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George Crawford - State of Washington
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Guests

Landry Bernard - NOAA/NDBC
 Charles McCreery - NOAA/PTWC
 Bruce Knight - FEMA
 Ruth Ludwig - U of WA
 Christa Von Hillebrandt - U of PR
 Elena Suleimani - U of AF
 James Godfrey - State of California (Alt.)
 Vickie Nadolski - NOAA/NWS
 James Partain - NOAA/NWS
 Tim Rulon - NOAA/NWS
 Vasily Titov - NOAA/TIME Center
 Angie Venturato - NOAA/TIME Center
 Marie Eble - NOAA/ Tsunami Project

TSUNAMI PROGRAM NEWS

Summary Report of the Tsunami Hazard Mitigation Steering Group Meeting, November 5-7, 2002, Seattle, Washington

Attendees: Steering Group

- Eddie Bernard - NOAA (Chair)
- Hal Mofjeld- NOAA (Acting)
- Jeff LaDouce- NOAA
- Richard Przywarty - NOAA
- Chris Jonientz-Trisler - FEMA
- Craig Weaver - USGS
- David Oppenheimer - USGS
- Roger Hansen - State of Alaska
- Ted Smith - State of Alaska (Acting)
- Richard Eisner - State of California
- Lori Dengler - State of California
- Brian Yanagi - State of Hawaii
- Laura Kong- State of Hawaii
- Mark Darienzo - State of Oregon
- George Priest - State of Oregon

Introduction of New Member and Guests

Eddie Bernard introduced Jeff LaDouce, Director, National Weather Service (NWS), Pacific Region, as our newest Steering Group member. He replaces Dick Hagemeyer, who passed away last year. Mr. LaDouce spoke briefly on his background prior to becoming the NWS Pacific Regional Director.

The Directors of the National Weather Service: Western Region, Vickie Nadolski; and Pacific Region, Jeff LaDouce; Tim Rulon from NWS Headquarters; James Partain from the NWS/Alaksa Region; and Landry Bernard from NOAA's National Data Buoy Center (NDBC) were welcomed and introduced to the group.

Review of Action Items from the Previous Meeting:

Action item open prior to May 17, 2001:

1. 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

Status: Document available on National Tsunami Hazard Mitigation Program web site and the *TsuInfo Alert* web site. **Closed.**

(continued, p. 3)

TsuInfo Alert

is prepared by the Washington State Department of Natural Resources
on behalf of the National Tsunami Hazard Mitigation Program,
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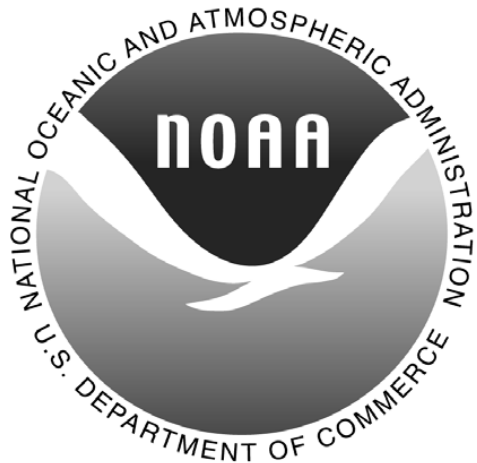
Participants in the TsuInfo program can request copies of reports listed in this issue from:
Library

Washington Department of Natural Resources
Division of Geology and Earth Resources
P.O. Box 47007
Olympia, WA 98504-7007
ph: 360/902-1472 or 360/902-1473
fax: 360/902-1785
e-mail: lee.walkling@wadnr.gov or connie.manson@wadnr.gov

The views expressed herein are those of the authors and not necessarily those
of NOAA, the Washington Department of Natural Resources, or other sponsors of
TsuInfo Alert.



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



(continued from p. 1)

Action item open prior to May 17, 2001:

2. *ACTION ITEM: Find out what information customers want on earthquakes to NWS and USGS Regional Networks so the MOU can be updated in light of new technology to clarify procedures and coordinate warnings better.*

Dick Hagemeyer suggested the following four steps: 1) find out what the customers want, 2) agree to a standard format, 3) obtain headquarters approval to place on NOAA Weather Radio and EMWIN, and 4) determine how to get the information to those who will put the messages on NOAA Weather Radio and EMWIN.

Action: Oppenheimer, Hagemeyer, Hansen

Status as of May 17, 2001: The feed from the University of Washington needs to be expanded. Reviewed text messages are to go onto EMWIN. The USGS is ready but needs a NOAA contact to proceed. Software needs to be developed. Oppenheimer will provide background to Weyman before proceeding. **Open**

November 2002 Status: We have made some success on the earthquake side since this item was opened. We now have quake data being entered into a common system. NWS is developing a system (currently experimental) to download USGS data on the NOAA weather wire and put on the gateway. There are still issues to discuss as the information dissemination policy problem needs further definition. It was agreed that Jeff LaDouce would take the lead on this item and work with Oppenheimer and Hansen to develop a subcommittee to address this issue.

Action: Oppenheimer, LaDouce, Hansen

Status: Ongoing

3. *ACTION ITEM: Develop procedures for use of buoy data by warning centers by July 1, 2001.*

Action: Sokolowski, González, Bernard, McCreery

Status: The FY 03 DART proposal would use any enhanced funds for DART Data Interpretation for Emergency Management **Closed**

4. *ACTION ITEM: In honor of Dick Hagemeyer the Steering Group unanimously agreed to establish a yearly tsunami mitigation award to recognize a particularly outstanding state mitigation activity. A volunteer was solicited to draft the award criteria. Dr. Bernard prepared a letter introducing the award to the NOAA Administrator, with copies to the Assistant Administrator for Oceanic and Atmospheric Research and the Assistant Administrator for Weather Services. Each Steering Group member present at the meeting signed the letter and it was mailed on November 9.*

Lori Dengler volunteered to draft the criteria for the award by December 1, 2001.

Status: Award criteria were developed and the award criteria and application form were placed on our web site. The award was advertised in the Natural Hazards Observer,

TsuInfo Alert, and on the tsunami bulletin board. Deadline for submissions was September 1, 2002. **Closed**

5. *ACTION ITEM: The recommendation letter on Warning Center 24/7 operation drafted in response to the August 2001 Review is to be sent to NOAA and USGS in a timely manner.*

Action: Bernard, Weyman, Przywarty

Current Status: NOAA conducted an in-house study. USGS met with NOAA. There needs to be a better understanding of the requirement before resources can be discussed. States were asked to submit their requirements to Eddie Bernard by December 1, 2002. **Open**

6. *ACTION ITEM: Write a report on research interest, ranking priorities and identifying a list of representatives at other agencies. Draft is due by January 2002 to Eric Geist, USGS. Final report due April 2002 for review by the full NTHMP Steering Group.*

Action: Tsunami Research and Advisory Committee (TRAC)

Current status: González attended NSF conference and reported on research needs. Everyone to e-mail their priorities to Frank González. **Open**

7. *ACTION ITEM: One Program reviewer (August 2001) commented that the program is out of balance. The program's current emphasis is on detection and risk mapping but does not address the sociological issues of dealing with the behavior of human beings. Also the program does not include anyone trained in disciplines that study human behavior. The reviewer also noted that more of a team approach is needed not just federal-state or state-local.*

To address this recommendation, the group plans to identify where the social science community can advise the NTHMP on the usefulness of its activities.

Action: Jonientz-Trisler and each state.

Status: The mitigation subcommittee and Eddie Bernard participated on a panel at the Natural Hazards meeting. Two social scientists were invited to the panel and were included in the discussions. If there is enhanced funding in FY 03, a multi-state project to develop a social science tool is planned. **Closed**

8. *ACTION ITEM: Encourage ITIC to be the archive for all tsunami event data. The Steering Group will offer cooperation and some resources.*

Action: Bernard to write a letter to NWS/Weyman by January 1, 2002.

Status: The ITIC Newsletter has been improved to include tsunami events and is available on the ITIC web site. The "Great Waves" booklet was reprinted and all 20,000 copies have been distributed. Another printing is planned if states need more copies. Copies of the ITIC Inventory of

Tsunami Materials were handed out to each person present.
Closed

9. *ACTION ITEM: Prepare an arrangement between NWS and OAR on mirror or duplicate real-time web sites.*

Action: Weyman, Bernard

Status: Due to the transition of the DART buoys to NDBC, NDBC will now probably provide that capability.
Closed

10. *ACTION ITEM: States to include in their Statements of Work a requirement to provide electronic and hard copies of mapping products to TIME.*

Action: States

Status: This has been done. **Closed**

11. *ACTION ITEM: A working group needs to develop a draft document on mapping certification procedures by May 2002.*

Action: González will chair a working group to prepare a draft of mapping certification procedures. Working group named includes: Rich Eisner, Tim Walsh, Gerard Fryer, Doug Luther, George Priest, Lori Dengler, Vasily Titov, Costas Synolakis, Elena Suleimani, and Antonio Baptista.

