Exploring Satellite Imagery for Immediate Damage Assessment in Seminole County, Florida

Executive Analysis of Fire Service Operations
in
Emergency Management

By:
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An applied research project submitted to the National Fire Academy as part of the Executive Fire Officer Program.
July 2005

Certification Statement

I hereby certify this paper constitutes my own product, that where the language of others is set forth, quotation marks so indicate, and the appropriate credit is given where I have used the language, ideas, expressions or writings of another.

Furthermore, this paper was prepared using the format available to students who started the program prior to September 2003.

Signed:_____

Abstract

After a natural disaster in Seminole County, the challenge of performing an immediate damage assessment was cumbersome and resource intensive. The purpose of this research paper is to determine the feasibility of using Satellite Imagery to perform immediate damage assessment in an effort to better deploy Seminole County's resources. The author will use descriptive research methods to answer the follow research questions.

1. What are the required components of an immediate damage assessment?
2. Is Satellite Imagery available for a post-incident natural disaster in a reasonable time frame?
3. How can Satellite Imagery be used to determine the required damage assessment information?
4. Identify the Satellite Imagery resources which can provide Seminole County with the required information.

Through extensive Internet and periodical review, a survey was emailed to a randomly selected group of professional Satellite Imagery and GIS providers. Their replies offered the information to answer the above questions. The results derived with a list of immediate damage assessment components. The research shows companies do offer image services, but few offer images within two days, assessment tools, and GIS compatibility in one package. The researcher recommended a program of this scope would assist commanders in the deployment of resources and better use of the work force during a disaster. The data collected in this project supported the concept of imagery being used for

damage assessment and the integration of that data into a GIS system. By using the depth provided from the GIS will allow the identification of damaged target areas with extensive population and permit commanders to respond accordingly.

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Introduction

In the summer of 2004, the Central Florida area experienced three major hurricanes. Seminole County Fire Department responded to the needs of its citizens during these storms, and performed immediate damage assessment after each storm. After a natural disaster in Seminole County, the challenge of performing an immediate damage assessment is cumbersome and resource intensive. The purpose of this research paper is to determine the feasibility of using Satellite Imagery to perform immediate damage assessment in an effort to better deploy Seminole County's resources. The author will use descriptive research methods to answer the follow research questions.

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Background and Significance

The process of immediate damage assessment (IDA) after a natural disaster is required to obtain situational information for those who make decisions on deploying resources. During the summer of 2004, Seminole County Fire Department had three opportunities to perform IDAs. Three hurricanes intersected Seminole County over a 10-week period and caused significant

damage and flooding over a 300 square mile response area. Although all response vehicles were staffed and staged for response, the IDA was difficult and time-consuming. Once the winds decreased to a safe level, all vehicles were deployed to predetermined areas for area assessment. The areas identified were the station map pages the personnel use on a daily basis. The units, using a Department designed form, drove every street in the assigned area and recorded any significant damage to each citizen's home and property. Road blockages and significant infrastructure damage were also listed on the set of forms. When completed, the forms were then faxed to the person gathering the data. The stations also had a map of the first run areas where they would plot the road blockage they could not remove during the assessment process. All of this information was delivered to the Emergency Operation Center where it was compiled and placed in the needed context. This entire process would take two days; depending on the amount of damage and the number of alarms the crews responded to which interrupted their assessments.

Over the years, the fire service in Seminole County traditionally performed an immediate damage assessment for each jurisdiction. Their ability to assign available personnel and equipment to perform the IDA was a natural fit for the fire service. Recently, Seminole County responded to over 23,000 alarms in the unincorporated sections of the county in 2003, compared to the 20,000 in 2002. The eight municipalities within the county have experienced comparable growth including the increase of calls for service. The future perspective shows an exponential increase in the citizens need for services. This growth creates a

difficult and more time-consuming process of collecting damage information. This also increases the need to respond to alarms, and the increase in the number of areas to assess.

This project is linked to Executive Analysis of Fire Service Operations in Emergency Management class at the National Fire Academy's Executive Fire Officer Program by defining an Immediate Damage Assessment.

> Immediate damage assessments are conducted during the initial stages of an event to incident. The immediate damage assessment determines the amount of damage, or probability of damage, that the event already has caused. This specifically includes the impact on life and property with in the incident. (NFA 2004, SM 6-3)

The previous quote explains what an immediate damage assessment is, and this paper is researching another more efficient way of completing the process. Another related area is the need for a complete and timely damage assessment. "Response to the emergency and the recovery from it effects are much more effective when the damage assessments are conducted properly" (NFA 2004, SM 6-9). This statement typifies the need for a complete, accurate and timely assessment.

