

Using Realtime Weather for Emergency Response GIS
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ABSTRACT

The use of GIS within Emergency Operations Centers (EOCs) combines visual intelligence and map data from a variety of sources within a real-time situation map. One type of information that is critical to any emergency response is weather. Temperature, winds, humidity, weather radar and lightning strikes can all impact the situation and response tactics must adapt accordingly.

Real-time sources of weather data are now available in GIS-friendly formats for use in the EOC. Real-time weather data can be used to feed trajectory models such as CATS, HAZUS MH and ALOHA, among others. This "weather-aware" GIS also makes location-based notifications possible during a crisis.

The National Spill Control School at Texas A&M University conducts training and emergency response exercises using GIS as the scenario generator. By adding a realtime weather capability to the GIS, more realistic scenarios are presented.

GIS IN THE EMERGENCY OPERATIONS CENTER (EOC)

GIS as an Integrating Technology

GIS has been used within emergency response operations for several years now. Present and emerging technologies allow GIS to take an even more active role during a crisis to contribute help when it is needed most. GIS can provide visually stunning graphics, interactive applications and live status maps to those working in the EOC as well as in the field. ArcGIS is being used by many EOCs in the interest of maximum interoperability. The goal is a Common Operational Picture (COP).

GIS is a powerful data fusion tool, providing rich content and visual intelligence. In the EOC, GIS provides a wonderful graphical status map, just like the big table-top maps in the old war movies. Only in this case, the map is interactive and constantly being updated.

Sources of Weather Information for GIS

One factor that affects almost any emergency response is the weather. Temperatures, winds, storms and precipitation can influence the events and responses, so knowing something about the actual current state of the weather is vital to planning an appropriate response. The passage of a cold front or squall line can completely change the direction of a HAZMAT, biohazard or radiological plume. Realtime Weather data is readily available now from both government and commercial sources through satellite-delivered and Web-based data portals. Both free and fee-based systems are available.

One free source of weather data is offered by the National Weather Service (NWS). The NWS now provides GRID Doppler weather radar and a selection of other layers in shape file format for use in GIS. These data layers are accessed via NWS website and a special download interface, which must be accessed manually. Users can even save weather data as KMZ files for display within Google Earth. While this service is free of charge, it is a manual system with only limited data access.

Weather data services are available from ESRI Business Partners that take GIS weather to another level. One provider offers seamless national coverage of over 30 layers of information including radar, lightning strike locations, temperatures, winds, watches and warnings and dozens of other critical layers - all in a GIS-ready format. These layers are accessed from GIS via streaming GIS web server.

The web service also provides access to information from over 8,000 private and public sector realtime weather stations across the U.S. The National Weather Service even adds these stations to its own 1,200 stations to provide much better coverage of the country and for input to the NWS supercomputer models.

In addition to standard national radar, precipitation, lightning, watches and warnings, users of weather data services can also access thousands of realtime video cameras mounted on selected weather stations. These video feeds can provide visual intelligence for observers in the EOC. The video feeds are hot-linked within ArcMap.

Realtime Weather for Model Input

GIS can also serve as the map interface for spatial models such as CATS, EPA's ALOHA (airborne chemical plume dispersion) and FEMA's HAZUS MH (Earthquake, Hurricane, Flooding applications).

Each of these tools includes a map component and the output can be viewed in the GIS along with other relevant map information. What these models require in order to work properly, is a source of current weather input, including temperatures, winds, humidity, precipitation and other data. A flood model requires information on rainfall totals and rainfall rates in order to be useful. An airborne plume dispersion model requires accurate information about wind speed and direction, temperature, humidity and sky cover.

Another application of realtime weather is for Location-Based Smart Notifications. For example, all users within six miles of a lightning strike can receive a warning via GPS-equipped cell phone, pager or Blackberry-type device. These warnings are "smart" because the users' locations are tracked and only relevant warnings are sent. (This is a vast improvement over zip code or other warning methodologies.) The notifications can also be issued for any number of user-

defined parameters, including heat index, freeze warnings, tornado warnings, etc. Even non-weather notifications can be issued by this system such as Amber Alerts. The Location-Based Smart Notifications are useful for a wide variety of applications and are made possible by GIS and wireless technologies. This is an incredibly practical and useful location-based service.

The U.S. Department of Homeland Security is currently establishing a dense network of realtime weather sensors in the top ten metro areas through a project called "Urbanet". These weather stations will be located at fire stations, hospitals and other locations where backup power and Internet are available. This weather data will be used to feed into detailed plume models for Homeland Security purposes.

Real-World Examples

In a recent series of disaster drills for the U.S. Navy, GIS was used to generate the scenarios, document and critique the participants. Each of the scenarios included weather as a factor. The scenarios included airplane crashes, fuel tank ruptures, tornadoes and other mock events. HAZMAT spills generated airborne plumes that needed to be modeled and projected. Realtime GIS weather was used to provide input to the plume model in ALOHA. In other scenarios, there was actual lightning in the area and the realtime lightning strikes were tracked to monitor for crew safety. Realtime weather has also been used to provide input for the emergency response application called CATS, which is used by the Military, Federal, State and Local Government agencies.

Keep it Simple

When evaluating the use of emerging technologies in an emergency response environment, everything needs to be rugged and very easy to use. Often, volunteers and other non-GIS personnel will be called upon to perform data collection or damage assessment. So the more user-friendly the tools are, the better. Realtime streaming weather as a GIS layer needs to be easily accessed and used and can provide a valuable addition to the overall picture of events.

Conclusion

GIS has become an extremely powerful tool for integrating a wide variety of information, including realtime weather information. Since weather affects just about any type of emergency response, having live access to current conditions, radar, lightning and other information all within a GIS environment allows for a Common Operating Picture (COP).

There are many specialized applications for modeling, planning and managing emergency responses, which require timely and accurate weather data as an input. GIS web services can provide easy access to local weather data in near realtime for these models and applications.

Geo-referenced realtime weather data also opens up the possibility of "Smart Notifications" by email, text or cell phone to precisely those about to be impacted by the weather. In this way, GIS technology and Location-Based Services (LBS) are used to deliver intelligent alerts to those that are actually going to be affected by the weather, instead of entire zip codes or counties.

Since realtime weather data services are web-based, they can be accessed anywhere that Internet access is available, including mobile command centers and "Virtual EOCs". The convergence of wireless communications and GIS has made the possibility of the Virtual EOC a reality. Being able to access sources of streaming realtime weather data from the EOC or from the field is a capability that many first responders are finding to be indispensable.

For more information on the National Spill Control School, go to <http://www.sci.tamucc.edu/nscs> or call 361-825-3333.