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Geospatial Information Systems (GIS) and Their Evolving Role In Emergency Management and Disaster Response

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Introduction

On September 11, 2001, almost immediately after the first plane crashed into the North Tower of the World Trade Center (WTC), the Geospatial Information (GIS) Unit of the Fire Department of New York City, then called the "Phoenix Unit," swung into action. The first map they produced was simple: It delineated the buildings within the World Trade Center complex and identified them by name and by street address. This proved a valuable guide to the thousands of fire fighters and other emergency personnel converging on Lower Manhattan to conduct rescue operations, many of whom were not familiar with the area. Phoenix staff then superimposed a 75' x 75' grid across a map of the disaster area to support intensive and methodical search efforts. These initial maps provided the first instance of a "common operational picture," or COP, for New York City leadership and responders.

They were only the first of hundreds of mapping products that were produced during the three months immediately following the WTC attack to satisfy the thousands of information requests made by the dozens of federal, state, local, and private agencies that comprised the response community. Within one week of 9/11, even with the collapse of the building that housed the city's Emergency Operations Center and the evacuation of the city's GIS headquarters office two blocks north of the WTC, there were at least six functioning GIS production centers, providing information and mapping support for rescue, response, and recovery operations, and to the public by making maps available over the Internet. It can truly be said that data organized, analyzed, and visualized on the basis of location was ***the*** predominant way that information was operationalized and made available to response managers. In retrospect, it can be reasonably generalized that effective use of GIS is a pre-requisite for the effective management of a large-scale disaster.

In 2008, the National Academy of Sciences published a study of the GIS role in disaster response: "The committee's central conclusion is that geospatial data and tools should be an essential part of all aspects of emergency management — from planning for future events, through response and recovery, to the mitigation of future events." The report goes on to say: "In all aspects of emergency management, geospatial data and tools have the potential to contribute to the saving of lives, the limitation of damage and the reduction in the costs to society of dealing with emergencies."[1]

A book published by GIS software leader ESRI in 2002, based in part on 9/11 GIS operations states:

"…now, as never before, GIS technology has become integral to any comprehensive disaster management plan — as essential for dealing with a catastrophic event as bandages and radios."[2]

While well trained, led, and equipped first responders are always the most important part of a disaster response, timely and accurate information and intelligence is probably their most important pillar of support.

What is geo-enabled information?

Practically all information related to events and activities in the real world are characterized by one or several types of location data. For computerized information, this means that almost every digital record has one or more fields that capture either an address, a geospatial coordinate (latitude/longitude), a parcel identification number, or some other indication of where an object or an event is located. While different databases may contain unique assemblies of hundreds of other attributes, when a jurisdiction standardizes on a common set of addresses and coordinates, it is then possible to use ubiquitous location fields to link information together across databases. Moreover, GIS then makes it possible to visualize these combinations of data in map form and to produce a wide variety of analytic products, such as flood risk and plume analyses.

For emergency managers, the importance of location can most immediately be understood in reference to E-911 emergency response operations. Critical to the dispatch of police, fire, and EMS personnel is knowing not only what kind of incident is occurring, but <u>where</u> it is taking place, <u>where</u> the closest response resource is located, and what is the <u>best route</u> to get there, taking into account one-way streets, street closings, and road work. Dispatch systems are designed to manage location information in the fastest and most accurate way possible so that response times are kept at a minimum — and it is widely understood that the faster the response time, the greater the chance for saving lives, minimizing injury, and reducing property damage. When dispatch information is imprecise or downright wrong, there are documented instances where this has directly led to the death of someone in need of rapid assistance. Getting location right is a very, very serious business.

A related example is relevant for homeland security managers concerned about infrastructure protection. One Call (811) operations exist in cities and counties across the U.S. to coordinate street openings. One Call systems require that as part of the permitting process, a property owner, utility company, or public works agency wishing to excavate beneath the street or sidewalk surface must first ascertain where all buried infrastructure is located, to ensure that lines are not cut or damaged. Agencies and companies in charge of underground utilities examine their maps and engineering drawings in the vicinity of the proposed excavation and then send workers into the field to mark out locations on the street with spray paint. In more sophisticated operations, the utility lines can be assembled electronically onto a common map for use in the field. One Call enables utilities to avoid outages that leave their customers without service, and reduces the high cost of repairing broken infrastructure. Injuries and deaths also can be avoided. In a large city or urban county, there may be many dozens of One Call dispatches daily.