The relationship of this project and United States Fire Administration Operational Objective number 4, "to appropriately respond in a timely manner to emergent fire and all-hazards issues" (FEMA 2004, p. 2), is due to the process of damage assessment being the ground work for a response to an emergency and assists in the appropriate assignment of resources.

Literature Review

The process of immediate damage assessment is one of the major building blocks in the response to disaster. The Federal Emergency Management Agency (FEMA) maintains that, “An ineffective or delayed immediate damage assessment can cause unreasonable responses to emergencies” (NFA 2004, SM 6-3). Furthermore, the ability to perform a total evaluation can quickly be performed via helicopter and placing priority on areas “where large numbers of people may have been injured” (NFA 2004, SM 6-6).

The information acquired in an immediate damage assessment is used to help a command officer make informed decisions on the allocation of resources and lifesaving efforts.

During the assessment of the post attack World Trade Center in 2001, “thermal imaging cameras provide helpful information for the identification of fire” (Kerle, Ozisik 2004, section 1.2). In 1999, a devastating earthquake in Turkey overwhelmed the response personnel by the sheer size and damage wreaked upon the four providences in their area. The area had over forty thousand collapsed structures, and an estimated fifteen thousand people were killed. The rescuers knew the pancake collapse structure were areas where the occupants had the “least opportunity to escape” (Kerle, Ozisik 2004, section 1.3).

There are some other ways the processes of assessing damage were used in an altogether different situation. During an infestation of Pine Caterpillars in the forest of a northern providence in China, data was collected over six years on the amount of damage left by these insects. The assessment of the data

reflected issues like tree canopy, scrub coverage, and soil thickness (Deyong, Gang, Xiaoyun 1997, p. 1). Using the historical information, the study was able to assist foresters in evaluating the “factor causing the occurrences and development of insect plagues and plague scales” (Deyong, Gang, Xiaoyun 1997, p. 3).

In summary, the process of performing damage assessment and the data collected are similar in all types of disasters. Someone must collect the primary information, place it in a format, and have a base to compare and identify the aberrancies. In contrast, earthquakes, hurricanes, and terrorist attacks have different factors to identify and assist operational personnel with their decisions and the deployment of resources.

The use of Satellite Imagery in the process of damage assessment has proved to be a widely popular research project in other areas of the world. In the Philippines, researchers used Satellite Imagery to identify the threat of debris flow to roads and bridges in an effort to reduce losses. “Remote sensing could hold a timely and cost effective solution to identify the potential source of debris flow” (Honda, Phillips, Yokoyama 2004, Abstract section). These researchers used Satellite Imagery and computer programming and digital aerial photography to create a model used to answer their research questions.

The European Space Agency and the Canadian Space Agency conducted a project called the REMSAT II, The Real-time Emergency Management via Satellites. They “fostered the use of space technology in response to emergency and managing large events” (British Columbia Forest Service 2004, p.1). The

team used satellites in combination with other equipment to track crew positions, and provided real-time imagery to the command post to support the decision-making process. Furthermore, the team used high-resolution Satellite Imagery to manage risk, their example is the imagery was used to identify the “susceptibility of forest and grassland to wildfires” (British Columbia Forest Service 2004, p.1).

Immediately after Hurricane Charley passed over Florida, Digital Globe Company acquired high-resolution imagery of the damage on Florida’s Gulf Coast. “The imagery is invaluable for federal and civil government agencies responsible for coastal and inland damage assessment” (GISdevelopment.net).

The use of Satellite Imagery in damage assessment has been used for flood monitoring, wildfire firefighting operations, and, most recently in Florida, to evaluate the losses from hurricanes. This information motivated the researcher to investigate the use of such imagery further and how it may assist Seminole County in the damage assessment process.

The use of Satellite Imagery in damage assessment has been used in the many cases mentioned above. The way it is used to identify damage is another issue. For instance, Australia used imagery and Geographical Informational System (GIS) “in order to develop a methodology to generate fire hazard categories” (Bhaskar 2000, Abstract section). In Bhuj, India, the use of Satellite Imagery and GIS were used to identify earthquake damage. “The results of fast damage assessment received by field operators could help the civil protection in order to better coordinate the emergency operations” (Andre, Bohakon, Chiroiu, 2001, Abstract section).

The damage assessment of Hurricane Charley used pre-incident aerial maps and “change detection (permanent landscape/coastal alterations), watershed and floodplain mapping (updated Digital Flood Insurance Rate Maps), long-term environmental and reconstruction monitoring, in identifying and calculating property loss” (GISdevelopment.net). In Thailand, researchers used Satellite Imagery by filtering certain pixels in images taken over a year to create a visualization of rice growing areas as that “the rise in water levels can be observed before the land is actually flooded” (Sakural-Amano 2000, Abstract section).

