



U.S. Department of Homeland Security



System Assessment and Validation for Emergency Responders

The U.S. Department of Homeland Security (DHS) established the System Assessment and Validation for Emergency Responders (SAVER) Program to assist emergency responders making procurement decisions. Located within the Science and Technology Directorate (S&T) of DHS, the SAVER Program conducts objective assessments and validations on commercially available equipment and systems, and develops knowledge products that provide relevant equipment information to the emergency responder community.

SAVER Program knowledge products provide information on equipment that falls under the categories listed in the DHS Authorized Equipment List (AEL), focusing primarily on two main questions for the emergency responder community: "What equipment is available?" and "How does it perform?" These knowledge products are shared nationally with the responder community, providing a life- and cost-saving asset to DHS, as well as to Federal, state, and local responders.

The SAVER Program is managed by the National Urban Security Technology Laboratory (NUSTL), which also prepared this TechNote.

For more information on this and other technologies, contact the SAVER Program by e-mail or visit the SAVER website.

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GIS and Event Modeling for Disaster Planning

To ensure the safety and security of people in a disaster area, Geographic Information Systems (GIS) have been used to give emergency responders the information they need to make quick and effective decisions in response to disaster events. Knowing the number of people to be evacuated and sheltered is essential information to emergency responders in the event of a disaster. GIS disaster event models coupled with population data can quickly generate GIS maps that illustrate population statistics of those affected by a disaster and provide real-time information for evacuation and shelter-in-place planning.

Introduction

Disaster events are naturally occurring catastrophes and/or deliberate acts. They can bring devastating consequences to the affected area, particularly if occurring in a populated city. The capabilities and features of GIS enable emergency responders to quickly provide information for evacuation and shelter-in-place when such events occur. GIS uses a geographical system for capturing, storing, checking, and displaying data related to positions on the Earth's surface. GIS is a computer software that can be used for data management, risk analysis, and visualization to map information showing the affected areas, safe zones, number of people in potential danger, population density, evacuation routes, and designated shelters. Emergency responders can use GIS to understand and analyze the reactions of various segments of the populace in response to disaster events.

GIS Disaster Event Models

GIS is capable of visualizing three-dimensional data such as buildings, infrastructure, and municipal facilities, as well as two-dimensional data such as streets, roads, and rivers on a geographic map. GIS also has a feature to integrate aerial photographs with different kinds of data and/or population data on one map (Figure 1) or multiple maps for situational awareness and disaster planning. Modeling data are the computed results obtained from GIS disaster event models (i.e., flood model, earth quake model, storm surge

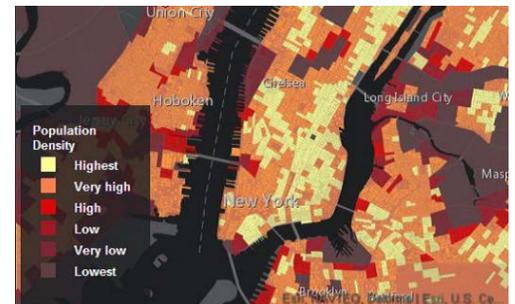


Figure 1. GIS population data map

Figure courtesy of Environmental Systems Research Institute

model, hazardous/radiological plume model, etc.), and are used in GIS to display the model outputs in a geographical system. Population data can be pre-disaster population, which includes the number of people at certain areas and locations during daytime, nighttime, and rush hours. Accurate population data is critical when applying a GIS disaster event model for assessing potential impacts, predicting an estimate of people at risk in an event, and providing real-time information in a timely and effective manner in response to a disaster event.

Applications

In 2003, the U.S. Army Corps of Engineers used a GIS flood model and population data to estimate the affected land areas and visualize the most dangerous areas for Hurricane Isabel (Figure 2). GIS generates the inundation maps with floods and the geographic maps including the locations and information of local buildings and facilities. These types of GIS maps can be updated in real time and can be easily communicated to emergency responders for rescue operations.



Figure 2. GIS flood model

Figure courtesy of U.S. Army Corps of Engineers

Many atmospheric plume models are linked with GIS to visualize plume dispersion in a geographically defined area with various topographic features, or in a city with buildings and facilities. Pre-stored geographic map and population data can be integrated with plume models using GIS to generate information that would be of value when making decisions on evacuating or sheltering-in-place the affected populations. For example, the plume model depicted in Figure 3 indicates that evacuation routes should avoid downwind areas. Decision-makers can clearly visualize the affected regions when using GIS. The Federal Emergency Management Agency (FEMA) uses GIS in disasters ([disaster response](#)). The



Figure 3. GIS plume model

Figure courtesy of J. Atlas, MD FACEP

emergency responders in FEMA apply a GIS disaster event model coupled with population data to estimate populations at risk and damages in affected areas. They also produce GIS maps from model outputs and damage assessment data with maps and/or tables. Fire departments like Baltimore City Fire Department ([Baltimore](#)), also use GIS to optimize the deployment of limited emergency medical resources. GIS displays fire perimeters on maps if there is potential fire spread to a larger area. The department uses GIS as an aid in identifying population evacuation requirements and effectively provides fire and rescue services. GIS disaster event models coupled with population data have proven to be useful for planning and preparing in response to disaster events.

Conclusions

GIS provides decision-makers with the information they need to determine staffing and resource needs, and to supply dispatchers with a comprehensive view of a disaster and the response required. Accurate population data that provide the number of people in an area and where they live is essential to the model estimates of people at risk, as well as for recovery and reconstruction. The vulnerability of a population to disaster events depends on a number of factors such as proximity to the events, population density, disaster preparedness and awareness, existence of early-warning systems, economic development of the area, and scientific understanding of the hazards and their dispersions if hazardous materials are involved. Vulnerabilities associated with the responses can be better understood when disasters have been identified and visualized in GIS maps.