues, Stubb's called on aWhere, Inc., an LI Company focused on how consumer goods companies understand and manage their business. aWhere has been working with Stubb's to improve their marketing, sales and forward-looking supply. They started by looking at a two-year sales history. Next, aWhere ran a regression and spatial analysis to help to predict the number and location of stores Stubb's could add. By analyzing the location opportunities within a retail chain, Stubb's can present a very compelling story as to which stores should and shouldn't carry their product and which stores would benefit from promotions. They looked at three different levels of geographical analysis to help determine this: 1) demographic profile of their buyers; 2) demographic profile of potential target stores; and 3) overall demand and/or growth rate for their category at a market (macro) level.

Now Stubb's has a better idea of predicting the number of stores they can add and the next set of stores to which they should distribute, rather than grappling with many thousands of stores they think should be buying their product. aWhere does this by geographies, since Stubb's needs enough stores in each area to make distribution and marketing cost effective. This system provided Stubb's with distribution guidelines and a road map for growth.

LI helps to build a compelling story as to why a retail chain buyer should buy a product they should be carrying on their shelves. In this case, Stubb's can tell the buyer which stores they want to be in, along with why they have the demographics of customers who would want to buy their product. This reasoning helps to make Stubb's come across in the marketplace as a smarter and bigger company. Stubb's and aWhere even looked at new trends, such as gluten-free sauces, and where the demand is.

Jim Pollock, President of Vertical Markets of aWhere, said, "Smaller companies like Stubb's Bar-B-Q are hungry for affordable LI. There is no need for a GIS department, with LI now offered as a managed service on a hosted platform from companies like aWhere." Today, with the aid of sophisticated and scalable LI tools provided as needed and on demand, small and mid-market companies can prioritize the stores with which to work and predict where their product will sell the best.

"BI is about day-to-day decision making and strategic planning. This means that large amounts of apparently meaningless pieces of data have to be restructured into multi-dimensional cubes to make sense of the data—to identify the crucial information needed by management. LI is the bridge between geo and existing systems like ERP, CRM and e-commerce. With Geo-BI, it's more than a bridge; we fuse BI and Geo into one Spatial OLAP (Online Analytical Processing) system. This makes it easier to feed, to manage, and to scale. And, more importantly, it allows quicker, more direct and powerful analysis and visualization capabilities with maps and spatial queries, in sync with charts, graphs and other visual gimmicks we usually see in BI dashboards and reports."

-Luc Vaillancourt, Spatialytics

Some of us can look at both raw and refined data and see patterns and trends that, to most of us, are invisible or unrecognizable. It is rare to find a marketing, sales, product management, strategy or C-Level executive who has the power, skills and ability to do this. As a result, companies could be missing types of signals that can be relevant to their business, directly impacting the bottom line, particularly if they are not able to look at correlations and causes for growth that predict upward and downward demand. This problem can be complicated by numerous disparate data sets, with no cost-effective linking mechanism or available integration capabilities.

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Imaging NOTES

Executive Interview

Lawrie Jordan

Director of Imagery, ESRI

A PASSIONATE PIONEER IS BACK IN THE SADDLE

LAWRIE JORDAN IS DIRECTOR OF IMAGERY FOR ESRI, AS WELL AS SPECIAL *Assistant to Jack Dangermond, President of ESRI. In this capacity, he serves as an advocate for successful applications of all forms of imagery within the GIS enterprise, including environmental, civil, and defense solutions. Mr. Jordan has over 30 years of experience as a leader in the field of image processing and remote sensing, including a long-standing strategic partnership with ESRI. He has been an advisor to numerous government organizations on current and future trends involving imagery and satellite programs. His background education is in Landscape Architecture, with degrees from The University of Georgia and Harvard University.*

INTERVIEWED BY KAREN NOZIK
Eco-writer, LLC
www.eco-writer.com

IMAGING NOTES (IN) **You started ERDAS straight out of graduate school and built a successful career. What inspired you to be in the industry in the first place?**

LAWRIE JORDAN (LJ) Graduate school was really the motivation. I had the good fortune to go to Harvard Graduate School of Design back in the early '70s. This is the school where the current GIS technology has its roots. Jack Dangermond, our founder, went through the same program under Professor Carl Steinitz. At the time, we were building digital GIS databases there by hand doing manual encoding of the data. Then, in 1972, the first digital imaging satellite was launched, LANDSAT-1. At the time it was known as ERTS: Earth Resource Technology Satellite. What was great about this was that the vegetation information from it was already digital. This saved us a tremendous amount of time building these digital GIS databases. Instead of manually encoding the data, we could pull it directly off the satellite. So I became fascinated with that. And I thought, wow, this is really interesting.

With two very good friends, Bruce Rado, also a graduate school colleague, and Nicholas Faust from Georgia Tech – the three of us got together, and started ERDAS in 1978.

We have a broad range of products that are part of that ArcGIS family, and all of them are imagery enabled and imagery aware. We have desktop products, we have server products, we have mobile products; we now have a cloud initiative and all of those have imagery at their center, at their core.

IN **And then you had twenty years of success, then you decided to retire, and then you came out of retirement to work for ESRI. What made you come out of retirement?**

LJ We sold the company to Leica Geosystems in 2001, and I decided it would be great to spend more time with my two beautiful young daughters. They were growing up so quickly. Next thing you know, they're just as tall as their dad, off to college, and I'm sitting around sort of thinking, you know, gee, this "retirement thing" is pretty boring. I miss the technology. I miss my friends, I miss the project work that we used to do and the success stories, and the technology is always fascinating.

A friend said, "Why don't you give your friend Jack Dangermond a call and see what his thoughts are?" I gave him a call, and he said, "Come on out; let's talk."

IN **And how are you finding the challenge of it?**

LJ It's a fascinating time. I call it, "The Dawn of a New Era – The Platinum Age of Imagery." We're seeing an explosion of gorgeous, high-resolution, multi-spectral imagery, very rich color fidelity, very high pixel resolution, near real-time systems… It's really exciting.

IN **It is amazing to think how fast the technology is moving. From the time you retired to the time you re-entered the work force, especially in the last three years…**

LJ It's true. The commercial companies that are launching these systems are doing a tremendous job. Imagery is a driving force in GIS. We like to think of imagery and GIS as two sides of the same coin. They're really complementary to each other, they complete each other, they reinforce each other, they inform each other, and they are really incomplete without each other.

IN **Has the global economic meltdown affected ESRI's business?**

LJ You know it's curious; there's no doubt that these are stressful times for everybody on the planet. However, that being said, our business continues to grow. We've seen significantly positive growth last year and again this year. So we are both confident and enthusiastic. I think there's a growing awareness that even in a difficult situation, GIS technology can actually help you reduce cost and save money if applied wisely.