The use of imagery combined with other technology has allowed these groups to achieve their goals. The motivation of this research is to identify the ways Seminole County may use the archived and acquired information for the purpose of damage assessment.

There are thousands of companies offering some sort of imagery to the public and private sectors. The company, Space Imaging, states they offer “products designed to meet the full spectrum of customer requirements with a complete range of resolution and spectral options” (spaceimaging.com). Another company, Terraserver.com, states they have “become the leading provider of a wide range of aerial photography and Satellite Imagery” (terraserver.com). Lastly, Wise Imagery states they “provide Mapping and GIS services to Federal, State and Local governments as well as commercial consumers” (wiserimagery.com). The companies listed above offer a variety of products geared around Satellite

Imagery. The need to further identify and locate those which can provide this service to the needs of Seminole County is the influence for this project.

Procedures

In order to locate the requirement of a Seminole County damage assessment, the researcher reviewed the current forms and procedures SCFD uses in disaster situations. The researcher also reviewed the components of a damage assessment in the course manual for the National Fire Academy's Executive Analysis of Fire Service Operations in Emergency Management. A comparison was performed and a list of requirements was created.

An extensive internet search was performed using Google and the phrases, Satellite Imagery and Satellite Imagery Providers. These actions provide an immense amount of information and contacts. Within this search, the researcher located a GIS and Satellite Imagery portal named GIS Development where these companies offer guidance and information to each other and the public. The search engine in the portal provided the basis for a list of contacts in this business. A search of the portal using the phrase *satellite image providers* was used to create a list of companies. An email address list was then created by randomly picking a company, locating the information request person, and placing them on the email list. A survey (Appendix A) was then electronically mailed to each address. The survey provided the information required to answer the last three research questions.

Limitations

The cost of obtaining, integrating, and other technical functions of the imagery was not considered in this project. Also, the phrases Satellite Imagery, aerial photography, and remote sensing are synonymous in relation to digital images.

Definitions

Geographical Information System (GIS) is powerful computer software for managing all sorts of information according to precise geographical location**.** (web.ask.com)

A pixel is “the basic unit of the composition of an image on a television screen, computer monitor, or similar display” (dictionary.reference.com).

Results

A review of SCFD’s damage assessment form and a review of the EAOFSEM manual produced a list of progressively less important situations to report an immediate damage assessment. (Appendix B)

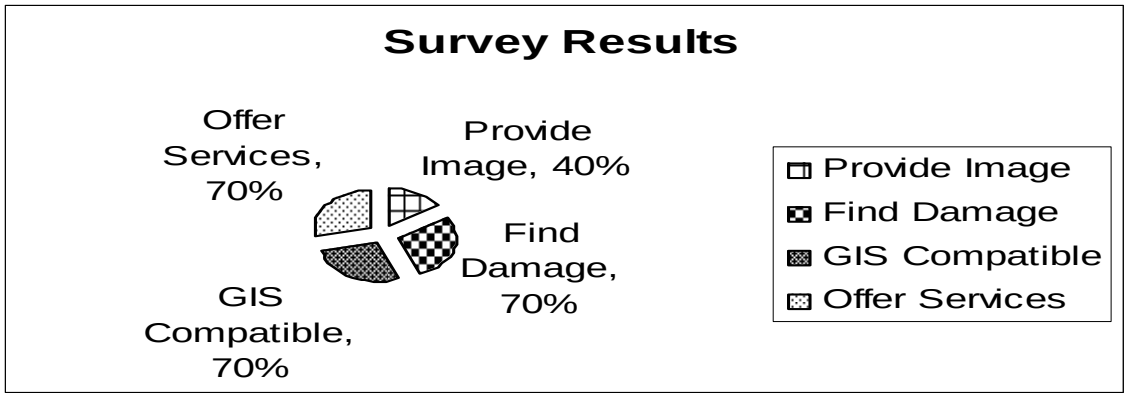
The results of the survey are as follows: of 70 surveys sent, 11 were returned or 15.7%. Of those, ten actually answered the questions and one was not in this type of business.

To assist in answering the second research question, in reference to the timely delivery of a satellite image, 40% of the returned surveys advised they could provide an image in a reasonable amount of time. The researcher used a 2 day timeframe to determine this variable, and the respondents were not advised

of the window to eliminate any bending of the facts. A spreadsheet was created to assist in the computations of the statistics. (Appendix C)

The second survey question asked if the respondent knew of computer software available to analyze and compare old and new images for discrepancies. Seventy percent answered yes to this question. The third question asked if there was GIS compatibility with the information obtained. As in the results of question two, 70% also stated they were compatible. These statistics answer the third research question on how the damage is identified and placed in a useable format.

