TsuInfo Alert

prepared on behalf of the

National Tsunami Hazard Mitigation Program

by the Washington Department of Natural Resources

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Volume 3, Number 1, February, 2001

Activities of the National Tsunami Hazard Mitigation Program for FY2000

by Eddie Bernard

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Overview

During the fourth year of the program, great progress was made in reaching the original goal of mitigating the impact of tsunamis on US coastlines. With funding secured for the fifth year, the program is poised to reach major goals that were identified in the 1996 implementation plan. As a checkpoint along our path to mitigating the impact of tsunamis, a review of the program is scheduled to take place on August 7, 2001 in Seattle, Washington. Five experts in tsunami science and mitigation have been selected to review our progress to date and our future plans to ensure that the program is addressing major mitigation issues. Other representatives from NOAA, FEMA, and the USGS and from the states of Alaska, California, Hawaii, Oregon, and Washington will also offer additional assessment of the program.

The Steering Committee held a meeting in Seattle in May and Hilo, Hawaii in November 2000. During the Hilo meeting, we had a reception at the Pacific Tsunami Museum and a field trip to the Hawaii County Civil Defense Operations Center and the USGS's Hawaii Volcano Observatory. The following summaries provide highlights of this year's activity.

I. Hazard Assessment : Inundation maps

At the close of 2000, all five states are engaged in producing/upgrading inundation maps that are in turn used to create evacuation maps for coastal communities. The Center for Tsunami Inundation Mapping Efforts (TIME) coordinates and assists the states in the development of inundation maps for coastal communities at risk that are identified and prioritized by the states (http://www.pmel.noaa.gov/tsunami/time/). This year work was conducted in collaboration with the U. Southern California, the Oregon Graduate Institute, the University of Alaska, the University of Hawaii state geoscientists, and state emergency management officials and staff. Frank González, co-director of TIME, was asked to evaluate the lessons learned from inundation mapping over the past four years by polling the five states. His assessment pointed out three lessons learned: 1) inundation maps have been accepted by communities and are proving to be useful emergency management tools, 2) mapping costs are higher than originally thought, and 3) production of maps is delayed by grid construction and source specification uncertainties. Recommendations include: 1) improve computational grid development, 2) develop standard methodology and tools with user-friendly interfaces, and 3) put into place a web-based interface so users can see what, if any, data is available. The direction that TIME should go in the future is to be less of a grid supplier and focus on providing modelers with raw data and quality control.

Four maps were completed for California coastal areas near San Diego, Los Angeles/Long Beach, Santa Barbara and San Francisco/San Mateo (http://www.pmel.noaa.gov/tsunami/time/CAsite.html); these maps also include more than 30 smaller communities. Two maps were completed for the Grays Harbor and Pacific County coasts of Washington (http://www.pmel.noaa.gov/tsunami/time/status.html), encompassing more than 25 communities. The model development effort and the necessary computational grid were completed for the Kodiak, Alaska region, including three at-risk communities (http://www.pmel.noaa.gov/tsunami/time/AKsite.html). One map was completed for the Coos Bay, Oregon coastal area. In total, 6 maps were pro-

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WASHINGTON STATE DEPARTMENT OF
Natural Resources
Doug Sutherland - Commissioner of Public Lands

(continued from p. 1)
duced, covering more than 6 major population centers and more than 50 smaller coastal communities.

II. Warning system upgrades

The year 2000 marked the first complete year when the NOAA warning centers had access to the improved seismic data and deep ocean water level data. Using the improved seismic data, both centers made significant reductions in the time necessary to locate and determine magnitude for earthquakes throughout the Pacific. Although there was no tsunami to test the deep ocean data, engineering tests and earthquake triggered events demonstrated that the system worked as designed. The tests were also valuable in identifying and resolving problems associated with transmitting sea level data from the sea floor to the warning centers and onto the internet in real time.

A. Seismic Upgrade

The USGS's installation of communications interface in FY99 has been of great value to the two NOAA tsunami warning centers. With over one year's experience using this new interface, both centers report that the geographical expansion of seismic stations reporting to them in real time has reduced the time it takes to determine an earthquake location and magnitude by about 50%. Because these data are from upgraded seismometers, earthquake locations and magnitudes are also more accurate. Efforts are underway to use these extensive and improved data to determine a magnitude estimate fast enough to reduce the time of issuing a tsunami warning from 15 to 8 minutes for the West Coast and Alaska Center. For distant earthquakes (more than 600 miles), the Pacific center sees a reduction in warning issuance from 55 to 25 minutes. Fourteen new and/or upgraded real time seismic stations were installed so that there are now 24 operational stations in Alaska (8), California (3), Hawaii (3), Oregon (3), Washington (7). Equipment is in hand to complete the installation of the remaining 28 stations identified in the original implementation plan by the end of FY01.

B. Deep Ocean Sea Level Upgrade

Redundant components in the acoustic modem data link that were implemented on the California system prototype in early FY00 have greatly increased the data return of earlier systems. Because of this prototype's performance, this new design is now in use for all deep ocean assessment and reporting of tsunami (DART) moorings. In August 2000, the NOAA Ship Ronald H. Brown recovered three moorings, which were deployed in October 1999 and survived the harsh North Pacific winter. These three moorings were replaced by three redesigned systems with redundant components. To save resources and improve reliability, the newly deployed systems have no surface mooring acoustic release and each system is equipped with a bottom package having a lifetime of 2 years. The DART buoys are transmitting real-time data with estimated system return>95%. Each DART system has successfully cycled through a pre-programmed test designed to verify system operation during a simulated trigger event. In addition, appropriately located DART systems have responded to recent earthquakes by triggering into real-time tsunami reporting mode. The engineering tests and earthquake triggered tests give us increasing confidence in the performance and siting of the DART Network, which continues to operate as designed. Currently, four systems are providing data in the North Pacific: three south of the Alaskan archipelago and one off the central Oregon coast (http://tsunami.pmel.noaa.gov/dartqc/Wave Watcher).

In November 2000 the first training course in interpreting deep ocean tsunami data was held in Hilo, Hawaii for warning center leaders and state tsunami advisors.

III. Mitigation

A. State reports

1. Alaska provided tsunami signs to Homer and Seward and installed signs in a remote area frequented by kayakers and inundated in 1964. The Division of Emergency Services also collaborated with the West Coast & Alaska Tsunami Warning Center, the National Weather Service, and the Red Cross to present briefings, program information, and solicit program participation in the remote coastal communities of Unalaska and Sand Point. Earthquake effects are linked with tsunami education through Shake Cottage demonstrations at local fairs. The Cottage must be attached to a truck during the simulated earthquake. Liability concerns are met by use of a four-point aircraft harness, hold-harmless agreements for demonstrations at schools, and informative warning signs posted on the cottage. Numerous requests have been received without advertising, illustrating that the Cottage is a "media magnet".

2. California 's Office of Emergency Services presented inundation maps at five workshops held in Oakland, Eureka, Anaheim, Santa Barbara and San Diego in March and April. During the workshops the methodology used to produce the maps was presented along with the limitations on the use of these projections. Discussions were held on how to convert an inundation map to evacuation plans and how to deal with the local problems, such as how to evacuate a beach. The projections generated lots of media interest and a demand for more projections along all coastlines. The Humbolt county fair drew 8,000 visitors. A shake table and wave tank demonstrated tsunami and earthquake concepts. A new Crescent City map shows the 1960 and 1964 inundation areas, evacuation routes, and paleo-tsunami deposits. The Redwood Coast Tsunami Work Group continues to meet quarterly. An interactive computer that demonstrates tsunami models and travel times is planned for future fairs.

3. Hawaii initiated a modeling project to better assess the threat of local tsunamis by conducting a series of numer-

ical experiments at historical sites of past local tsunamis and evaluating the tsunami impact on coastal communities. A distant tsunami modeling project was also initiated to provide precomputed wave heights to Civil Defense emergency managers for use during a tsunami warning from a distant tsunami. A tsunami coastal recorder that uses cellular telephone technology to detect tsunami flooding was purchased. Hawaii appointed new tsunami advisors, Dr. Laura Kong and Dr. Gerard Fryer. Hawaii is developing a post-tsunami data survey tool using previous guides. The tool could be a model for other states and should be in place before the next tsunami. A 30-minute tsunami preparedness video, that includes both Hawaii survivor stories and response issues, was completed and distributed. Hawaii Civil Defense also sponsored tsunami awareness month in April.

4. Oregon Emergency Management sponsored an earthquake and tsunami planning workshop for lodging facilities, completed revisions to its tsunami curriculum for K-12 schools, purchased and distributed tsunami road signs, produced tsunami evacuation maps for Douglas and Clatsop Counties, and distributed a road sign problem survey. A partnership has been formed with the Coquille tribe who wants to install road signs and commence an education program for their area. Evacuation planning and brochure development continues with schools and communities.

5. Washington produced a 30 second tsunami evacuation Public Service Announcement video, prepared a curriculum for K-6 and 7-12, completed the Mt. Octopus NOAA Weather Radio transmitter installation which dramatically improves the dissemination coverage, installed evacuation and interpretative signs, and printed tsunami evacuation signs as decals to combat theft of the expensive signs. Washington announced that Dr. Harold Mofjeld was their new tsunami advisor and urged all states to appoint one to improve the quality of information during the next warning or actual event.

B. Multi-state projects

1. Land use/development guidance

Larry Mintier, contractor, completed the draft document that addresses avoidance of new development in tsunami run-up areas, location and configuration of new development in run-up areas, and design and construction of new buildings to minimize tsunami damage. The report will be published and distributed in 2001.

2. Tsunami warning guidance

Mark Darienzo greatly improved the original tsunami warning guidance written by Robert Olson Associates, Inc. for use by local and five state governments to improve or develop new, locally-activated, consistent public tsunami warning systems, procedures, and methods. Emergency managers in the states have reviewed the report. Comments from the emergency managers indicated this guide would be useful to them. This document will become a living document, updated as new technologies are developed. Mark Darienzo will place the final document on the Oregon web site. A tsunami warning workshop will be held in Portland, Oregon with emergency managers in May 2001 to review the guidance and discuss issues related to improving local response to NOAA's tsunami warnings.

C. State/NOAA Coordination

1. Historical Tsunami Data Base

The final Windows version of the historical tsunami data base (HTDB/US) program is being finalized along with a new operating manual. A CD containing the program and the manual will be distributed to all Steering Group members in December 2000 for review.

2. Tsunami Ready Community

The Tsunami Ready Community Program is modeled after the National Weather Service (NWS) Storm Ready Program. The program objectives are to promote tsunami hazard preparedness as an active partnership between the emergency management agencies, the public, and the NWS tsunami warning system. The main goal is improvement of public safety in tsunami emergencies. The Tsunami Ready Program establishes minimum criteria for a community to be awarded the Tsunami Ready certification. Communities accepting the challenge and meeting the requirements set by the NWS Tsunami Ready Program are designated as Tsunami Ready Communities. Communities are chosen based on community interest, accessibility, size, vulnerability, and community needs. Communities benefit because they are more prepared and their position is improved for receiving State and Federal funds. Each state will nominate a community as a pilot tsunami ready community in 2001 to test the concept and make refinements in the criteria.

3. WCM activity

At the California inundation projection workshops, NWS warning coordinating meteorologists Chuck Morrill and John Lovegrove gave presentations on warning operations.

4. The TsuInfo program

The TsuInfo program is managed by the Washington Division of Geology and Earth Resources library. As in the first year of that program, the library continues to collect books, videos, and articles about tsunami hazards and mitigation for the program participants.

The primary communications tool for this project is the TsuInfo Alert newsletter. The newsletter is issued bi-monthly and is mailed to 246 subscribers, primarily in the five Pacific states. Those issues are also available on the Internet at http://www.wa.gov/dnr/htdocs/ger/tsindex/html The newsletter includes news about the National Tsunami Hazards Mitigation Program, program progress in the states, and other tsunami mitigation information. The newsletter has been a particularly successful part of the TsuInfo project: in a recent questionnaire, 60 percent of the respondents rated it as "excellent"!

Summary Report of the Tsunami Hazard Mitigation Steering Group Meeting
November 14-15, 2000
Hilo, Hawaii

Attendees

Steering Group
- Eddie Bernard - NOAA
- Brian Yanagi - State of Hawaii
- Chris Jonientz-Trisler - FEMA
- Laura Kong - State of Hawaii
- Craig Weaver - USGS
- Mark Darienzo - State of Oregon
- Gary Brown - State of Alaska
- George Priest - State of Oregon
- Roger Hansen - State of Alaska
- George Crawford - State of Washington
- Richard Eisner - State of California
- Tim Walsh - State of Washington
- Lori Dengler - State of California

Guests
- Frank González - NOAA
- Delores Clark - NOAA/NWS Public Affairs
- Vasily Titov - NOAA
- Gerard Fryer - U of H Manoa
- Charles McCreery - PTWC
- Michelle Teng - U of H Manoa
- Tom Sokolowski - WC/ATWC
- Kwok Fai Cheung - U of H Manoa
- Michael Blackford - ITIC
- George Curtis - U of H
- Stan Goosby - PDC
- Dan Walker - HI Civil Defense
- Lt Alan Yelvington - USCG
- Zygmunt Kowalik - U of AK
- Michael Hornick - FEMA IX
- J. Larry Mintier - J. Laurence Mintier & Associates
- David Oppenheimer - USGS

Review of action items from the previous meeting:

1. There was considerable discussion on how to confirm the availability of resources after a disastrous event. The group formed an ad hoc subcommittee to formalize the next steps. The subcommittee consists of: Richard Przywarty, Frank González, Eddie Bernard, George Priest, and Costas Synolakis.