Status: No action. **Open**

12. *ACTION ITEM: Draft a Strategic Plan on how to interface with the Federal Response Plan in case of an event. 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.*

Action: Jonientz-Trisler to draft Strategic Plan, Subcommittee to report on review of the NOAA Response Plan and how it interacts with the states.

Current status: Highest priority. Partain will convey the name of the person responsible for the Federal Response Plan to Bernard and Jonientz-Trisler. Jonientz-Trisler and Hornick will draft the Strategic Plan. **Open**

13. *ACTION ITEM: Begin interaction with National Science Foundation and NWS to draft a Tsunami Research Institute Plan and find funding sources.*

Action: Bernard, González

Current status: González attended NSF meeting and presented research needs. This item is part of the Tsunami Research and Advisory Committee (TRAC). **Closed**

14. *ACTION ITEM: Draft a letter to USAPI to request a specific needs assessment before membership in the NTHMP.*

Action: Yanagi, Jonientz-Trisler

Status: Letter written, will be sent soon. **Open**

15. *ACTION ITEM: Bernard to e-mail to all Steering Group members the spreadsheet with FY 03 budget numbers as discussed during the meeting. Yanagi to send letters to Congressional members in Hawaii for support for the proposed FY 03 budget. States to also send letters of support to their state Congressional members.*

Action: Bernard, Yanagi, states

Status: Yanagi sent out the letter and the spreadsheet as discussed. Bernard also e-mailed out the FY03 budget Senate Mark Up showing an appropriation of \$6.3m.
Closed

Status Report of Program Elements

Develop State/NOAA Coordination and Technical Support.

NWS Pacific Region Director, Jeff LaDouce, met with the Japanese to assure them that cooperation would continue on tsunami issues. The warning center is standardizing product IDs and working to create public-friendly products. NWS is surveying users on how messages are disseminated and interpreted by users. Warning Coordination Meteorologists will work with their user communities to provide a usable product to the public. As approved by the International Coordination Group for the Tsunami Warning System in the Pacific (ITSU), the warning center will change to the moment magnitude (M_w) threshold for warnings. The PTWC will issue fixed warnings to local areas only on M_w 7.6 to 7.8 earthquakes. TsunamiReady and Hawaii State accomplishments are contained in the coordination report.

(Editors' note: See <http://www.pmel.noaa.gov/tsunami-hazard/coordinationreportNov02.html>)

Deploy Tsunami Detection Buoys

FY 2002 Accomplishments are listed in the DART status report.

The transfer of operational responsibility, with continued engineering support by the Pacific Marine Environmental Laboratory (PMEL), for the DART array from PMEL to the National Data Buoy Center (NDBC) is underway. NDBC personnel were on site at PMEL in April 2002 to gather information. NDBC personnel were onboard R/V EWING to participate in the DART mooring maintenance and deployment in July. PMEL engineering personnel visited the NDBC facility in Mississippi in late October 2002 to assist NDBC with assembly procedures and provide technical assistance where needed.

The timeline of the technical transfer has been reduced from 3 to 2 years and is expected to be completed by October 2003. The expected impacts of this transfer remain:

- *Improve Warnings* — NDBC will maintain the DART array and provide the necessary 24/7 support for the warning centers. This level of support is inappropriate for a research laboratory.
- *Infuse technology* — This action will transfer a prototype

system from a research laboratory to an operational center, enhancing public safety.

- *Increase efficiency* — NDBC can assimilate the DART array into its operations and gain efficiencies by consolidating platforms, ships, and technicians.

Future plans for the system (if enhanced funds become available) include two-way communication using the Iridium satellite system. The seventh buoy deployment is currently planned for Spring 2003.

(*Editors' note:* See <http://www.pmel.noaa.gov/tsunami-hazard/Nov02dartstatus.html>)

Produce Inundation Maps

The NOAA Center for Tsunami Inundation Mapping Efforts (TIME) held a 2002 Puget Sound Tsunami Workshop in June 2002. The report from this workshop will be published soon. Historically, most tsunamis in Puget Sound have been caused by landslides.

Copies of the "Seattle Inundation Mapping Project - Mw 7.3 Seattle Fault earthquake scenario" products CD ROM were given to each state. This was the center's first attempt to provide GIS files for easy access by state officials.

(*Editors' note:* See <http://www.pmel.noaa.gov/tsunami-hazard/TIMENov02.pdf>)

Develop Hazard Mitigation Programs

Chris Jonientz-Trisler presented the mitigation subcommittee report. (*Editor's note:* See <http://www.pmel.noaa.gov/tsunami-hazard/mitigationreportNov02.pdf>)

Each state gave a report on their activities.

Alaska report (*Editors' note:* see <http://www.pmel.noaa.gov/tsunami-hazard/AKmitigationreport02.html>)

California report (*Editors' note:* see <http://www.pmel.noaa.gov/tsunami-hazard/CAMitigationreport02.html>)

Hawaii report (*Editors' note:* see <http://www.pmel.noaa.gov/tsunami-hazard/HIMitigationreport02.html>)

Oregon report (*Editors' note:* see <http://www.pmel.noaa.gov/tsunami-hazard/ORmitigationreport02.html>)

Washington report (*Editors' note:* see <http://www.pmel.noaa.gov/tsunami-hazard/WAMitigationreport02.pdf>)

Improve Seismic Networks

David Oppenheimer reported the USGS has completed the installation of common interface software at the warning centers. The CREST network is basically completed and in maintenance mode. Alaska has 18 of 21 stations operating with 3 left to install. Northern California has 9 stations operating and 2 left to install. A total of 50 of 56 stations are installed. CREST stations represent approximately 50% of the broadband stations in each of the five states.

(*Editors' note:* See http://www.pmel.noaa.gov/tsunami-hazard/crest_rept10.pdf)

Public Affairs Working Group Report

Ann Thomason presented the Public Affairs Working Group (PAWG) Report. All states have been active in outreach activities.

The NWS Western, Alaska, and Pacific Regions are planning to hold a Tsunami Coordination Meeting in Hawaii in February 2003. The meeting will include the WC/Alaska Tsunami Warning Center, the Pacific Tsunami Warning Center, and ITIC along with Warning Coordination Meteorologists from the three regions. At least one day of the meeting will be devoted to emergency managers from the three regions of British Columbia.

(*Editors' note:* See http://www.pmel.noaa.gov/tsunami-hazard/PAWG_REPORT_FY2002.pdf)

FY 03 Budget

At the last Tsunami Hazard Mitigation Program Steering Group meeting, the Steering Group proposed an FY 03 budget of \$7.3m to meet the agreed upon goals for the next five years. At meeting time, the U.S. Senate has agreed upon a \$5.3 m plus \$1 m Tsunami Warning and Environmental Observatory for Alaska (TWEAK) budget for the Tsunami Hazard Mitigation Program (the Program). However, the U.S. House of Representatives has not voted on a budget for the Program. The funding for the Program is now a line item in the NOAA/National Weather Service (NWS) budget at \$2.3m.

Based on the uncertainty of the amount of an FY03 budget as well as when the budget appropriations will be passed each of the states and program elements were asked to submit proposals for core funding of \$2.3 m. This amount represents the funding currently available in the continuing resolution. States and program elements were also asked to provide an enhanced budget based on the current Senate mark of \$5.3 m.

Budget discussions focused on the core funding amount of \$2.3m and the following proposals were authorized by unanimous vote:

Alaska Proposal: a core budget of \$50K for mitigation and \$38K for mapping for a total of \$88K, Cooperative Institute For Arctic Research (CIFAR) proposal for funds to operate UAF CREST seismic net \$294.4K (see USGS proposal).

California Proposal: a core budget of \$50K for mapping, \$38K for mitigation for a total of \$88K.

Washington Proposal: a core budget of \$50K for mitigation, \$38K for mapping, and \$130K for a multi-state project for a total of \$218K.

Hawaii Proposal: a core budget of \$50K for mitigation and \$38K for mapping for a total of \$88K.

Oregon Proposal: a core budget of \$50K for mitigation and \$38K for mapping for a total of \$88K.

Administrative Budget for Chairman Support: originally requested a core budget of \$115K for transfer of funds, chairman support, Chairman's travel, and travel support for

three standing committees. The administrative budget was reduced by \$19,544 to help fund the shortfall in the seismic budget. Total approved administrative budget was \$95,456.

USGS Proposal: a core budget of \$450.3K funding to USGS for the CREST seismic project and \$294.4K funding to UAF for a total of \$744.7K was approved. The core budget is considerably higher this year due to USGS requiring that salaries, maintenance of stations, and communications costs be recouped for the CREST network.