I'll give you one example of this. One of our big clients has been using our

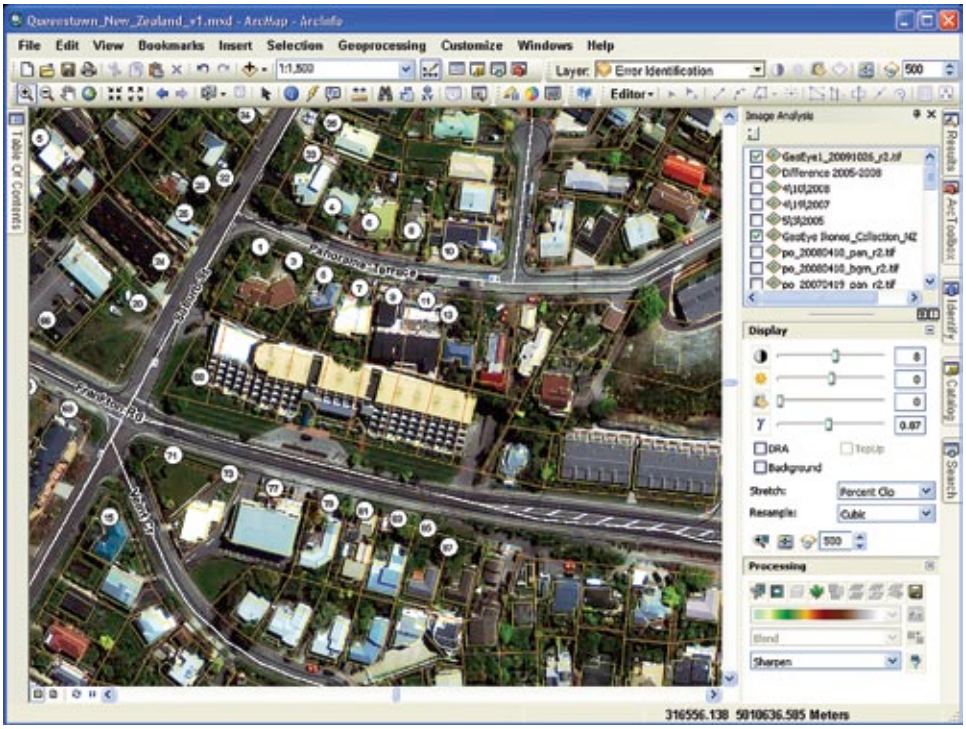


FIGURE 1. *GeoEye-1 high-resolution satellite imagery over Queenstown, New Zealand with local government parcel basemap.*

technology to figure out where to locate stores for years and years. So curiously, when the economy started affecting their business, you would think our sales to this client would go down, but they actually went up! They bought more licenses to figure out which stores they no longer needed to keep open.

So it's just fascinating. There can be silver linings everywhere you look. And I think the technology has true value in good times and in bad. And from a global sustainability standpoint, I think it's timeless. GIS itself has actually evolved into a critical infrastructure, and it's the primary technology to help us sustain the Earth's environment. No doubt about it.

IN **Do farmers have access to this kind of technology?**

LJ Absolutely. Every aspect of the agricultural industry on the planet uses this technology. I was recently in Colombia, and the coffee growers – actually they grow the little bushes and the beans – use it. We got to meet [people from] the country's largest coffee-growing association – really fascinating people. They count the bushes and they do an inventory using our mobile technology. They actually have their imagery in maps on a mobile pad and they count these things and add up their inventory and look at the health of things. Precision farming is a big application of this, and the entire continent of Europe has various programs for agricultural subsidies to determine how many hectares of the land are in sustainable crops, and farmers get paid subsidies. This is all driven by imagery and GIS.

IN **Which ESRI products fall under your domain?**

LJ There are two main areas of responsibility for my position, both of which I enjoy and take seriously. The first is serving as Director of Imagery, which includes responsibility for the company's overall imagery strategy. The second is as special assistant to Jack Dangermond, which involves providing all necessary support to insure our messaging, vision and purpose is delivered globally, often in person. There really is a global market for this technology, and ESRI has been global for a long time. Imagery is clearly a global phenomenon.

IN **So as the Director for Imagery, 100% falls under your domain, yes?**

LJ We have a whole suite of products; our flagship product is ArcGIS, the new version 10, and we have a broad range of products that are part of that ArcGIS family, and all of them are imagery enabled and imagery aware. We have desktop products, we have server products, we have mobile products, we now have a cloud initiative and all of those have imagery at their center, at their core. The fact that imagery is prevalent throughout our entire line is a key strength, and I am fortunate to be able to work with each of the teams who are creating these capabilities.

IN **Great job to come out of retirement for!**

LJ Oh, it's fascinating. I would pay them to let me work here! I couldn't be happier. Someone said recently, you seem really happy lately! Of course I

am, I get to do what I love to do, and I'm around the people that I really enjoy and appreciate and I'm learning every day – so many things to learn about this; you're always a student.

This is story telling. This is saving lives, saving time, saving money, making the world a better place.

IN **Anything we haven't covered that you'd like people to specifically know?**

LJ I would like to add that I love *Imaging Notes*. The graphics, the quality, the lay out… everything about it to me is fascinating. I wish we'd had this from the very beginning back in the '70s. It's a great magazine. We're big fans of it; I have it on my desk and I look at it every time it comes out. It communicates very effectively because it takes some of the science and the mumbo jumbo out of it and it gets right to storytelling. And I think that's the essence of how we communicate with each other is to not go over some technical feature function check list, like, "Oh yeah, we do maximum likelihood, and we do parallel processing…" This is story telling. This is saving lives, saving time, saving money, making the world a better place – asking, how did they do that? Tell me all about it, tell me a story.

One final thing I want to make clear. We don't really look at other companies as competitors. We don't think of Google as a competitor. We respect them highly. They have done a great service to society. We're very much inter-operable with them. But our agenda is focused on listening to what users tell us they want instead of asking, "Do we do what this company does, or that company does?" The main focus is to key in on the success of the users. Pay attention to them, and everything else works out, and it has. And they'll let you know if you're not paying attention to them – which is a good thing.

So that's really the reason why we get together in San Diego [at the User Conference] every year, is to listen. We're listening. And we actually act on it. So if you come year after year, you'll see that people say, "Thank you. We told you this last year, and here it is this year."

IN **Is it odd for you that you now work for ESRI? Do you ever feel like you used to work for the Red Sox and now you work for the Yankees?**

LJ No, not at all. ESRI and ERDAS worked closely together for many years. I respect them all very highly, and we continue to enjoy good friendships. The previous management of ERDAS made a business decision some time earlier to pursue a different path, so of course we respected that. Although the companies' technologies are no longer tightly integrated, they are still interoperable at the data exchange level.

Today, we have a new set of imagery partners that we're doing much tighter integration with, such as ITT VIS and their ENVI product. I just came from their board meeting across the parking lot! They have some great technology and they're doing a lot of investment in integrating within ArcGIS, which is key to success for us. We're very proud of them. Good folks, good technology. Originally I thought of them as only hyperspectral years ago but they are so much more than that. They're very much into advanced feature extraction, work flows, a bunch of other great imagery tools.

So no, again we don't really think of other companies or other ones that are in the market space as competitors that drive the agenda. Our customers drive the true agenda. And the main challenge is to continue to listen to them, and then deliver what it is that they tell us they need. And it's a job that's never done. And that's a good thing that it's not. It's keeping us all very busy.

ESRI's Strength through Partners

More than 2,000 companies in 46 countries belong to the ESRI Partner Network. ESRI partners range from large multinational corporations such as BAE Systems, Inc., to specialty companies such as TerraGo Technologies. They all develop and deliver cutting-edge geospatial solutions and services using ESRI's software platform, and they integrate their technology with it.