The last question asked if their company offered these products, and again 70% advised they did provide these products. Although the research identifies seven companies, the software offered or the process to identify the damage, and integrate this data into the GIS, only four could offer the imagery. Further, only one can provide the full package of imagery, damage assessment recognition and GIS compatibility as stated in the Results sections. The results show the clear pattern in the availability of GIS compatible software for damage assessment. The comment from the respondents (Appendix D) also advised that a short timeframe to gather Satellite Imagery is a best case scenario.



Discussion

The result of the investigation of the components of an immediate damage assessment has created a sound list of issues to enable the user to identify the priorities and provide a command post with valuable decision-making information. “An ineffective or delayed immediate damage assessment can cause unreasonable responses to emergencies” (NFA 2004, SM 6-3). Therefore, having a comprehensive list is the first key to proper assessment process.

As with the 2001 attack on the World Trade Center, the tools and techniques are different. There “thermal imaging cameras provide helpful information for the identification of fire” (Kerle, Ozisik 2004, section 1.2) for the purpose of providing safety of responders, a component in the results of the research.

An earthquake in Turkey in 1999 used the damage assessment process to assist rescuers to identify pancake collapse structures where the occupants had the “least opportunity to escape” (Kerle, Ozisik 2004, section 1.3) using a huge component of the check list of situations.

The use of Satellite Imagery to identify damages from disasters is nothing new. The timeliness of receiving the image can be difficult as the research suggested. In one case, the imagery was received in real-time as with the Real-time Emergency Management via Satellites project in Canada. They “fostered the use of space technology in response to emergency and managing large events” (British Columbia Forest Service 2004, p.1). The results identified four

sources of imagery within two days and one within hours. This fulfilled the requirement of the second research question.

The thought process of the third research question was to incorporate the GIS into the damage assessment process. If a computer program can identify the damage, then the GIS can place value and population data at the fingertips of the user, and the proper resources are easily allocated. The survey results showed 70% of the respondents could integrate the two processes. In Thailand, the researchers created their own program so “the rise in water levels can be observed before the land is actually flooded” (Sakural-Amano 2000, Abstract section). In Australia, researchers used imagery and Geographical Informational System (GIS) “in order to develop a methodology to generate fire hazard categories” (Bhaskar 2000, Abstract section). This is a direct link to the use of the two systems together.

The final research question was to create a resource list should this research prove to be valid and feasible. Although, the research identifies seven companies who offer the software or a process to identify the damage, and integrate this data into the GIS; only four could offer the imagery. Only one can provide the full package of imagery, damage assessment identification, and GIS compatibility as stated in the Results sections. The company Space Imaging states they offer “products designed to meet the full spectrum of customer requirements with a complete range of resolution and spectral options” (spaceimaging.com). Another company, Terraserver.com, states they have “become the leading provider of a wide range of aerial photography and Satellite

Imagery" (terraserver.com). Wise Imagery states they "provide Mapping and GIS services to Federal, State and Local governments as well as commercial consumers" (wiserimagery.com). The research shows companies do offer image services, but few offer timely images, assessment tools, and GIS compatibility in one package.

The organization will benefit from the institution of the systems researched in this paper. The process of an immediate damage assessment is more uniform and streamlined. The process no longer would take the entire on-duty crew, but a few experts in these fields. The information received from this type of program is fast, efficient, and complete. Such information can also assist in the deployment of crews to critical areas and ensure the most in need receive the assistance. This system also relieves the crews from damage assessment and allows resources to respond to the identified incidents.

Recommendations

It is the researcher's recommendation a cost analysis be performed to identify the feasibility of starting this system.

Secondly, further study should be directed toward grant money and partnerships with a university to facilitate a pilot program in this field. The amount of expertise and the cutting edge nature of such a program would require vast knowledge in imagery, GIS, and advanced technologies.

Lastly, a program of this scope would assist commanders in the deployment of resources and better use of the work force during a disaster. The data collected in this project supported the concept of imagery being used for

damage assessment and the integration of that data into a GIS system. Then using the depth the GIS to identify the damaged target areas with extensive population and respond accordingly.

Future researchers should consider that the level of technology is changing quickly, and the ability to gain imagery is changing even faster. One should contact those in this paper who have responded to the survey, and inquire on new types of opportunities on this subject.