TIME Center Proposal: a core budget of \$190K for scientist and modeler salaries, and for computer support was approved.

DART buoys Proposal: a core budget of \$994,244 to maintain 6 DART buoys was approved.

After much discussion the Steering Group unanimously approved the core budgets as submitted. Votes on the core proposals (with comments, if any) from the 5 states and 3 agencies were recorded on ballots, initialed, and provided to the Chairman. Enhanced budgets were discussed but final enhanced budgets discussions were postponed until the Spring 2003 meeting awaiting a budget appropriation from Congress.

Immediate, critical problems are occurring in the states because states have not been taking salaries from the Program but have been donating in-kind support for the past 6 years. States were supplementing using earthquake funds from FEMA until these funds were lost 2 years ago. This loss of funds has reduced state emergency management staffs. States cannot continue to run both earthquake and tsunami programs without an infusion of funds from the Program. In Washington, 3 or 4 coastal counties are ready to quit the Program for lack of funds. Washington State Emergency Management has been doing what it can to keep the coastal programs going, but has reached the limit of what it can do without new funds. The new Homeland Security requirements for states as well as the uncertainty of the FEMA reorganization and inclusion into a Homeland Security Department all add to the competition for future earthquake and tsunami program funding.

The Program Chairman said that there is a need to build funding lines and support for base for the program using salary dollars. In addition, the group should press for funds for the 3 items proposed in the \$7.3m budget not included this year in the enhanced budgets for \$5.3m.

ACTION ITEM 1: Enhanced mitigation budgets need to be formulated and coordinated.

Action: States to formulate new enhanced mitigation budgets, Chris Jonientz-Trisler to coordinate enhanced mitigation budgets for discussion at the Spring 2003 meeting.

Open

Richard H. Hagemeyer Tsunami Hazard Mitigation Award

A selection panel of Steering Group members served as judges for this award. The panel selected Professor Lori Dengler as the winner of the first Richard H. Hagemeyer Tsunami Hazard Mitigation Award from the following three nominations. She was presented with a commemorative plaque during the Steering Group meeting. NOAA prepared a press release naming the winner of the award.

TsuInfo Program, nominated by Chris Jonientz-Trisler. The *TsuInfo Program* was recognized for its work in compiling and providing access to tsunami mitigation information to those who need it. This has been accomplished by maintaining a library collection about tsunami mitigation, disaster management, and tsunami research as well as producing the bi-monthly *TsuInfo Alert* newsletter.

The Cannon Beach, OR, Fire District Tsunami Warning Program, nominated by Mark Darienzo. The Cannon Beach Fire District was recognized for developing a sophisticated tsunami warning system made up of several elements including sirens with voice capability, Emergency Management Weather Information Network (EMWIN), NOAA Weather Radios, emergency vehicles, and other elements. This system was established through local initiative with funds coming exclusively from the community.

Professor Lori Dengler, nominated by Richard Eisner. Prof. Dengler was recognized for her leadership in tsunami hazard mitigation through her involvement in the Redwood Coast Working Group, community education activities in Del Norte and Humboldt counties, through her contributions to the National Tsunami Hazard Mitigation Program, and her participation in the activities promoting and supporting mitigation in coastal counties of California. Her contributions span all areas of consideration for the Hagemeyer Award.

(Editors' note: See <http://www.pmel.noaa.gov/tsunami-hazard/Hagemeyeraward.htm>; http://www.pmel.noaa.gov/tsunami-hazard/award_presentation.html; and, <http://www.publicaffairs.noaa.gov/releases2002/nov02/noaa02147.html>)

Report on the Puerto Rico Tsunami Warning and Mitigation Program

Prof. Christa von Hillebrand, Director of the Puerto Rico Seismic Network and Co-Principal Investigator of the FEMA/UPR tsunami project briefed the group on the status of the program. The first recognition of a need for a tsunami program came in September 1998 after Hurricane Georges. The National Tsunami Hazard Mitigation Program helped Puerto Rico prepare a proposal for funding for a tsunami program. The tsunami program was funded with a \$362K grant from FEMA and a University of Puerto Rico in-kind grant of \$120.9K. The objective of the program was to extend to U.S. citizens in the Caribbean the same concern for tsunami hazard mitigation afforded citizens in the National

Tsunami Hazard Mitigation Program states. Since the program was begun all of the first generation inundation maps for Puerto Rico have been completed.

(Editor's note: See <http://poseidon.uprm.edu/>)

Response and Recovery

Bruce Knight from FEMA Region X discussed the Federal Emergency Plan. Following a disaster and upon notification by the President of the United States, FEMA becomes the coordinating agency and brings with it significant spending authority to provide emergency services. Under the Stafford Act, the Federal Government can pay up to 75% of the repair cost of infrastructure. Besides repair, the main goal is to look to reduce future losses. (See Previous Action Item 12 above)

NOAA Weather Radio on a Pole

George Crawford, Washington Emergency Management, gave a short presentation on the NOAA Weather Radio on a Pole. The NOAA Weather Radio on a Pole is a notification system for beach heads and high trafficked areas to facilitate the notification process of citizens. The system allows for local information input and is powered by battery and charged by wind. The system is currently being tested in Ocean Shores, Washington.

Cascadia Subduction Earthquake Regional Readiness Workshop

George Crawford reported briefly on this Workshop that was sponsored by the Washington Army Corps of Engineers in July 2002. The purpose of the workshop was to get Federal, state, and local agencies involved in disaster management to discuss intergovernmental operations and issues in preparing for and responding to a catastrophic earthquake scenario in the Pacific Northwest. The scenario for the workshop was a Moment-magnitude 9.0 earthquake. The exercise pointed out numerous issues that players had not realized and showed just how complicated coordination between/among agencies is following a disaster. The bottom line is that the National Tsunami Hazard Mitigation Program must have a Disaster Response Plan in place to effectively support any major tsunami that affects the Pacific Rim states. (See Previous Action Item 12 above)

Next Meeting Date and Location

May 20-21, 2003, Oakland, California. Primary purpose of the meeting is to discuss FY 03 budgets based on appropriated funding which should be decided by Congress by then.



HAPPY HOLIDAYS FROM *TSUINFO ALERT!*



Here are a few "tsunami" gifts you can add to your shopping list:

Tsunami CD's. Collect the band's music! Or buy tickets to a concert.
(<http://www.simplemachines.net/tsunami.html>)

Tsunami Wave laundry detergent. It's an all-natural laundry alternative, featuring T-Wave cleaning capsules and Tsunami Wave[™] enzymes. (<https://www.tsunamiwave.com/>)

Tsunami lures. The perfect gift for the fisherman in your life.
(http://www.interq.or.jp/rock/tsunami/l_english/index.html)

Tsunami clothing. (<http://www.tsunamiclothing.com/>)

Tsunami Front Bumper System for 2001-2002 Civic Coupe/4Dr. All new. Designed especially for Honda enthusiasts, our new Front Bumper System also incorporates a new designed grill that fits to OEM standards.
(http://www.roadcatalogs.com/store/tsunami_spoilers.html)

Tsunami Martial Arts Videos are the finest of their type in the world and unmatched in the quality of their production and content. They are distributed in North America by Dragon Associates Inc.
(<http://www.dragon-tsunami.org/Tsunami/Pages/Thome.htm>)

Tsunami Flutes. These flutes are five hole flutes fashioned in the style of the Native American Woodlands tradition. The woodlands style flute has the flue, or air passage, carved into the flute body. The "bird", which is flat on the bottom, sits on top of the flue, resulting in a channel for the air, and thus producing the rich, full tone indicative of the Woodlands flute. (<http://www.tsunamiflutes.com/HTML/about.html>)

Tsunami kayaks. (<http://www.tsunamikayaks.com/>)

HAZARD MITIGATION NEWS:

FEDERAL EMERGENCY MANAGEMENT AGENCY, FISCAL YEAR 2003 BUDGET-- A LEGISLATIVE UPDATE*

by Brandy Christine Berker-Keippala

from: The George Washington University Crisis and Emergency Management Newsletter, v. 3, no. 1, October 2002,
<http://www.seas.gwu.edu/~emse232/emse232oct2002fem1> Reprinted with permission

The President's 2003 Budget provides many changes for the Federal Emergency Management Agency (FEMA). The discretionary budget authority is \$6.6 billion with the major allotments to the Disaster Relief Fund and Emergency Management Planning Assistance. Programs with essential changes include the Flood Insurance Program, Disaster Mitigation, Flood Map Program, and the Emergency Food and Shelter Program.

