Internet Map Services: Bringing the Weather to Your Desktop

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Advancements in Internet-based technologies have had a dramatic effect on society's ability to prepare for and manage disasters. From the ability to acquire and disseminate information in a matter of seconds to allocating services and resources, the Internet has permanently altered that landscape of Emergency Management Planning (EMP).

These advancements are amplified when considered in the application of weather-related emergencies, the potential for extreme climate events, and technologies such as Geographic Information Systems (GIS).

From government-based emergency responders to service organizations, forecasting and analyzing weather data in the context of information served through a GIS interface can transform a potentially catastrophic event into one that was forecasted, planned for and, in some cases, mitigated. Now, it's possible to gain access to this valuable information free of charge.

Researchers at The Pennsylvania State University set out to develop a protocol to aid those who specialize in emergency preparedness and the mitigation of property losses by providing easier access to crucial weather data.

Internet Map Services (IMS) represent the latest in GIS and Internet combined technologies that have opened up an important window of opportunity for increased information sharing.

Example of a web-based disaster event mapping application: Aerial photographs show City Island, a park located within the Susquehanna River near Harrisburg, Pa. These images are included in a web-based GIS application developed by PASDA, the public geospatial data clearinghouse for Pennsylvania, to show damage to the region following Hurricane Ivan. (top) City Island in 2003. (bottom) City Island post-Hurricane Ivan in 2004.

The Penn State initiative focuses on identifying climate and weather data vital to potential users and converting and providing that data via IMS. The first series of data came from the National Oceanic and Atmospheric Agency's National Weather Service (NWS) and is part of the National Digital Forecast Database (NDFD).

This breakthrough is particularly significant to those who work within the emergency management and disaster-planning arena, who are seeking to mitigate the impacts of these events.

The future of GIS and its application within emergency management and property loss mitigation efforts is potentially limitless. The variety of situations within which IMS can be used is vast, and as technology, user interests, capabilities, and the Internet improve and increase, the list of potential applications expands exponentially.

What is GIS?

All disasters and crises have one common element: They need to be managed and mastered. In other words, they require preparation, planning, and response.

To effectively address emergency situations, well-designed, coordinated and timely data and information systems must be in place and easily accessible. Whether it is an environmental threat, such as Hurricane Katrina, or an emergency of local, national or international proportions, GIS is there to help manage and mitigate situations that arise on a daily and sometimes hourly basis.

Those familiar with this system will say it is software that supports the integration of digital map data such as roads and streams, points of interest, elevation, aerial photos and satellite imagery into a single interface. It provides an overview of an area or a problem, and even allows the user to model a potential problem or impact.

In reality, it is all of that and more. The system incorporates all aspects of data and information processing, modeling, and integration. In addition to data and software, GIS can also help manage, analyze, and model events and responses.

GIS software and data allow for querying and integrating information and associated attributes that are spatially referenced to a point or area on the earth. Simplified, this system can be seen as one capable of integrating, storing, editing, analyzing, sharing, querying and displaying geographically referenced information.

In its infancy, the system was bound to the world of the desktop computer. The user was required to have the software installed and the data loaded on a computer or an internal network. Advances in technology have broken GIS out of this confined environment.

This interactive information can be easily shared with personnel for the assessment and coordination of post-disaster response efforts and the allocation of resources.

These advances now allow the user access not only at home or in the office, but also in the field. This provides the ability to search for, gather and combine information through queries to quickly access and visually display critical information by location.

The powerful combination of the Internet's exponential growth, the increasingly widespread and easy access, and the widespread availability of information from data clearinghouses, has pushed GIS into the mainstream. It is now possible for Internet users to view aerial photos and satellite imagery with no GIS software requirement simply by using a browser or Google Earth.

It is also possible for users to access web-based mapping applications and view data through data clearinghouses across the country. Many of these clearinghouses have specialized applications and some have developed applications tailored to disaster response on behalf of state government agencies.

