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Internet and Emergency Management: Prospects for the Future*

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This article reports on the growing value of Internet resources for the emergency management profession. The analysis has six components: (1) a brief history of the field prior to the introduction of the Internet; (2) an overview of the changes in emergency management since the introduction of the Internet and a summary of the characteristics of Internet communications; (3) some descriptions of how the Internet is currently used in flood, earthquake, and volcano research; (4) examples of Internet use as a tool for education; (5) federal and state employment of the Internet in emergency management during disasters and for public education and awareness between disasters; and (6) conclusions and suggestions for further research.

The Internet has evolved into an everyday tool that allows the integration of information across disciplines and professions, national and international boundaries. However, as Botterell (1996) points out, we cannot yet "call the Internet the ultimate answer to our emergency communication problems. It would be more accurate to speak of the Internet as a useful and instructive prototype for what may eventually become a coherent emergency information infrastructure."

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This paper explores both past and present relationships between emergency management and the Internet. While examining current Internet use by emergency managers at the local, state, and federal levels, we call attention to some representative examples of sites that are of value for disaster mitigation teaching and research. For the reader's convenience, the World Wide Web (WWW) address for each site is given in the text and also in an expanded table (see Table 1), which also contains the addresses and descriptions of other related sites. The sites are listed in order of their appearance in the paper.

The prospects for breakthroughs in technology are limitless, and it is impossible to predict the future usages of Internet communications. The paper considers only how such innovations have, so far, influenced the emergency management community. As to the present, since thousands of sites are added each week and addresses are often changed, any examination of the Internet can capture but a snapshot in time. Readers should therefore regard this paper as a pointer to general directions for their own research and not a definite guide to the Web.

This discussion of the value of the Internet to the emergency management profession has six parts: (1) a brief history of the field prior to the introduction of the Internet; (2) an overview of changes to emergency management since the introduction of the Internet and a summary of the characteristics of Internet communications; (3) some descriptions of how the Internet is currently used in flood, earthquake, and volcano research; (4) examples of Internet use as a tool for education; (5) federal and state employment of the Internet in emergency management during disasters and for public education and awareness between disasters; and (6) conclusions and suggestions for future research.

A Brief History of Emergency Management as a Profession

Civil defense was the original emergency management, born during the Cold War. Consequently, most emergency managers until the mid-l980s were retired military officers who, because of their military experience, were regarded as qualified to handle the extreme situations that occur in emergencies. Based on federal directives, the primary concern was reduction of losses from nuclear war. The shift to an emphasis on natural hazards began in the mid-l970s. In 1979, the Federal Emergency Management Agency (FEMA) was formed, which ushered in the present era of comprehensive emergency management.

Until recently, emergency managers were often isolated from their colleagues in other cities and states. Many were in one-person offices without budgets for long distance telephone calls, travel money for educational seminars, or libraries with numerous useful references. Few had professional training in emergency management. Part-time positions were common.

Drabek (1989, p. 27) summarizes four of the most important trends in the emergency management profession.

1. Local emergency managers are gaining influence in city governments.
2. Personal computers are being widely adopted. (Drabek could not envision the implications that the personal computers would have, but he was foresighted enough to recognize their burgeoning importance.)
3. Local emergency management is becoming more important relative to state or regional domains.
4. More formal credentials related to the occupation have been developed.

These four trends are still continuing. In regard to professional education, for example, the National Association of Schools of Public Affairs and Administration, the International City Management Association, and the National Council of Emergency Management have urged the development of independent undergraduate and graduate-level degree programs. Emergency management courses have become a more integrated part of public administration programs. FEMA's Emergency Management Institute offers a wide range of courses through state emergency management offices.