What applies to E-911 and One Call operations is relevant to just about every kind of government initiative that delivers a service to the public or supports a jurisdiction's physical plant. It is no surprise, then, that disaster-related operations — which can be seen as a combined E-911 and One Call response only on a vast scale — similarly require the highest quality location information delivered in close to real time. Disaster response, if properly planned, can leverage the geospatial data and technologies used for innumerable steady state applications.

Origins of geospatial data and enterprise systems

Typically, an enterprise GIS system is based on aerial photography, which produces an accurate image or picture of an entire jurisdiction with each point (pixel) on the image-map being within a foot or less of absolute accuracy. Using the imagery layer as a base, features are extracted and formed into layers that can include streets, building footprints, parcel boundaries, water bodies, elevation, land use, infrastructure networks, population, and service boundaries. Individual agencies using these "common" layers as a foundation can build additional customized layers corresponding to their own responsibilities and operations. With their geo-data in hand, agencies then can design applications to support their operations. With a large base of common data layers and shareable program components, enterprise GIS systems facilitate the development of applications across many agencies. GIS systems have been shown to pay for themselves within three to five years. Improved tax collections made possible by GIS analysis and operations support can by themselves justify the building and sustaining of an enterprise GIS system costing many millions of dollars.

Approaching enterprise data integration: Agencies within a jurisdiction that has an enterprise GIS are strongly motivated to exchange strategic data layers, and can derive great benefit from sharing and integrating information. Because agency map layers are built on a common enterprise-wide base, these layers can be exchanged between agencies with the assurance of a high degree of accuracy and compatibility. As geospatial layer-sharing increases, it can start to approach true "enterprise data integration:" an information technology goal from the inception of the technology revolution. In a jurisdiction with an enterprise GIS, the emergency manager will be able to import data layers built by any agency, with the assurance that the acquired information meets common accuracy and compatibility standards.

Sharing and aggregating data beyond the jurisdiction: When adjoining jurisdictions working with their state adopt common geospatial data formats and establish data-sharing protocols, geospatial information can be combined across government boundaries — much the same way that standardized LEGO pieces can be assembled — leading to ever greater benefits and opportunities for collaboration. This has particular relevance during a disaster event, which rarely involves just one government entity. Responder teams may need to be called in from the surrounding region or from across the nation. Supplies may need to be transported via air, rail, truck, or ship across thousands of miles. Disaster victims may require transport to distant hospitals and shelters. Infrastructure damage at the center of the event may affect the surrounding regions. In each of these instances, combining the geospatial information across multiple states to relate and make visible all these moving parts and essential facilities is important to the success of the response.

The information challenge of a disaster

Disaster prevention, planning, and response require extraordinary expertise, anticipation, collaboration, and courage. Because disasters often occur by surprise, evolve with great rapidity, affect large areas, and cause widespread damage, information systems to support emergency operations must be capable of responding quickly, accurately, and comprehensively. A jurisdiction that has developed good GIS information and has brought the assets together in its EOC is in an excellent position to quickly understand the physical features and the numbers of people threatened by an emergency event. Such jurisdictions also have the information foundation to support the disaster response. Therefore, GIS operations must be integrated into the Incident Command System (ICS) developed by the Federal Emergency Management Agency (FEMA). If the lead agencies of emergency support functions (ESF) adopt a common GIS foundation, internal ESF operations will be enhanced, and cross functional support and collaboration will be greatly facilitated.

Preparing and sharing pre-incident data is only one dimension of GIS disaster response. Data collection efforts also must extend to the new information generated by the disaster itself. A disaster typically causes violent changes to the natural and the built environment that can continue and evolve for days and weeks. Because infrastructure systems are so interdependent, damage to a critical feature may set off a series of even more dangerous cascading effects. People across a wide area may be injured, cut off from essential services, and in need of immediate assistance. Successful emergency operations require the rapid and continuous monitoring and collection of information that identifies these changes and enables responders to react quickly to new conditions. The requirement to be aware at all times of all aspects of a disaster event is often expressed as the need for a common operational picture (COP).