ACTION: The committee was to research and formalize the next steps.

OPEN: Three new members were added to the subcommittee: Mike Hornick, Chris Jonientz-Trisler, and Richard Eisner. There was a discussion of what role the National Tsunami Hazard Mitigation Program Steering Group would have in tsunami disaster response. NOAA currently has no input in times of disaster. The current National Post-Storm Data Acquisition Plan provides only for data collection. Mike Hornick, FEMA Region IX proposed a 2-step action plan: 1) The Federal Response Plan needs a tsunami action plan. Mike Hornick and Chris Jonientz-Trisler and FEMA HQ need to develop this plan, and 2) the States need defined data collection activities. The subcommittee will review the NOAA Response Plan document and how it interacts with the states and report at the next meeting.

2. Develop state requirements for earthquakes below magnitude 6.5.

ACTION: Lori Dengler

CLOSED: Lori has queried emergency managers in California, Oregon, and Washington and the general response was that no additional information is needed at this point. See report.

3. The Steering Group requested an assessment of lessons learned and how to go forward on where and how to map areas.

ACTION: TIME to collect and summarize data.

CLOSED: TIME prepared an assessment report of lessons learned and this was provided to each member and guest at the meeting. He discussed the findings with the group. See mapping below.

4. There was discussion concerning a common plan (MOA) for mitigation procedures. A subcommittee was formed to collect current procedures, analyze them, and report at the next meeting.

ACTION: The subcommittee: Mark Darienzo, Tim Walsh, Richard Eisner, George Priest, Gary Brown, Brian Yanagi, Michael Hornick, and Chris Jonientz-Trisler.

CLOSED: The group felt this was a duplicate of action item number 1 above and deleted the item.

5. States suggested that a web site be established to house PowerPoint Presentations from all five states.

ACTION: States, PMEL

ONGOING: PMEL Computer Services has been contacted on providing server space for this project. They suggested using jpg or gif images rather than PowerPoint images to avoid compatibility problems between systems and versions of PowerPoint. PMEL has begun their image library and will continue to add to it. Due to the large storage capacity needed for image files, it was suggested that states and agencies outside PMEL host their own sites for their image libraries and PMEL would link to them from a new Image Library web page on our tsunami-hazard web site.

6. The third draft of the Tsunami Warning Systems: Guidance document for State and Local Officials was given to Steering Group Members at the last meeting for review and comment by May 31, 2000.

ACTION: Mark Darienzo and all Steering Group Members

CLOSED: The final draft of the document was shown

to Steering Group Members. Mark Darienzo will publish and place on their web site.

7. Richard Przywarty to prepare a short implementation plan based on Lori Dengler's Strategic Implementation Plan for Tsunami Mitigation Projects and present at the November meeting.

ACTION: States and agencies with information on how to make the Tsunami Ready Program work, please foward this information to Richard Przywarty. R. Przywarty will draft a straw plan and e-mail it to Steering Group members requesting points of contact. He will collaborate with L. Dengler on the Tsunami Ready Plan.

OPEN ONGOING: The Tsunami Ready Program was presented to the Steering Group by Tom Sokolowski (see item below). R. Przywarty, T. Sokolowski, L. Dengler will continue to refine this Program.

8. The Steering Group requested that PAWG prepare other backgrounders on tsunami issues. Specific issues need to be selected by the Steering Group.

ACTION: Steering Group to determine issues for backgrounders, PAWG to create and post backgrounders on web site.

CLOSED: PAWG members were contacted and no new backgrounder issues have been requested.

9. Ad hoc subcommittee to be named by Bernard to nominate reviewers for the August 2001review.

ACTION: Bernard

CLOSED: Reviewers named are: Hiroo Kanamori, Dennis Milletti, Phillip Liu, Douglas Luther, and Richard McCarthy.

10. All programsl/states were asked to submit their 2001 budget numbers to E. Bernard by July 31, 2000. Final budgets will be presented at the November meeting.

ACTION: All

CLOSED: All budgets were presented and discussed at the November Steering Group Meeting.

11. George Priest stated that the program needs more ongoing support for modeling. He suggested that perhaps NSF could designate a program for tsunami modeling research to which modeling proposals could be written.

ACTION: E. Bernard to contact C. Astill at NSF concerning this suggestion.

CLOSED: E. Bernard made contact with C. Astill. No such program can be officially nominated. E. Bernard suggested that as we are doing community modeling, the scientist doing the modeling could submit a proposal to NSF at the same time.

Overview

Eddie Bernard discussed the funding history of the program and the current FY 2001 budget. The Program is not included as a line item in the NOAA FY 2001 Budget although supported by Department of Commerce and the National Oceanic and Atmospheric Administration (NOAA). The President has vetoed the current Department of Commerce, Justice, and State budget meaning that NOAA is under a continuing resolution until December 5. The House/Senate Conference Report included $2,300,000 for the Program. If there are no changes in the conference report and the Commerce, Justice and State budget is signed into law, available funds for the Program's FY 2001 budget are $2,070,000 after the 10% NOAA tax.

Develop NOAA/State Coordination and Technical Support

The final Windows version of the HTDB/US program is currently being checked. A new operating manual is being prepared and reviewed.

Improve Seismic Networks

The Consolidated Reporting of EarthquakeS and Tsunamis (CREST) showed that during the past 6 months no new activity has been conducted at the Warning Centers except for support of telemetry links. Installation of seismic iinstrumentation continued as weather and equipment inventories permitted. David Oppenheimer briefed the group on what it takes to install a seismic station and discussed the reasons why stations are not installed yet: staff shortages as staff time was not budgeted in the FY 2000 budget, new equipment replacing old microwave equipment, and implementation issues.

Deploy Tsunami Detection Buoys

Three DART buoys were recovered and three were deployed in August 2000. There are now 4 DART systems deployed and operational. DART systems are transmitting real-time data with an estimated system return of greater than 95 percent. The PMEL Engineering Development Division is working on a new BPR printed curcuit board design to replace electronic components that are no longer commercially available. A prototype is now being developed and will be ready for testing in Spring 2001. The Tsunami Warning Centers are receiving the data transmissions from the DART buoys via the GOES satellite. They also receive the data via the web. When the systems triggered either through scheduled tests or actual earthquake events, the system worked exactly as designed.

Produce Inundation Maps

Frank González gave his report on the lessons learned and how to proceed from here. He also distributed copies to the members. The assessment pointed out three lessons learned: 1) The National Tsunami Hazard Mitigation Program maps have been accepted by communities and are proving to be useful emergency management tools, 2) mapping costs are higher than originally thought, and 3) production of maps is delayed by grid construction and source specification uncertainties. Recommendations include: 1) improve computational grid development, 2) develop standard methodology and tools with user-friendly interfaces,

and 3) put into place a web-based interface so users can see what, if any, data is available. The direction that TIME should go in the future is to be less of a grid supplier and focus on providing modelers with raw data and quality control.

George Crawford provided an agenda, list of participants, and purpose for the Puget Sound Tsunami/Landslide Workshop will be held January 23-24, 2001, in Seattle at the NOAA Sand Point campus (Bldg. 9). The Workshop is a partnership of NOAA/PMEL, USGS, and Washington State Emergency Management. The goal of the workshop is to develop an action plan to generate tsunami inundation maps and other tsunami/landslide mitigation products for Puget Sound communities. The workshop arose from discussions at the last Steering Group Meeting in May 2000 at PMEL.

ACTION ITEM: States and TIME are to decide on division of mapping projects funding for FY 01 so that Frank González can provide the mapping budget by December 1, 2000.

ACTION ITEM: Hal Mofjeld (PMEL) to provide a short tutorial on tsunami wave forms to tsuhaz prior to the May 2001 Tsunami Workshop in Portland, Oregon.

Mitigation

Highlights of the state mitigation efforts since the May 2000 meeting were discussed. Tsunami hazard signs have been installed in Homer and Seward, Alaska, as well as in a remote area frequented by kayakers and inundated in 1964. Earthquake effects are linked with tsunami education through "Shake Cottage" demonstrations at fairs. This "Cotage" is a "media magnet" and MSNBC has requested an interview with the Alaska Department of Emergency Services. California's inundation maps and landslide data has drawn considerable southern California media attention. Larry Mintier presented the latest version of Tsunami Hazard Mitigation Guidelines, a multi-state project led by California. Hawaii is developing a post-tsunami data survey tool using IOC guides. The state video was completed and shown to the group during the meeting. Oregon has continued with evacuation planning and brochure development as well as surveying communities on tsunami sign problems. Washington presented several new education products including a tsunami evacuation public service announcement and curriculum for K-6 and 7-12. The Subcommittee Coordinator will rerun and expand the 1994 baseline survey to measure performance.

ACTION ITEM: Chris Jonientz-Trisler will rerun and expand the 1994 baseline survey to measure performance. The results of this survey will be compared to the 1994 baseline survey and the results presented at the August 2001 review of the program.

The Subcommittee Activities Matrix and Program Gaps were discussed as well as the FY 01 budget. The budget discussion was incomplete.

ACTION ITEM: The Subcommittee Coordinator indicated the budget discussion would be finalized during a conference call with all subcommittee members as soon as possible.

ACTION: All Mitigation Subcommittee members

Local Tsunami Warning Systems and Procedures: Guidance for Local Officials

Mark Darienzo reported on this open item from last meeting. The final draft of the report dated October 23, 2000, was distributed to the Steering Group members. The report has been reviewed by emergency managers in the states. Comments from the emergency managers indicated this guide would be useful to them. This document will become a living document, updated as new technologies are developed. Mark Darienzo asked Steering Group members for any final comments they may have. He also indicated that he will place the final document on the Oregon web site.

ACTION ITEM: Steering Group members to send any final comments on the guidance document to him not later than January 1, 2001.

ACTION: Each Steering Group Member

ACTION ITEM: Final Local Tsunami Warning Systems and Procedures: Guidance for Local Officials document to be placed on the Oregon web site prior to the May 14-15, 2001 workshop and Steering Group meeting.

ACTION: Mark Darienzo

Tsunami Workshop

Mark Darienzo has planned a Tsunami Workshop for local emergency managers for May 14-15, 2001. The group agreed to hold the workshop on May 14-15 and to follow the Workshop with next the Steering Group meeting on May 16-18. It was agreed that the Warning Center Geophysicists in Charge would attend the workshop to help clarify warning center messages and when to issue the all clear. Mark Darienzo did a cost comparison between having the workshop in Seattle using the NOAA facilities or having the workshop at the Portland Airport Sheraton Hotel. Costs for workshop participants were less if the workshop were held at the Airport Sheraton Hotel. The Steering Group members agreed to hold the workshop at the Portland Airport. A draft agenda for the workshop was distributed. The Steering Group meeting itself could be held at the Portland NWS SFO or at the DOGAMI offices.

ACTION ITEM: All Steering Group members are to send comments on the proposed workshop agenda to Mark Darienzo. Mark Darienzo will contact state emergency managers for names of people to invite to the workshop and will arrange for the meeting sites for the workshop and Steering Group meeting.

ACTION: All Steering Group Members, Mark Darienzo

Tsunami Ready Community Program

Tom Sokolowski, Geophysicist in Charge of the West Coast/Alaska Tsunami Warning Center presented the draft of the Tsunami Ready Community Program prepared by Richard Przywarty in response to the action item from last meeting. The Tsunami Ready Community Program is modeled after the National Weather Service (NWS) Storm Ready Program. The program objectives are to promote tsunami hazard preparedness as an active partnership between the emergency management agencies, the public, and the NWS tsunami warning system. The main goal is improvement of public safety in tsunami emergencies. The Tsunami Ready Program establishes minimum criteria for a community to be awarded the Tsunami Ready certification. Communities accepting the challenge and meeting the requirements set by the NWS Tsunami Ready Program are designated as Tsunami Ready Communities. Communities are chosen based on community interest, accessibility, size, vulnerability, and community needs. Communities benefit because they are more prepared and their position is improved for receiving State and Federal funds. The draft requires further refinement and a subcommittee consisting of Richard Przywarty, Tom Sokolowski, and Lori Dengler was appointed to continue working on the draft of the program.