Furthermore, a list of schools offering courses on emergency management can be found through a list organized by the Natural Hazards Research and Applications Information Center, a clearinghouse for natural disaster materials (*www.colorado.edu/ hazards).* The courses are offered in a wide variety of programs, including urban planning, medical schools, engineering, geography, and sociology programs showing that emergency managers emerge from several different disciplines and an assortment of universities. For example, Frontier Community College in Fairfield, Illinois, has training in communications radiological monitoring, writing emergency management plans, and the psychological aspects of disaster. A student considering a Ph.D. degree in geography would be wise to learn about the Hazards Research Laboratory at the University of South Carolina. The lab's homepage lists facilities, individual faculty, and particular research projects (*www.cla.sc.edu/geog/hrl/ home.html*).

Current Emergency Management and the Internet

Internet communication enables people involved with reducing environmental risks or mitigating disasters including earthquakes, volcanoes, floods to communicate quickly and effectively. Twenty years ago even the notion of global environmental management was a new one. Remote sensing techniques and super-computers for detecting and modeling changes on the earth were just being implemented. Now we take real-time radar images for weather fore-

casting for granted and chart the ozone hole and ocean temperatures with technology that no longer seems "new."

It is interesting to compare Internet use now to that of the use of a 1970s technology: the Citizens' Band (CB) radio. In 1978, an extensive study of CB use during floods in Minnesota noted that one recurrent theme relating to CB use was "an intense concern expressed, and a great deal of action directed toward determining, both through official and unofficial means, the status of kin and friends" and that "many non-victim friends experienced heightened emotions of altruism" (Drabek et al. 1979, p. 10). Similar public reactions on the Internet have been reported in recent disaster events (Williams 1995). At that time it was estimated that a CB user was in one out of five American households. Statistics from the MIDS site (*www.mids.org*) indicate comparable (or larger) e-mail access now. The emotionally comforting setting that the CB radio offered 20 years ago is replicated in more rich and more interactive terms by the Internet today. People can discuss with others in similar circumstances how they are feeling and their hopes and fears. (For a discussion of responsible and irresponsible Internet statistics see *www.anamorph.com/docs/stats/stats.html.)*

Characteristics of Internet Communications

In the mid-l990s the communications environment is becoming more efficient and also more egalitarian. Formerly, information flow in emergency management was top-down. Local officials would often learn information only on a "need-to-know" basis as deemed by their superiors, not when the information became available. Internet communication has radically changed the relay of information so that in most cases the "generals" hear the news about road closures and flood gage readings at precisely the moment the data are first available and at the same time as the "underlings."

The Internet not only opens channels in a timely fashion, but barriers of race, gender, nationality, geographic location, or physical disability virtually disappear. One important medium of communication is the "listserv." (Listservs are discussions of a particular topic by e-mail that are forwarded to anyone who wishes to sign onto the list of participants.) Monitoring emergency management listservs, one finds queries from high school students, dispatchers from New York City, county planners from Montana, and geography professors from universities in the same unbiased, unmediated forum. The only qualification for participating in a listserv is an interest in a particular topic. In some ways barriers between government and private-sector information provision are breaking down to better solve problems in emergency management. Scientists routinely talk directly with practitioners in ways never

before perceived as desirable or possible.

Emergency managers are of no one particular discipline; likewise, the information they need is not limited to the purview of any one scientific discipline. Today emergency management studies are conducted by researchers with various specialties, including the physical and natural sciences as well as sociology, psychology, anthropology, geography, economics, political science, and public administration. A psychologist might ask how well victims are sleeping after a tornado; a geographer might map the rebuilt environment and ask whether the new spatial patterns will place the community at greater risk; a political scientist might explore the process by which a community makes mitigation decisions (Drabek 1989, p. 21).

As the barriers between disciplines continue to break down, problem solving and integrated management will lead to more informed decision-making and possibly leaps in disaster mitigation. The distinction between technological and natural hazards may also crumble.

As the hierarchical nature of information flow has changed, so has the hierarchical structure of scientific access shifted. No longer is it necessary to have an advanced degree to be in a position to see the newest data. In the past, concerns were voiced as to possible drawbacks to all information being instantly available to everyone. In the past few years, some meteorologists suggested that when everyone had these data, then their jobs become harder. That is, untrained people could misinterpret the data and require more "hand holding" than the National Weather Service would be prepared to provide, especially in an emergency situation. This proposed problem does not seem to have materialized to any significant degree so far. For emergency managers, the new access is a definite plus; they find that after they study local patterns of rain-gage and stream-gage data over a period of time, the factual basis for their own decision-making improves in terms of timeliness and accuracy.