What really is a common operational picture (COP)?

The sharing of critical information among response agencies, between first responders in the field and incident managers at the EOC; across jurisdictions, states, regions, and even countries; and between all levels of government and the private sector is understood to be of vital importance during a disaster response. Shared information is critical for situational awareness, which is the basis for all decision making. (How can you make a good decision without accurate and current information to base it upon?) Developing a common operational picture (COP) is the task most often associated with the bringing together of geospatially enabled information so that all key responders can see the same information and better coordinate their efforts and collaborate.

COP, with its conceptual origins in military doctrine, is most often tied to the production of maps showing the locations of friendly and enemy troops across a battlefield.[3] As applied to domestic disaster response, the National Incident Management System (NIMS) says: “A common operating picture is established and maintained by gathering, collating, synthesizing, and disseminating of incident information to all appropriate parties involved in an incident." NIMS goes on to state that achieving COP allows on-scene and off-scene personnel to have the same information; and enables the incident commander (IC), Unified Command (UC), and supporting agencies and organizations to make effective, consistent, and timely decisions. It states that COP information must be updated continually to maintain situational awareness.[4]

We should be looking at the COP as one very important component of the overall geospatial information environment required to deal with a disaster.[5] In a disaster, each responding agency likely will have its own missions, each with its own information needs. The Disaster Geospatial Information Environment (DGIE) must be designed in advance so that all the entities in a response get the information they require while contributing information generated by their observations and activities. If all this information was included in one centralized COP, the "picture" would be an overwhelming amount of detail that no one could possibly make sense of. The central COP must be an ever-changing selection of the information judged to be most important for sharing among incident leaders to support strategic decision making, and facilitate collaboration and coordination between response partners.

A diverse team of information and incident specialists having the broadest possible view of the overall disaster information environment needs to select and continually update the key data components of the central COP so that it keeps pace with the ever-evolving character of the disaster. More narrowly focused agency and mission-specific COPs also need to be developed, often with greater technical detail and complexity. The details of the DGIE and the master COP and mission-specific COPs that emerge from it still need to be fully defined and are beyond the scope of this chapter. But, bearing these concepts in mind, we can now go on to look at important elements of a comprehensive geospatial disaster response.

Building a comprehensive geospatial disaster response

Emergency managers have an enormous number of geospatial capabilities at their disposal from local, state, federal, and private partners. The challenge will be to identify, select, acquire, and integrate them to meet your jurisdiction's needs and requirements. One size will not fit all. There are a number of key strategies that bear thinking about.

Networking for geospatial effectiveness: The effectiveness of information technology is diminished when data is kept within agency stovepipes and in formats that make integration difficult. On the other hand, the value of information systems increases when data from diverse sources can be integrated easily and rapidly turned into needed products. Enterprise GIS, when done correctly, creates the potential for all organizations within a jurisdiction or a wider region to share data in any combination necessary to solve a problem or support an operation. Improved sharing methods and tools continue to be made available. For example, many states currently maintain public data warehouses that allow the downloading of large selections of state and local information. Additionally, an increasing number of organizations now deploy web mapping and feature services (WMS, WFS) that enable authorized users to browse a remote site, search for a desired information layer, and either view or download that data into their own environment.

As the technical means for accessing data improve, a question comes to the forefront: How can data owners from different organizations facilitate sharing and collaboration especially when the information in question is considered sensitive? Relationships between agencies and governments, necessary for cooperative and coordinated action, don't materialize out of thin air. Every organization has information they are reluctant to share for security and competitive reasons. Sometimes it is precisely this closely held information that is most critical to share — even if in a limited way — with the response community. Among the most important pre-requisites for effective geospatial support for your EOC is the existence of a network of GIS practitioners in your region who are willing to work together to form a trusting community and work out sharing arrangements. Happily, most states and large jurisdictions in the U.S. have at least one GIS users group or network. Emergency managers should make certain that their GIS staff actively participates in these groups and uses them to build partnerships. Data sharing is critical to all phases of emergency management but is most essential during a response when all those trust relationships, developed in advance, enable rapid data sharing when it counts most. No one should need to engage in protracted, time-wasting negotiations for data when lives are on the line.