Disaster Relief Fund: The Disaster Relief Fund (DRF) is the avenue through which FEMA provides "a significant portion of the total Federal response to victims in Presidentially-declared major disasters and emergencies." Discretionary resources to cover prior year declarations and 2003 obligations are requested at \$1.8 billion, \$292 million less than estimated in the 2002 budget. In addition, \$1.1 billion in grant recoveries over a two-year period is expected to benefit the program, bringing the program total to \$2.9 billion for FEMA disaster relief.

Disaster Mitigation: The Hazard Mitigation Grant Program, currently funded through the Disaster Relief Fund, will be replaced with a new competitive grant for pre-disaster mitigation. This new independent program will assure funding remains stable with \$300 million allocated to the program in the budget.

Emergency Management Planning Assistance: \$3.5 billion of the allocated \$3.747 billion of this program will be available for first responder grants. The program is broken into: Readiness, Response and Recovery - \$139 million; Fire prevention and training - \$195 million; Information technology services - \$18 million; Flood insurance and mitigation programs - \$19 million; Regional operations \$1 million; National Preparedness \$3,039 million; and Executive Direction \$4 million.

National Preparedness will provide \$30 million for the "coordination, integration, and implementation of preparedness and consequence management programs and activities focused on developing, building and maintaining the national capability for dealing with weapons of mass destruction, terrorism incidents and other threats." In addition, this program will provide the \$3.5 billion for first responder grants.

The First Responder Grant program "would consolidate several existing programs, including a first responder grant previously funded within the Department of Justice (funded at \$635 million in 2002). As part of the consolidation, FEMA will take over the functions of Justice's Office of Domestic Preparedness." This program would also include the FEMA Fire Investment and Response Enhancement (FIRE) grant program.

National Flood Insurance Program (NFIP): Proposed reforms for the NFIP include: Phase out taxpayer subsidies of second homes and vacation properties, require that mortgage borrowers insure the full replacement value of their properties, end state taxation of flood insurance policies, and include the cost of expected coastal erosion losses in premiums for policies issued in coastal areas" FEMA estimates \$-360 million for the NFIP total Mandatory outlays in the 2003 budget.

Flood Map Program: The modernization of flood maps, including digitization and publishing of the maps on the Internet is estimated at \$350 million.

Emergency Food and Shelter Program: Funds from this program are used to support homeless shelters and other organizations by providing funds for emergency food and shelter. The budget proposes a transfer of this program from FEMA to the more appropriate Department of Housing and Urban Development.

*All information for this report is taken from both the Budget of the United States Government, Fiscal Year 2003 and the Budget of the United States Government, Fiscal Year 2003 Appendix unless otherwise stated. These documents can be downloaded from the internet at the following web sites: Budget of the United States Government, Fiscal Year 2003. Available at <http://www.gpo.gov/usbudget/fy2003/pdf/bud26.pdf>, accessed September 25, 2002. Budget of the United States Government, Fiscal Year 2003 Appendix. Available at [tp://www.gpo.gov/usbudget/fy2003/pdf/app23.pdf](http://www.gpo.gov/usbudget/fy2003/pdf/app23.pdf), accessed September 25, 2002. In addition, amounts are estimated unless otherwise stated.

h h h

FEMA'S NEW PRE-DISASTER MITIGATION GRANT PROGRAM

by Falah Al-Mahan

from: <http://www.seas.gwu.edu/~emse232/emse232oct2002fem2>

The George Washington University Crisis and Emergency Management Newsletter, v. 3, no. 1, October 2002

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The Pre-Disaster Mitigation Grant Program is administered by the Federal Emergency Management Agency (FEMA) and authorized by Section 203 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, 42 USC, as amended by section 102 of the Disaster Mitigation Act of 2000 to provide funds to States and local governments for implementing long-term pre-disaster mitigation countermeasures that would prevent or minimize loss and damages that result from anticipated major disasters. The main purpose of the program is to reduce the loss of life and property due to natural disasters and to enable mitigation measures to be implemented ahead of time before it is too late to make a difference.

However, FEMA strongly urges States and communities to use the required hazard mitigation planning processes to successfully set short and long range mitigation goals and objectives. Hazard mitigation planning is a collaborative process that could assess vulnerabilities and identify hazards affecting the communities. And therefore minimize or eliminate the effects of these hazards.

Funding for the program is provided through the National Pre-Disaster Mitigation (PDM) fund but in order for States and local governments to receive funding, they must comply with FEMA's regulations. To be eligible for PDM funding there are certain criteria to be met. These criteria are designed to ensure that the most cost-effective and appropriate projects are selected for funding. FEMA regulations require that the projects are part of an overall mitigation strategy for the anticipated disaster areas. The amount of funding that can be given to states is dependent on how well they meet the required criteria, the higher criteria they meet the more money they get. One of the most important

criteria is that applicants must participate in the National Flood Insurance Program and be in good standing, not on probation or suspended. States that meet higher mitigation planning criteria may qualify for 20 percent under the Disaster Mitigation Act of 2000.

There are five types of eligible activities under the PDM Program: management costs (up to \$50,000 for grantees); information dissemination (up to 10%), mitigation planning, technical assistance (for sub-grantees), and mitigation "brick and mortar" projects. A mitigation "brick and mortar" project is any action that results in elimination or long-term reduction of damages to public or private property from natural hazards.

An approved mitigation plan is required for mitigation "brick and mortar" project grants. Therefore, PDM applicants are strongly encouraged to focus on the development of multi-hazard mitigation plans. FEMA's new planning regulation, 44 CFR Part 201, Hazard Mitigation Planning, establishes criteria for State and local hazard mitigation planning, which will take effect beginning on November 1, 2003. To make pre-disaster mitigation planning more effective, the President's fiscal year 2003 budget proposal included a competitive grant program for pre-disaster mitigation. FEMA is preparing to implement the program competitively if enacted by Congress.

For more information, see:

<http://www.fema.gov/fima/pdm.shtm>

http://www.fema.gov/fima/plan01_04n.shtm

http://www.fema.gov/regions/v/newsletter/volume_4/news_n01.htm

h h h

CALIFORNIA PROFESSOR RECEIVES FIRST HAGEMEYER TSUNAMI AWARD

Lori Dengler, a professor of geology who has studied the impacts of tsunamis on the northern coast of California, has been named the first recipient of an award named in honor of the manager of the U.S. Tsunami Warning Program. The new award was created by the National Tsunami Hazard Mitigation Program, of which NOAA is the lead federal agency, to recognize individuals or groups who help build tsunami resistant U.S. communities.

A professor at Humboldt State University's Department of Geology in Arcata, California, Dr. Dengler received the award November 6, 2002 during the annual meeting of the National Tsunami Hazard Mitigation Program (NTHMP) in Seattle. NTHMP is a state/federal partnership created to reduce the impacts of tsunamis on U.S. coastal areas by coordinating the state efforts of Alaska, California, Hawaii, Oregon and Washington with the federal efforts of the National Oceanic and Atmospheric Administration (NOAA), the Federal Emergency Management Agency (FEMA), and the United States Geological Survey (USGS).

"Professor Lori Dengler's work in the field of tsunamis is innovative and unique," said Eddie N. Bernard, director of NOAA's Pacific Marine Environmental Laboratory in Seattle, and chairman of the national tsunami program steering committee. "Ever since she became involved with the program, Professor Dengler has made major contributions in a variety of areas. Through her efforts to raise awareness and educate people about tsunamis, she has helped save lives. I am very pleased that she was selected as the first recipient of the Hagemeyer Award."

The Richard H. Hagemeyer Tsunami Mitigation Award was named for Richard "Dick" Hagemeyer, who was internationally recognized for his leadership in developing the United States Tsunami Warning Program. Hagemeyer joined the National Weather Service in 1950 and from 1982 until his death in 2001 he managed the U.S. Tsunami Program and was the United States representative to the International Coordinating Group for the Tsunami Warning System in the Pacific. He was a member of the NTHMP from its inception and his staunch support for tsunami mitigation was a major force in the development and success of the program.

Dengler was nominated by the Governor's Office of Emergency Services of the State of California. In the nominating document, Dengler is described as "a leader in tsunami hazard mitigation through her involvement in the Redwood Coast Working Group, community education activi-

ties in Del Norte and Humboldt counties, contributions to the NTHMP, and participation in the activities promoting and supporting mitigation in coastal counties in California. Her contribution spans all the areas of consideration in the Hagemeyer Award."

Other contributions in tsunami awareness and education by Dengler include the publication of *On Shaky Ground*, which provides information about tsunami hazards and mitigation for the general public; fundraising for community activities centered around tsunami education and mitigation; and writing the national Strategic Implementation Plan for Tsunami Mitigation Projects which provided the framework for a national plan as well as activities in five states.

Dengler was also cited for her "presentations on historic tsunami and the current tsunami threat to the west coast of the United States (that) have energized the programs of California and have been an essential element in supporting local planning in the state."