ACTION ITEM: Continue to refine the draft Tsunami Ready Community Program proposal.

ACTION: R. Przywarty, T. Sokolowski, L. Dengler

ACTION ITEM: Each State is to recommend one pilot community for the program by January 1, 2001.

ACTION: Each State

Public Affairs Working Group Report

The members of the Public Affairs Working Group (Delores Clark, Jana Goldman, Marilu Trainor, and Ann Thomason) prepared and distributed the PAWG report for FY 2000. The program has received considerable media attention during the year.

Review of the Last 5 Years and Plans for the Next 5 Years

(Phase II-sustained efforts) The Tsunami Hazard Mitigation Plan calls for assessment of the Tsunami Hazard Mitigation Program after 5 years. To fulfill this requirement, the first day of the International Tsunami Symposium in August 2001 will be devoted to a review of the Tsunami Hazard Mitigation Program. The program will be reviewed by tsunami experts.

Eddie Bernard presented a draft outline of Phase II of the National Tsunami Hazard Mitigation Program for discussion. This draft outline included a review of Phase I accomplishments and recommendations based on the original National Tsunami Hazard Mitigation Plan. Deficiencies need to be addressed as well as recommended activities to correct these deficiencies. Deficiencies were identified in response, recovery, and data collection. The need to expand beyond the 5 original states in the program and to coordinate with other agencies were also identified as deficiencies. Each Steering Group member was asked to prepare their program reviews of the last 5 years for presentation at the May 2001 meeting.

ACTION ITEM: In preparation for the review in August 2001 and keeping in mind the original Tsunami Hazard Mitigation Plan, each Steering Group member should prepare a presentation for the May 2001 Steering Group Meeting that focuses on 1) what did you promise to do? 2) what did you do? and 3) what impact did it have?

ACTION: Each Steering Group Member

The plan for the next 5 years includes the three information bodies from Phase I Mitigation: the International Tsunami Information Center, the Pacific Tsunami Museum, and Connie Manson's *TsuInfo Alert* newsletter. Recommended activities for the future include warning operations, mapping, mitigation, developing a response scenario, recovery, and data collection. An organizational structure and budget need to be determined; therefore, each Steering Group member was asked to think about their expectations for the next 5 years.

ACTION ITEM: Each Steering Group member is to prepare a summary of their expectations and budgets for the next 5 years. (In other words, where do you want to be at the end of the next 5 years?)

ACTlON: Each Steering Group Member

FY 2001 Budget

For FY 2001, $2.3 million has been appropriated for the Program. There is an add-on of $1 million for the Tsunami Warning and Environmental Observatory for Alaska (TWEAK), a letter of intent by Ray Highsmith at the University of Alaska. It was suggested that Ray Highsmith include Roger Hansen and Sigmund Kowalik in writing the proposal for TWEAK. TWEAK calls for a buoy in shallow water and the current DART buoys are not designed to operate in less than 1000m of water. Development of a buoy for TWEAK would depend on receiving funding up front. There is a shortfall of $230K for FY 2001 for buoys. Eddie Bernard proposed and the Steering Group approved shifting $220K from the CREST seismic program, which has an underrun, to cover the buoy shortfall. Mapping is short on funds this year and it was suggested that the mapping funds should be at least doubled in the next five year plan. This year there is a TIME shortfall of $82K which may be absorbed by PMEL. A discussion of the question of how to report the mapping effort pointed out the difficulties of this issue and a method agreeable to all must be developed.

ACTION ITEM: Frank González and the States were asked to discuss and agree on the method of reporting the inundation mapping effort no later than March 2001.

ACTION: Frank González and States

Presentations

Distant Tsunami Modeling - Dr. K. Fai Cheung

Local Tsunami Modeling - Dr. Gerard Fryer

Tsunami Coastal Recorders - Dr. Daniel Walker

Meeting Dates and Locations for 2001

May 14-15 Tsunami Workshop, Portland, Oregon

May 16-18 National Tsunami Hazard Mitigation Program Steering Group Meeting, Portland, Oregon

August 7-9 International Tsunami Symposium, University of Washington, Seattle, Washington (The NTHMP Review on August 7 will replace our normal fall meeting)

Natural Hazards Caucus Holds Event, Releases Discussion Paper

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On January 22nd, the Congressional Natural Hazards Caucus kicked off its activities in the new 107th Congress with a roundtable event to consider the impacts of the recent earthquake in El Salvador and to discuss the broader natural hazards challenges facing the United States. In conjunction with the event, caucus co-chairs Sen. John Edwards (D-NC) and Sen. Ted Stevens (R-AK) released a discussion document prepared for the caucus, highlighting why the nation is becoming more vulnerable to natural disasters and what actions Congress can take to solve the problem.

Senators Edwards and Stevens formed the Congressional Natural Hazards Caucus last year to provide a forum on Capitol Hill for natural hazard issues and to provide their colleagues with an opportunity to demonstrate their commitment to reducing hazard losses. The caucus, which currently includes seventeen senators, is supported by the Natural Hazards Caucus Work Group -- outside organizations, including AGI and a number of its member societies, that share the senators' interest in raising the profile of natural hazards issues in Congress.

The caucus held its first forum last June, and at that event the senators called on the work group to develop a document that would identify key challenges for the caucus to address. The resulting discussion paper was released at Monday's roundtable event, held in the Dirksen Senate Office Building.

Over 100 people attended the event, which provided an opportunity for the senators to learn about the recent earthquake in El Salvador and its implications for the United States. The caucus heard from two speakers: Dr. P. Patrick Leahy, U.S. Geological Survey (USGS) Associate Director for Geology, and Dr. William Hooke, Senior Policy Fellow at the American Meteorological Society.

Leahy updated the senators on the January 13th earthquake and resulting landslides in El Salvador, which killed over 600 people and destroyed more than 21,000 houses. He also spoke about areas in the U.S., such as the Pacific Northwest, that also are vulnerable to earthquake-triggered landslides. Leahy told the senators that programs such as the Advanced National Seismic System and the USGS stream gaging network help provide Americans with the data needed to understand the potential for natural disasters in vulnerable areas throughout the country.

Hooke summarized the key points from the work group's discussion paper, concluding: "Natural hazards are no respecters of political party, or society's schedule, or national agenda. They are not constrained by state or regional or national boundaries. They cannot be contained physically. We can't cap the volcano, or forestall the earthquake, or halt the winter storm. However, we can limit the damaging impacts of these extremes--by appropriate policy, by cautious land use, proper engineering, and other steps, including public education and awareness well in advance of the hazardous event. We can provide more timely warnings, and thus improve emergency response. We can do more to promote long-term recovery. We can keep score, and learn from mistakes. In that spirit, the members of the work group look forward to working with the Congress as you work to reduce America's vulnerability to natural hazards."

The discussion paper is available for download at http://www.agiweb.org/workgroup. It identifies a number of challenges for Congress to address both in the near future and long term:

- We do not know how much the nation is paying for natural disasters. Congress could initiate a process to more accurately tally up costs.
- What are the cost and benefits of mitigation? Congress could insist that responsible agencies document the effectiveness of mitigation activities.
- Improving emergency response and advance notice of a hazard is a priority. Congress should support geophysical research and improved instrumentation to increase lead times, accuracy, and specificity of warnings.

- Long-term recovery from disasters takes a long-term approach. Congress can work with federal agencies, state and local governments, and the private sector to improve coordination in the post-disaster period.
- The federal-state-local relationship needs to shift its emphasis in order to help prevent citizens from becoming victims in addition to helping them after the disaster strikes. Congress can review whether existing law is effective, and set an example by insisting that new federal facilities include cost-effective mitigation measures.
- Advances in the use of information technology in our daily lives has underscored the nation's increasing reliance, and thus vulnerability, on critical infrastructure. Congress can identify barriers that may prevent the entry of new technologies that could improve hazard mitigation.

During the question-and-answer period, Senator Edwards picked up on the first theme of the discussion paper, asking how much disasters cost the taxpayers. Stevens, who chairs the Senate Committee on Appropriations, expressed similar concerns about the trend of increasing costs to the U.S. Treasury. He emphasized the need to focus more on prevention and preparation before these events take place.

In his remarks, Dr. Hooke also discussed a separate document prepared by work group organizations for the incoming Bush-Cheney Administration's transition team. The preparation of that document was spearheaded by the American Meteorological Society. Signatories include AGI and several of its member societies: the American Geophysical Union, the Association of American State Geologists, and the Seismological Society of America. Entitled "A National Priority: Building Resilience to Natural Hazards," its themes correspond closely to those in the caucus discussion paper with the bottom line being: the time has come for a new national approach to natural hazards. The transition document can be viewed at http://www.ucar.edu/communications/awareness/2001/.

For more information about this event and other caucus documents, please visit http://www.agiweb.org/workgroup.

AGU's Revised Position on Natural Hazards

At the 2000 Fall Meeting in December, the American Geophysical Union (AGU) Council reaffirmed a revised version of AGU's position statement, "Meeting the Challenges of Natural Hazards." This position was first adopted in 1996. The revised version (see accompanying text box) contains the same message as the original, but in concise language more easily understood by policy-makers and other non-scientists.

The statement calls for more research in the geophysical processes to help understand the nature of natural hazards. However, it also clearly indicates that research alone will not improve the ability of society to withstand a natural disaster. Multidisciplinary approaches involving groups as disparate as builders, insurers, and relief organizations are required to improve mitigation efforts worldwide. The policy statement also emphasizes the need to communicate the results of scientific research to the public, especially those communities situated in areas particularly susceptible to extreme natural hazards.

The hazards statement and other AGU position statements are available online via AGU's Science & Policy Web page at www.agu.org/sci_soc/policy/sci_pol.html.

---Peter Folger, Public Affairs Manager, AGU

from: Eos, v. 82, no. 3, p. 28

Position Statement on Meeting the Challenges of Natural Hazards

Natural hazards (earthquakes, floods, hurricanes, landslides, meteors, space weather, tornadoes, volcanoes, and other geophysical phenomena) are an integral component of our dynamic planet. These can have disastrous effects on vulnerable communities and ecosystems. By understanding how and where hazards occur, what causes them, and what circumstances increase their severity, we can develop effective strategies to reduce their impact. In practice, mitigating hazards requires addressing issues such as real-time monitoring and prediction, emergency preparedness, public education and awareness, post- disaster recovery, engineering, construction practices, land use, and building codes. Coordinated approaches involving scientists, engineers, policymakers, builders, lenders, insurers, news media, educators, relief organiza- tions, and the public are therefore essential to reducing the adverse effects of natural hazards.

In order to reduce our vulnerability to natural hazards, AGU strongly endorses:

-- fundamental research on Earth and space and moni toring of natural hazards;

-- dissemination of the relevant results to the public, especially vulnerable communities; and

-- implementation of multidisciplinary efforts needed to apply effective mitigation strategies worldwide.

Adopted by AGU Council December 1996; revised and reaffirmed December 2000.

from: Eos, v. 82, no. 3, p. 28

TSUNAMI NEWS BRIEFS

Bush Names New FEMA Director

On January 4, president-elect George W. Bush named Joe Allbaugh, a long-time adviser, the former governor's chief of staff, and the manager of Bush's presidential campaign, to head the Federal Emergency Management Agency (FEMA) under the new administration.

Although the position remains subject to Senate confirmation, one political observer commented that if Allbaugh is confirmed, his strong association with Bush could bode well for FEMA and disaster management generally, since it would continue the agency's close relationship with and access to the president - a relationship initiated under the Clinton administration with the appointment of Clinton associate James Lee Witt as director and the subsequent elevation of the position to cabinet status.

Senate committee hearings on Allbaugh's nomination have not yet been scheduled.

from: Disaster Research 337, January 12, 2001

NASA Joins Project Impact

In December FEMA and the National Aeronautics and Space Administration (NASA) signed an agreement under which FEMA will use NASA science, technology, and remote-sensing research to aid emergency management and disaster prevention activities.

The Memorandum of Understanding was signed by FEMA Director James Lee Witt and NASA Administrator Daniel S. Goldin at NASA headquarters in Washington, D.C. The FEMA-NASA partnership is part of the FEMA program "Project Impact: Building Disaster Resistant Communities" and NASA's Earth Science Enterprise, a coordinated research program that studies the earth's land, oceans, ice, atmosphere, and life as a total system.

The cooperative agreement will result in updated and more accurate maps of floodplains, a better understanding of wildfires, and maps to improve disaster recovery and mitigation by state and local communities throughout the U.S. The first cooperative activity under the agreement involves using advanced technology to map floodplains in California's Los Angeles basin, as well as around Sacramento, California; Virginia Beach, Virginia; the Red River along the North Dakota and Minnesota borders; and San Francisco, California.

As the agreement is further implemented, FEMA and NASA will use a variety of public and private satellites and aircraft-mounted earth-observing instruments to improve understanding of - and preparedness for - flood, wildfire, and geologic hazards.