For partner companies, being part of this network allows them to tap into ESRI's technological and marketplace strategies to develop and market their own business offerings built on ESRI's software platform. For ESRI, these relationships are important, since partners help extend the company's market reach by connecting and working with new users in both new and existing markets.

The ESRI Partner Network provides companies with access to detailed product information, development and deployment best practices, and marketing and sales resources. For example, BAE Systems developed the SOCET for ArcGIS extension using ESRI's comprehensive product information and access to ESRI developers. SOCET for ArcGIS lets users work with SOCET GXP for image analysis and ESRI's ArcMap application in ArcGIS Desktop at the same time. Users can take advantage of advanced functions in both SOCET GXP and ArcGIS. One benefit of using SOCET for ArcGIS is SOCET GXP's automatic attribution of features from image source metadata. This makes it possible to add easily the image date, time, circular error, and sensor type to a feature class in the geodatabase.

In recognition of the strong emphasis on imagery by ESRI in recent years, *Imaging Notes* has pulled together a few key partners for this special section on ESRI Business Partners.

The ESRI Partner Network features three tiers: Platinum, Gold and Silver. Platinum and Gold partners get to work directly with ESRI on sales, marketing, and technical development for their ESRI technology-based products. ITT Visual Information Solutions, a business partner specializing in imagery, works closely with ESRI to develop and promote products such as ENVI EX, which ITT developed using the ESRI platform. With ENVI EX, ArcGIS users can easily extract features from imagery and seamlessly view the results within ArcGIS.

ESRI's strength in the imagery community is revealed through the number of imagery partners that offer best-in-class solutions, such as Lizardtech's MrSID wavelet image and lidar compression technology, which integrates with ESRI's platform.

To learn more about ESRI Partner Network members and their solutions and find out how to become an ESRI partner, visit www.esri.com/partners.

Maximize the Value of Your Imagery

Quickly get imagery to people who need it with the ArcGIS® Server Image extension.

"When we tested ArcGIS Server Image extension, we found designers, technicians, and digitizers were all very pleased with the processing time. It was twice as fast, in some cases even faster, than previous systems."

Cindi Salas
GIS Manager
CenterPoint Energy

The ArcGIS® Server Image extension helps organizations manage large catalogs of rasters and imagery to make imagery available to more people in less time. Dynamic mosaicking and on-the-fly image processing allow users to quickly serve multiple imagery products from one set of source imagery, reducing data redundancy and storage requirements.

For more information, visit **www.esri.com/image** or call 1-888-373-1353.

For ESRI locations worldwide, visit **www.esri.com/distributors**.

ESRI®

ArcGIS 10

BUILT WITH THE REMOTE SENSING SPECIALIST IN MIND

Earth imagery and remote sensing data are inextricably tied to geography. Consequently, imagery and geographic information system (GIS) technology have always complemented and informed one another. The upcoming release of ESRI ArcGIS 10 embraces that symbiotic relationship and delivers a powerful imagery workstation and a new data structure for effectively processing, managing, and disseminating imagery.

Imagery as Background

Most organizations need current high-resolution imagery. ArcGIS 10 enables fast access to high-quality basemaps and background imagery while giving users access to more advanced imagery capabilities as their requirements increase. Web services replace the logistical constraints of direct file access, taking the form of static Web-based caches or dynamic datasets provided by ArcGIS Image Services.

Imagery Analysis

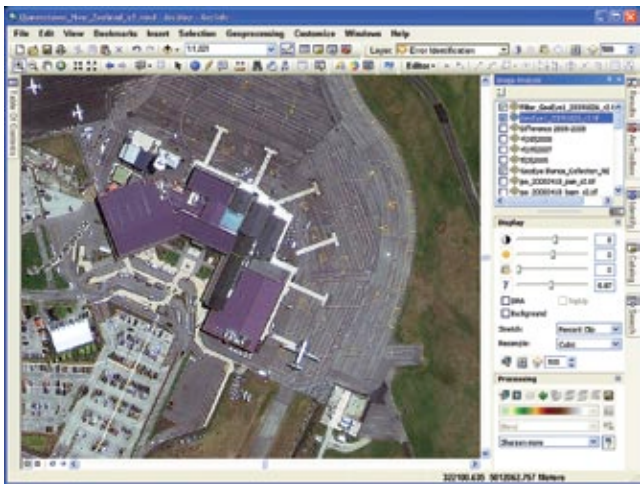
Many users need to further exploit imagery content to extract information by either detailed interpretation or analysis. ArcGIS 10 provides the tools to quickly access, visualize, and exploit all forms of imagery and information. It includes an Image Analysis window that provides one-click access to a variety of imagery functionalities. New tools in the ArcGIS Spatial Analyst extension perform complex analysis of gridded datasets such as elevation and landcover. The Image Classification toolbar provides traditional supervised and unsupervised classification of optical imagery.

Existing users of imagery solutions can use these capabilities to integrate imagery and other geospatial data from many sources into a single environment. For users with advanced and domain-specific functionality requirements, ESRI works with business partners who develop solutions that are closely integrated with ArcGIS.

Imagery Access

Simple imagery management in ArcGIS 10 helps users access large collections of preprocessed imagery quickly. Managing large stores of imagery can be challenging, because imagery is often stored in multiple formats, different projections, and varying pixel sizes. The mosaic dataset, a new data structure in the geodatabase, enables imagery to be managed efficiently without changing the source files. Dynamic mosaicking resolves the traditional issues for handling imagery and enables large imagery collections to be accessed seamlessly and served using ArcGIS Server.

These capabilities shorten the imagery analyst's workflow by making imagery data accessible to GIS, CAD, imagery, mobile, and Web applications. They also exploit the full information potential of imagery, increasing its value.



GeoEye-1 image of Queenstown Airport, New Zealand (on-the-fly sharpening applied).

Imagery Management

Many organizations collect large volumes of data using a variety of aerial and satellite sensors. The ArcGIS mosaic dataset enables these organizations to quickly manage and serve imagery. Users take advantage of advanced processing tools such as on-the-fly orthorectification, pan-sharpening, and color correction. They use ArcGIS Server to disseminate multiple imagery products from the same source while providing advanced cataloging, searching, and extracting capabilities. For advanced and domain-specific functionality, ESRI integrates closely with partners that provide tools for automated georeferencing and atmospheric corrections.

With ArcGIS 10, remote sensing professionals now have an exciting and powerful new environment to work with their data. For more information on Imagery in ArcGIS 10, visit www.esri.com/imagery.

EyeQ Launches

GEOEYE ELEVATES INSIGHT THREE POWERFUL WAYS

GeoEye is proud of its long and rewarding relationship with ESRI and pleased to support ESRI at this year's International User Conference.

"We are excited to partner with ESRI to provide their global world-class users access to our superior-quality imagery," said Tara Byrnes, director, GeoEye's North American Channel Sales. "We look forward to expanding our strategic relationship over the coming years."