Basic Changes to Emergency Management as a Result of Internet Access

The Internet allows emergency managers to communicate with colleagues with no geographic limitations. As long as the colleagues are hooked up, it doesn't matter whether they are across town or across the world. This ease of communication aids in lifting the level of professionalism among emergency managers. For example, there is a large volume of e-mail concerning conferences and training programs. Many courses are available on-line. Technical questions, relating to such matters as radio frequencies or which vendor companies are more reliable, are addressed in listservs. An emergency manager in a small town in Nebraska having a problem with stream contamination can

ask for advice from thousands of colleagues with one brief inquiry. Emergency managers compare notes constantly about the best stream gages, solar panels, and many other practical matters. Previously, such information might have been found through a catalog or from a vendor, but the new media save valuable time and clear the way for in-depth learning from others' experiences. Professional development and daily exchange through e-mail and listservs may be the most important component of the Internet for emergency managers.

One such listserv, called "Networks in Emergency Management" (nets-em), is a electronic discussion group through Simon Fraser University in Vancouver, Canada, which was established to promote the exchange of ideas and information concerning emergency management communication and information systems. ("Nets-em" can be subscribed by e-mailing to "Majordomo@sfu.ca" and placing the following command in the body of your message: "subscribe nets-em your-e-mail-address.")

Internet as a Tool for Research in Emergency Management

For the researcher, the Internet can provide up-to-date information and excellent references. Here, we briefly discuss such findings for floods, earthquakes, and volcanoes. The examples shown are by no means exhaustive. Many other hazards have also extensive Internet coverage. One of the sites which attempts to organize all the emergency management sites is the University of Illinois Urbana/Champaign (*www.ag.uiuc.edu:80/~disaster/disaster.html*). Sites ranging from FEMA to the Red Cross to the Mennonite Disaster Service to the Global Health Disaster Network and the state and local Webpages are grouped in three large categories. All are linked through simple hypertext access. (Hypertext is a way of automatically linking one document or WWW site to another by highlighted keywords.) Such compilation sites are a key to finding what is available quickly.

Flood. The Global Flood Monitoring site at Dartmouth tracks flood events around the world on a daily basis (*www.dartmouth.edu/artsci/geog/floods/index.html*). It is sponsored by NASA and the European Remote Sensing Agency. The news sources are also scoured daily, so that background information for each event is available. The site allows viewing of cloud-penetrating radar and high resolution synthetic-aperture radar images from remote sensing to reveal the extent and impacts of floods. Formerly, scholars might wait for years to see articles in scientific journals. Now students, emergency managers, and others can monitor flood events in nearly real-time. The link between the database and the remote sensing technology shows great promise for increasing our understanding of floods. The Dartmouth site also eliminates the nationalistic myopia that pervades in American newspapers that give preference to news

concerning the United States. On this site, the news from China arrives when the flooding takes place and is as important as news from Mississippi.

Earthquake. Literally hundreds of sites are available on earthquakes. The sites we discuss are not necessarily the best sites for every researcher's particular purpose. Here, we have selected specific sites on earthquakes that display the Internet's value for archival research and interdisciplinary opportunities. For example, to learn about the 1994 Northridge earthquake in Los Angeles or the 1995 earthquake in Kobe, Japan one can find a vast array of sites including those which were established just minutes after the earthquake. Many sites were set up in real-time and are not yet deleted. Before these Internet opportunities were available, to find out about the Northridge earthquake it was necessary to arduously search newspaper microfilm or interview people whose stories might be affected by post disaster events or interpretations. Internet research shows exactly which roads were closed, where and when shelters were set up, and what individual actions were recommended. Specific warnings and cautions about disconnecting utilities were also available. Internet archives are a growing rich data source for research and education. Unlike the traditional library, all this is available 24 hours a day and seven days a week.