For more information about this new alliance, see the FEMA Web site: http://www.fema.gov/impact/nasa1207.htm.

from: Disaster Research 337, January 12, 2001

USGS Joins FEMA's Project Impact

The U.S. Geological Survey (USGS) and the Federal Emergency Management Agency (FEMA) recently signed an agreement to promote mutual activities in support of FEMA's "Project Impact: Building Disaster Resistant Communities" initiative - a major national disaster reduction program.

The partnership will enhance federal efforts to improve disaster recovery and mitigation in communities throughout the U.S. Under the new agreement the two agencies will apply science to better understand and prepare for the natural events that cause disasters. The agreement formalizes the strong working relationship that the USGS and FEMA have maintained for more than 20 years. The USGS will provide FEMA with crucial earth science information on natural hazards such as earthquakes, floods, volcanoes, wildland fires, and landslides -information crucial to reducing the nation's vulnerability to natural disasters.

More information about this partnership is available from both the USGS and FEMA Web pages: http://www.usgs.gov and http://www.fema.gov. Interested persons can also contact Kathleen K. Gohn, USGS, Office of Communications, 119 National Center, Reston, VA 20192; (703) 648-4242; fax: (703) 648-4466; e-mail: kgohn@usgs.gov.

from: Disaster Research 336, December 28, 2000

E-Journal Seeks Articles

The new electronic journal "American Emergency Management Response [AEMR]" seeks articles from emergency management professionals, academics, and members of government at all levels. The journal was created by the Association for National Defense and Emergency Resources and the Department of Political Science at the University of Akron as a public service for individuals, scholars, and decision makers concerned about emergency management. E-mail articles, in Word or WordPerfect IBM format, should be sent to acook@uakron.edu. For instructions on submitting paper copies, see the AEMR Journal Web site: http://www.uakron.edu/ander.

from: Disaster Research 331 - October 19, 2000

Congress Passes Disaster Mitigation Act of 2000

On October 10, in an effort to reduce the growing demand for federal disaster assistance, Congress passed the Disaster Mitigation Act of 2000. Based on the Federal Emergency Management Agency (FEMA) initiative Project Impact, Public Law 106-390 emphasizes local community involvement in implementing long-term strategies to in=crease disaster resistance. This is the first major change to the Robert T. Stafford Disaster Relief and Emergency Assistance Act since that law was passed in 1988.

In passing the legislation, Congress recognized that a greater emphasis needs to be placed on identifying and as-

sessing risks from natural disasters, implementing adequate measures to reduce losses, and ensuring that critical services and facilities will continue to function after a natural disaster.

Some highlights of that lengthy piece of legislation:

- The bill creates a National Predisaster Mitigation Fund and authorizes funding for the next three years. The act grants the president authority to provide Mitigation Assistance Awards - technical and financial assistance to states and local governments that have identified local risks and have formed effective public-private partnerships. Each state is to recommend to the president up to five local governments to receive funding. Assistance awards are to be based on the extent and nature of hazards to be mitigated, the degree of commitment by the state or local government to reduce damage from future disasters, ongoing commitment by states and local governments for hazard mitigation, the compatibility of hazard mitigation efforts with state goals and priorities, and other criteria. The federal government may provide up to 75% of financial assistance for mitigation activities in most communities, and up to 90% of costs in small, impoverished communities. The legislation also requires the creation of "Multihazard Advisory Maps" in no less than five states subject to recurring hazards, such as floods, hurricanes, and earthquakes.
- The act repeals the Individual and Family Grant Program under the original Stafford Act and replaces it with a new section specifying federal assistance to individuals and households. The act also establishes new requirements for obtaining assistance to repair, restore, reconstruct, or replace damaged facilities, including arequirement that private nonprofit organizations that do not provide critical services must apply for Small Business Administration disaster loans before they can receive disaster assistance from FEMA. It also reduces the amount of federal assistance that will be provided to eligible public or private facilities that have been damaged more than once in the past 10 years and have failed to mitigate the hazard.
- Communities that suffer a substantial loss of tax and other revenues as a result of a major disaster and have demonstrated a need for financial assistance in order to perform governmental functions may still receive disaster loans of up to $5 million.
- The Hazard Mitigation Grant Program (HMGP) remains and still allows up to 15% of total disaster assistance funds to be used for a specific hazard mitigation measure. However, a state, local, or tribal government may be eligible for up to 20% federal funding if the state has an established mitigation plan in place at the time of a presidentially declared disaster.
- The legislation requires the president to establish an interagency task force, chaired by the FEMA director, for coordinating the implementation of predisaster hazard mitigation programs. The task force must include representatives from federal agencies; state, local, and tribal governments; and the American Red Cross. The president may require safe land-use and construction practices as a condition of funding. The legislation also delegates to qualified states the authority to administer the Hazard Mitigation Grant Program.
- The act authorizes the president to provide grants, equipment, supplies, and personnel to any state or local government for the mitigation, management, and control of "any fire on public or private forest land or grassland that threatens such destruction as would constitute a major disaster." This section will take effect in one year, after the president prescribes necessary regulations for its implementation.
- Finally, Congress also requires FEMA to conduct a study of participation by Indian tribes in emergency management, including training, predisaster, and post-disaster mitigation, disaster preparedness, and disaster recovery at federal and state levels. The study is to assess the capacity of tribes "to participate in [and administer] cost-shared emergency management programs."

The complete text of this legislation can be obtained from any federal repository library or from the Library of Congress Web site: http://thomas.loc.gov. Additional information should be available from the FEMA Office of Public Affairs, 500 C Street, S.W., Washington, DC 20472; (202) 646-4600; fax: (202) 646-4086; e-mail: eipa@fema.gov; Internet: http://www.fema.gov.

from: Disaster Research 335, December 18, 2000

FEMA and other Disaster/Hazard-Related Agencies Funded for Another Year

More than two weeks after the above-mentioned Disaster Mitigation Act was passed, through Public Law 106-377, Congress provided money to fund it and keep the Federal Emergency Management Agency operating. It also funded the Department of Interior and Department of Agriculture through Public Law 106-291, including disaster programs managed by the Bureau of Land Management, the U.S. Geological Survey, and U.S. Forest Service. The text of these laws, indicating the amounts bestowed on various programs, is also available on-line at the Library of Congress Web site listed above.

from: Disaster Research 335, December 18, 2000

Draft IASPEI Centennial Earthquake Catalog Available On-Line

A group of earth scientists are constructing a centennial global earthquake database for the "International Handbook of Earthquake and Engineering Seismology." This handbook is being prepared to celebrate the 100th anniversary of

the International Association of Seismology and Physics of the Earth's Interior (IASPEI) in the year 2001 (see http: //www.whklee.org/iaspei.html for details).

The group has constructed a preliminary version of the earthquake hypocenter catalog. (The details of the event characterization and selection process will be described in a paper that will accompany the database.) The provisional catalog is now available for examination in compressed (binary) format. It can be retrieved by executing ftp://ciei.colorado.edu/pub/user/engdahl/Handbook using your Internet browser. Comments about this catalog and its format are invited, but the developers are especially interested in identifying any missing events and in the accuracy of hypocentral parameters and magnitudes of earthquakes that readers may be particularly familiar with. Comments should be directed to Bob Engdahl, Center for Imaging the Earth's Interior, University of Colorado, Boulder, CO 80309; e-mail:engdahl@gldmutt.cr.usgs.gov or engdahl@ colorado.edu

from: Disaster Research #334, December 1, 2000

A Note on EMAP

In a previous issue we mentioned EMAP, the new voluntary Emergency Management Accreditation Program for state and local emergency management programs. EMAP is being developed by a consortium of national organizations, and in that earlier article. We would like to acknowledge them here. They include the International Association of Emergency Managers, National Emergency Management Association, Federal Emergency Management Agency, U.S. Department of Transportation, Association of State Floodplain Managers, Institute for Business and Home Safety, International Association of Fire Chiefs, National Association of Development Organizations, National Conference of State Legislatures, National Governors Association, National Association of Counties, National League of Cities, and the U.S. Environmental Protection Agency.

from: Disaster Research #334, December 1, 2000

Island County, Washington project targets visitors

A pilot project to alert tourists to coastal weather and tsunami hazards started in October in Island County.

Developed by the State and Local Tsunami Workgroup, the visitor information pilot project is a result of a partnership that includes local businesses, marinas, chambers of commerce, the road and ferry divisions of the Department of Transportation, and Washington State Parks.

Critical alert and warning information is relayed to visitors in two ways. The first is the placement of NOAA weather radios in businesses, critical facilities, and recreational attractions. These Visitor Emergency Information sites are identified by a cling sticker [NOAA Weather Radio logo] that is placed in the business window or door identifying it as a participant.

The second part of the program has placed brochures in hotels/motels, chambers of commerce, and restaurants explaining the program and how to respond if an alert or warning is broadcast.

The workgroup includes representatives from Pacific, Grays Harbor, Clallam, Jefferson, and Island counties; the Washington Departments of Transportation and Natural Resources; and the Emergency Management Division of the Washington Military Department.

This group is also looking at the development of emergency lights, reader boards, and signs that will identify local NOAA weather frequencies. These will be placed in high occupancy areas, beach accesses, bridges and ferry docks.

from: Emergency Responder, November-December 2000, p. 2

March '01 EENET Schedule

These are the satellite broadcasts scheduled by the Federal Emergency Management Agency's Emergency Education Network (EENET) (all programs begin at 2:00 pm Eastern time; length varies from 1 to 2 hours.):

February 21, National Alert Broadcast

February 28, Consequence Management News, Equipment, and Training (CoMNET) Magazine

March 7, "Fire Quest 2000." A game-show-style program taped live at the Virginia Association of Hazardous Materials Response Specialist's Conference, with questions and answers on topics ranging from hazmat and fire to general knowledge

March 14, CHER-CAP, The Lake Havasu City Exercise, The Comprehensive Hazmat Emergency Response/ Capability Assessment Program (CHER-CAP) is designed to help local communities identify planning deficiencies, work toward a greater understanding of Hazmat risks, update plans, train responders, and test systems for strengths and needed improvements

March 21, National Alert Broadcast

March 28, Weapons of Mass Destruction, "Live Response"

Note: Satellites and transponders vary for these programs, see the EENET Web site, http://www.fema.gov/emi/eenet. htm, for broadcast details.

Additional broadcasts are frequently added. For the most current listing, or to sign up for regular e-mail updates about EENET events, see the EENET Web Page above.

from: Disaster Research 336, December 28, 2000

HAZARD WARNING SYSTEMS: REVIEW OF 20 YEARS OF PROGRESS

by
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Abstract: The United States has no comprehensive national warning strategy that covers all hazards in all places. Instead, public warning practices are decentralized across different governments and the private sector. Uneven preparedness to issue warnings exists across local communities; hence, people are unevenly protected from the surprise onset of natural disasters. Without changes in this situation, inequalities will grow larger, and the gains made in saving lives over the past decades may well be reversed. Since the first assessment of research on natural hazards was completed in 1975, there have been significant improvements in forecasts and warnings for some hazards but only marginal improvements for others. Forecasts for floods, hurricanes, and volcanic eruptions have improved most significantly, and public dissemination of warnings has improved the most for hurricanes. However, a 100% reliable warning system does not exist for any hazard.

INTRODUCTION

Warning systems detect impending disaster, give that information to people at risk, and enable those in danger to make decisions and take action. This definition is simple, but warning systems are complex, because they link many specialties and organizations—science (government and private), engineering, technology, government, news media, and the public. The most effective warning systems integrate the subsystems of detection of extreme events, management of hazard information, and public response. These relationships are maintained through preparedness including planning, exercise, and training. This article summarizes advances in warning-related predictions, forecasts, disseminations, and responses over the past 20 years. It does so by addressing four questions:

- How have prediction and forecasting improved?
- How has warning integration improved?
- How has warning dissemination improved?
- What do we know about response to warnings?

In addition, three major steps to improve warning systems are offered.

HOW HAVE PREDICTION AND FORECASTING IMPROVED?

Most advances in prediction and forecasting since the nation's first hazard assessment in the 1970s have come from much improved monitoring, instrumentation, data collection, and data processing. Some of these have resulted from advances in theories and models, but no radical theoretical breakthroughs have occurred in the past 20 years. The ability to deliver warnings to the public—which means a thorough integration of the scientific component with an effective delivery mechanism—has a checkered record. Table 1 estimates the relative improvement in prediction/forecast and warning integration over the past 20 years [see Mileti (1999) for a discussion of improvements for each hazard in Table 1]. Even given the natural uncertainty in the behavior of hurricanes, improvements in prediction and forecasting capabilities and the ability to graphically present scientific information and warnings for that hazard have been exemplary. This is the case for nuclear power as well, although the impetus for that improvement came from regulatory requirements. Some advances have been made in predicting, detecting, and forecasting floods, tornadoes, volcanoes, landslides, and chemical accidents, but these improvements have yet to be fully integrated into warning dissemination systems. Earthquakes represent a unique case: while dramatic improvements have been made in integrating the warning process, our ability to predict earthquakes has not improved. Finally, four hazards have shown little change in either prediction/forecast or warning integration: droughts, wildfires, snow avalanches, and tsunamis.