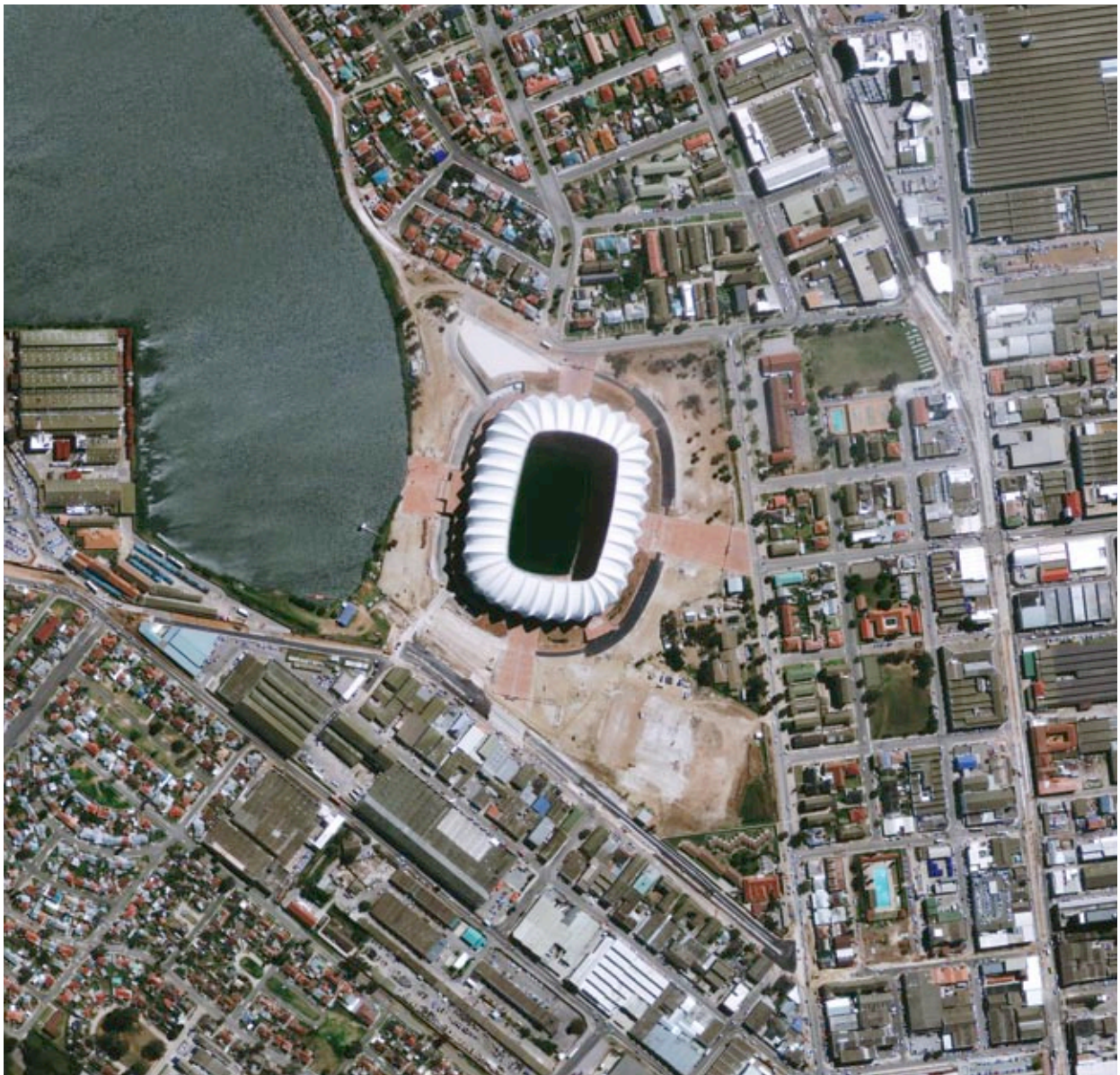
The GIS industry is synthesizing location intelligence and services with the tools to explore data that help its users to make complex business decisions. GeoEye, a premier provider of superior satellite and aerial imagery, location information products and image processing services, is introducing a new information services business line to meet customer demands for these tools.

Imagery Collection

Imagery Collection is currently GeoEye's largest business line. GeoEye's imagery products serve worldwide market demand for imagery and information products to map, measure and monitor the Earth for national security, emergency response, environmental assessment, mining and oil and gas markets, the forestry industry and much more.

(continued on page 42)

This half-meter resolution GeoEye-1 image features Nelson Mandela Bay Stadium, Port Elizabeth, South Africa. The stadium is one of the ten venues for the 2010 FIFA World Cup tournament, June 11-July 11, 2010. The image was taken on Oct. 8, 2009 by the GeoEye-1 satellite from 423 miles in space as it moved from north to south over Africa at a speed of four miles per second.



Access the world's most accurate high-resolution commercial imagery. At GeoEye, we're providing global companies in diverse markets, including oil and gas, with Information Services backed by unrivaled knowledge, experience and technical capabilities. From infrastructure development to site management to risk mitigation, GeoEye enables you to oversee critical assets more efficiently by providing timely, relevant location information and image-based insight. To see what a trusted and proven partner can do for you, contact GeoEye.

Image intelligence. Delivered intelligently.

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ESRI BUSINESS PARTNERS FOR IMAGERY

(continued from page 40)

Production Services

Through its advanced Production Services business line, GeoEye processes raw data from a wide range of both government and commercial imaging satellites and then merges the source images into very precise value-added geospatial products to meet the needs for increased demands for better and better accuracy.

Information Services

Now, GeoEye is pleased to announce its newest business line, Information Services. These are managed services that will provide enterprise access to secure, timely and accurate geospatial information. GeoEye created its information services business line to give customers global on-demand access to imagery and related information products over the Web. GeoEye's new Web-based services, called EyeQ, will provide the core infrastructure for this new geospatial information services business.

EyeQ offers a Web interface with tools that function as our customer's data center. EyeQ will serve up imagery and other content throughout the customers' data network and out to their customers and partners. With EyeQ, GeoEye's customers will get easy access to their imagery, tailored to their needs. EyeQ will be available twenty-four hours a day, seven days a week.

EyeQ allows users to consume GeoEye's satellite imagery directly in ArcGIS via Web Mapping Services. Users can subscribe to content, ensuring they have current imagery over their project areas. EyeQ also provides an easy-to-use user interface to manage their content subscriptions throughout their organizations.

GeoEye has partnered with ESRI's professional services team on numerous projects over the past decade to provide fast, fluid, collaborative and interoperable services to GeoEye's customers, suppliers, operations, sales and financial teams.

"GeoEye initiated development of many of these projects using software available through the ESRI Software Beta Program and was able to go live, taking full advantage of the best and most current ESRI functionality," said Deke Young, senior director, GeoEye Business Systems. To learn more about one of these projects, visit GeoEye's GeoFUSE News Web page, http://geofuse.geoeye.com/news/Default.aspx.

Together, GeoEye and ESRI leverage each other's strengths and successfully develop solutions that promote GeoEye's mission to enable our customers' success by consistently providing superior-quality location intelligence and services, resulting in timely and vital insights – anywhere, anytime.