Individuals or groups concerned with tsunami mitigation are eligible for the Richard H. Hagemeyer Tsunami Mitigation Award. Each year the award will recognize the project or program that most exemplifies building tsunami-resistant U.S. coastal communities.



MORE TSUNAMI NEWS...

Wewak Earthquake and Tsunami Survey

An article about the 9 September 2002 earthquake and tsunami in Wewak, Papua New Guinea, by Hugh Davies, University of Papua New Guinea, was published in the current issue of Tsunami Newsletter (ITIC). The issue (v. 34, no. 5) is available online at <http://www.shoa.cl/oceano/itic/pdf-docs/Xxxiv-05.pdf>.

Tsunami/Seiche on the Wishkah River, Washington?

"Subject: November 4, 2002 Alaska Earthquake

For the record I wanted to submit my observations of earthquake effects in Washington. While fishing with my son from the banks of the Wishkah River (near Aberdeen, WA) at approximately river mile 1, or 2 max., and at approximately 2:30-3:00 pm (didn't have my watch available), we noticed that the river started surging upriver, and then back out again. This was occurring on the out-going tide. This continued, although lessening with each surge for 5-10 minutes. I was at first concerned that it was a tsunami, but thought it was more like observing a wave sloshing back and forth within a tub.

Best regards, Dave Molenaar, Aberdeen, WA."

from: email message sent to the University of Washington
Department of Earth and Space Sciences; reprinted with permission

Oregon's Tsunami Evacuation Map Program: Rockaway Beach

The Oregon Tsunami Evacuation Map Program began in the late nineties with funds from the National Tsunami Hazard Mitigation Program (NTHMP). The first series of maps were developed by coastal jurisdictions in coordination with Oregon Emergency Management (OEM) and the Oregon Department of Geology and Mineral Industries (DOGAMI). However, the maps were first attempts and not consistent among jurisdictions with respect to format, text, and quality. In some cases, they were made prior to development of detailed inundation maps for selected areas on the coast. With NTHMP funds, Douglas County started the state on the road to consistency by developing a tsunami evacuation map for Reedsport/Gardiner using GIS. GIS made it easier to produce maps with the same format and text, thus providing residents and tourists with a consistent message up and down the coast. DOGAMI and OEM then began to create a new series of maps using GIS, again in coordination with coastal communities and with funding from NTHMP. The Rockaway Beach map is the first one produced in the new format.

So far, Oregon has produced new tsunami evacuation maps for 11 coastal areas. Four more will be added next year. Copies of the maps are printed and sent to the communities for distribution. Some communities have even chipped in funds to print additional copies. Electronic versions are also made available. In addition, the Rockaway

Beach map is the first map to mention the banding program: yellow bands around poles indicate the hazard zone, green bands indicate the safe zone. The colors match the map colors for hazard and safe zones. The banding program is supported by many coastal jurisdictions. Rockaway Beach was the first community to implement it.

In conclusion, the combination of evacuation maps, bands, and tsunami signs greatly increases a community's awareness of the tsunami hazard and its ability to respond quickly to tsunamis.

Kudos and Congratulations!

We [Disaster Research] have been interested observers of the hazards world for over 25 years now and, like many of our colleagues, have often despaired at the lack of recognition of the importance of mitigation programs by anyone outside of our relatively small "hazards community."

Thus it was most heartening to read recently that Brian Tucker, president of GeoHazards International, was awarded a MacArthur Fellowship - one of those "genius" grants that drop from the sky to unsuspecting, but highly deserving, individuals. To our knowledge, it is the first time this MacArthur program has so honored anyone even remotely involved in the disaster or emergency management field.

We couldn't agree more with their selection. As many DR readers know, Brian has worked in various corners of the developing world to mitigate earthquake hazards, and, most importantly, he has succeeded. He and his crew at GeoHazards appear to have learned how to deal with social, political, and economic realities and synthesize those with the science, engineering, and planning necessary to actually *do* something to reduce vulnerability to seismic hazards.

So our most sincere congratulations to Brian - the entire hazards community can be proud of what he has done . . . and can learn from him as well.

The Editors (of Disaster Research)

from: Disaster Research 376, October 14, 2002

NOAA/National Geophysical Data Center

The National Geophysical Data Center (NGDC) manages environmental data in the fields of marine geology and geophysics, paleoclimatology, solar-terrestrial physics, solid earth geophysics, and glaciology. The NGDC Solid Earth Geophysics Division acquires, processes, and analyzes socioeconomic and technical data on geologic hazards and disseminates these data.

Tsunami and Significant Earthquake Program: NGDC catalogs information on tsunamis and significant earthquakes, including effects such as fatalities and damage. These databases are accessible online via Oracle databases and ArcIMS interactive maps. The interactive maps provide integrated web-based GIS access to tsunami events and run-ups, significant earthquakes, volcano locations, and auxili-

ary geospatial data such as topography, population density, and major cities. Additional capabilities are being developed, including radial searches and links to associated photos and reports.

NGDC has completed and published several tsunami reports. "A Brief History of Tsunamis in the Caribbean Sea", "The Tsunami History of Guam: 1849-1993", and "Tsunamis and Tsunami-like Waves of the Eastern United States" were published in the *Science of Tsunami Hazards Journal* (<http://sthjournal.org/sth2.htm>). "Two Decades of Global Tsunamis" will appear soon in the same journal.

from: EQ, Summer 2002, p. 15-16

Building Code Service

The International Code Council (ICC) has launched its eCodes Online Subscription Service, making it easier for the construction industry to access the latest building and safety codes. Subscribers to the new service may download an array of codes in Adobe eBook Reader format to a desktop or laptop computer. Subscriptions vary in duration and price and provide users with access to a number of codes. Visit www.ecodes.biz for complete subscription information.

from: Design/Build Business, October 2002, p. 9

LOCAL TSUNAMI WARNING AND MITIGATION WORKSHOP--SUMMARY

Petropavlovsk-Kamchatskiy, Russia, September 10-15, 2002

submitted by Dr. Mikhail Nosov (Faculty of Physics, Moscow State University) and Dr. Boris Levin (Russian Foundation for Basic Research, Moscow)

reprinted, with permission from, *Tsunami Newsletter*, v. 34, no. 5, October 2002, p. 10-11
complete newsletter is available online: <http://www.shoa.cl/oceano/itic/pdf-docs/Xxiv-05.pdf>

Destructive effects of many tsunamis are confined to areas within about one hour of the initial propagation time (that is, within a few hundred km of their source). These tsunamis are classified as local, as opposed to regional and Pacific-wide tsunamis whose destructive effects could be well outside (up to 10,000 km) of their area of origin. In all main Pacific tsunamigenic regions, the majority of tsunami-related casualties and property damage come from local tsunamis. The very short tsunami travel time increases the local tsunami hazard, and therefore presents an important challenge for the research community and decision-makers to identify ways for reducing losses of lives and property damage from the local tsunamis. Two international tsunami workshops have recently been held in Russia ("Tsunami Mitigation and Risk Assessment," Petropavlovsk-Kamchatskiy, 1996, and "Tsunami Risk Assessment Beyond 2000: Theory, Practice and Plans," Moscow, 2000). The success of these two meetings, as well as recommendations of the XVIII Session of UNESCO/IOC/ICG/ITSU, inspired us to convene another international tsunami workshop in Petropavlovsk-Kamchatskiy.

As one of the most active seismic- and tsunami-prone areas in the Pacific with a long history of recorded tsunamis, and complemented by interesting environmental features, Kamchatka was an appropriate place for international tsunami community members to convene to discuss local tsunami problems. Additionally, the workshop took place on the 50th anniversary of the 1952 Great Kamchatka Earthquake and Tsunami. The November 5, 1952 earthquake generated a catastrophic tsunami which killed more than 2000 people. The town of Severo-Kurilsk (Paramushir Island, south of Kamchatka) was completely destroyed. This catastrophic event served as a starting point for tsunami re-

search in Russia, and many of the Russian tsunami community felt it their moral duty to convene a workshop in commemoration of the event.

Over 50 scientists (45 registered participants) from 12 countries (Bulgaria, Canada, France, French Polynesia, Indonesia, Italy, Japan, New Zealand, Republic of Korea, Russia, Turkey, U.S.A.) attended the Workshop. The Workshop programme and all submitted abstracts can be accessed online at <http://ocean47.phys.msu.su/>.

The Workshop participants made 50 oral presentations on the following topics: 1952 Kamchatka Earthquake and Tsunami, Historical Catalogues and Databases, Seismotectonics of Tsunami, Numerical and Analytical Models of Local Tsunami Behavior, Mitigation and Risk Assessment, Tsunami Geology and Paleotsunamis, Tsunami Measurement and Data Analysis, Hydroacoustic Methods in Tsunami Research. A separate student session, which Workshop participants unanimously recognized as being of high quality, was also convened to attract the participation of young scientists.

