

Mapping Matters

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Your Questions Answered

The layman's perspective on technical theory and practical applications of mapping and GIS

Q: How effective are GIS and mapping techniques for rapid response and rescue efforts?

Anonymous

Answer: Aerial survey is the most effective way to monitor and survey damages for catastrophic events. Reasons for this include:

- the vantage point aerial imagery provides at a safe distance from the event site,
- the effectiveness of modern imaging and sensing technologies in collecting vast varieties of digital data crucial to assessing affected areas (lidar, multispectral imagery, hyperspectral imagery, and thermal imagery in addition to traditional aerial imagery), and
- the rapid turnaround time for disseminating data and derived information to decision makers and first responders, thanks to advancements in data processing and storage capabilities.

The increased ability of both public and private agencies to distribute, visualize, and manipulate large sets of raster data over the World Wide Web is another major advantage to using aerial survey data for response and recovery efforts. The Web provides an easy and effective means for sharing geospatial data at record speed. The USGS Earth Resources Observation Systems (EROS), for example, established a public-access website (<http://gisdata.usgs.net/hazards/katrina/>) in support of disaster response activities following Hurricane Katrina. Within hours of Katrina making landfall on the Gulf Coast, EROS began uploading imagery to state and local governments, FEMA, and other federal agencies—providing imagery and lidar-derived contours of the devastated area, which helped prioritize the recovery efforts.

Many geospatial vendors have provided valuable services in recent years to different public and private agencies during emergency situations. Enabling more informed decision-making for timely allocation of limited resources, these services can help reduce human suffering and save lives. Amidst nearly all recent major natural or manmade disasters, such as the 9/11 tragedy at the World Trade Center, Hurricanes Katrina and Rita, and the recent California's wildfires, concerned agencies managed within hours of the event to contract with willing vendors to provide "rapid response mapping" services.

The main elements of an integrated and effective rapid response mapping system are:

- **Mission Planning Subsystem:** Effective planning determines the required logistics for executing the mission with reduced time and costs while maintaining the quality of the final products. In addition, these mission planning systems can include models that enable stakeholders to automatically determine all necessary support elements that are needed for field or office-based activities, including historical and publicly-accessed geospatial data. Navigating airport availability, power sources, and other services in or around the disaster area is a mandatory requirement before deployment.

- **Data Acquisition Subsystem:** An effective aerial system includes one or more sensors such as a digital camera and/or thermal, lidar, multispectral, or hyperspectral sensors. In addition, auxiliary data collection systems such as GPS and IMU are crucial as they shorten the turnaround time of data processing by providing the proper sensor georeferencing.
- **Data Processing Subsystem:** Data processing can be approached by one of two scenarios, based on mission requirements:
 - ♦ **Deployable Data Processing System:** Such systems, which can be pay-loaded with the acquisition aircraft or trucked to the affected region, can vary in capability and sophistication depending on the size of the project and other contractual terms concerning products turn around time. In general, a deployable system contains all necessary software and hardware for processing airborne GPS/IMU data, performing aerial triangulation if necessary, as well as orthorectification of any aerial imagery.
 - ♦ **Office-supported system:** Ordinary mapping production-line environments not normally dedicated to rapid response mapping can become totally or partially dedicated to processing rapid response data as it arrives from the field through express mail. The main advantage of this approach is the unlimited processing capability as compared to the hardware that can be transported and installed in the field. However, the product turnaround time is longer with this approach. It is also important to budget for the time required for the overnight shipping of the collected data and for the time required to disseminate final products to rescue and response staff in the field.

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- **Information dissemination and dispatching subsystem:** This is shaped by combined efforts between the contracting agencies, whether governmental or private, and the firm executing the production mission. The dissemination of final products and information could be in digital or paper media, as required by

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end-users. First responders and rescue staff most likely prefer paper maps for visual interpretation while decision-makers and planners may prefer digital and statistical results needed for further analysis. As I mentioned earlier, the World Wide Web and ftp servers as dissemination tools are becoming very popular. However, caution must be practiced in planning the dissemination efforts based on the situation surrounding the struck area; in many cases, the lack of basic services such as power or internet connectivity hinder electronic data transfer.

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Increased attention to homeland security and emergency preparedness combined with USGS/FEMA response to recent natural disasters have contributed to the commoditization of rapid response mapping products. In addition, recent success on numerous rapid response projects spread over a wide array of events have encouraged many manufacturers to offer complete aerial systems providing automated and near real-time production of GIS data for emergency events. In order to serve the ever-evolving rapid response mapping industry, national guidelines and specifications for rapid response need to be developed through cooperative efforts among FEMA, the USGS, the Department of Homeland Security, and most definitely ASPRS. This will serve both data providers and contracting agencies alike by providing:

- ♦ accelerated negotiations and contracting during time-critical situations through well-defined specifications suitable for rescue and disaster management projects; and
- ♦ a mutual understanding of what deliverables are required for rapid response situations, thereby eliminating confusion between standard mapping products required for engineering-grade study and design with products used for rescue and disaster management. Endorsing less stringent accuracy requirements for rescue and disaster management tasks result in faster turnaround and less expensive contracts.

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