Breaking the barrier: IMS and weather data

The development of Internet Map Services (IMS) has increased the ability and ease of sharing information. Users are no longer required to access data in different formats, scales, or projections and convert them.

With IMS, the data is managed and made accessible through a host server and automatically integrates with any data currently in use in a desktop GIS software program. These services are also revolutionizing the use of weather and climate information; previously some of the most complex and time-consuming data for users to access, convert and integrate. This development can empower those working in the emergency management and disaster-planning arena and their ability to mitigate the impacts of these events.

This article focuses on temporal, real-time, short-term weather forecast data, which encompass everything from radar to precipitation to wind speed. This information is designed to be integrated with the data created for pre-disaster planning, disaster prevention, as well as mitigation, recovery, and risk management.

The data is offered free of charge, primarily because it has already been paid for using federal tax dollars through projects done on behalf of the federal government. This is unlike third-party companies who offer similar services and charge annual fees to repackage this information.

The Penn State IMS allows any user with GIS software to add real-time weather data to an existing application with a click of a button.

The services currently offered are three temporal satellite and radar images, 14 NDFD (National Digital Forecast Database) and four NDGD (National Digital Guidance Database) data sets, all provided by the National Weather Service.

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These services are updated round-the-clock daily at predetermined time intervals. This takes the burden of continually downloading and reformatting data off the user since the work is being done on the server side, not the user side.

For example, the user no longer downloads and checks hundreds of megabytes of compressed data that can potentially expand to thousands of files and several gigabytes. In addition, the IMS ensures that the data are continuously available and that they have real-time stamps, such as the time and date of every forecast interval. The data also come with metadata, which gives the user comprehensive information about each IMS data set.

Surface smoke concentration is besides ozone data one of the most recently added data layers. One example of its use is a depiction of the surface smoke concentrations in $\mu g/m^3$ caused by two large wildfires in Northern California, including the 14,000-acre blaze burning at Henry Coe State Park in southern Santa Clara County. It clearly illustrates the wildfire's negative impact on the air quality in the San Francisco Bay Area as of 1 p.m. on Sept. 6, 2007. As a result, residents, especially children, seniors, and those with respiratory problems, in the affected areas were advised to close windows and stay indoors.

Smoke information combined with forecasts of temperature, precipitation levels, wind speed and direction, can help officials, scientists, as well as communities analyze, plan and make the appropriate decisions with regard to the potential threats facing their regions.

Based on user input and feedback, we are constantly adding new data. Recent requests from organizations such as the National Hurricane Center in Miami alerted us to additional layers that could bring an added dimension and provide even more time-sensitive data to users in the field.

On the horizon

The future of these applications within emergency management and disaster mitigation is as vast as the variety of situations within which IMS can be used. These will only continue to grow as technology advances.

The use of personal handheld devices outfitted with GIS and wireless capabilities increases the portable dimension and real-time applications for IMS.

The emergence of Google Earth, as both an informative and interesting resource to one that allows real time integration of IMS, is one example of the possibilities. The Penn State IMS data can currently be viewed within the Google Earth interface, but this capability just scratches the surface of the power that such readily-available visualization tools offer. The development and integration of these applications can span the globe and cross state, regional, and international borders.

The aim of the Penn State initiative is to put the NWS data in a GIS-ready format that can improve the safety of communities while reducing the associated costs. By putting this information into the hands of the people charged with reducing losses to lives and property associated with natural disasters, it may be possible to gain a better understanding of how they may be better managed and ultimately prevented.

Author's Note: The development of these services was initially funded by a grant from The Pennsylvania State University GIS Council. This information is being made available free of charge through the support of several outlets including PASDA http://www.pasda.psu.edu and the regional Mid Atlantic Information Node (MAIN) of the geospatial National Biological Information Infrastructure (NBII) data portal http://main.nbii.gov. Questions regarding these services should be directed to Dr. Bernd J. Haupt, bjhaupt@psu.edu. The authors would like to thank Jack Settelmaier, Ken Waters, and other members of the National Weather Service for their collaboration and advice in developing these services.

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