The Workshop also included field trips to Khalaktirka Beach and Kotelnoe Lake, where participants were exposed to paleotsunami methodology and practice by Professor Joanne Bourgeois (USA) and Dr. Tatiana Pinegina (Russia).

The International Workshop was organized jointly by the IUGG Tsunami Commission and the International Coordination Group for the Tsunami Warning System in the Pacific of the UNESCO. P. P. Shirshov Institute of Oceanology of the Russian Academy of Sciences (RAS) and the Kamchatka Seismological Department of Geophysical Service of the RAS led the Workshop as local organisers. The Workshop co-conveners were Prof. Joanne Bourgeois (USA) and Dr. Mikhail Nosov (Russia).

The Workshop organisers wish to acknowledge the Intergovernmental Oceanographic Commission (UNESCO), International Tsunami Information Center, Russian Foun-

ation for Basic Research, Russian Academy of Sciences, and International Ocean Institute (Malta) for financial support of this meeting.

LOCAL TSUNAMI WARNING AND MITIGATION WORKSHOP--SELECTED ABSTRACTS
Petropavlovsk-Kamchatskiy, Russia, September 10-15, 2002

from: <http://oceanc47.phys.msu.su/scripts/Search.pl>

Hydroacoustic Detection of Tsunamigenic Landslides

Gerard J. Fryer; Jacqueline Caplan-Auerbach; Philip Watts; Frederick K. Duennebieer

Submarine landslides pose one of the most severe local tsunami hazards, but there are few detailed case studies of such events. Nor is there yet any means to identify such events rapidly enough to provide a useful tsunami warning. From studies of the ocean entry at Kilauea volcano, we are convinced that submarine landslides can be rapidly identified, and their tsunamigenic potential assessed, from records of nearby or distant hydrophones suspended in the water column. Lava flows from the continuing eruption of Kilauea Volcano in Hawaii extend the shoreline seaward by building a large lava delta. The delta grows over poorly-consolidated glassy sand, so it fails frequently. When lava is flowing, there are 3-10 landslides a day, and about one large bench collapse per month. Our spectrograms of hydroacoustic data recorded off Kilauea show the classic landslide signature of an initial rumble and a drawn-out hiss. By scaling from laboratory experiments we estimate landslide shape and motion, which in turn allow rough estimates of tsunamigenic potential. How these techniques might be exported to other geological settings we cannot yet say, since other geo-logical systems are unlikely to mimic the Kilauea ocean entry closely. We therefore encourage hydroacoustic investigation of slides in other environments and large wave tanks.

The techniques described here permit rapid differentiation between a landslide and an earthquake source, from the frequency content and the duration of hiss coda. Such differentiation is essential in a warning system because of the different character of the tsunamis generated (high runup over a short extent of coastline vs. low runup over a large extent of coastline). We point out that tsunamigenic landslides can occur minutes to hours after their triggering earthquake. This work is only in its infancy, but we are already convinced that deploying hydrophones near sensitive facilities will provide invaluable information for tsunami warning.

Establishment of Post-tsunami Technical Clearinghouses: An Operational Model for Hawaii

Laura S. L. Kong; Brian Yanagi; Daniel A. Walker; Stan Goosby

A destructive tsunami can attract a large number of tsunami professionals interested in investigating and documen-

ting its scientific, economic, and social impact on communities. At the same time scientists want to collect runup and inundation data and obtain eyewitness accounts, government emergency officials are focusing their highest priorities on public safety, damage reconnaissance, and critical facility integrity evaluations. Without coordination, perishable data collection may prove logistically difficult before erosion or bulldozers eliminate the evidence, and could conflict with emergency responses. The establishment of a Post-Tsunami Technical Clearinghouse (TTC) can provide the framework for the coordination of activities, and integration of scientific and engineering investigations with emergency operations. In addition, the TTC can serve as a forum for sharing daily field information, and as a point-of-contact for interactions with the media and public. Its goals would be to assist in response, damage assessment, and early recovery without increasing the burden on emergency officials, facilitate researcher access to the affected areas, and contribute to the capture of valuable and perishable data. This model is based on current U. S. efforts to develop post-earthquake technical clearinghouses.

In Hawaii, tsunami scientists are writing the Hawaii Post-Tsunami Scientific Survey Plan, which identifies and trains island-based volunteers to make tsunami observations before and within hours and days after a destructive tsunami. The Plan uses the IOC Post-Tsunami Survey Field Guide and adapts it to Hawaii conditions; hand-written and electronic data collection are being considered, and historical data will be included in each team's field notebook. The Plan will be incorporated into Hawaii State Civil Defense operating procedures, pre-clear participants for restricted area access, and include pre-established mission agreements with other government agencies. The TTC will partner with the Pacific Disaster Center to establish a reliable and secure telecommunications and information sharing network with sufficient bandwidth and accessibility. User-friendly web tools and GIS applications that permit electronic sharing of multi-disciplinary datasets will be developed.

Recent Enhancements to PTWC Local/Regional Tsunami Warning Capabilities for Hawaii

Charles S. McCreery; Barry F. Hirshorn; Robert K. Cessaro; Stuart A. Weinstein; Daniel A. Walker; and Gerard J. Fryer

In historical times Hawaii has been struck by two major local tsunamis and a few much smaller ones. The two major

events, in 1868 and 1975, were the result of $M > 7$ earthquakes along the southeast flank of the island of Hawaii. They each had maximum runups along that coast exceeding 13m. Other much smaller local tsunamis, all also on the island of Hawaii, appear to have been triggered by earthquakes but were probably caused or enhanced by submarine landslides. No historical local tsunami has caused damage to islands further up the Hawaiian chain.

Over the past few years the Richard H. Hagemeyer Pacific Tsunami Warning Center (PTWC) in Ewa Beach, Hawaii, has worked with Hawaii State Civil Defense, the University of Hawaii, the U.S. Geological Survey and others to enhance its warning capabilities for these events. It now receives real time Hawaii seismic data from 7 broadband stations, 3 accelerometer stations, and more than 40 short-period stations. These data along with new software permit the accurate location of hypocenters generally within about 40 seconds of an event, and the rapid subsequent computation of a variety of local earthquake magnitudes. As a result, the average response time for issuing tsunami bulletins for Hawaii earthquakes has dropped from about 13 to 4 minutes since 1999. This faster response provides time for an official warning to coastal populations in Hilo and Kona, each located about 15 minutes tsunami travel time away from the 1868 and 1975 events. In addition, eight new run-up gauges have been installed along Hawaii's southeast and southwest coast. These will permit more rapid detection and evaluation of major local tsunamis. Taking into consideration numerical model results for a major tsunami generated along the southwest flank of the island, these runup gauge data are essential to rapidly evaluate if a significant tsunami threat exists for other islands including Oahu that would be impacted in less than 30 minutes.

Probability Distributions and Risk Assessment for Landslide Tsunamis

Philip Watts

A review of tsunamis during the 1990s reveals around 30% of maximum runup peaks probably involved tsunamigenic mass failure. Submarine mass failure includes underwater slides, underwater slumps, and reef failure, most often triggered by a nearby earthquake. Earthquakes above magnitude 7 are typically accompanied by thousands of mass failure events, although most of these will not be tsunamigenic. A geological context derived from marine surveys is needed to identify prospective mass failures and to predict their size and location. Probabilistic calculations of underwater slides and slumps throughout the Pacific Basin yield preliminary probability distributions of mass failure generated tsunamis. Tsunami amplitude is estimated from accurate curve fits based on numerical simulations of mass failure events. As observed, about 35% of all earthquakes generate landslide tsunamis that surpass coseismic displacement in amplitude. A finite probability exists for mass failure to generate tsunamis with amplitudes in excess of 10 meters. The probabilities of nearshore and offshore earthquakes can be converted directly into tsunami hazards from submarine mass failure. Indicators of prospective tsunamigenic landslides such as sedimentation rate or liquid limit improve our ability to predict future events and to assess their impact on coastal populations and development. This kind of probabilistic calculation may play an important role in tsunami risk assessment from landslide tsunamis.

Land Use Planning and Natural Hazards Awards

Skye A. Sieber, a recent graduate of the University of Oregon, has been awarded \$1,000 by the Institute for Business & Home Safety (IBHS), for her work in the area of land use planning and natural hazards.

Ms. Sieber's winning paper was titled "An Evaluation of Hazard Mitigation Planning in Oregon: Four Case Study Flood Mitigation Plans." She is now employed as a Recreation Planner with the Siskiyou-Rouge River National Forest.