Motivated by the Northridge earthquake, civil engineer Jean-Pierre Bardet organized a University of Southern California-based Internet bulletin board to enable the exchange of data and emergency information about that and other earthquakes. When a year later the Kobe quake struck, the bulletin board system was already in place, and the Japanese were invited to use the system which proved extremely helpful. Also, Japanese researchers agreed to release all their data and post their findings on an Internet bulletin board (*Los Angeles Times* 1995).

Furthermore, if for no other reason, Internet communication is valuable to augment existing resources. During the Kobe earthquake, a newly-purchased $80 million satellite communication dish was crippled immediately after the quake when it shifted off its foundation. The Internet, however, remained available. In addition, the new medium showed its adaptability to crisis when, in response to the potentially overwhelming burden of heavy electronic traffic, mirror sites were set up around the world. These sites enabled users to continue to receive invaluable information such as press releases, lists of missing persons, the extent of the damages, and the effects of mitigation efforts.

Though seemingly a sidelight to the scale of the earthquake itself, one fascinating Internet application is found at the University of Kobe homepage (*ccs.cla.kobe-u.ac.jp/Asia/Visitor/Furm/index.html*). An American who teaches English there had his students compile experiences of the quake incident. Their poetic and touching eyewitness accounts are accessible on the Web right next

to the latest technical reports on the seismology. Thus, the Kobe Cross Cultural Studies English Composition Project provides this rich data source to everyone who is working on Kobe issues. Sites like this one may aid in keeping the science human. Also, such synergism helps break the tendency for seismologists (and other specialists) to talk only to others in their own field.

One earthquake site which organizes all the WWW information on this topic is the "Earthquake Resource Center" at *www.comet.net/earthquake/index1.htm.* The list of recent earthquakes is continually updated. Or, one can go to the United States Geological Survey site (*wwwneic.cr.usgs.gov/neis/current/world.html*) to find a world map studded with symbols of recent quakes. The links to geographic software facilitates detailed research around the world.

Volcanoes. Two different compilations of all volcano sites have been assembled. "Scott's Internet Hotlist: Volcanoes and Earthquakes and Geoscience" is one site *http:/www.rcch.com/hotlist/ScotList.htm*). It has six single-spaced-sized pages listing sites from "African Volcanoes" to "Lassen Peak Eruption, May 19, 1915" to "Volcanoes and Global Climate Change." Another page also listing volcanoes organized along more hypertext lines is called "Cambridge Earth Sciences 'Volcanoes.'" (*www.esc.cam.ac.uk/astaff/pyle/volcs.html).*

Internet as a Tool for Education

Opportunities abound to use the Net with regard to emergency management and curriculum. One of them is the Global Learning and Observations to Benefit the Environment (GLOBE) at *www.globe.gov.* It is organized by the University Corporation for Atmospheric Research (UCAR) in Boulder, Colorado, and supported by such agencies as the National Oceanic and Atmospheric Association (NOAA), the Environmental Protection Agency, and the National Science Foundation. This is an example of a growing trend. Instead of each agency doing a site, they collaborate. GLOBE gives students around the world an incentive to learn about science by collecting raw data for a real world project. Students take environmental measurements which are used as a continually up-dated information base. Students interact globally on e-mail and work in real-time on their projects.

Through GLOBE, classroom activities are established for students around the world based on actual events just taking place. For example, in 1995 students could help predict the path of Hurricane Opal or learn how much wind speed would be required to lift roofs based on data used by the National Hurricane Center. Certainly these exercises enliven the curriculum and the students' understanding of these extreme events.

Even now, teachers who have access to fast enough computers can use actual archival footage of disasters such as tornadoes, flooding, and volcanoes

erupting with full sound. The possibilities for students to "be there" just after these events happen around the world will increase as machines get less expensive and faster.