Ultra-Rapid Airborne Imagery for ArcGIS Image Server

TRIMBLE DSS: ULTRA-FAST, MAPPING-GRADE IMAGERY HELPS MAKE GIS REAL-TIME

Thanks to an explosion in geospatial information needs for emergency preparedness and rapid response, GIS professionals are demanding more – and ever-faster access to – highly accurate orthorectified imagery. Decision-ready map products, increasingly built upon centimeter-resolution digital airphotos, are crucial for providing near real-time situational awareness, monitoring security events, and coordinating rescue and relief efforts.

Direct Georeferencing: The DSS Advantage

Traditionally, the creation of accurate aerial ortho images required a network of ground survey points and time-consuming aerotriangulation. But in most disaster scenarios, tight timelines and hazardous conditions don't allow for the collection of ground survey points. This is where the Trimble Digital Sensor System (DSS) really shines. Direct Georeferencing mapping technology, using GNSS-aided inertial sensors, eliminates the need for ground control points in aerial image production, and dramatically speeds up post-processing and delivery of image map data to first responders.

Rapid Workflow: GIS-ready Ortho Imagery within Hours of Landing

Trimble DSS RapidOrtho is a turnkey airborne mapping system specifically designed for rapid response. The system captures and generates centimeter-resolution color and infrared digital orthophotos and orthomosaics, producing an accurate and radiometrically consistent product. With RapidOrtho, images can now be developed in seconds: this means that a mapping mission of two hours' flight time can be taken to full orthophoto product in as little as two hours after landing.

Better still, there is little need to compromise accuracy for speed of delivery. DSS RapidOrtho's ultra-fast results are certified as mapping grade by the USGS.

Helping to Make GIS Real-time

This rapid turnaround from the sensor to the end user isn't just for rapid response applications! The availability of ultra-fast, high accuracy ortho imagery is helping to make GIS real time for every user.

Hurricane Katrina image captured with Trimble DSS RapidOrtho; courtesy of NOAA/NGS.

ESRI BUSINESS PARTNERS FOR IMAGERY

Streaming SPOTMaps to Your GIS

NEW SPOTMAPS SUBSCRIPTION SERVICE

SPOT Image Corp. has introduced a new subscription service that streams its popular SPOTMaps datasets directly into ArcGIS. The SPOTMaps Subscription Service is a cost-effective way for subscribers to have instant access to the rich information content and spatial detail of SPOT satellite imagery.

Considered by many GIS users as the ideal digital basemap, SPOTMaps are seamless, orthorectified image mosaics covering entire countries and regions at 2.5-meter spatial resolution. Created from recently acquired natural-color SPOT 5 scenes, these off-the-shelf products are ready for immediate delivery in a variety of GIS-compatible formats, including ESRI ArcGIS, Google Earth Enterprise and others.

With an annual subscription, SPOTMaps subscribers receive unlimited access to up-to-date geographic information covering their area of interest – a country, region or the entire worldwide SPOTMaps archive. Renewing subscribers also enjoy a 20 percent coverage refresh of their data every year.

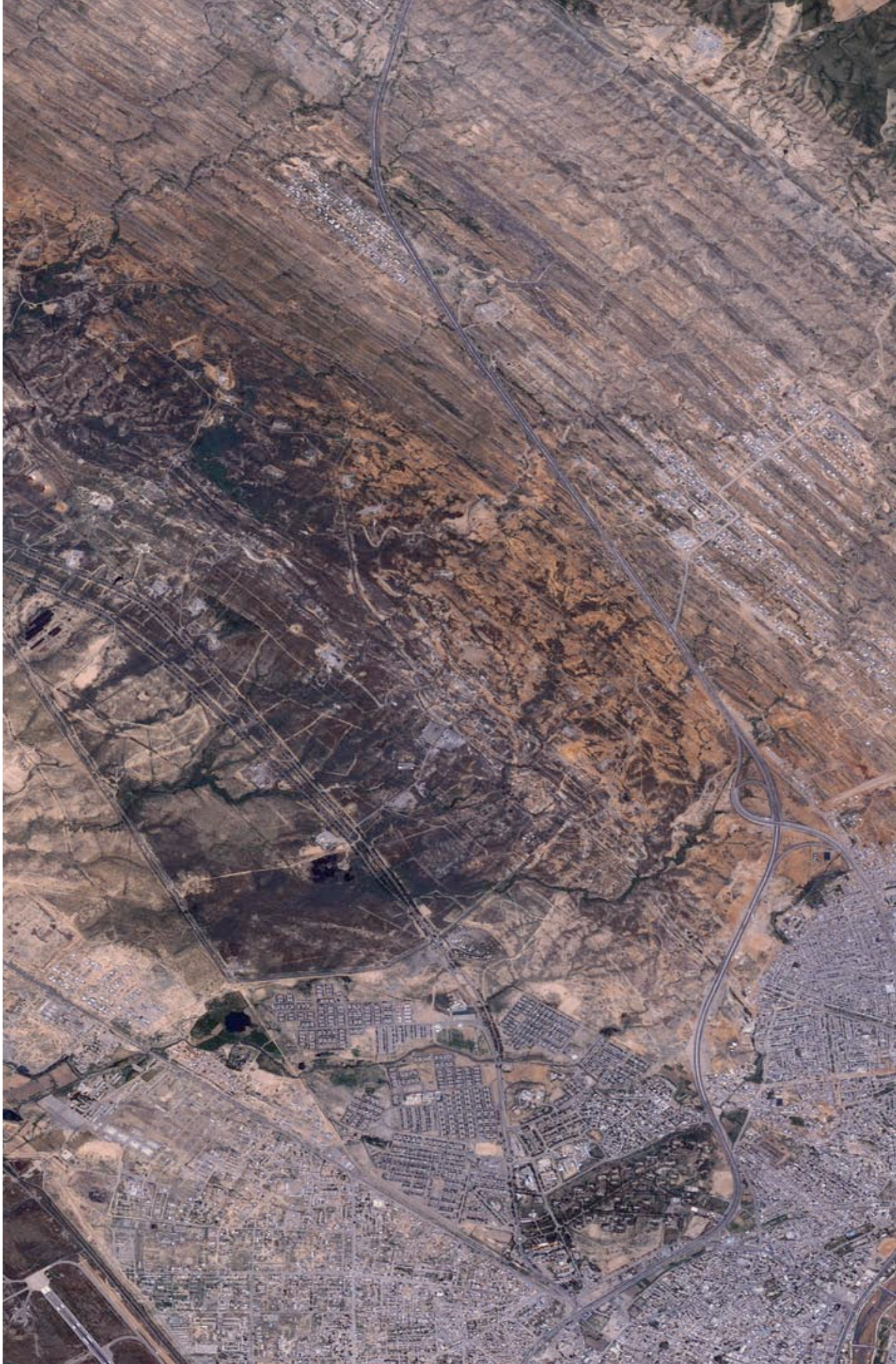
In addition to significant cost savings, subscribers to the SPOTMaps service enjoy immediate desktop access to imagery for projects requiring fast turn-around, even in remote and poorly mapped parts of the world. As a GIS basemap, SPOTMaps provides a unique combination of spatial detail and synoptic coverage that can be overlaid with higher-resolution raster datasets as well as customized vector layers. SPOTMaps have been purchased by GIS users around the world for infrastructure siting, environmental impact studies, disaster response, visualization & simulation, 1:10,000-scale map generation, and situational awareness in hostile environments.