Assess your GIS capabilities: Arrange to have one or several extended meetings with your jurisdiction's GIS Director and with other key GIS leaders. Let them lay out for you the data, applications, and technologies that already have been created for the EOC and for other response agencies within your jurisdiction. Those assets must then be related to emergency management needs, including all the emergency support functions. If there is a noticeable absence of a particularly important and strategic set of data layers, or other data preparedness gap, you must find ways to meet these needs. For example: If your jurisdiction is at frequent risk of storm surge, it is essential that you have accurate land elevation data and shoreline bathymetry to do accurate flood modeling and to develop evacuation plans. There are many programs at the federal and state level that you can explore to help you achieve your data-building goals. Your GIS capabilities also need to be related to the emergency management software that you have selected to support your operations. ETeam, WebEOC and DisasterLAN are applications that support disaster operations. These systems can interface with your GIS operations and can incorporate GIS map products. Determine the degree to which your EM software is interactive with your jurisdiction's GIS and then decide whether a stronger integration of the two would add value.

Prepare ahead of time: As with so many aspects of emergency management, the worst time to collect the basic information necessary for a swift and effective response is in the midst of the chaos of a major event. Assuming your jurisdiction has a robust GIS data infrastructure, it will be necessary for your EOC to have ready-to-use critical information, including imagery (overhead and oblique), the transportation network, building footprints, parcels, ground elevation, water features, etc. Many EOCs have developed data catalogues that describe each of the data layers they keep on hand, or that are readily available from other agencies and organizations. Additionally, it is essential that key analytic layers be produced ahead of time, including high-quality flood and storm surge risk information. Based on the threat profile of your jurisdiction, other kinds of predictive GIS analyses can include plume models for your most potentially dangerous chemical storage and manufacturing plants. The FEMA HAZUS application can be used to model in advance the type of damage that might be expected from a major storm or earthquake, and the kinds of resources that would be needed to respond effectively.

Mapping templates of the GIS products most likely to be needed during an emergency also should be prepared in advance to save time. For example, following a hurricane or other high wind event, it is essential that the status of key roads be rapidly evaluated and communicated. Within a map template, vital roads and transportation hubs should be depicted in advance, with various status icons at the ready to identify where debris, damage, or high water makes travel difficult or impossible. This template then can be rapidly populated with field information and quickly modified when road status changes.

Use GIS to maintain vigilance: Watch Command serves as an EOC's early warning system. The sooner a threat can be identified, the sooner you will be able to effectively activate and mobilize your resources. By anticipating problems and pre-positioning personnel, equipment, and information in advance, you can maximize resources available for immediate use during the "golden hours," giving you the greatest opportunity to minimize death, injury, and damage. There are a number of GIS tools that can give you a jump on disaster preparedness and response, and these must be at the fingertips of your Watch Command personnel, who should be trained in their use.

For example, Watch Command must be able to track weather events using the National Oceanographic and Atmospheric Administration's (NOAA) National Weather Service's (NWS) online map viewer that can predict the path and the intensity of major storms, such as hurricanes and blizzards, often days in advance (http://www.weather.gov/). The NWS also can identify areas, which due to excess snow accumulation or rain fall, are vulnerable to flooding. Real-time measures and predictive estimates of river height and flood risk are available for viewing or download and can be combined with your own property and elevation maps. The Army Corps of Engineers maintains a website that monitors ice jams and provides historic data of past ice jams to alert jurisdictions of this flooding risk. (See: http://www.crrel.usace.army.mil/ierd/icejam/icejam.htm) The United States Geological Survey (USGS) provides historic and real-time map data on seismic events and tsunami risk. (See: http://earthquake.usgs.gov/earthquakes/recenteqsww/ and (http://nctr.pmel.noaa.gov/) Similar tools exist for wildfires (http://activefiremaps.fs.fed.us/), drought (http://www.drought.gov/portal/server.pt/community/drought_gov/), and communicable diseases such as the flu (http://www.cdc.gov/flu/weekly/usmap.htm), among others. The GIS-based predictive and tracking tools most suitable for the threat environment of each EOC should be identified and put into active use. Watch Command will need the support of GIS staff to get up to speed on the most appropriate sites for your jurisdiction.