Examples of Internet Sites Utilized During and Between Disasters

Oklahoma Mesonet. The Oklahoma Mesonet is an example of comprehensive, multi-valence monitoring at the state level (*geowww.gcn.uoknor.edu).* The Mesonet is funded by millions of dollars in oil recharge money available in Oklahoma. Automated remote sensor stations, 111 total, are set up around the state to continually monitor numerous weather and soil parameters every 15 minutes. Even elementary schools are participating. Having such a vast dataset will be an invaluable tool for meteorological research on tornadoes, floods, and other events.

Emergency Management Weather Dissemination Project. The NOAA Forecast Systems Laboratory (FSL) established the dissemination project in 1991 to provide emergency managers real-time weather-related information in a graphical format (www-ad.fsl.noaa.gov/pddb/emwdp/emwdp.html). A year ago, most National Weather Service products were still in text form even though high-resolution, visual presentations are more quickly interpreted and offer much more information per unit. Now, perhaps a majority still are, but more localized data in graphic form is appearing on sites based with private-sector Internet providers used by regional NWS field offices such the one in Eureka, California (www.northcoastweb.com/nws). Emergency managers have welcomed the opportunity to set thresholds interactively and generate graphics based on their own needs. Data such as fire, weather, and flood vulnerability indexes are available. Also, individual entities like schools, airports, and highways can be selected (Subramaniam and Jesuroga 1995).

For example, an emergency manager might select the following set of parameters: a one inch per hour rainfall rate, twenty-five mile per hour winds, and temperature less than thirty degrees Fahrenheit on any segment of the Interstate highway. Action, such as whether a helicopter search is wise, can be based on specific, very local conditions. Kelsch (1995) is conducting ongoing research on how emergency managers are using these real-time weather data and gathering suggestions for making the displays more useful. The NOAA/FSL Emergency Management Weather Dissemination Project homepage indicates that the plan is to take this real-time weather forecasting system nationwide.

Federal Government Sites. FEMA, the government agency responsible for disaster mitigation and relief, maintains a Global Emergency Management System (GEMS) which contains information on emergency management,

mitigation, and emergency services. It is found listed on FEMA's homepage, *www.fema.gov.* Also, this homepage cross-lists with numerous other agencies and organizations at the state, local, nongovernmental, and international levels which deal with various aspects of disaster. Such titles as, "what to include in a family disaster kit," "the difference between a watch and a warning," and "how to inspect utilities after an earthquake," are all available on-line. FEMA, at more than one-half million hits per week, even during quiet, non-disaster times, is one of the most popular WWW sites. This makes it a powerful medium for disseminating information about the agency and hazard mitigation in the broadest context. People find the information when they need it. Unlike a brochure which is easily lost, the Internet references are always available. FEMA reaches thousands of people interested in keeping current with ongoing disasters and provides opportunities for individuals to register for disaster aid as well as to find out the latest warnings, road closures, upcoming conferences, career opportunities, and other essential information 24 hours per day. Another federal site, that of the National Hurricane Center (*www.nhc.noaa.gov*), has had similar usage. Robert Burpee states that extensive "hits" on the Center's Homepage disseminate public information about hurricanes and enhance public awareness around the country in ways that the agency would otherwise be unable to reach as comprehensively (Iacovelli 1995, p. 20).

Sites Activated During Recent Flood Events

FEMA has added innovative sites during recent disasters. During the early part of 1996, parts of Washington and Oregon experienced the worst flooding in over thirty years. The FEMA Web page, at that time titled "Internet Coverage of the Floods of '96," was a good link for the residents and emergency managers to use as a source for lists of sites (*www.fema.gov/DIZAS/ws96.htm*). Some of the hypertext headings included: key telephone numbers; preparedness information; recovery information; news from State Disaster Field Offices; disaster maps; and FEMA weather links.

"The Electronic Universe Project" at the University of Oregon led the way in innovation and comprehensive links to coverage of the 1996 Northwest floods (*zebu.uoregon.edu/index.html*). Of particular interest here was the historical comparisons made to data on the previous record flood of 1964.