Subscription rates are based on coverage area. SPOTMaps are currently available for over 80 countries that can be delivered immediately directly to the customer's GIS desktop through a streaming WMS feed. Packaged in manageable file sizes, subscriptions can also be delivered on portable hard drives.

To select your SPOTMaps area of interest and start your annual subscription, contact sales@spot.com. You can also visit http://access.spot.com to purchase a SPOTMaps product online.

◀ **FIGURE 1.** Aswan Dam in Egypt in 2.5-meter natural color from SPOTMaps. This image also appears on the cover, with more information on page 6.

ESRI BUSINESS PARTNERS FOR IMAGERY



◀ **FIGURE 2.** Kirkuk, Iraq in 2.5-meter natural color from SPOTMaps.

▶ **FIGURE 3.** The Swiss National Park was created by Switzerland on August 1, 1914, in the canton of Graubünden in the southeast of the country. Today, the park covers 172 sq. km, and its alpine flora and fauna flourish on the mountain slopes of 1,400-3,200 meters around the sources of the Rhine and Inn rivers. The Swiss National Park is in the category of so-called strict nature reserves, where nature is left entirely to run its own course. A pioneer in this area, Switzerland is now developing forest nature reserves as a new tool to preserve and encourage biodiversity. Project supported by Planet Action.

SYMPOSIUM ON

Dimensions and Directions of Earth Observation Systems

@

GEOSPATIAL WORLD FORUM

18 - 21 January, 2011 HYDERABAD, INDIA

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Executive Interview

Joel Campbell

President of ERDAS

HARNESSING THE INFORMATION OF OUR CHANGING EARTH (AND INDUSTRY)

WITH OVER 20 YEARS OF EXPERIENCE IN THE GEOSPATIAL INDUSTRY, CAMPBELL *is a well known and highly regarded speaker, lecturer and trainer throughout the world. Prior to joining ERDAS, Campbell served in a variety of senior positions in sales, business development and product management. Previous employers include GeoEye, Definiens, EarthData and ESRI. Before joining ERDAS, Campbell was the Senior Director of Product Management for GeoEye, where he helped support the company's expansion into new commercial markets and managed the launch of products from the GeoEye-1 Earth imaging satellite. During more than a decade with ESRI, he held chief leadership and management positions in the U.S. sales operation. Campbell joined ERDAS as the President in 2009.*

IMAGING NOTES (IN) **Over the past two decades, there have been periods when the direction of the geospatial industry was determined mostly by the availability of new technology and other times when it was mostly led by user needs. Where is that balance now?**

JOEL CAMPBELL (JC) What drove the industry over the past two decades has been user needs. To digitize paper maps, we built scanners to accommodate large formats, line tracing software, digitizing tablets, etc. The technology really has matured in terms of base capability and how people generate specific geospatial derivative products. We are now seeing users who are expecting to have integrated workflows very closely aligned with their work processes — for example for updating parcel records or elevation contours from new imagery. For us, the balance is always with what our customers need. We are focused on solving their problems, and we use this to drive all of our enhancements and new product releases; not on creating the shiny new toys that we think might be neat.

IN **How has the division of labor between the major players in the industry shifted over time and where is it headed now? For**

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▲ *Joel Campbell, President, ERDAS*

example, ESRI is moving aggressively into imagery and you recently said that ERDAS needs to be more compatible with vector GIS and CAD systems. Is the market space getting blurred?

JC The lines are starting to blur between traditional CAD, GIS, and imagery-related companies, driven in large part by the maturity of the data. For decades the effort was concentrated on building databases. Recently, there has been a paradigm shift: now, the focus is on measuring and managing change, which is supported by imagery and, increasingly, from new infrastructure — such as new bridges, water plants, or sewage systems designed in CAD.

If new imagery or LIDAR data is captured that shows a new building or building façade, it needs to be updated in the database. There is also a convergence of geospatial companies. Today, the work performed by our customers is so linked that we have no choice but to begin to blur the lines between traditional remote sensing, GIS and CAD. Competition is healthy for everyone, because it means we have more smart people and companies working to solve customers' problems.

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IN **How has the global economic meltdown affected the various segments of the geospatial industry? In particular, is demand for imagery down, just as the volume of available imagery is growing exponentially?**

JC On the pure business side, globally, regional, state, and local governments had tightened their budgets and the growth in geospatial projects began to slow. However, we are starting to see a turn-around. Governments are starting to do some of the projects that they have delayed.

The capture of new airborne imagery has suffered, due to four factors:

- state and local governments, which are responsible for most of these acquisitions, have tightened their budgets;
- the rise of airborne LIDAR and other supplements to existing imagery;
- very high resolution commercial satellites – such as WorldView-2 and GeoEye-1 – have created opportunities for imagery at a lower price point; and
- the announcement, last year, of the partnership between Microsoft and DigitalGlobe on the Clear30 program has disrupted the market, if for no other reason than it had everyone push the pause button before going forward with their acquisition programs.

IN **Can you provide an example of how a client is using your product?**

JC British Transport Police (BTP) is one of the many police forces working together on Olympic security planning. BTP is the national police force for Britain's railways and provides policing service to rail operators, their staff and passengers throughout England, Wales and Scotland.

BTP needed to understand how to effectively store and manage gigabytes of aerial imagery and raster mapping, and ultimately deliver that data in a timely fashion. BTP had also already invested in Oracle Spatial and proper data management tools were required. Regarding performance, BTP needed to upgrade bandwidth to remote sites. And finally, BTP wanted a better solution, and recognized the need for support and partnership from a respected industry leader in data management.

Looking towards the 2012 Olympic Games in London, BTP is implementing ERDAS APOLLO, a product with a unified enterprise platform for managing and serving large volumes of geospatial data located and distributed across multiple organizations. ERDAS APOLLO is being implemented to store and share BTP's gridded data stores, and to support the requirements of the spatial information infrastructure (SII) for Olympic security management. Through Open Geospatial Consortium and International Organization for Standardization (OGC/ISO) compliant web services, ERDAS APOLLO will enable rapid delivery of gigabytes of imagery by streaming data via the web and secure networks. This solution will allow BTP to securely organize and catalogue all geospatial data, imagery and maps, for efficient delivery using open-standard web services. See ***Figure 1***.

IN **To what extent and how is ERDAS moving to "the cloud"?**

JC It is high on our priority list. This summer you will see cloud offerings from ERDAS. We are exploring essentially three areas:

1. hosted systems, for customers that do not have the infrastructure required to perform certain tasks;
2. infrastructure on demand; we accomplish geospatial tasks that are very resource-intensive but seldom performed, such as building a terrain model for a county;
3. software as a service, allowing users to take full advantage of our services, on a monthly subscription, through the cloud.