Table 1. Improvements in Prediction, Forecast, and Warning Integration

Hazard (1)	Prediction/forecast (2)	Warning integration (3)
Flood	Some improvement	Not much improvement
Hurricane	Major improvements	Major improvements
Tornado	Some improvement	Not much improvement
Drought	Not much improvement	Not much improvement
Fire	Not much improvement	Not much improvement
Avalanche	Not much improvement	Not much improvement
Earthquake	Not much improvement	Major improvements
Volcano	Some improvement	Not much improvement
Tsunami	Not much improvement	Not much improvement
Landslide	Some improvement	Not much improvement
Nuclear power	Major improvements	Major improvements
Hazardous materials/ chemicals	Major improvements	Not much improvement

HOW HAS WARNING INTEGRATION IMPROVED?

Although warning integration has not been improved for all hazards, our ability to issue timely warnings for hazards in general continues to improve. This is attributable to a considerable amount of knowledge that has been developed on how to build an effective warning system. A key overriding principle that has continued to emerge from 25 years of warning research is that an integrated warning system maximizes public protection. Integration refers to the melding of scientific monitoring and detec-tion with an emergency organization that utilizes warning technologies coupled with social design factors to rapidly issue an alert and notification to the public at risk. Thus, warning systems must be considered as having scientific, managerial, technological, and social components that are linked by a variety of communication processes. A breakdown in the process can result in an ineffective warning, even if each individual component is properly performing its internal role, such as monitoring a volcano or making a decision that a threat to the public exists.

Warning Technologies

In the past 20 years, major advances have been made in warning system technology. The most common technologies used for public warnings are outdoor sirens, the electronic media, and officials going through the streets with loudspeakers (route alert). The major limitations of sirens were that people did not pay much attention to them and did not understand the meaning of different sounding signals. Now, electronic sirens with voice capabilities provide an alert mechanism as well as a voice message. The major limit of the electronic media in reaching the public with a warning message is that their effectiveness is highly variable depending on the time of day. Route alert is constrained by the number of emergency personnel available to disseminate the warning versus the size of the area to be warned.

Other technologies also exist. Tone alert radio (TAR) technology provides a highly personalized warning mechanism. The National Weather Service has used this technology for some time. Recent advances in battery design, self-diagnostic circuitry, and human factors engineering make TAR technology a very reliable method of disseminating warnings.

In 1994, the Federal Communications Commission announced they would replace the Emergency Broadcast System with the Emergency Alert System (EAS). The EAS is designed to take advantage of current digital communications technology. All commercial broadcast stations and cable companies will be required to participate in the system, which was implemented in January 1997. Some of the features of this new system are multiple alerting sources, remote operations, and targeting of specific geographical areas using specific area message encoder capabilities. EAS technology involves use of a standardized code that controls the functioning of the system. For example, the code can be set to interrupt normal programming for certain conditions and to choose the appropriate prerecorded audio and visual materials to be broadcast. The broadcast materials can be matched to the originator of the message, the event, and the location. Messages can be developed in multiple languages and sent out by the media channel appropriate for each foreign language speaking population. In addition, special radios, televisions, computers, and other electronic devices will be marketed that have remote activation capabilities. Eventually, EAS will replace the current TAR technology.

Telephones are obvious communication devices but have been limited in their emergency warning use. Computer technologies enabling rapid sequential auto dialing and switching equipment enabling simultaneous dialing have made the household phone part of an advanced rapid warning system. Computer controls of warning systems have enabled more specific targeting of warning delivery and increased system reliability by enabling silent testing. Little is known about the effectiveness of these systems.

A variety of technologies such as teletypewriters, telephone devices for the deaf, and voice carry over, and even strobe lights have enabled warning systems for people with hearing impairments. Overall, technology improvements have increased the potential speed of warning dissemination and provided greater system reliability. In the next decade, pagers will likely become an important public warning technology.

Warning System Type

One important general finding is that a single warning concept will not equally serve the requirements of all hazards (Mileti and Sorensen 1990). A system designed for a hurricane will not be good for a flash flood. Likewise, a general alert or warning may not be adequate when a very specific warning is needed. Cases exist where the warning clearly failed because the wrong system design was used or assumed. This is often found when a rare event occurs in a location with a frequently reoccurring event of a different nature (e.g., a tornado occurs in an area of frequent hurricanes). Thus an all-hazard warning system is inappropriate unless the specific needs imposed by each different hazard type are also considered.

Protective Actions

The most common recommendation for a protective action in a warning is to evacuate. Research, however, continues to document cases where evacuation is not the best action. A major cause of fatalities in flash floods is attempted evacuation in a vehicle. As a result, planning should consider an extended range of alternatives such as vertical evacuation for floods and hurricanes and in-place sheltering for tornadoes and earthquakes. Very little research has been conducted on the response of warnings to seek shelter (Liu et al. 1996)

Establishing Planning Basis

A number of questions face the emergency manager when issuing a public warning: How many people will respond? How fast will they act? What will they do? Where will they go? Will people go to an official shelter? How many vehicles will a family take? Will they bring adequate supplies? Will they bring a pet? (and other related questions of interest). In the absence of direct community experience, planners have used behavioral intent surveys to address these questions. The work of Nelson et al. (1989) with Hurricane Elena provides the first good empirical evidence that behavioral intent surveys do not accurately predict warning response. Social science knowledge on what influences variations in response and actual behavioral data provide a better planning basis than that provided by data collected from ‘‘what if’’ type surveys.

Shelter Use

Behavioral survey data have been used for predicting the level of shelter use (Mileti et al. 1992). Empirical research and theory development suggest mass care shelter use by evacuees in the United States averages about 15% of the evacuated population. Use generally increases in areas with an older population of low socioeconomic status and decreases with younger more affluent populations.

Institutional Populations

Institutional populations include schools, hospitals, prisons, nursing homes, and other facilities with a client population. The first systematic study of the response of institutions to warnings was conducted by Vogt (1990). This study showed that despite little preparedness for events other than fires, institutions were very adaptive at moving their clients and made effective use of volunteers. However, many difficulties were encountered in providing mass care for the clients at the shelter site.

Warning Myths

Many emergency managers in the United States believe in a set of popular myths and perceptions about warnings and public response to warnings. These myths all too often constrain the effectiveness of warning systems when implemented. The most common myth is the public panics in response to warnings of impending disasters. Social scientists have shown this is not the case except in situations where there is closed physical space, an immediate and clear source of death, and where escape routes are available but obviously not accessible to everyone (Quarantelli 1980, 1984). Second, officials are usually worried about overwhelming people with too much information. However, the public rarely, if ever, gets too much emergency information in a warning. Third, officials are concerned with issuing false alarms. The likelihood of people responding to a warning is not diminished by what has come to be labeled the "cry-wolf" syndrome if the basis of the false alarm is understood, although repetitive false alarms may decrease response (Dow and Cutter 1998). Fourth, officials think that a single spokesperson is a good practice to disseminate emergency information. People at risk who are the targets of emergency warnings need information from a variety of sources, not from one single source. Fifth, officials think that people will take action immediately on the receipt of a warning. Most people simply do not take action in response to warning messages as soon as they hear their first warning. Sixth, officials often think that people will follow recommendations made in a warning. Research shows, however, people will not blindly follow instructions in a warning message, unless the basis for the instruction is given in the message, and that basis makes "common sense."

Effective Messages

A well constructed message prototype for an emergency is important to the quick dissemination of information. The style and content of a message can have a dramatic effect on public response. Sufficient research has been conducted to discern a poor message from a good one and even a good one from one that reflects state-of-the-art practices (Sorensen and Mileti 1989; Vogt and Sorensen 1992). Five specific topics that are important to include in assembling the actual content of a public warning message are the nature, location, guidance, time, and source of the hazard or risk. The style aspects that are important to include are message specificity, consistency, accuracy, certainty, and clarity.

Public Education

There is no conclusive evidence regarding whether or not a public education or information program actually makes a significant difference of increasing human response to warnings. The most reasonable interpretation of the evidence, when considering the empirical, anecdotal, and practical, is that a good preemergency information program will increase response although the amount cannot be estimated. Conversely, a poor program will not likely make a great overall difference.

HOW HAS WARNING DISSEMINATION IMPROVED?

Much progress has been made recently on measuring and modeling warning dissemination and response (Rogers and Sorensen 1989; Sorensen and Mileti 1989; Lindell and Perry 1992). The knowledge generated includes data on

- The time decision makers take in reaching a decision to issue a warning
- The time it takes to disseminate a warning via different technologies and strategies
- The time it takes people to reach a decision to act on a warning
- The time it takes to carry out alternative protective actions

such as sheltering or evacuation

Among the general lessons learned from research in this area are the following:

• Officials are often slow in reaching a decision; slow decisions often prevent a timely warning to the public at risk.
• Most populations at risk can be notified in about 3 h or less without specialized warning systems.
• Warnings are more slowly disseminated at night than in evening or daytime hours.
• New warning technologies (such as telephone ring down systems) can achieve very rapid warning.
• Informal notification plays an important role in the warning dissemination in most emergencies.
• The time people spend responding to a warning corresponds to an S-shaped (logistic) curve.
• The time people spend in responding to a warning depends on the perceived urgency of the threat.
• The time required to evacuate a population is unrelated to the size of the population.

Fig. 1 depicts the general dissemination times of alternative communication technologies. Dissemination is based on the number of people initially notified by the warning technology and by the informal notification process. The latter is composed of family, friends, and neighbors contacting others who may not have heard the official warning. Informal notification can account for as much as one-half the initial warning in a disaster. The figure also shows that specialized warning devices are capable of more rapid dissemination of a warning than the media can achieve. In addition, recent work suggests the most effective warning systems have indoor and outdoor alert and notification components.

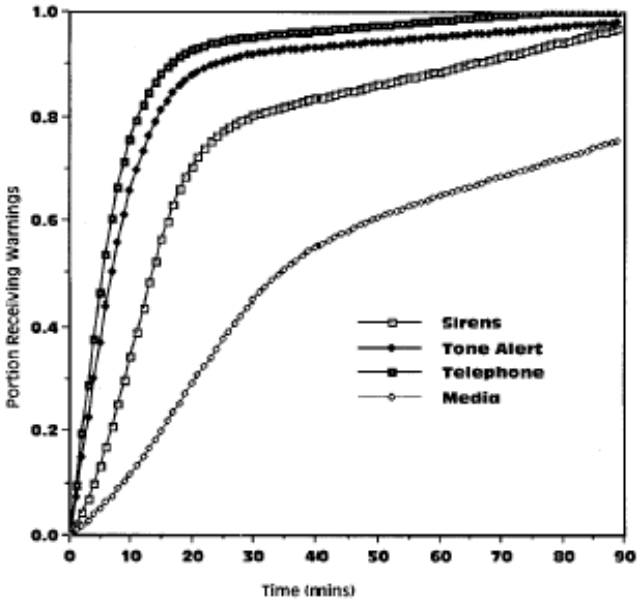

FIG. 1. Average Dissemination Time for Alternative Warning System Technologies (Rogers and Sorensen 1988)

WHAT DO WE KNOW ABOUT RESPONSE TO WARNINGS?

A significant level of knowledge has been developed on human response to warnings at the individual/family level and at the emergency warning organizational level (Drabek 1986). This is summarized in detail in several recent publications (Lindell and Perry 1992; Mileti and Sorensen 1990). Some of the key concepts and findings from this research are summarized in this paper.

Emergency Warning Organizations

General principles that facilitate and undermine coordination and effective organizational responses are fairly well defined. Simply stated, coordination seems to be maximized when organizations (1) know what they and other organizations are supposed to do in an emergency; (2) know who is to do it; (3) have designated and understood communication ties to others in the network; and (4) maintain flexibility (Anderson 1969; Dynes 1970; Mileti and Sorensen 1987; Lindell and Perry 1992). Communication problems, due to equipment and human failure, are the most significant causes of poor warning dissemination (Sorensen and Mileti 1987).

Public Response

A robust understanding of warning compliance has been developed by social science researchers. The focus of their research has been on whether or not people evacuate when advised to do so (Lachman et al. 1961; Withey 1962; Williams 1964; Drabek and Boggs 1968; Drabek 1969, 1983; Drabek and Stephenson 1971; Mileti 1975; Baker 1979; Perry 1979; Quarantelli 1980, 1984; Leik et al. 1981; Perry et al. 1981, 1982; Cutter and Barnes 1982; Perry and Greene 1982, 1983; Perry and Mushkatel 1984, 1986; Stallings 1984; Mileti and Sorensen 1988; Dow and Cutter 1998). In contrast, little work has been conducted on choice of protective action alternatives. Furthermore, little work has been conducted on explaining individual variations in response to warnings such as the timing ofresponse (Sorensen 1992). For example, what differentiates early or rapid responders from those who delay their response?