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Appendix A

Survey

Battalion Chief Gerald Bills
Seminole County Fire Department
150 Bush Blvd.
Sanford, FL.
gbills@seminolecountyfl.gov

Sir or Madam, I am writing to request some information in reference to satellite photography/imagery and its related technology. Currently, I am attending the National Fire Academy Executive Fire Officer Program; and, as a program requirement, a research project must be completed. The project I have chosen is to determine the feasibility of using Satellite Imagery to perform a damage assessment of Seminole County after a disaster. The project is graded and shared with Fire Departments all over the country. Please answer the questions below with reference to your company's capabilities and expertise.

1. How soon after a hurricane can a satellite image be retrieved and transferred to the customer (provided the weather is clear)?

2. Is computer software available to compare a new image with an old image to identify discrepancies (i.e. roof damaged buildings, trees blocking roads)?

3. If so, may the information be coordinated with our GIS system to ascertain specific location information (assuming software compatibilty)?

4. Is your company capable of offering any or all of the services mentioned above? If so, please list those services and provide a brief description.

When replying to the survey, please include your company information in order for the readers to contact you for additional information. All replies will be included in the projects appendix section

Thank you for your time and consideration. Please feel free to add any other information you deem useful.

Appendix B

Immediate Damage Assessment Check List

Need for immediate and emigrant action.

Threat of Life Safety to the public or Rescuers.

Damage to or potential damage to property.

Access to damaged areas.

Infrastructure damage. (roads, bridges)

Damage to County, City or State services.

Appendix C

Company	Question 1	Question 2	Question 3	Question 4	
Vexcel Corp	no	no	no	no	
LandVoyage	no	yes	yes	no	3 weeks for image
TerraFly	no	yes	yes	yes	30 days for image
Terraserver	yes	no	no	yes	2 day image, no GIS
ImageAmerica	yes	yes	yes	yes	hours for image via different method.
Sewall Company	no	no	no	no	Not there business, but great info source
PCI Geomatics	no	yes	yes	yes	weeks to get image
Observera	yes	yes	yes	yes	4 days for image
Intergraph	no	yes	yes	yes	weeks to get image
Digital Globe	yes	yes	yes	yes	2 days
Percent of yes	40%	70%	70%	70%	

70 Surveys	11 returned	15.71%

Appendix D

<dbuckley@sanborn.com>
Subject
Your project questions

Dear Chief Bills,

Thank you for your interest in Vexcel's satellite and remote sensing services and products. We really provide the ground station infrastructure to receive Satellite Imagery and create low-level image products. The higher-level information products you are interested in, for fire risk, hazard, and damage assessment are more typically provided by remote sensing services companies.

So, I would like to introduce Mr. David Buckley of Sanborn. David is an expert in use of Satellite Imagery for fire-related applications. I'm sure he would be happy to speak with you about your project and answer your questions.

Good luck.

Regards,

John E. Lee
Director of Business Development
Satellite Ground Systems - Vexcel Corporation
1690 38th Street, Boulder, CO 80301 USA
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john.lee@vexcel.com
www.vexcel.com
innovation in remote sensing
"LandVoyage.com
Support Team"

<support@landvoya To

Gerald,

The fastest turn around time for collecting satellite imagery that is high enough resolution to be able to see dammage resulting from fire, is about two weeks. That being said, the cost for such imagery is astronomical. My guess is that this is going to be the most difficult part of the equation to crack. Technologically speaking, next day, or even next week data is not available on a consumer level at this point. Our newest data is more likely going to be 1 year old at best. Our imagery is compatible with most GIS software. The imagery can be downloaded as a geo-referenced tif or jpg. Change detection would be up to the user to identify, but this could certainly be done. I would guess that you would need 2 meter resolution imagery to be able to see roof damage etc.

Let me know if you have any other questions and I will help.

LandVoyage.com Support Team
http://www.LandVoyage.com
support@landvoyage.com
Please respond to
tfcustrelations@c
s.fiu.edu

Mr. Bills,

Thank you for your interest in our services. You may find the answers to your questions below.

Yolanda
TerraFly Customer Service Representative

> [GBills@seminolecountyfl.gov - Wed Jun 08 19:47:59 2005]:
>

1. How soon after a hurricane can a satellite image be retrieved and transferred to the customer (provided the weather is clear)?

After the storm passes and the satellite is able to get a clear look at the area, a rush acquisition could be placed and the imagery could be acquired most likely within 30 days.

2. Is computer software available to compare a new image with an old image to identify discrepancies (i.e. roof damaged buildings, trees blocking roads)?

Our TerraFly software would allow you to fly over before (if available) and after imagery simultaneously. One would then be able to do a visual analysis of the disaster.

3. If so, may the information be coordinated with our GIS system to ascertain specific location information (assuming software compatibilty)?

The satellite image files are available in geotiff format which are GIS compatible.

4. Is your company capable of offering any or all of the services mentioned above? If so, please list those services and provide a brief description.