Respond with maximum information support: Should a disaster event actually occur, your GIS support operation will need to flip quickly into high gear. Everything will depend on whether you have properly planned to scale up your GIS operations to meet the extraordinary information needs of a disaster.

- **Networks of EOCs exchanging COPs:** A jurisdiction's Office of Emergency Management generally operates the "Central Command" EOC. However, it is almost certain that a number of operating agencies will need to activate their EOCs, as well. Also likely to be involved are the state EOC, federal agency EOCs, EOCs of jurisdictions across the region, and private sector EOCs. Each EOC will be the hub of a significant disaster response operation. Exchanging essential components of the COP between EOCs will be vital to ensuring the response is properly coordinated. How the different EOCs communicate needs to be designed in advance. Emergency planners must take into account that different EOCs will have different GIS viewers, data formats, and emergency management software packages. All barriers to the rapid sharing and integration of essential information must be reduced or eliminated.

- **Expanding capacity:** To manage the information needs of a large scale disaster, the Central Command EOC must be able to rapidly multiply the number of trained GIS personnel and have sufficient workstation, plotters, and data storage capabilities on hand. In New York City prior to 9/11, the Office of Emergency Management had one part-time GIS analyst. By the end of the first week of the response, NYC OEM alone had more than 50 GIS analysts working on shifts that provided 24 X 7 coverage to meet the information demands of the response community. It was fortunate that the hundreds of members of NYC's GIS community were highly networked through the NYC Geospatial Information and Mapping Organization (GISMO) and were able to be rapidly mobilized. GISMO members came from government, the private sector, not-for-profit organizations, and colleges and universities. Many served for weeks at the EOC as unpaid volunteers. All EOCs must have the ability to rapidly ramp up all aspects of their GIS operations to meet the needs of a disaster event.

- **Collecting and organizing field information:** A major disaster requires the deployment to the field of units from a number of different agencies with specialized missions. EMS, fire, and police teams will conduct rescue operations and work to suppress dangerous conditions. Public works teams will assess damage and start to repair water, sewer, transportation, and related infrastructure. Public health teams will identify health risks, and might be required to distribute medicine and vaccinations. Property department teams will assess damage to buildings and identify dangers that might require evacuation or repair. Utility teams will look for network breaks and outages, and seek to restore services as rapidly as possible. These field workers need their mobile devices to have access to key data, ranging from the location of disabled individuals to the structural composition of buildings and the presence of hazardous materials. Because first responders have direct contact with the evolving effects of the disaster, they also have the potential to be eye-witness informants. If their field devices are properly equipped with global positioning sensors and cameras, they can provide invaluable geocoded intelligence, in real time, across the entire landscape of the disaster — the coordinates of what could be hundreds of inputs automatically arranging themselves accurately on a central map. Also, having the GPS position of all field crews maintained in real time on a common map helps to identify opportunities for mutual aid between teams working in proximity to one another who might otherwise be blind to each others' presence. Additionally, GIS systems already have been used to organize "crowd sourced" data from citizens caught in the disaster area.

- **Integrated viewers:** A new generation of GIS viewer is currently in the process of being developed that will make COPs richer in content and easier to exchange. Such viewers can receive feeds from remote sensing devices, unmanned aerial vehicles (UAV), video cams, first responders in the field with handheld devices, cell phones, and data feeds from web mapping and feature services. These viewers also can display multi-layered floor plans and engineering drawings in 3D. The COPs created by these viewers can be made available to the entire response community, from emergency response teams in the field to the NICC and NOC in Washington, D.C. While still in the development phase, these viewers have the potential to revolutionize the way disasters are managed. One example can be found at the following link: http://www.vcoresolutions.com/fourdscape.php. This system is on display at the Long Island Forum for Technology in Bethpage, Long Island. Product development and commercialization are being supported by New York State and by the DHS Science and Technology Directorate.