Hers was one of two \$1,000 awards given Saturday, November 23rd, at the 2002 Association of Collegiate Schools of Planning (ACSP) conference in Baltimore, Maryland. The other recipient was Calah Young, who recently received her Masters in Regional Planning from the University of North Carolina at Chapel Hill. Ms. Young's winning paper was titled "Creating a Role for Regional Agencies in Hazard Mitigation Planning." She wrote the paper during her Federal Emergency Management Agency (FEMA) Hazard Mitigation Planning Fellowship. She is now employed as a senior planner in the Charleston office of Edwards & Kelcey.

This was the second year IBHS and ACSP teamed up to offer a scholarship award, which is designed to encourage planners to include natural hazards loss reduction in their research and practice.

Land use planning is the process communities use to identify appropriate and compatible uses for land within their jurisdictions. Land use is one element of an overall or comprehensive plan process that may also include transportation, housing, open space, community and social services, natural resources and environmental quality, public safety, and economic development.

IBHS is a national nonprofit engineering, research and communications initiative of the insurance industry. Its mission is to reduce deaths, injuries, property damage, economic losses and human suffering caused by natural disasters. For more information visit the IBHS web site, www.disastersafety.org.

RESEARCHERS USE SUPERCOMPUTER TO RIDE TSUNAMI

by Jay Lyman

NewsFactor Network June 7, 2002

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Using supercomputing power and a new computer code that covers the different stages of a tsunami caused by an asteroid, researchers at Los Alamos National Laboratory have a better picture of how these giant waves actually look and behave.

Previous efforts to chart an asteroid-caused tsunami--capable of reaching heights of more than 12 miles--required the use of separate computer codes for the different phases of the wave's progression from impact.

The researchers, who presented their findings at the American Astronomical Society meeting in Albuquerque, New Mexico, this week [*Editors' note*: June 7, 2002], used entirely new code in their latest modeling projects. The code produced what they believe is the most accurate picture yet of these destructive waves.

Before, different modeling applications had to handle the behavior of the asteroid, the water, and the tsunami, Los Alamos National Lab spokesperson Jim Danneskiold told NewsFactor.

Now, researchers can model the entire event--from the asteroid to the splash to the interaction with the surface below--all in a single custom-written 3D-modeling application.

Watching the Tide

The application, called SAGE (Nasdaq: SAGI), an acronym for SAIC Adaptive Grid Eulerian, helped researchers simulate six different asteroid scenarios with varying size, composition, and speed factors. Most large simulations come in one of two flavors: Lagrange, in which a grid or mesh of mathematical points matches with and follows molecules or other physical variables through space; and Eulerian, in which the mesh is fixed in space, thereby permitting researchers to follow fluids as they move from point to point.

The largest asteroid simulated using SAGE's Eulerian technique was one kilometer wide. It struck with an impact equal to 1.5 trillion tons of TNT and produced a 12-mile-high wall of water, researchers said.

Captured in Code

Building on previous simulations conducted by Los Alamos and Sandia National Laboratories, the researchers were able to follow a tsunami from splashdown to a coastal

city by modeling interactions between air, water, and asteroid.

"We looked in some detail at a couple of the key variables, especially the heights of tsunamis as a function of their distance from the point of impact," explained Los Alamos computer scientist Galen Gisler. "We modeled the heights of individual waves and studied how densely spaced they would be at various distances."

Results of the research--which could help disaster planners save lives--indicated that tsunamis might be nearly double the height predicted in previous simulations, but take nearly 25 percent longer to reach land.

Supercomputers Surf

The simulation, which took more than one million hours of individual processor time--three weeks on Los Alamos' Blue Mountain supercomputer and the ASCI White super-computer at Lawrence Livermore National Laboratory --predicted wave velocities of about 380 miles per hour.

Los Alamos Laboratory's Danneskiold said the simulation did not require as much processing power as a nuclear weapon simulation or a climate model, but still took a lot of code to pull off.

"The 3D takes a lot more computing power and a lot more code writing, but it gives you a more accurate representation of the physics," he said.

Riding the Wave

SAGE's power lies in its flexibility. Scientists can refine the mesh continuously and increase the level of detail the code provides about specific physical elements. The new Los Alamos simulation uses realistic equations to represent the atmosphere, sea water, and ocean crust. Researchers said their work on the tsunami simulation holds promise for other supercomputing research.

"Although this is important science and has potential value in predicting and planning emergency response, it's a great way to test and improve the code," Gisler said.

"We can [address] the problem better now by simulating an entire tsunami event from beginning to end and bringing more computing power to bear on some of the key variables."

CALENDAR OF HISTORIC TSUNAMI EVENTS

Nov. 5, 1952 Kamchatka earthquake and tsunami

The 50th anniversary of this event was commemorated with an international conference on local tsunami hazards in Petropavlovsk-Kamchatskiy, Russia, September 10-15, 2002. See article on page 12.

Dec. 16, 1811 New Madrid, MO earthquake (1 of 3)

See page 18 for an eyewitness account of earthquake and seiche in the Mississippi River!

See page 21 for Tecumseh's prediction of this earthquake!

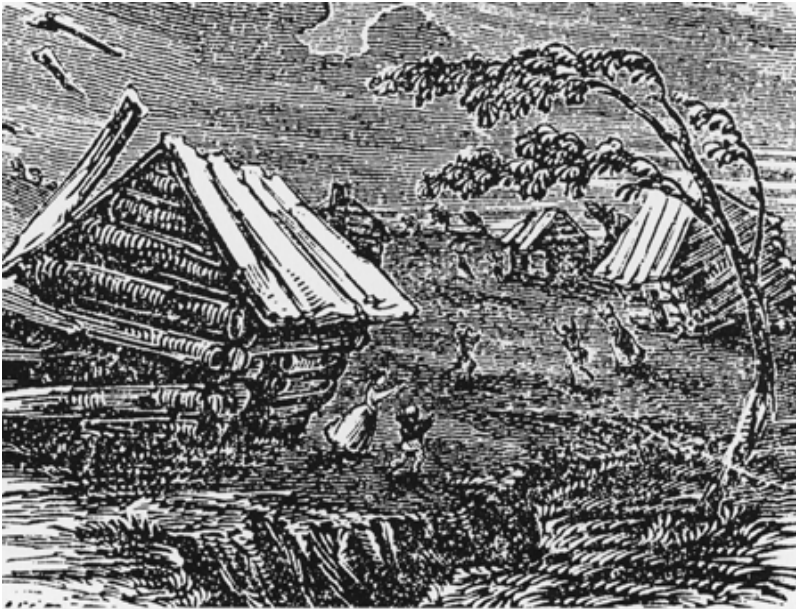
Contemporary newspaper accounts of Mississippi Valley earthquakes of 1811-1812 are at http://www.eas.slu.edu/Earthquake_Center/SEISMICITY/Nuttli.1973/nuttli-73-app.html

Isoseismal map of New Madrid quake is at http://www.neic.cr.usgs.gov/neis/eqlists/USA/1811-1812_iso.html

The New Madrid Fault Zone is shown at <http://quake.ualr.edu/public/nmfz.htm>

Jan. 23, 1812 New Madrid, MO earthquake (2 of 3)

Feb. 7, 1812 New Madrid, MO earthquake (3 of 3)



New Madrid woodcut

from: <http://quake.wr.usgs.gov/prepare/factsheets/NewMadrid/Woodcut.gif>

Infrequently Asked Questions

compiled by Lee Walkling

What famous lady was born on the day of the 1755 Lisbon earthquake/tsunami?

Maria Antonia was born in Vienna, Austria on the November day Lisbon was devastated by the 1755 earthquake. She didn't say "let them eat cake" since Rousseau included the quote in his book *Confessions* in 1768, before Maria came to France at age 14, changing her name to Marie Antoinette and marrying the Dauphin.

from: <http://www.knology.net/~leahmarie/antoinette1.html>



How many Christmas tsunamis have there been since 1 A.D.?

According to the Tsunami Event Database (<http://www.ngdc.noaa.gov/seg/hazard/tsevrch.shtml>) and the USGS' Today in Earthquake History (http://neic.usgs.gov/neis/history/his_12_25.html), these tsunamis were dated December 25:

1222 Cyprus

1541 Venezuela -- "Isla Cubagua--This low-lying spit of arid rock and sand was once home to Nueva Cadiz, the New World's first permanent settlement. The outpost was established in 1500, the year following the island's discovery by none other than Christopher Columbus, who took special note of the splendid pearls adorning the inhabitants. By 1530, the local oyster beds were producing an amazing 820 pounds of pearls each month for the Spanish Crown. Harvests were so productive that virtually all the pearls used in the jewelry and apparel of sixteenth century European royalty and aristocracy came from Nueva Cadiz.