Bruce Visser, the emergency/environmental manager for Marion County, Oregon, reports via e-mail that his agency used the Net extensively. People were informed about flood conditions, road conditions, and reporting procedures on the county homepages. The county also loaded digital photos from

daily helicopter overflights. In Salem, Oregon, one site took 41,000 hits during the days of high water. Visser says, "It performs a lot of community education without having to answer telephone calls. We also used it for e-mail from Emergency Operations Centers to Emergency Operations Centers."

During the current 1997 flooding season, a newspaper, "The Sacramento Bee," is one of the leaders for innovation and helpful links (*www.sacbee.com*). Along with the Eureka NWS site mentioned above, such new sites from various sources, governmental, non-profit, and commercial, reinforce each other's efforts and help to localize information even down to particular neighborhoods. Another example is the California Department of Water Resources, which maintains a homepage with all data related to state flooding problems (*wwwdwr.water.ca.gov*). It includes links to actual National Weather Service watches and warnings, road closures, and flood gage data.

Many residents along the Russian River in northern California found Internet data to be essential in the 1995 floods. Vital information about neighbors, emergency services, local power backup, and weather warnings were all available in 1995, and the data were not impaired by the flooding. Local residents were also able to relay essential river data continuously to the local office of emergency services.

Conclusions and Suggestions for Future Research

Though the Internet as a virtual world replacing reality may be overly touted by various writers, our present-day world has certainly been linked together in ways not before imagined. E-mail and hypertext alone have changed people's styles of communication and learning along with their professional duties and career paths. However, it is difficult to determine to what degree any new technology is going to provide new tools for different kinds of decision-making. For example, whenever the engineers at the NOAA/FSL asked emergency managers whether they wanted new computers with data-tracking capability, the answer was always, "Yes" (Gruntfest 1995). The engineers expected that the new equipment would be used as they intended. However, even with installed mechanisms to track how often a particular agency clicked on the new machines, it was not possible to tell by usage data that the machine was being for its designed purpose. In one case, the emergency manager was merely "happy with his new Pentium" which replaced his older computer, and another local official indicated privately that he thought the new equipment would be of greater value for his previous mitigation activities than for the new data sources from NOAA/FSL. Ultimately, decisions are made by people whose minds cannot be easily tracked by usage counters.

Also, problems occur with data overload and/or data reliability.

Information-searching on the Internet is faster than in the library, but it can be quite time consuming due to the amount of information on-line and the plethora of false leads. If one searches for the keyword "flood," hoping to uncover the latest information on recent events, one may instead find the personal homepage of someone whose last name is Flood. Mis-hits such as this are common. Improvements in search-engines and faster modems will one day alleviate this problem.

The Internet is a new medium, but some of the information one finds is not new or particularly inspiring. For example, one goal of the FEMA homepage is to provide public education. The agency puts all of its public information materials available on-line. Despite the electronic medium, the public education materials concerning actions to take during disasters appear staid. This highlights the need to clarify and illustrate presentations beyond what was considered appropriate for printed material.

The Internet may be most powerful when combined with other technologies. The possibility of combining geographic information systems and remote sensing technology with Internet sites to display where earthquakes and floods are occurring is already here. What John Pickles (1995 p. 238) recently stated after his research on geographic information systems will hold true for Internet resources as well, "We are only at the beginning of the process of delimiting and mapping the territory and content of this new currently solidifying terra incognita."

Concerning such new combinations, an innovative project called the Virtual Emergency Management Information System (VEMIS) is underway at Simon Fraser University's Telematics Lab which has established an experimental virtual emergency operations center which allows emergency managers to remain in the information loop through a wireless Internet connection powered by a car battery and utilizing the new 56 Kbps TCP/IP-based amateur radio packet network. A glimpse of the project, headed up by Peter S. Anderson, can be viewed at *hoshi.cic.sfu.ca/~anderson*. Such a unit could be invaluable during a disaster as it is very suitable for remote data gathering on scene. Current costs for the first pre-manufactured prototypes are approximately $1,200 (Anderson 1996). More work on such projects is needed so that the Internet can become a ubiquitous tool easily at hand.