Warning response involves a sequence of cognitive and behavioral steps. Lindell and Perry (1992) characterize warning response as a four-stage process:

• Risk identification: Does the threat exist?
• Risk assessment: Is protection needed?
• Risk reduction: Is protection feasible?
• Protective response: What action to take?

Mileti and Sorensen (1990) characterize the process as sequential:

• Hearing the warning
• Understanding the contents of the warning message
• Believing the warning is credible and accurate
• Personalizing the warning to oneself

Table 2. Major Factors Covarying with Warning Response

Factor (1)	Response due to factor increase (2)	Level of empirical support (3)
Physical cues	Increases	High
Social cues	Increases	High
Perceived risk	Increases	Moderate
Knowledge of hazard	Increases	High
Experience with hazard	Mixed	High
Education	Increases	High
Family planning	Increases	Low
Fatalistic beliefs	Decreases	Low
Resource level	Increases	Moderate
Family united	Increases	High
Family size	Increases	Moderate
Kin relations (number)	Increases	High
Community involvement	Increases	High
Ethnic group member	Decreases	High
Age	Mixed	High
Socioeconomic status	Increases	High
Being female versus male	Increases	Moderate
Having children	Increases	Moderate
Channel: Electronic	Mixed	Low
Media	Mixed	Low
Siren	Decreases	Low
Personal warning versus impersonal	Increases	High
Proximity to threat	Increases	Low
Message specificity	Increases	High
Number of channels	Increases	Low
Frequency	Increases	High
Message consistency	Increases	High
Message certainty	Increases	High
Source credibility	Decreases	High
Fear of looting	Decreases	Moderate
Time to impact	Decreases	Moderate
Source familiarity	Increases	High

• Confirming that the warning is true and others are taking heed
• Responding by taking a protective action

Social scientists have identified general and specific factors that affect the warning response process that include sender and receiver factors, situational factors, and social contact. The specific factors are summarized in Table 2 (Mileti and Sorensen 1990). Only a few of these factors can be manipulated as part of the warning process. The primary way a warning response can be affected by the emergency planner is in the design of the warning system including the channel of communication, public education, and specific wording of the emergency mes-sage. In addition, incentives can be offered to increase response, including information hotlines, transportation assistance, mass care facilities, and security and property protection (Lindell and Perry 1992).

WHERE DO WE NEED TO GO IN THE NEXT 20 YEARS?

There is little doubt that improvements in prediction, forecast, and warnings have dramatically reduced deaths and injuries in the United States since the nation's first natural hazard assessment (White and Haas 1975). This is true for all hazards, but the same is unfortunately not true for many other parts of the world, particularly lesser-developed nations. Obviously, warnings can save lives and some moveable property and can reduce injuries. Beyond that, short term (minutes to days) warning systems seem to have little direct bearing on sustainable development; if links do exist, they have not yet been explored. Although they reduce deaths and injuries, warning systems have not been demonstrated to have any significant impact on reducing damage to social infrastructure or private property or on reducing economic disruption. In fact, short-term warning systems may hinder the movement toward sustainability by allowing long-term occupancy of marginal lands. For example, if people can return to occupy areas of high hazard such as a floodplain or a landslide prone coastline because a warning system helped them avoid death or injury, the presence of a warning system may actually increase economic losses in the long run and jeopardize a sustainable economy. Again, the evidence is scanty and warrants further attention.

On the other hand, long-term warning systems (years to decades or longer) may have a major role to play in sustainable hazards mitigation. Long-term forecasts would provide local decision makers with some of the information needed to design their future communities. A certain amount of future losses would be part of any community's sustainable hazards mitigation plan because losses could never be reduced to zero. Long-term forecast systems would help redefine the risks that communities want to reduce, and information about the systems would be vital to the local planning process.

To improve integrated warning systems, three key steps are needed:

- A national warning strategy. The United States does not have a comprehensive national warning strategy. Warning practices are divided over different governmental entities and the private sector. For example, the new EAS being developed by the Federal Communications Commission is coordinated with the National Weather Service but not with other public or private providers of prediction and forecast information or with organizations involved with nonweather related hazards. Moreover, different local communities vary greatly in the quality and likely effectiveness of in-place warning systems. The nation needs to develop a comprehensive model for warning the public, provide it to local communities along with technical assistance, and make the degree of protection provided by warnings systems for all citizens more equitable.
- Improving warning systems. Public alert systems can be improved with new hardware and technology, but diffusing existing technology and warning preparedness knowledge is a much bigger problem in the nation today. Further technological advances will only increase

the gap between practice and the state of the art. An exception would be the development of very inexpensive equipment that could be easily installed and maintained and could rapidly alert and notify the public. The diffusion of specific area message encoder enabled EAS warning devices into American households will likely be a slow process. These devices are now commercially available; however, very few low-income residents will be able to afford them. Furthermore, the EAS cannot provide outdoor warnings.

- Improvements to local warning systems are needed on two fronts. The first is the dissemination of information on low-cost or no-cost improvements. This includes improved procedures and management practices, which can result in a much better warning system without major financial expenditures. The second is the provision of resources for a better warning system and related communications equipment. Few communities have the funds to install new equipment and will therefore require technical assistance and/or cost sharing. Better local management and decision making about the warning process are more critical than promoting more advanced technologies, although both would help. The most sophisticated equipment is relatively useless unless it can be used properly.
- Knowledge gaps. The ability of a system to provide timely public warnings begins with monitoring the environment to detect hazards. Detection technology is readily available for some hazards but is only in a state of development for others. Technological capabilities also vary with respect to the amount of lead time provided and the ‘‘noise’’ in the detection signal. Monitoring technologies, which provide ongoing data about the physical system, are of equal importance. Again, monitoring coverage is fairly good for some hazards but poor for others, such as hazardous materials accidents. Complete coverage of the entire U.S. land mass, or even of all populated areas, has not been achieved for any hazard. There is much room for improvement in the next 20 years.

ACKNOWLEDGMENTS

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Mark Darienzo has planned a tsunami workshop for local emergency managers for May 14-15, 2001 at the Portland Airport Sheraton Hotel. The workshop will help Warning Center Geophysicists-in-charge clarify warning center messages and when to issue the all clear.

http://www.nnic.noaa.gov/CENR/cenr.html (RECOMMENDED!)

Last week the Working Group on Natural Disaster Information Systems, Subcommittee on Natural Disaster Reduction, Committee on Environment and Natural Resources of the National Science and Technology Council released a 56-page report on "**Effective Disaster Warnings**." The report "compiles... a wealth of information on public and private sector R&D capability to provide early warning of natural or technological hazards. It is designed to assist scientists, engineers, and emergency managers in developing more accurate ...warnings... The goal of this report is to provide a broad overview of major issues related to warning the right people at the right time." The report focuses on emerging opportunities in technology that can focus warnings on particular populations and thus improve public safety. It notes that a major priority is to address con-cerns regarding data/information standards and dissemina-tion systems to be used, and recommends close collabora-tion between federal, state, local, and private-sector organi-zations. The report is available online in pdf format at http://www.nnic.noaa.gov/CENR/NDIS_rev_Oct27.pdf

L ANOTHER REMINDER 7

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Status of US Public Alerting, Interagency Notification & Other Emergency Information Dissemination Technology and Processes from the Local Emergency Management Perspective

by Patrick McFadden, Executive Director of the York County (Pennsylvania) Emergency Management Agency

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ALERT Systems, Inc. is a team of emergency management (adjunct faculty of FEMA's National Emergency Training Center) and engineering professionals.

This report is a composite of thoughts, observations, feelings and experiences of officials in local emergency management agencies from across the United States.

Current Status

The American public expects both effective and timely warnings and aid when lives and property are threatened. Unfortunately, US public alerting, mutual aid mobilization and interagency notifications depend upon a patchwork of obsolete, uncoordinated and ineffective communications tools and processes dating from the 1950's.

The US has historically taken a "home-rule" approach to emergency management. This arrangement generally serves the public well for small local emergencies. Unfortunately, it has also created a highly fractured market that is unappealing to technology developers in the private sector. No national EM association has enough clout to cause consensus on emergency information dissemination technology and standards. And the federal government has not filled the void with either policy or R&D funds in 50 years. As a result, enormous advances in communication and computer technology have heightened public expectations but produced no real improvement in the speed, accuracy or reliability in the flow of public safety information. Because of this, public confidence in EM is eroding and the number of lawsuits against governmental agencies after disasters is rising.

How far has the effectiveness of public alerting systems fallen? EM officials with jurisdictions over 5.5M people were asked how many people they could reach within 15 minutes of the onset of major threat. Using all of the alerting systems at their disposal---sirens, EAS, telephone ring-down, and weather radio---officials indicated they might reach 23% of residents at 3 AM and about 40% at 10 AM. Mobile lifestyles, satellite TV, home air-conditioner noise, and other factors continue to erode these numbers. Emergency officials find it extremely difficult to reach people that are deaf, hard-of-hearing, live in rural areas, work on factory floors, stay in hotels and motels, or shop in malls with current systems. Worse yet, all types of existing public alerting systems have failed completely on numerous occasions at critical times.

Current public alerting systems have inherent weaknesses. Their general dependence on AC power is a recipe for catastrophe in some scenarios. Call blocking, unlisted numbers, fax and Internet lines greatly limit the effectiveness of telephone ring-down approaches. Already 8% of the US public relies exclusively on cell phones that are not tied to specific locations. If local officials cannot reach populations with "Population Stabilization," "Protective Action Recommendations" messages, or issue evacuation or reserve mobilization orders on short notice, the value of domestic terrorism training and other preparations are largely wasted.

Existing wide-area public alerting systems cause "warning fatigue," "call floods" into 911 centers and other human response problems. Advanced storm-cell radar, plume cloud modeling and other computer-based tools do generate precise geographic coordinates that would allow real-time alerting of precise geographic areas to solve some of these problems. But local officials have no means for delivering information to the public with such precision. As a result, Florida and Georgia officials say many thousands of households threatened by hurricane Floyd moved needlessly, contributing to massive road congestion problems. This has profound implications for certain terrorism scenarios.

The interagency notification component of public safety is equally problematic. National and state agencies originate public safety alerts and information from hundreds of locations. Each agency has its own protocols and message formats. Information arrives or is relayed to 15, 000+ local EM agencies by phone, fax, National Guard radio channels, packet radio, special wire lines, satellite feeds, the Internet, state law enforcement networks, couriers in the form of state highway patrol officers and the news media. Many information distribution channels lack a backup. Few channels confirm message receipt or provide authentication codes. Few indicate message urgency audibly or visually so priority messages are routinely buried in fax machine bins with administrative material. Because of the multiplicity of channels and protocols, each of the thousands of local agencies and 911 centers duplicates unnecessary technical, procedural and training effort and costs. Worse yet, this complexity contributes to human errors.

Operational procedures at the onset of relatively common events like tornadoes already run 10 to 15 minutes and more. In recent years, sirens have activated as much as 7 minutes after the tornado has leveled a town. Cell phones, digital radio, intelligent highway and other new civilian alerting channels dictate still more procedural complexity and delay.

Many emergency situations like wildfires defy geopolitical boundaries so local officials routinely notify an array of agencies with jurisdictions over adjoining lands. When those agencies are closed at night and on weekends, this sequential telephone calling process is painfully slow. In major natural disasters or acts of domestic terrorism, such

delays become nightmares.

Well-intentioned federal agencies offer databases of information that can be invaluable to incident commanders in emergencies. But while much of this information is now posted on the web, local EM officials don't have the time to "surf" for the most current version at the onset of a crisis. Even if they did, data formats are often incompatible with the computer-aided software of local agencies. In some disasters, communication lines to the data would be gone so critical data needs to be pre-positioned on local sites. But individual local EM agencies don't have the staff or skills to constantly gather and translate all the relevant data for their geographic area.

Federal agencies are often organized according to specific public hazards and they try to mitigate problems with single-purpose information dissemination networks and protocols. But local EM agencies can't afford single-purpose solutions for every possible emergency scenario---wildfire, terrorism, chemical weapon stockpile, hurricane, etc, etc.--especially when each solution requires separate training, adds procedural complexity, increases maintenance budgets, and doesn't interface with other systems or software. Each new federal program like the CDC' Health Alert Network initiative further entrenches the patchwork approach to US emergency management.

Overall Observations

It's clear the United States needs to modernize the entire information delivery/dissemination process at the core of all emergency management activities. Band-aid fixes to current technology have not worked and cosmetic improvements to current processes are not acceptable.

It's clear that US emergency management needs a master technology vision or blueprint because few technology developers in the private sector are now willing to sign up for a cruise on a technology ship with a thousand independent rudders.