State geospatial resources

Many state emergency operations centers have substantial GIS capabilities that during a disaster should be integrated with local EOC efforts. Of course, these collaborative efforts need to have been worked out in advance. Following the 9/11 terrorist attack on the World Trade Center, the New York State GIS Division, based in Albany, which had personnel with remote-sensing expertise, coordinated most of the aerial photography operations taking place in the skies over NYC. State remote-sensing support provided essential information and removed a major burden from strained NYC GIS personnel. Luckily, prior to 9/11, NYS and NYC GIS managers had established a strong collaborative relationship, which paid off during the crisis.

Post-9/11, a number of states have developed disaster-related mapping systems that during steady state and emergency conditions can be utilized by local jurisdictions. Several years ago, NYS GIS deployed the Critical Infrastructure Response Information System (CIRIS) that continues to provide state and local responders with online access to hundreds of layers of critical infrastructure information.

Because the effects of a major disaster cannot be confined to one jurisdiction, states are essential partners capable of bringing together information and analysis from multiple jurisdictions in the surrounding region where ripple effects from the disaster will be felt. Local EOC and GIS managers need to sit down with their state counterparts and identify in advance geospatial capabilities and networks that would be shared in case of a major event.

Federal geospatial resources

Federal government agencies, including the Departments of Homeland Security, Interior, and Defense, among others, recognize the importance of geospatial systems for disaster and emergency response, and have been developing valuable geo-oriented data, analysis, technologies, and techniques. However, this wealth of capabilities doesn't automatically translate into improved operations at the state and local level. It is the job of state and local EOCs and public safety agencies to examine these offerings, work with their federal partners, and acquire, customize, and integrate those capabilities that meet their needs. It helps that, over the past few years, federal agencies have been increasing their regional outreach activities. The following are a few of the offerings that state and local governments can draw upon. In the space allowed, only brief descriptions can be offered. Follow the references and URLs provided to find additional information.

GeoCONOPS: The GeoCONOPS is a multiyear effort focused on the geospatial communities supporting DHS and FEMA activities under the NRF. The Federal Interagency GeoCONOPS is intended to identify and align the geospatial resources that are required to support the NRF, ESF, and supporting mission partners. The GeoCONOPS document has many relevant sections that state and local governments will find of value. Go to http://www.napsgfoundation.org/blog/napsg-blog/113-dhs-releases-geoconops-30-a-napsg-call-for-input to download the Final Draft of Version 3.0 of the GeoCONOPS, dated June 2011. Many of the descriptions of federal capabilities in the following section are drawn from the GeoCONOPS publication.[6]

Homeland Security Information Network (HSIN): The Homeland Security Information Network (HSIN) is a national secure and trusted web-based portal for information sharing and collaboration between federal, state, local, tribal, territorial, private sector, and international partners engaged in the homeland security mission. HSIN is made up of a growing network of communities, called Communities of Interest (COI). COIs are organized by state organizations, federal organizations, or mission areas such as emergency management, law enforcement, critical sectors, and intelligence. Users can securely share within their communities or reach out to other communities as needed. HSIN provides secure, real-time collaboration tools, including a virtual meeting space, instant messaging, and document sharing. HSIN allows partners to work together instantly, regardless of their location, to communicate, collaborate, and coordinate.
http://www.dhs.gov/files/programs/gc_1156888108137.shtm

GeoSpatial Information Infrastructure (GII): The DHS Geospatial Information Infrastructure (GII) is the governing body of geospatial data and application services built to meet common requirements across the DHS mission space. DHS OneView is a lightweight Internet application providing geographic visualization and analysis to individual users. OneView is implemented within the GII by the Geospatial Management Office (GMO). OneView provides access to HSIP Gold data layers and to other federal data resources. OneView users have the ability to add external data sources to their view in common web service formats (KML, KMZ, WMS, and GeoRSS). Anyone with a valid HSIN account may access OneView at https://gii.dhs.gov/oneview.[7]

HIFLD Working Group: The Homeland Infrastructure Foundation-Level Data (HIFLD) Working Group was established in February 2002 to address desired improvements in collection, processing, sharing, and protection of homeland infrastructure geospatial information across multiple levels of government and to develop a common foundation of homeland infrastructure data to be used for visualization and analysis on all classification domains. The HIFLD website (https://www.hifldwg.org/) contains extensive information, useful links, and application forms related to HSIP Data and HIFLD activities. If you work for government in a HLS/public safety capacity, you can apply for HIFLD access.