This paper indicated excellent Internet research and teaching opportunities for emergency management and hazard mitigation. Firsthand stories by Japanese students in Kobe can be accessed right next to data on where the most recent quakes have occurred. Students around the world are working together. Global interactions can revolutionize curricula. Previously when teaching natural disasters, aside from brief newspaper coverage about only a very select few disasters around the world, students were not exposed to

exactly how state, local, and federal officials were handling events that were happening that particular day. Now, student research projects can cite up-to-the-minute references.

This paper summarized the sources available on floods, earthquakes, and volcanoes and discussed FEMA resources. Oklahoma and Colorado are using the Internet for environmental monitoring, and in recent California and Oregon floods it has helped in emergency management decisions by both the professionals and the people at risk.

Furthermore, the Internet has been beneficial in emergency management by providing comprehensive data resources and increasing professionalism because of a sharing of expertise. Whether the changes brought by expanded use of the Internet in emergency management is revolutionary or evolutionary is a question still unanswered. Technology for technology's sake does not necessarily mean improved decision making or reduced losses. One hundred years ago when telephones were just diffusing as a new technology, every time the phone rang it was answered. Now, Internet carries the same "novelty of the new" where most people still answer their e-mail though they rely on phone answering machines to screen their phone calls.

In the one-and-a-half years since we began this project, we have seen remarkable changes in the number of sites, links, and the levels of sophistication available. We even see caveats from agencies stating that emergency managers and others must not solely rely on Internet sources, and that they must always have reliable backup systems in place. Many more vendors provide overviews of their services and discussions of their success stories. We see sites such as the National Weather Service site in Eureka, California, where user surveys are incorporated in the initial design. This allows the agency to keep responding to user needs in an integrated fashion. Moving images and sounds are being incorporated more regularly. Having many local newspapers on lines also makes it easier to keep up with events around the world. In the January 1997 flood events emergency managers could monitor levee breaks and mitigation efforts through the daily reports in the *Sacramento Bee*. For novices, the two best sites for developing an understanding of emergency management are the FEMA site and the Natural Hazards and Research and Applications Information Center site. These sites are constantly revised to keep up with recent events and innovations.

The primary role of the Internet is based on the importance of broader, more open, and free communication. Also, in disasters the mental health comfort for nonprofessionals must not be overlooked. Being able to talk with other people around the world who have been victims of similar natural disasters, federal bureaucracies, or simply wet basements has wide public benefit.

Future research efforts aim to monitor and promote the benefits of Internet

use to state and local emergency managers. We should learn how to continue to encourage interdisciplinary and nondisciplinary specific problem solving approaches. Based on what we have seen thus far, there are reasons for optimism.

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INTERNET SITE	SITE ADDRESS	SITE USES
Natural Hazards Research and Applications Information Center	*http://www.colorado.edu/hazards*	Academic research, education, disaster links
Hazards Research Laboratory at the University of South Carolina	*http://www.cla.sc.edu/geog/hrl/home.html*	Academic Research, education
Illinois Extension Service	*http://www.ag.uiuc.edu:80/~disaster*	Public information, disaster links
Global Flood Monitoring	*http://www.dartmouth.edu/artsci/ geog/floods/index.html*	Public information, weather
University of Kobe, Japan	*http://ccs.cla.kobe-u.ac.jp/Asia/Visitor/Furm/index.html*	Public information, eye-witness accounts of earthquake
Earthquake Resource Center	*http://www.comet.net/earthquake/ index1.html*	Public information, earthquake links
USGS - World Earthquakes	*http://wwwneic.cr.usgs.gov/neis/current/world.html*	Public information, earthquake map - recent quakes
Scott's Internet Hotlist: Volcanoes and Earthquakes and Geoscience	*http:/www.rcch.com/hotlist/ScotList.htm*	Public information, earth science links
Cambridge Sciences "Volcanoes"	*http://www.esc.cam.ac.uk/astaff / pyle/volcs.html*	Public information, volcano links
Global Learning and Observations to Benefit the Environment (GLOBE)	*http://www.globe.gov*	Education
Oklahoma Mesonet	*http://geowww.gcn.uoknor.edu*	Disaster management, weather, local/state data management
NOAA Forecast Systems Laboratory	*http://www-ad.fsl.noaa.gov/-pddb/ emwdp/emwdp.html*	Public information, weather
NWS - Eureka, California	*www.northcoastweb.com/nws*	Disaster management, localized
FEMA	*http://www.fema.gov*	Disaster recovery, best starting point for links
National Hurricane Center	*http://www.nhc.noaa.gov*	Public information, weather