Aquisition of the imagery
Integration into TerraFly (more info at TerraFly.com)

> When replying to the survey, please include your company information in order for the readers to contact you for additional information. All replies will be included in the projects appendix section

> Thank you for your time and consideration. Please feel free to add any
> other information you deem useful.
>

Gerald,

Here goes.

1) We don't have satellites ourselves, so we can't say for certain. Of the
satellite vendors we work with, it's usually a few days. But, they usually require a decent size area for purchase (64 sq km or more).

2) Don't know

3) Don't know

4) Only #1 through our alliance with OrbImage, but they require 192 square kilometers for purchase.

Terraserver.com

1. How soon after a hurricane can a satellite image be retrieved and transferred to the customer (provided the weather is clear)?

ImageAmerica does not offer satellite data. Considering our capability we would submit that satellite data is not resolved enough, accurate enough, available quickly enough or cloud free enough.

As the pioneering company in the all-digital collection, processing and delivery of large area, 6-inch resolution digital orthoimagery, ImageAmerica can collect county sized areas in hours and process that data into seamless, fully orthorectified base maps for purposes of mapping for damage assessment in a matter of days.

ImageAmerica is included in the USGS Emergency Response vendor list for just such an occasion.

2. Is computer software available to compare a new image with an old image to identify discrepancies (i.e. roof damaged buildings, trees blocking roads)?

Yes. See the Hitachi “Housediff” product.

3. If so, may the information be coordinated with our GIS system to ascertain specific location information (assuming software compatibilty)?

Yes

4. Is your company capable of offering any or all of the services mentioned above? If so, please list those services and provide a brief description.

We are able to provide both the highly accurate, large area coverage damage assessment mapping data and the change detection software for the purpose described. Some discussion should occur to make sure procedures and data sources are in place to support such an effort.

When replying to the survey, please include your company information in order for the readers to contact you for additional information. All replies will be included in the projects appendix section

Thank you for your time and consideration. Please feel free to add any other information you deem useful.

Tom Maher
COO, VP Business Development
ImageAmerica
200 S Hanley Rd, Suite 1050
Clayton, MO 63105
800-275-0133
314-726-4600
fax: 314-726-4700
cell: 314-495-8356

I apologize for the late response. I work for Intergraph Corporation and we
supply aerial cameras to Government and private companies for the acquisition and processing of imagery like you are looking for. Our latest technology for acquisition is a digital camera that is used from a fix wing aircraft. We have several installed in the country and even one in the Florida Department of Transportation. If you would like us to follow-up with you, Travis Ritter is our representative in Florida that can supply some information.

Hi Gerald,

The James Sewall Company does not do this type of work, but for what they're
worth, following are my 2-cent answers to your questions...

1. I cannot comment on the timeliness of satellite data acquisition, but I can point out another issue besides weather that will impact timeliness. Satellites orbit the earth in predefined tracks designed to maximize coverage of the intended targets. For high resolution commercial satellite companies the intended target is the world. There is a periodicity for which

any given earth location can be imaged by a given satellite. So the timeliness factor is compounded by having clear skies when the satellite is overhead. It is a very hit-or-miss endeavor.

2. Yes, there is software available to do change detection. Erdas Imagine image processing software (http://gis.leica-geosystems.com/) is one such application. How well it works on actual data is another story. The problem is consistency between the base imagery and the updated imagery. Imagery scale, color depth, shadows, and datum/projection information can all impact
the quality of the automated change detection results. You can expect a lot of false negative and false positives from a change detection process. Much interactive work would be required to QC the results of an automated change detection process.

3. You can expect that every software product will handle the results of a change detection process differently, but all will have some way of getting the detected areas out to a vector format which could be ingested into a GIS
system. The location information is inherent since the change detection process cannot function reliably without georeferenced base and update imagery.

4. As mentioned above, we do not do this type of work. I highly recommend you take a look at EarthData International . EarthData has developed an airborne rapid response system mapping system (http://www.earthdata.com/s-rapid.html) designed specifically for disaster mapping projects.

Good luck on your project.

Allen

Allen Grafton
Project Manager
James W Sewall Company
136 Center Street
PO Box 433
Old Town, ME 04468
207-827-4456 x210
207-827-3641 (fax)

Hello Mr. Bills

Here is the information you requested.

Company Information:

Our company, PCI Geomatics, has built image-processing and GIS software and solutions for over 22 years. Our software is used for many earth monitoring applications, including forest fire monitoring and remediation (click here to find examples of our customers' work: http://www.pcigeomatics.com/users_gallery/ug_03.pdf and http://www.pcigeomatics.com/users_gallery/ug_01.pdf).

Find out more about us at www.pcigeomatics.com .