HSIP Gold and HSIP Freedom: HSIP Gold is a unified homeland infrastructure geospatial data inventory for common use by the federal Homeland Security and Homeland Defense (HLS/HD) Community. It is a compilation of over 450 geospatial datasets, characterizing domestic infrastructure and base map features, which have been assembled from a variety of federal agencies and commercial sources. HSIP Freedom is a subset of HSIP Gold data that can be made available to state and local governments. https://www.hifldwg.org/

Virtual USA (vUSA): Virtual USA, an initiative of the DHS Science and Technology (S&T) Directorate, is creating a new way for emergency managers to operate and collaborate. Virtual USA was built by a partnership of practitioners who defined:

- how shared information should be documented and described,
- the technical tools necessary to share information,
- agreements needed to set standards for sharing,
- the partners that should join the sharing consortium, and
- how access to the system would be controlled.

Virtual USA gives emergency managers transparency into the information that is shared, as well as control over who has access to it, where, and for how long. All shared information lists a personal point of contact, so users know who to call with questions. https://vusa.us.solution.html

Interagency Remote Sensing Coordinating Council (IRSCC): As stated in the Federal Interagency Geospatial Concept of Operations (GeoCONOPS): The Interagency Remote Sensing Coordination Cell (IRSCC) is an interagency body of remote-sensing mission owners with capabilities that enable the primary federal responder to plan, coordinate, acquire, analyze, publish, and disseminate situational knowledge. When activated, the IRSCC provides visibility of the remote-sensing missions that are the statutory responsibility of the member organizations. This provides the community (federal, state, local, and tribal governments) information about ongoing remote-sensing missions before, during, and after a Stafford Act declaration.[8]

Next steps, key considerations

As you move forward in your thinking about how you wish to take advantage of geospatial data and technologies to support your emergency management and disaster response operations, you may wish to keep in mind the following objectives:

1. **Work toward defining your Disaster Geospatial Information Environment (DGIE), central COP and mission COPs:** Choreographing the movement of data to get the right information, into the right hands at the right time is key to a successful disaster response, but it is a complex and demanding effort. It will be necessary to understand the information needs of all potential disaster responders and align them with information sources ranging from local databases to remotely sensed data captured by satellites, fixed-wing aircraft, and UAVs. Each agency likely to participate in a disaster response should be asked to reveal its disaster information management plan: how it will collect data from the field, how it will produce analytic and operational products, and how it will create its own, customized COP. Every jurisdiction's EOC needs to develop a methodology by which a central COP can be formed through the selection of the most important information inputs from across the response community. This is likely a long-term design and development effort that will require constant testing and fine tuning.

2. **Put data sharing agreements in place to prevent negotiations during a disaster:** Sharing data between agencies, between levels of government, and between private firms is not easy, but in a large-scale disaster such sharing is essential to provide responders and the public with critical information, which likely will affect their safety and well-being. Without knowing the status of electric outages, the work of many government agencies may be impeded. Without knowing the condition of roadways, crews seeking to restore power may find they cannot reach downed wires or damaged transformers. The Virtual USA program (vUSA) of the DHS Science and Technology Directorate can help to promote data sharing between organizations that reduces or eliminates concerns about the exposure of sensitive data. Another federal capability that can help promote data sharing is the Protected Critical Infrastructure Information (PCII) program. PCII (http://www.dhs.gov/files/programs/editorial_0404) is an information-protection program that enhances voluntary information sharing between infrastructure owners and operators, and the government. PCII protections mean that homeland security partners can be confident that sharing their information with the government will not expose sensitive or proprietary data. The vUSA and PCII programs should be considered when designing your data-sharing plans.