INTERNET SITE	SITE ADDRESS	SITE USES
FEMA - ANW Floods >96"	*http://www.fema.gov/DIZAS/w96.htm*	Public information, localized flood archive
The Electronic Universe Project	*http://zebu.uoregon.edu/index.html*	Public information, floods
The Sacramento Bee	*http://www.sacbee.com*	Disaster information, localized
California Dept. of Water Resources	*http://wwwdwr.water.ca.gov*	Disaster management
Virtual Emergency Management Information System (VEMIS)	*http://hoshi.cic.sfu.ca/~anderson*	Academic research, emergency communication

Additional sites not discussed in the paper:		
Western U.S. Flooding	*www.ncdc.noaa.gov/rcsg/wflooding/wflooding.html*	Disaster management, regional
USGS - Real Time Data	*http://water.usgs.gov/public/realtime.html*	Disaster management, localized
Cal. Office of Emergency Services - Levee Map	*www.oes.ca.gov:8001/html/flood/leveemap.html*	Disaster management, localized
Current Warnings for California	*www.met.tamu.edu/personnel/students/mkay/warnings_ca.html*	Disaster management, localized

INTERNET SITE	SITE ADDRESS	SITE USES
Natural Hazards Research and Applications Information Center	*http://www.colorado.edu/hazards*	Academic research, education, disaster links
Hazards Research Laboratory at the University of South Carolina	*http://www.cla.sc.edu/geog/hrl/home.html*	Academic Research, education
Illinois Extension Service	*http://www.ag.uiuc.edu:80/~disaster*	Public information, disaster links
Global Flood Monitoring	*http://www.dartmouth.edu/artsci/ geog/floods/index.html*	Public information, weather
University of Kobe, Japan	*http://ccs.cla.kobe-u.ac.jp/Asia/Visitor/Furm/index.html*	Public information, eye-witness accounts of earthquake
Earthquake Resource Center	*http://www.comet.net/earthquake/ index1.html*	Public information, earthquake links
USGS - World Earthquakes	*http://wwwneic.cr.usgs.gov/neis/current/world.html*	Public information, earthquake map - recent quakes
Scott=s Internet Hotlist: Volcanoes and Earthquakes and Geoscience	*http:/www.rcch.com/hotlist/ScotList.htm*	Public information, earth science links
Cambridge Sciences "Volcanoes"	*http://www.esc.cam.ac.uk/astaff/ pyle/volcs.html*	Public information, volcano links
Global Learning and Observations to Benefit the Environment (GLOBE)	*http://www.globe.gov*	Education
Oklahoma Mesonet	*http://geowww.gcn.uoknor.edu*	Disaster management, weather, local/state data management
NOAA Forecast Systems Laboratory	*http://www-ad.fsl.noaa.-gov/pddb/ emwdp/emwdp.html*	Public information, weather
NWS - Eureka, California	*www.northcoastweb.com/nws*	Disaster management, localized
FEMA	*http://www.fema.gov*	Disaster recovery, best starting point for links
National Hurricane Center	*http://www.nhc.noaa.gov*	Public information, weather

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FEMA - ANW Floods '96"	*http://www.fema.gov/DIZAS/w96.htm*	Public information, localized flood archive
The Electronic Universe Project	*http://zebu.uoregon.edu/index.html*	Public information, floods
The Sacramento Bee	*http://www.sacbee.com*	Disaster information, localized
California Dept. of Water Resources	*http://wwwdwr.water.ca.gov*	Disaster management
Virtual Emergency Management Information System (VEMIS)	*http://hoshi.cic.sfu.ca/~anderson*	Academic research, emergency communication

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