1. How soon after a hurricane can a satellite image be retrieved and transferred to the customer (provided the weather is clear)?

The frequency at which remote sensed images are captured is dependent upon the particular satellite. Some satellites have daily revisit rates while others may take several weeks. There will always be a trade-off between the revisit rate and the resolution of the image (pixel size). In general, the more frequent the revisit time, the lower the resolution (greater pixel size).

After retrieval, the satellite image vendors process the images. (This processing varies, but generally it is meant to remove geometric and radiometric distortion from the images.) Generally, they can provide an image product to the customer within a matter of days. The customer may elect to purchase a fully-processed product from the vendor, or to do some measure of the processing themselves.

2. Is computer software available to compare a new image with an old image to identify discrepancies (i.e. roof damaged buildings, trees blocking roads)?

Yes, our Geomatica software suite can help you perform this analysis, often called Change Detection. There are several accepted methods of change detection, but all depend on proper registration of the new and old images to each other.

Not only does our software support a wide variety of change detection methods, but it also includes high quality image-to-image registration.

3. If so, may the information be coordinated with our GIS system to ascertain specific location information (assuming software compatibilty)?

Yes. By superimposing GIS layers on the imagery and performing overlay and

statistical analysis, you can easily update and create new GIS information with the Satellite Imagery.

With support for over 100 common raster and vector formats, our users rarely encounter problems with software and data compatibility.

4. Is your company capable of offering any or all of the services mentioned above? If so, please list those services and provide a brief description.

My answers above address our capabilities in a general way, and we'd be happy to discuss your needs in more detail. Please contact me at my coordinates below at your convenience.

I look forward to speaking with you.

Sincerely,

Vincent

Vincent Goodfellow
PCI Geomatics
250-382-5800 ext 230
www.pcigeomatics.com

"Todd Jamison"
<TJamison@observera.com>
Subject
your request for some information in reference to satellite photography/imagery and its related technology

Battalion Chief Gerald Bills,

1. How soon after a hurricane can a satellite image be retrieved and transferred to the customer (provided the weather is clear)?

Typically the weather right after a hurricane is ideal for collecting Satellite Imagery. The time it takes to collect and transfer imagery to the ground station or the customer in not the real problem because

this has been done in less than 24 hours for customers in the past. The real problem is the fact that the satellite(s) may not be in the right place on orbit to image the area you need. As a rule of thumb, the pointable high resolution commercial satellites used can only revisit the same location on the earth once every 4 days. Of course, you can increase this revisit time by using images from more than 1 satellite.

2. Is computer software available to compare a new image with an old image to identify discrepancies (i.e. roof damaged buildings, trees blocking roads)?

What you are asking about here is change detection. There is any number of methods, tools, and software applications that can be used for this. These methods can range from the simple (i.e. looking at 2 large format printed images and visually identifying change) to the complex where computer programs are used to mathematically add and subtract pixel to determine change. Observera has developed a hardware/software solution called the Change Detection Workstation (CDWS) that combines commodity hardware, open source and Commercial-off-the-shelf (COTS) software, workflow management practices, and web-based analysis tools that empower the unsophisticated users to perform effective change detection. The CDWS also provides reporting capabilities so that printed documents can be readily produced and sent into the field.

Before we leave this topic there are a couple of important points that needs to be addressed. First, the types of change that you refer to here (roof damaged buildings, trees blocking roads) require fairly high resolution imagery to identify. In today's commercial market, the best resolution imagery available is approximately 0.6m (2 foot) per pixel but more commonly these images are 1m (3 foot) per pixel. Given this, there may be some limits in the degree of damage you can identify. Next, high resolution imagery is expensive. Finally, high resolution images are large (an individual image file size can be over 1GB).

3. If so, may the information be coordinated with our GIS system to ascertain specific location information (assuming software compatibility)?

Imagery and change detection products should be compatible with just about any GIS system out there. Images can be produced as GeoTIFFs which are universally supported in any GIS software. Of course, other formats can be produced if necessary to integrate with your GIS system.

All commercial Satellite Imagery is delivered with some geographic reference. Typically the positional accuracy of these products are +- 10m to 25m from the actual location. If this accuracy is sufficient for your intended use (i.e. it gets you close enough) than chances are the products directly from the commercial vendors will be sufficient. If more accurate location information or more precise change detection is required then these data will require additional processing. Precise positioning and co-registration of images collected at different times or by different imaging systems is accomplished using sophisticated sensor models and the use of satellite ephemeris data (data about the position of the satellite when the actual image was collected).

4. Is your company capable of offering any or all of the services mentioned above? If so, please list those services and provide a brief description.