3. **Develop GeoCONOPS and GeoSOPS that reflect your jurisdiction's unique threats and vulnerabilities:** Following the 9/11 terrorist attack on the World Trade Center in NYC, the GIS community was asked by NYC OEM to develop maps and analysis to support the response. The Emergency Mapping and Data Center (EMDC) had to start from scratch. They didn't know what elements needed to be put into the maps demanded by incident commanders and the mayor. They did not know what information products responders required to best support their efforts. They did not know how to effectively collect critical intelligence from the field. They didn't know how to properly distribute the maps produced. They had to learn all these things, and many more, on the fly with considerable waste of time and effort. Emergency managers should consider building upon the GeoCONOPS work

already done by federal DHS, and develop detailed standard operations procedures covering information collection and analysis, COP development, and information distribution activities. Never neglect an opportunity to bring GIS into your exercises to the maximum extent possible. During a disaster, GeoCONOPS and GeoSOPS will ensure that GIS personnel know exactly what they need to do, so that no time will be wasted producing those first essential maps.

4. **Take responsibility for integrating all available tools:** A great wealth of GIS data, GIS technology and federal geo-oriented products and capabilities await your use. Matching all these options with your particular challenges is a difficult undertaking. It will be up to each region, each state, and each locality to integrate the mix of capabilities most suited to their needs. Fortunately, this does not need to be done in a vacuum. State and local EOC managers can consult with a variety of federal GIS personnel in their region. EOC managers also can work with national GIS organizations whose mission is to foster collaboration across states, counties, cities, and municipalities. These organizations include the National States Geospatial Information Council (NSGIC: www.nsgic.org), Public Technology Institute (PTI: www.pti.org), the National Alliance for Public Safety GIS Foundation (NAPSG: www.napsgfoundation.org), and the Geospatial Information Technology Association (GITA: www.gita.org). These organizations are working to identify best practices and to promote collaboration and sharing. They also can help put you in touch with the federal GIS representatives in your region.

Conclusion

We are at the leading edge of a new information-based revolution in the way disasters are managed and in the way critical data is generated and exchanged within the response community and with the public. Thanks to the efforts of government and the private sector, the lessons learned from the geospatial responses to past disasters have led to new capabilities better able to deal with these disruptive events. The visualization, integrative, and analytic powers of GIS make it ideally suited to support the needs of emergency responders from incident commanders to rescue workers in the field. If we continue to work collaboratively, our progress will be rapid, and the payback can be enormous.

Dr. Alan R. Shark is credited writing this chapter with the active consultation from the local New York GIS Community. Dr. Shark serves as the Executive Director and CEO of Public Technology Institute (PTI). Celebrating its 40th year, PTI is a national, non-profit organization that focuses on technology issues that impact local government and thought-leaders in the public sector. Dr. Shark's career has spanned over 28 years as a highly recognized leader in both the nonprofit management and technology fields, with an emphasis on technology applications for business and government. He is an assistant professor at Rutgers University where he teaches a masters-level course on technology and public administration. Dr. Shark was elected a Fellow of the National

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Endnotes

1. Successful Response Starts with a Map: Improving Geospatial Support for Disaster Management, National Academy of Sciences, 2007, ISBN:978-0-309-10340-4

2. Confronting Catastrophe, A GIS Handbook; page X, R.W. Greene, ESRI Press

3. Wikipedia; available at http://en.wikipedia.org/wiki/Common_operational_picture; Internet; accessed May 7, 2012

4. Department of Homeland Security, "National Incident Response Plan," December 2008, Pages 23-24; www.fema.gov/pdf/emergency/nims/NIMS_core.pdf

5. Lieutenant Colonel Jeffrey Copeland, "Emergency Response: Unity of Effort Through A Common Operational Picture," U.S. Army War College, Carlisle Barracks, PA 17013-5050; www.dtic.mil/cgi-bin/GetTRDoc?AD=ADA479583

6. Department of Homeland Security, Federal Interagency Geospatial Concept of Operations (GeoCONOPS), Final Draft, Version 3.0, June 2011

7. Ibid: pages 153-154

8. Ibid: pages 151-152