IN **Who are ERDAS' natural allies in the industry, its main competitors?**

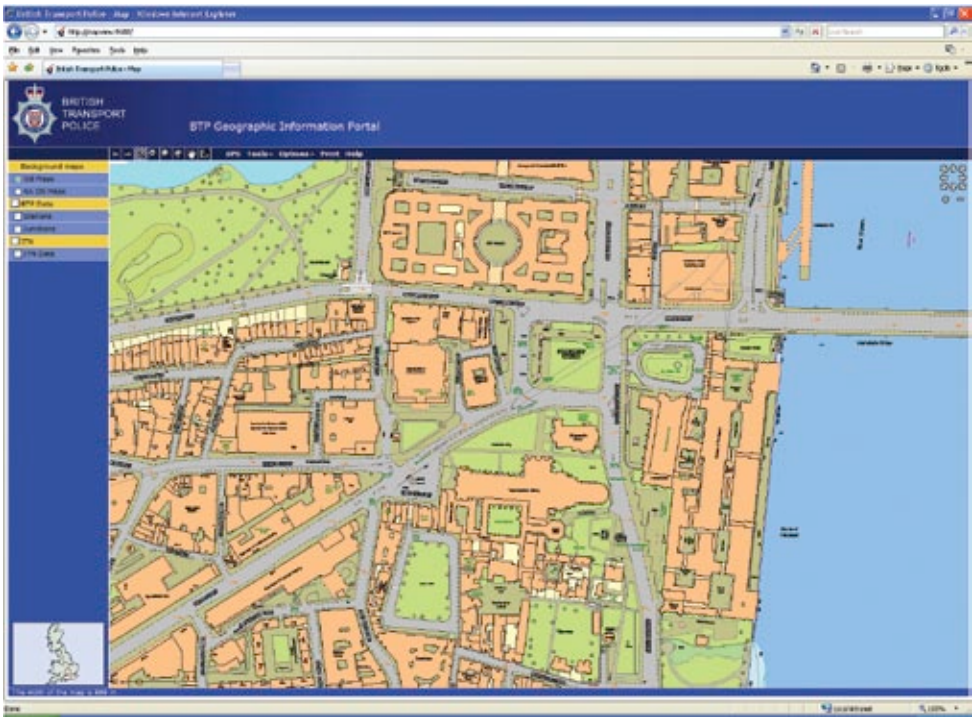
JC Our natural allies include hardware manufacturers and data acquisition companies. We have strong ties with commercial satellite and aerial imagery providers, who are the front end of the value chain that we support. We also have some software allies — for example CAD companies, database manufacturers (such as Oracle and Microsoft), TerraGo Technologies, and Safe Software. The technology they offer is complementary to ours and fuels our technology.

Who our competitors are depends on the market space. We compete with PCI Geomatics and BAE in photogrammetry and with PCI Geomatics and ITT in image analysis. In server software, we compete with open source, PCI Geomatics, ITT, and, on occasion, with ESRI. The only company with which we have 100 percent overlap is probably PCI Geomatics; with other companies, the overlaps are small to medium.

In the server space the emergence of standards has led to a crowded market. I happen to believe that is a really good thing; we have an opportunity to work together and make each other stronger. Ten years ago, ERDAS and others helped to set up the Open Geospatial Consortium to create spatial database models and representation. Today, that area, in which there are well documented and extensive standards, is the most crowded area of the industry. It means that we are all interoperable and there is room for all of us in a single customer's environment. More competition is better for the customer.

IN **What will be some of the uses for ERDAS' technology in the future?**

JC There will be more on-demand, real-time processing of data from a variety of sources and platforms — including UAVs, tower-mounted sensors, full motion video and laser-mapping — not just for visualization but also for image analysis. This has already begun in the military space and we will see it evolve in the commercial sector, with products released in the next three to five years. We call ERDAS "the Earth to Business Company," because we help people make informed decisions – whether it be to manage a watershed, assess the risk of an insurance policy, or decide where to locate a new coffee shop. We want to shorten the gap between asking the question and getting the answer needed for the decision.



▲ **FIGURE 1.** *ERDAS APOLLO catalogs and delivers BTP enterprise geospatial data over the web, via BTP "Map View".*

IN **ERDAS has been very successful. What is it doing to give back?**

JC We are owned by a large Swedish conglomerate, Hexagon, which has a very proactive charity approach. At the grass roots, we help our users do their job without fear or concern for financial payback. Two recent examples are the earthquakes in Haiti and Chile, and the current oil spill in the Gulf of Mexico. In Haiti, within a day of the earthquake, our staff configured and put online a geospatial server. We used all of our connections — staff, colleagues, families, clients — to collect pre-earthquake and post-earthquake data, load it on the server, configure it, and make it available to anybody doing work in the rescue and recovery effort. We now have nearly 2 terabytes of freely distributable data on that server and about 170,000 users have taken advantage of it. We set it up and made it available without trying to figure out the business relationships.

Regarding the oil spill, we've reached out to about 400-500 of our customers to support them as they respond to the disaster. In all of our offices around the world, we also participate in a number of local efforts, including Walk for the Cure, blood drives, collections of toys for homeless shelters, and other less formalized, employee-led initiatives.

IN **You have been in the geospatial industry for nearly 20 years. What attracted you to it in the first place?**

JC I came from a very unorthodox root. Originally, I was in broadcast television; then I worked in local government as a political appointee where I helped to implement a GIS and I was struck by the ability it gives you to look at things visually, geographically, and to analyze relationships. I suspect the visual component appealed to me because of my broadcast television background. Also, understanding that geography is a very compelling analytical platform for building roads, bridges etc. has continued to be fascinating to me. It is a constantly growing and changing industry and for me, that has been very exciting.

IN **You have worked for several large geospatial companies. Did your moves from one company and position to another somewhat track changes in the geospatial technology and market?**

JC My moves have tracked the market more than the technology. I spent most of my 20 years in the industry in and around ESRI, helping customers build databases. Lately I have worked for image capture and image analysis software companies. As we constantly measure the Earth with remote sensing technology, the power of leveraging that data is a very compelling place to be, professionally and from a market perspective. That is how I ended up at ERDAS.

IN **What is your management philosophy, in a nutshell?**

JC What I bring is mostly about openness, honesty, and transparency, building on the foundations that have made ERDAS a great company for the past thirty plus years. If we continue to manage our work in a transparent, honest way, with open communication and no secrets, this ultimately benefits our organization in everything that we do.

IN **What new ideas or directions do you bring to ERDAS? What do you want to accomplish in the next few years?**

JC I am not sure that I would classify what I bring to ERDAS as new ideas or directions. Hopefully, I bring new focus and energy to reclaim what we've always had as market-leading remote sensing products. We have not talked much about it over the past few years. We continue to be a market leader in photogrammetry and image processing. We are increasingly seen as a reputable and credible geospatial server software provider.

We want to shorten the gap between asking the question and getting the answer needed for the decision.

We want to re-establish the presence of ERDAS that has been missing for the past couple of years. Over the past five years, we've changed our name two or three times, ultimately back to ERDAS. This has caused some loss of continuity and identity. Our leading position in remote sensing and photogrammetry did not change, but our profile has changed significantly. Now that we have the ERDAS name back and we have a solid portfolio, we want to raise our hand and say, "We're still here!"

IN **What is your approach to hiring? Are university-level remote sensing programs in the United States graduating the number and quality of people you need?**

JC Our approach is to make sure that we get really bright, energetic, committed people who really want to work at ERDAS and share our vision. We hire at multiple levels. We have a very robust university recruitment program, typically hiring at the masters level. We bring students in for a semester at a time, and then many stay to take full-time positions at ERDAS.