It's clear that US emergency management needs private sector innovation. Rich Davies of the Western Disaster Center stated recently, "The Netscape Internet browser grew from an idea to a $2B company in the span of 5 years while EM technology hardly budged."

It's clear that technology is now advancing more rapidly than government agencies can make decisions, get moneys appropriated and deploy systems. NOAA is still deploying the weather radio system after 50 years while recording media and other consumer technology have advanced 3 and 4 generations.

It's clear that individual federal agencies lack a "big-picture" perspective of the problems confronting local emergency agencies so it's highly unlikely the federal government an provide an integrated solution. As an example, the all-hazard warning focus of this roundtable is only one part of a larger but generally unrecognized overall emergency information delivery problem. The entire problem must be addressed together for optimum results and use of limited budgets.

After decades of no real advancement of alert and notification technology, it's clear we need to find a new means to overcome the barriers of "home rule" and uncoordinated federal activity.

Recommendation

We recommend the creation and endorsement of a small non-profit public/private or quasi-governmental commission to craft and maintain the national vision for all EM information dissemination technology. Let's call that organization USEM for purposes of this discussion.

USEM should be free of federal rules as per the US Post Office. Commission members should be representatives of national EM associations, private sector EM technology developers, and federal government agencies including FEMA, the federal counter terrorism taskforce and the Department of Defense.

USEM should prepare an EM technology roadmap at least every 5 years as is now done with the federal radio navigation plan. The commission should have authority for the Natural Disaster Information Network. The commission should foster relevant standards and protocols. USEM should commission relevant research and provide peer review.

Conclusion

Periodically, major threats force a convergence of federal, state and local emergency management interests that foster at least de facto standards. The threat of Soviet nuclear bombers in the 50s led to "civil defense" sirens and the EBS/EAS system. 50 years of societal and technical change, the emerging threat of domestic terrorism and other factors are again forcing a convergence of interests. This opportunity must not be squandered!

On behalf of local emergency management throughout the US, I ask:

*That federal agencies understand their uncoordinated activities cause problems with serious consequences for local EM agencies.

*That federal agencies relinquish individual information dissemination networks in favor of a standardized fault-tolerant all-hazards network.

*Your support for a public/private commission to coordinate that standardized fault-tolerant all-hazard network, and to oversee related standards and development activities on behalf of emergency management agencies at all levels of government.

*Your funding of the innovative alert and notification technology needed by EM agencies at every level of government.

The good ship USS Emergency Management needs a rudder. We can't afford another 50 years of inaction.

New Tsunami Mitigation Materials
Added to the DGER Library, December 2000 through January 2001

compiled by
Connie J. Manson

Note: **Free reprints of these materials are available**. (See page 2 for ordering information)

Curriculum materials

Washington Emergency Management Division, 1999, Surviving great waves of destruction; Tsunami curriculum-- Grades 7-12: Washington Military Department, 52 p.

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NEW PUBLICATION

Local Government Capability Assessment for Readiness (CAR). 2000. CD-ROM. $795.00. Copies can be ordered from ERI International, 4537 Foxhall Drive NE, Olympia, WA 98516; (360) 491-7785; fax (360) 493-0949; email: info@eri-intl.com; Internet: http://www.eri-intl.com. Demo CD and information packet available upon request.

This CD contains a computer program that assesses the operational capabilities of local governments to mitigate, prepare for, respond to, and recover from emergencies and disasters. It assists users in establishing priorities and analyzing the effectiveness of emergency management programs. The program focuses on the Federal Emergency Management Agency's CAR program, which covers: laws and authorities, hazard identification and risk assessment, hazard management, resources management, planning, control and coordination, communications and warnings, operations and procedures, logistics and facilities, training, exercizes, public education and information, and finance and administration. Other professional standards, such as the NFPA 1600, are also incorporated. The program assists users in evaluating current states of readiness, developing strategic plans, and creating long-term work plans to improve program effectiveness.

WEBSITES

http://www.tsunami.gov/ttt/ttt.htm

This is the site to visit if you want **tsunami travel time** maps. It is hosted by the West Coast/Alaska Tsunami Warning Center and has links to 25 Pacific-wide tsunami travel time maps produced at the WC/ATWC, for locations in Alaska, B.C., Washington, Oregon, California and Hawai'i.

http://geohazards.cr.usgs.gov/pacnw/hazmap/

Seismic Hazard Maps (Earthquake Hazards Program - Pacific Northwest) This site also links to the complete hazards map series and the science behind the maps at the National Seismic Hazard Maps Project site.

http://tsun.sscc.ru/htdbpac

In December of 1998, a new website supporting the comprehensive Pacific Tsunami Catalog was established. The site contains basic tsunami parameters on almost 1490 historical tsunamigenic events that occurred in the Pacific from 47 B.C. up to the present time, along with nearly 8000 coastal run-up and tide-gauge observations of wave heights. The site provides users with screen forms for data search by a number of criteria, for their listing, sorting and for intensity-magnitude charts. The website is now version 2.1, dated October 30, 2000

from: http://omzg.sscc.ru/tsulab/IUGGTCrep99.html

http://www.geohaz.org/radius.html

One of the major initiatives of the recently completed United Nations International Decade for Natural Disaster Reduction (IDNDR) addressed the issue of reducing seismic risk in large cities of the developing world. Although officially completed over a year ago, the RADIUS (Risk Assessment Tools for Diagnosis of Urban Areas Against Seismic Disaster) Project continues to produce useful tools and information. Indeed, recently the project has released a "Summary Report" and CD-ROM. The report summarizes all projects carried out under RADIUS. The CD-ROM contains the project description, reports from the collaborating institutes and case-study cities, guidelines for RADIUS-type projects, several additional documents and reports, as well at the projects' "tool for earthquake damage estimation."

These materials are being distributed to the various cities, organizations, and individuals involved in the RADIUS project; however all the information is currently being up-loaded to the World Wide Web at the address above for interested persons to download and use.

from: Disaster Research #334, December 1, 2000

http://library.thinkquest.org/C003603/

This |Forces of Nature| site, put together by a group of students as a contest entry, provides a detailed introduction to avalanches, droughts, earthquakes, flooding, fog and mist, forest fires, hurricanes, landslides, monsoons, severe storms, tornadoes, tsunamis, volcanoes, and windstorms. The infor-mation covers descriptions of the physical phenomena, their impacts, recent occurrences, historical case studies, and interviews, as well as guidelines and tips for event predic-tion, preparation, and prevention. There are also simulations, classroom activities and experiments, resource tools, teacher curriculum aids, interactive topic exploration programs, mul-timedia galleries, games, and quizzes intended to teach appreciation and understanding of the natural world, with emphasis on avoiding the consequences of Earth's evolution and revolution. Kudos to these kids! *from:* Disaster Research #334, December 1, 2000

http://www.disasterlinks.net

This site is just what its name implies: dozens of links to disaster Web sites arranged in approximately 30 categories, from "Satellite Images" to "Icebergs," brought to you by CBS News. Includes the category "Tsunamis."

from: Natural Hazards Observer, v. 25, no. 3, p. 14.

http://www.nrt.org

The National Response Team (a national planning, policy, and coordinating body consisting of 16 federal agencies) has published an on-line version of "Joint Information Center (JIC) Model: Collaborative Communications During Emergency Response" - a detailed publication on conducting crisis communication during emergency response. The guide is also useful for other situations in which multiple organizations need to collaborate to provide timely, useful, and accurate information to the pubic and other stakeholders. The publication includes a number of useful sample documents, worksheets, checklists, and forms. [Adapted from "Emergency Partner Postings" - the newsletter of the Emergency Information Infrastructure Partnership (EIIP) - http://www.emforum.org/eiip/vo05no04.htm.]

from: Disaster Research #334, December 1, 2000

http://www.fema.gov/library/lib06.htm

Two new planning publications from FEMA, "Planning for a Sustainable Future" (FEMA 364, the sustainability booklet), and "Rebuilding for a More Sustainable Future" (FEMA 365, the sustainability guidance) are now posted on the Mitigation Library page of the FEMA Web site.

from: Disaster Research 336, December 28, 2000

http://www.egroups.com/group/disasterpio

This e-mail list has been established for emergency management public information officers; however, anyone can participate. To subscribe, go to http://www.egroups.com/ group/disasterpio, or send a blank e-mail message to disasterpio-subscribe@egroups.com.

from: Disaster Research #334, December 1, 2000

http://images.usace.army.mil/

Need a picture of flood, hurricane, or earthquake damage? emergency responders in action? flood mitigation structures? Take a look at the U.S. Army Corps of Engineers "Digital Visual Library," which includes both a photo library and a graphic library. The images are provided to visually communicate the programs and projects of the Corps, as well as the events with which it must contend. The searchable library includes photographs, illustrations, artwork, clipart, logos, maps, and posters from around the world. New images are added frequently.

from: Disaster Research 335, December 18, 2000

http://www.aquarius.geomar.de/omc/omc_intro.html

Or perhaps you need a map? Why not create your own? It's easy on this "Online Map Creation (OMC)" site - a great resource for students, geographers, geologists, geophysicists, seismologists, or anyone else needing a quick map for a talk or paper. This site allows a person to create an on-line or downloadable map (in any of several different projections) by simply entering the coordinates and defining the qualities he or she would like to see, such as political boundaries, rivers and lakes, cities, topography, tectonic features, seismic faults, etc.

from: Disaster Research 335, December 18, 2000

http://www.colorado.edu/hazards/annrpt/00annrpt.html

Over 2,400 people receive"Disaster Research," and another 15,000+ receive the "Natural Hazards Observer," the Hazards Center's printed periodical. The center's Web site now offers 58 Quick Response reports and 11 Working Papers. If you would like more information about what the Natural Hazards Center has been up to lately, including the titles of all recent publications, see the "Natural Hazards Research and Applications Information Center 2000 Annual Report," now on-line at the address above.

from: Disaster Research 335, December 18, 2000

YEAR IN REVIEW--2000:
More Catastrophes, Fewer Casualties

The world was hit by a record number of natural disasters last year, and global warming and a rising population could aggravate the situation in the future, according Munich Reinsurance's (Munich Re's) annual summary of global disasters announced in a press release on December 28 (see http://www.munichre.com).

Although the number of natural disasters rose by over 100 last year, to 850, the number of deaths was much lower than in 1999 because less populated areas were affected. Some 10,000 people died as a result of these disasters, compared to 75,000 in 1999. Natural disasters in 2000 caused an estimated $30 billion (compared to $100 billion in 2000), with insured losses of $7.5 billion (compared to $22 billion). The lack of major earthquakes and a relatively moderate cyclone season, combined with the general absence of losses in heavily populated areas, made 2000 a comparatively inexpensive year.

The year's greatest disaster was the flooding that left 500,000 homeless in Mozambique, while windstorms were also clearly at the top of the year's list with more than 300 events. The latter dominate the insurers' loss figures and account for 73% of the insured losses. At the same time, as in previous years, floods, including severe inundation in India, Southeast Asia, and Britain were also a significant cause of damage (23% of insured losses). In addition, storm surges, mudflows, and landslides in the Swiss and Italian Alps in mid-October generated economic losses of about $8.5 billion, with probable insured losses of roughly $470 million.

The cyclone season in the Pacific and the North Atlantic produced a typical number of hurricanes, typhoons, and cyclones in 2000; fortunately, exposed countries came off lightly, with the greatest damage in Taiwan, South Korea, and Belize.

In the U.S., perhaps the most notable natural disasters were the summer's forest fires in the western United States, especially New Mexico.

Despite the moderate losses in 2000, Munich Re is quick to point out that there is no reason to be sanguine - the year's statistics are likely an anomaly in the trend in recent decades toward greater and greater losses due to increased population and property being at risk. Moreover, a likely increase in weather-related and climate-related natural catastrophes due to global climate change could also exacerbate losses.

Munich Re has also recently published a CD-ROM in two languages (German/English) - "World of Natural Hazards" - that provides a multimedia source of information on global catastrophes. Digital techniques provide the user with a simple and fast method of identifying the natural hazards threatening any point on the globe and permit an initial approximate evaluation. The CD-ROM provides a modular world map of natural hazards; a tool for identifying local hazards; information on hazards science and related insurance issues; a catalog of world-wide catastrophes; a country-by-country database; information on earthquake and windstorm scales; additional information on topics of special interest, such as climate change, El Nino, and megacities; and details on services provided by Munich Re. Information about the CD(approximately $25) is also available from the Munich Re Web site, http://www.munichre.com.

from: Disaster Research 337, January 12, 2001

Video reservations

Place a check mark (T) beside the video(s) you want to reserve; write the date of the program behind the title. Mail to: TsuInfo Alert Video Reservations, Lee Walkling, Division of Geology and Earth Resources Library, PO Box 47007, Olympia, WA 98504-7007; or email lee.walkling@wadnr.gov

___**Adventures of Disaster Dudes** (14 min.)
Preparedness for pre-teens

___**The Alaska Earthquake, 1964** (20 min.)
Includes data on the tsunamis generated by that event

___**Cannon Beach Fire District Community Warning System** (COWS) (21 min.). Explains why Cannon Beach chose their particular system

___**Disasters are Preventable** (22 min.)
Ways to reduce losses from various kinds of disasters through preparedness and prevention.