Yes, Observera is an imagery science and geospatial information company. We have been in the business of developing sensor models, advance image processing algorithms and change detection applications for the past 10 years. We have access to and can provide commercial imagery and advanced products. We use both COTS and open source technologies in our production environment. The CDWS provides turn-key capabilities to ingest, process, catalog, analyze and report changes similar to the ones you have identified above.

If you have any questions or you require any additional information, please feel free to contact us.

Tim Leary
(tleary@observera.com)

Observera, Inc.

4451 Brookfield Corporate Drive, Suite 107

Chantilly, VA 20151

(703)-378-3153 (703)-378-3166 (fax)

Subject: Information

1. How soon after a hurricane can a satellite image be retrieved and transferred to the customer (provided the weather is clear)?

Depends upon the satellite and the revisit period. Some satellite data providers can do this fairly rapidly, others aren't so fast. It also depends upon the queue of customers and how much they've paid the vendor to task the satellite. I know of some folks who have requested data and never gotten any after 9 months or more.

2. Is computer software available to compare a new image with an old image to identify discrepancies (i.e. roof damaged buildings, trees blocking
roads)?

Yes, most image processing packages can do temporal (time) change detection.
We have software that can do this and most image processing packages can do this.

3. If so, may the information be coordinated with our GIS system to ascertain specific location information (assuming software compatibilty)?

Yes, image processing packages can either run right inside a GIS or process outside the GIS and import the data to be utilized.

4. Is your company capable of offering any or all of the services mentioned above? If so, please list those services and provide a brief description.

We offer the software, but not the services.

Intergraph
Phil Kern
Program Manager
The Americas
Earth Imaging Solutions Centre
Z/I Imaging
Phone: 256-730-1827
Fax: 256-730-2096
E-mail: pfkern@ingr.com

P. S. Florida DOT has a high resolution digital camera they purchased from us called the Digital Mapping Camera (DMC). You can contact Teddy Harris at
FDOT for information on obtaining imagery both pre and post disaster. He did this for much of the hurricane damage last year.

When replying to the survey, please include your company information in order for the readers to contact you for additional information. All replies
will be included in the projects appendix section

Thank you for your time and consideration. Please feel free to add any other
information you deem useful.

"DigitalGlobe
Customer Service"

<info@digitalglobe.com> To

Dear Gerald Bills,

Thank you for contacting DigitalGlobe.

I have provided the information you requested in the body of your original message.

I would also like to let you know of a business partner who has a special emphasis in Wildfire Risk Assessment, Emergency Response Planning , and Forest Composition Analysis. Native Communities Development Corporation (NCDC Imaging) is a DigitalGlobe Reseller headquartered in Colorado Springs, Colorado. NCDC is an Indian owned enterprise whose mission is to assist Tribal governments and Federal, State and Local agencies concerned with the management of natural resources, to plan and develop sustainable community enterprises, utilizing state of the art assessment, planning and management techniques. Their contact information is:

Native Communities Development Corporation

Satellite Imaging & Mapping Division

1235 Lake Plaza Dr.
Suite 221
Colorado Springs, CO 80906

Sales Contact: William J. Whatley, VP of Operations
E-mail: wwhatley@ncdcimaging.com
Telephone: (719) 579-9276
Fax: (719) 632-5614
Web Site: www.ncdcimaging.com

If you have any further questions please contact us again.

Thank you again for contacting DigitalGlobe.

Sincerely,

Andrew Abrahamson
DigitalGlobe Customer Service Department
DigitalGlobe® http://www.digitalglobe.com
1601 Dry Creek Drive
Longmont, CO 80503

1-303-684-4084

1. How soon after a hurricane can a satellite image be retrieved and transferred to the customer (provided the weather is clear)? QuickBird has a revisit time of 5-7 days to every where on the planet so we could image the area with in 7 day at the max so the max delivery time would be 8 to 9 days. It is possible that we could deliver the image in 2 days min.

2. Is computer software available to compare a new image with an old image to identify discrepancies (i.e. roof damaged buildings, trees blocking roads)? This is a little tricky because we would have to have a before image of the area in our archive to perform this and we don't have complete coverage of every where in our archive. If we do have an archive image you would be able to visually distinguish between the two as was done for the Tsunami. (See Tsunami Gallery at www.digitalglobe.com/tsunami_gallery.html)

3. If so, may the information be coordinated with our GIS system to ascertain specific location information (assuming software compatibilty)? Yes depending on the product level you could get geolocational accuracy up to 2.5 meters.

4. Is your company capable of offering any or all of the services mentioned above? If so, please list those services and provide a brief description. This would depend on the specific situation. Refer to the links below for product information.

Digital Globe (Homepage)http://www.digitalglobe.com