When I started at ERDAS, I was surprised to find that we have an extremely tenured employee base: many of our staff have been with the company for more than 15 years, many for more than 20 years, and at least one person — the first employee that ERDAS hired, Jeff Dooley — has been here for more than 30 years! We don't have a large turnover. We have a very skilled, committed, dedicated and loyal staff. We try to replicate that in our hiring and look for people who want to have a career with ERDAS, out of both the industry and university programs. The university remote sensing programs in the country are doing a fabulous job. However, we are having increasing difficulty in finding people who have studied photogrammetry. Those programs are not growing in the United States as much as we and the industry could support. We are working with universities to make sure that those programs do not go away for good.

IN **Do you have some talent, skill, or activity not related to geospatial technology that might surprise our readers?**

JC Those who know me would agree that I am an open book. In terms of hobbies, I enjoy photography, sailing and golf. Since I also love to travel, I take pictures that capture the human element as well as the physical geography of the places I visit. At ERDAS, we have a number of folks who share this passion, and I've encouraged our employees to capture their worlds as well. We've started printing and framing some of the most compelling photographs throughout our Atlanta office, so we can all enjoy these pictures and celebrate the beauty and diversity of the Earth.

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has shifted instead to ensuring current capabilities become more efficient through international collaborations such as the Global Earth Observation System of Systems and public-private partnerships. To some extent, the private sector has stepped up with centralized remote sensing capabilities of its own, such as databases of street-level imagery from Google Street View and Bing Streetside.

These trends will continue, but centralized systems alone cannot fill the gap. An emerging field called community remote sensing (CRS) may be our best means to bridge environmental knowledge from global to local scales. CRS employs citizens and non-professionals to remotely sense and understand the world around them, and to augment our centralized systems with this knowledge.

Work similar to CRS has been done in the related areas of citizen science, citizen mapping, and e-science. But CRS itself encompasses novel techniques and skills that differ from these related disciplines. It is not just citizens taking pictures; the community can participate through calibration, validation, analysis, and many other activities that bring together the best of centralized and decentralized capabilities.

Community remote sensing is sufficiently transformational that the Institute of Electrical and Electronics Engineers (IEEE) International Geoscience and Remote Sensing Society has selected CRS as a conference theme for its upcoming international conference in Honolulu this July (www.igarss2010.org). Other organizations, including the U.S. Geological Survey and the Geological Society of America, have held or are planning similar events with a community remote sensing theme.

The private sector will lead this revolution; CRS is founded on consumer technologies such as human scale sensors, personal computing, social networks, and software applications. But government policies, such as encouraging centralized observing systems with CRS adjuncts, can accelerate the transformation.

The private sector has long been a source of innovation, both in technology and business methods. Over the next 20 years, such innovation applied to remote sensing's scale gap will be critical, allowing tight budgets to do more for less, making existing systems work more efficiently, and introducing new ways to solve society's toughest problems.

Remote Sensing's Scale Gap

COMMUNITY REMOTE SENSING FILLS THE GAP

GUEST EDITORIAL *By Bill Gail*

How will the private sector contribute to the field of remote sensing two decades hence? Among its important new functions will be filling what may be called remote sensing's "scale gap" – the emerging demand for human-scale observations not readily supplied by traditional spaceborne and airborne remote sensing.

To understand why this is so, it helps to first review the evolving private-sector role over the last two decades. By the late 1980s, communications and remote sensing had emerged as the two largest economic benefits from space exploration. In contrast to the robust commercial communications satellite industry, remote sensing was largely a government-led activity. The private sector supported government-led programs by building spacecraft, developing applications, and performing services under contract. A few focused markets, such as aerial imagery, were the exceptions.

About 20 years ago, this paradigm began to change. The first breakthrough came with the introduction of truly commercial remote sensing satellites by Worldview (now DigitalGlobe), Orbimage and Space Imaging (both now part of GeoEye). This was followed by consumer adoption of online mapping through portals such as Mapquest, Google, Yahoo, and Bing. The appetite for high-resolution imagery was further driven by location-centric Web sites, focused initially on high-value applications like real estate. Widespread adoption of personal navigation devices and location-based mobile applications has recently amplified the trend. Even the intelligence community has ridden these waves through commercial imagery purchase programs such as EnhancedView.

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This commentary first appeared in the March 22, 2010, edition of *Space News*.

Related trends have helped nudge the center of gravity away from government toward the private sector. Technologies such as digital aerial cameras and LIDAR (light detection and ranging) systems opened new opportunities for commercial offerings. Increased government outsourcing spurred the market. Even traditional government-led systems such as the National Polar-orbiting Operational Environmental Satellite System (NPOESS) evolved toward a stronger private-sector role, though the recent NPOESS breakup into the Joint Polar Satellite System reversed this trend.

Adding to this has been the "democratization" of remote sensing. Local government sources of remotely-sensed information have grown, two examples being security cameras and traffic sensors (including private-sector offerings such as Traffic.com). Analytical/geographic information system tools are increasingly available to the casual user, non-government sources have emerged, and Internet content-sharing mechanisms such as WikiMapia, YouTube, and Flickr have proliferated. The extent of consumer-focused remote sensing applications may now exceed all government uses.

As we look to the next 20 years, the uses of remotely sensed information will only increase; the ability of governments and businesses to improve efficiency and grow productivity requires increasingly sophisticated information about the world in which they work. Most interesting will be demand for filling the 'scale gap'. No longer is moderate spatial resolution with regional coverage at low refresh rates sufficient.

The scale gap reflects a current mismatch between supply and demand. Society's demand for information at diverse space and time scales grows exponentially, while the ability of our traditional sources to supply the information grows linearly. Tomorrow's applications will require work at a wide range of scales – global coverage with low refresh, high-resolution hyper-local, and more – with many problems spanning multiple scales. Renewable energy is a great example; accurate knowledge of both long-term climate and near-term weather are required to optimize power generation, particularly in the wind and solar sectors.

Centralized satellite and aircraft observing systems have struggled to address this gap. Such systems are ultimately limited by their cost and complexity; for the foreseeable future, budget realities will constrain the deployment of new observing systems. Governments' focus

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General Co-Chairs' Welcome

On behalf of the IEEE Geoscience and Remote Sensing Society and the IGARSS 2010 Organizing Committee, we are pleased to invite you to Honolulu for IGARSS 2010. We are thrilled to be returning to Hawaii to host IGARSS on its 30th anniversary! In the true spirit of an international event, we will continue our tradition of gathering world-class scientists, engineers, and educators engaged in the fields of geosciences and remote sensing from around the world. We anticipate well over one thousand participants to enjoy a week of technical sessions, tutorials, exhibits and social activities.

For this 30th anniversary IGARSS we will celebrate our accomplishments over three decades of leadership in remote sensing instrumentation, techniques, and applications development. But perhaps more importantly we will look ahead to the future of our field with some fresh approaches and perspectives through our conference theme: Remote Sensing: Global Vision for Local Action. One such activity will be embodied in our plenary session, which will focus on the emerging field of Community Remote Sensing. We hope this plenary session, along with special tutorials and technical sessions, will inspire and excite our community for what is possible in the coming decade. We look forward to seeing you in Honolulu in July 2010!

Karen St.Germain and Paul Smits
General Co-Chairs

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