___**Forum: Earthquakes & Tsunamis** (2 hrs.)
CVTV-23, Vancouver, WA (January 24, 2000). 2 lectures: Brian Atwater describes the detective work and sources of information about the Jan. 1700 Cascadia earthquake and tsunami; Walter C. Dudley talks about Hawaiian tsunamis and the development of warning systems.

___**Killer Wave: Power of the Tsunami** (60 min.)
National Geographic video.

___**Numerical Model Aonae Tsunami - 7-12-93** (animation by Dr. Vasily Titov) and **Tsunami Early Warning** by Glenn Farley, KING 5 News. (Note: the the Glenn Farley portion cannot be rebroadcast.)

___**The Prediction Problem** (58 min.)
Episode 3 of the PBS series "Fire on the Rim." Explores earthquakes and tsunamis around the Pacific Rim.

___**The Quake Hunters** (45 min.)
A good mystery story, explaining how a 300-year old Cascadia earthquake was finally dated by finding records in Japan about a rogue tsunami in January 1700.

___**Raging Planet; Tidal Wave** (50 min.)
Produced for the Discovery Channel in 1997, this video shows a Japanese city that builds walls against tsunamis, talks with scientists about tsunami prediction, and has incredible survival stories.

___**Raging Sea: KGMB-TV Tsunami Special**. (23.5 min.)
Aired 4-17-99, discussing tsunami preparedness in Hawaii.

___**The Restless Planet** (60 min.)
An episode of "Savage Earth" series about earthquakes, with examples from Japan, Mexico, and the 1989 Loma Prieta earthquake in California.

___**Tsunami and Earthquake Video** (60 min.)
Includes "Tsunami: How Occur, How Protect," "Learning from Earthquakes," and "Computer modeling of alternative source scenarios."

___ **Tsunami: Killer Wave, Born of Fire** (10 min.)
NOAA/PMEL. Features tsunami destruction and fires on Okushiri Island, Japan; good graphics, explanations, and safety information. Narrated by Dr. Eddie Bernard, (with Japanese subtitles).

___**Tsunami: Surviving the Killer Waves** (13 min.)
Two versions, one with breaks inserted for discussion time.

___**Tsunami Warning** (17 min.)
San Mateo (California) Operational Area Office of Emergency Services. This is a good public service program, specifically made for San Mateo County. Citizens are told what to do in cases of tsunami watches or tsunami warnings, with specific inundation zones identified for the expec- ted 20-foot tall tsunami. An evacuation checklist is provided, as well as locations of safe evacuation sites. This video gives the impression that all tsunamis are teletsunamis (generated at a source more than 1000 km from the coastline) which therefore provide time for warnings. Locally-generated tsunamis are not dis-cussed.

___**USGS Earthquake Videotapes "Pacific Northwest"**
USGS Open-File Report 94-179-E

___**Understanding Volcanic Hazards** (25 min.)
Includes information about volcano-induced tsunamis and landslides.

___**The Wave: a Japanese Folktale** (9 min.)
Animated film to help start discussions of tsunami preparedness for children.

___**Waves of Destruction** (60 min.)
An episode of the "Savage Earth" series. Tsunamis around the Pacific Rim.

___**Who Wants to be Disaster Smart?** (9 min.)
Washington Military Department/Emergency Management Division. 2000. A game show format, along the lines of *Who Wants to be a Millionaire*?, for teens. Questions cover a range of different hazards.

___**The Wild Sea: Enjoy It...Safely** (7 min.)
Produced by the Ocean Shores (Washington) Interpretive Center, this video deals with beach safety, including mention of tsunamis.

Check the title(s) you would like and indicate the date of your program. The video(s) will be mailed one week before the program date. You will be responsible for return postage.

Name:
Organization:
Mailing address:
City, State, Zip:
email:

CONFERENCES

March 26-30, 2001

European Geophysical Society (EGS) XXVI General Assembly. Nice, France: Includes session NH8, "Tsunamis," the aim of which is to "present current understanding of tsunami generation, propagation, and impact, as well as the tools available to assess and mitigate tsunami hazard." The symposium is open to all contributing disciplines - from geophysics to economics. Abstracts are due by December 1, 2000. The EGS abstract format as well as other information about the congress may be found at: http://www.mpae.gwdg. de/EGS/EGS.html, and http://www.mpae.gwdg.de/EGS/ egsga/nice01/nice01.htm. For general information about the assembly, interested persons can also contact: EGS Office, Max-Planck-Str. 13, 37191 Katlenburg-Lindau, Germany; tel: +49-5556-1440; fax: +49-5556-4709; e-mail: egs@copernicus.org; WWW: http://www.copernicus.org/EGS/EGS.html.
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March 30-April 3, 2001

International Association of Emergency Managers (IAEM) 2001 Mid-Year Meeting. National Emergency Training Center, Emmitsburg, Maryland: Contact: IAEM, 111 Park Place, Falls Church, VA 22046-4513; (703) 538-1795; fax: (703) 241-5603; e-mail: iaem@aol.com; WWW: http://www.iaem.com.

April 17-18, 2001

Partners in Emergency Preparedness Conference. Bellevue, Washington: See: http://hrs.crgnet.com/wwen, or contact Shad Burcham, King County Office of Emergency Management; (206) 205-8106; e-mail: shad.burcham @metrokc.gov.

September 8-12, 2001

National Emergency Management Association (NEMA) Annual Conference. Big Sky Resort, Montana: Contact: Tina Hembree, NEMA, P.O. Box 11910, Lexington, KY 40578; (606) 244-8162; fax: (606) 244-8239; e-mail: thembree@csg.org; WWW: http://www.nemaweb.org.

October 21-24, 2001

Western States Seismic Policy Council (WSSPC) Annual Conference. Sacramento, California: Contact: Todd R. Fleming, Program Manager, WSSPC, 121 Second Street, Fourth Floor, San Francisco, CA 94105; (415) 974-6435; fax: (415) 974-1747; e-mail: tfleming@wsspc.org; WWW: http://www.wsspc.org.

November 3-7, 2001

International Association of Emergency Managers (IAEM) Annual Conference and Exhibition. Riverside, California: Contact: IAEM, 111 Park Place, Falls Church, VA 22046-4513; (703) 538-1795; fax: (703) 241-5603; e-mail: iaem@aol.com; WWW: http://www.iaem.com.

February 24-27, 2002

Coastal Disasters 2002. Organizers: Coasts, Oceans, Ports, and Rivers Institute of the American Society of Civil Engineers; the Coastal Zone Foundation; and others. San Diego, California: Contact: Lesley Ewing, California Coastal Commission, 45 Fremont Street, Suite 2000, San Francisco, CA 94105; (415) 904-5291; fax: (415) 904-5400; e-mail: lewing@coastal.ca.gov -or- Louise Wallendorf, Hydromechanics Laboratory, U.S. Naval Academy, 590 Holloway Road, Annapolis, MD 21402-5042; (410) 293-5108; fax; (410) 293-5848; e-mail: lou@usna.edu. Also, see: http://www.coastal.ca.gov/cdsolutions; e-mail: CDSolutions@coastal.ca.gov.

May 28-30, 2002

Tsecond Tsunami Tsymposium. Sponsor: The Tsunami Tsociety. Honolulu, Hawaii: Abstracts due September 1, 2001. Contact: The Tsunami Society, P.O. Box 37970, Honolulu, HI 96817 -or- James Lander, Conference Chairperson, (303) 497-6446; e-mail: jfl@ngdc.noaa.gov.

GRANT AWARDED

Coastal Tsunami Effects: Mitigation Component. Funding: National Science Foundation, $128,000, 36 months. Principal Investigator: Jane Preuss, GeoEngineers, Inc., 600 Stewart Street, Suite 1215, Seattle, WA 98101; e-mail: jpreuss@geoengineers.com

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INFREQUENTLY ASKED QUESTIONS

compiled by Lee Walkling

from: Ambraseys, N. N., 1962, Data for the investigation of the seismic sea-waves in the eastern mediterranean: Seismological Society of America Bulletin, v. 52, no. 4, p. 896-898.

Who was the earliest (western) writer to speculate on the origins of tsunamis?

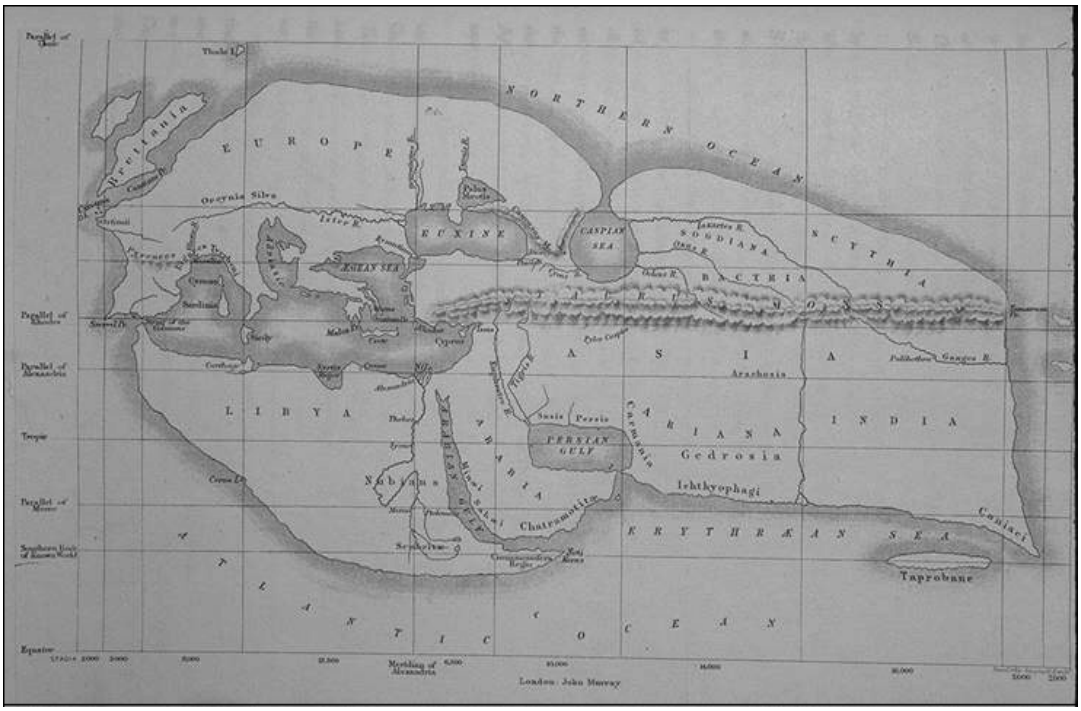
Thucydides, in the fifth century b.c. "The cause, in my opinion, of this phenomenon must be sought in the earthquake. At the point where its shock has been the most violent, the sea is driven back, and suddenly recoiling with redoubled force, causes the inundation. Without the earthquake, I do not think such an occurrence would ever happen"

Who was the Greek geographer to reach the explanation closest to the modern understanding of tsunamis?

Strabo, writing in 7 B.C., " The cause of the rising and the falling of the sea, of its inundation of certain tracts of country, and of its subsequent retirement from them, is not to be sought for in the varying levels of the beds of the sea, in that some are lower and others higher, but in the fact that the beds of the sea themselves sometimes rise, and, on the other hand, sometimes sink, and in the fact that the sea rises or recedes along with its beds; for when the sea is lifted up, it will overflow and when it is lowered, it will subside to its former level....Therefore, it remains for us to find the cause in the floor of the sea, either that which underlies the sea or that which is temporarily flooded, but preferably the submarine floor. For the floor (of the sea) that is saturated with water is far more easily moved and is liable to undergo more sudden changes...Deluges, as we have seen, are caused by upheavals of the bed of the sea; and earthquakes, volcanic eruptions, and upheavals of the submarine floor raises the sea, whereas the settling of the bed of the sea lowers the sea....and in a similar way settling in the bed of the sea, both great ones and small, may also occur, if it be true, as people say that yawning abysses and engulfments of districts and villages have been caused by earthquakes..."

Why aren't Aristotle, Pliny or Seneca cited in modern tsunami literature?

They believed in a "cavernous and perforated interior of the earth and the opening of chasms at the floor of the sea being the condition essential to the generation of a seismic sea-wave." In *De Mundo*, Aristotle says, "During earthquakes chasms open in the floor of the sea, and its waters often retire or waves rush in; this is sometimes followed by a recoil and sometimes there is merely a forward surge of the sea..."



Reconstruction of World Map according to Strabo (18 A.D.)

from: http://www.henry-davis.com/MAPS/AncientWebPages/115.html (Reprinted with permission.)

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