The good times came to an abrupt end in 1541 when an earthquake and ensuing **tidal wave** [sic] destroyed the settlement. The once-prosperous colony was never rebuilt; forty years of unrestrained harvesting had exhausted the pearl beds to the point of collapse. To this day, the oysters have not recovered sufficiently to be commercially viable. The collapse stands as the New World's first conservation caveat: if you overharvest a marine resource, it may never recover."

from: <http://www.oceanrealm.net/au2001/natural.html>

1859 N. Molucca Is., Indonesia

1899 S. California (Hemet-San Jacinto) -- "December 25, 1899, 12:25. A magnitude 7.0 earthquake in southern California apparently was caused by a shift along the San Jacinto fault on its highest mountainous section, several kilometers southeast of San Jacinto, where many large caves occurred. A large wave broke on the sea coast without doing any damage. The San Jacinto fault is about 75 km inland and could not have generated the **tsunami** directly. The wave, if it is related to the earthquake, would have to be due to seiche or a submarine landslide. (Soloviev and Go, 1975, p. 213, 214)."

from: Lander, J. F.; Lockridge, P. A., 1989, United States tsunamis (including United States possessions), 1690-1988: U.S. National Oceanic and Atmospheric Administration Publication 41-2, 265 p.

1922 SE. New Zealand

1932 Gansu, China -- 70,000 deaths. One of the world's most destructive earthquakes. Magnitude 7.6

1933 E. Samar Island, Philippines

1969 Leeward Islands

1982 Timor, Indonesia (Flores Island Region) --

Thirteen people killed, 390 injured, 1,875 homes destroyed and other buildings damaged. Landslides and unconfirmed local tsunami in eastern Flores.

Who accurately predicted the New Madrid earthquake?

According to Allan W. Eckert, author of *The Frontiersman*, the Shawnee chief Tecumseh predicted the New Madrid earthquake of December 16, 1811 to the day. There is an excerpt at <http://www.ratical.com/ratvile/Tecumseh.html> of the story of Panther-Across-The Sky.



See page 21 for Tecumseh's story.

NEW MADRID EARTHQUAKE EYEWITNESS ACCOUNTS

(Editors' note: The New Madrid, Missouri earthquakes of 1811-1812 didn't generate tsunamis, but they did generate local seiches. We present these accounts in our continuing effort to provide information about tsunamis and related phenomena.)

John Bradbury (from The Virtual Times, Huntsville Edition, <http://hsv.com/genlintr/newmadr/acct2.htm>; Reprinted with permission)

"On December 15, 1811, John Bradbury, a Scottish naturalist, was headed down the Mississippi River with a party of boatmen. They were tied up for the night just upstream from the Chicksaw Bluffs (the future Memphis) and Bradbury was fast asleep when "a most tremendous noise" panicked the group. "All nature seemed running into chaos," he later wrote, "as wild fowl fled, trees snapped and river banks tumbled into the water." Bradbury recorded twenty-seven shocks.

"Called the New Madrid Earthquake, largely because New Madrid (Missouri) was the closest settlement, the quake actually began along the Saint Francis River in Arkansas some sixty-five miles southwest of New Madrid. Bradbury was closer to the epicenter than the residents of the town of New Madrid who were awakened by shaking houses and falling chimneys.

"After the first December rumbling, jolts continued. One Louisville observer recorded 1,874 separate quakes between December and March. During this time the epicenter moved closer to New Madrid, and on February 7 the residents deserted what once had bid fair to become the metropolis of the middle Mississippi River. The houses had fallen, and possibly even the land on which the town stood had sunk by March.

"Because so few persons were in the area of greatest damage and most of those who were there were illiterate, only a few firsthand accounts provide detailed information. Stories and legends grew apace, however, for the earthquake was felt all over North America, and reinforced the evangelical religious notion that the end of the world was at hand. Henry Schoolcraft, who took to poetry to record the quake wrote: "the rivers they boiled like a pot over coals, And mortals fell prostrate, and prayed for their souls."

"Actually, the 1811-1812 earthquake was merely a continuation in a series which included rumblings in 1699, 1776, 1779, 1792, 1795, and 1804. These predecessor quakes were quite possibly even stronger; and some of the changes later credited to the New Madrid Quake probably came earlier. In time, the quake was credited with causing the Mississippi River to flow backward, with creating the "Sunk Lands" in the Saint Francis River Valley, in raising Crowley's Ridge, and creating Reelfoot Lake in Tennessee.

"If another quake of the magnitude of the New Madrid Quake of 1811 should hit the region, it would be the worst natural disaster in American history. Especially vulnerable are buildings of brick and concrete. Almost all of downtown Memphis would fall. The highways and interstate systems would be shattered and bridges destroyed. Massive gas line ruptures would threaten life and property. If the Mississippi

River were already near flood stage, the destruction of levees could result in the flooding of perhaps a quarter of the state (of Arkansas). Overall the loss of life could run into the hundreds of thousands.

"Despite its prominence as one of the great recorded natural events in American history, the New Madrid earthquake had very little impact on the history of the region. Although minor tremors were felt off and on, and some timid folks, especially in the 1890's decided to move elsewhere, the earthquake remained irrelevant to life until Iben Browning, a business consultant with some scientific pretensions, announced that another quake was due on December 3, 1990.

"Despite numerous scientific attacks on Browning's methodology, the public became truly alarmed. Local communities took disaster relief seriously and sales of earthquake policies soared. Many residents stockpiled water, flashlight batteries, plastic bags, and toilet paper. Timid folk even left the state (of Arkansas). Days prior to the supposed event, every motel room near New Madrid was taken up by news persons ready to cover the projected disaster.

"December 3, 1990, passed with nary a tremor and the quake became the Great Non-Event of 1990. Nevertheless, the publicity did have a positive effect as few area residents could claim to be unaware of eastern Arkansas' natural heritage."

*from: Dougan, M. B., 1994, Arkansas odyssey--
The saga of Arkansas from prehistoric times to present:
Rose Publishing Company, Inc., 684 p.*

George Heinrich Crist

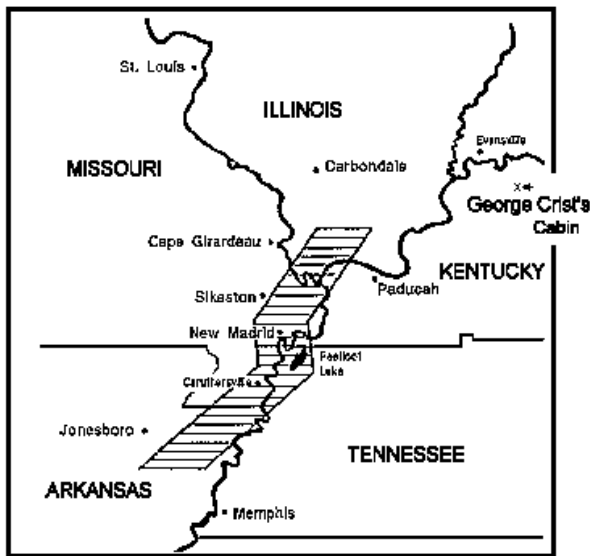
This account of the New Madrid Earthquake was recorded by George Heinrich Crist, residing at the time in the north-central Kentucky county of Nelson, near the present location of Louisville. It was submitted by Floyd Creasey, 4th tier great-grandchild to author, now a Texas resident.

16 December 1811--"There was a great shaking of the earth this morning. Tables and chairs turned over and knocked around - all of us knocked out of bed. The roar I thought would leave us deaf if we lived. It was not a storm. When you could hear, all you could hear was screams from people and animals. It was the worst thing that I have ever witnessed. It was still dark and you could not see nothing. I thought the shaking and the loud roaring sound would never stop. You could not hold onto nothing neither man or woman was strong enough - the shaking would knock you lose like knocking hickory nuts out of a tree. I don't know how we lived through it. None of us was killed - we was all banged up and some of us knocked out for awhile and blood was every where. When it got day break you could see the damage done all around. We still had our home it was some

damage. Some people that the home was not built too strong did not. We will have to hunt our animals. Every body is scared to death. We still do not know if anybody was killed. I made my mind to one thing. If this earth quake or what ever it was did not happen in the Territory of Indiana then me and my family is moving to Pigeon Roost as soon as I can get things together.

23 January 1812 -- "What are we gonna do? You cannot fight it cause you do not know how. It is not something that you can see. In a storm you can see the sky and it shows dark clouds and you know that you might get strong winds but this you can not see anything but a house that just lays in a pile on the ground - not scattered around and trees that just falls over with the roots still on it. The earth quake or what ever it is come again today. It was as bad or worse than the one in December. We lost our Amandy Jane in this one - a log fell on her. We will bury her upon the hill under a clump of trees where Besys Ma and Pa is buried. A lot of people thinks that the devil has come here. Some thinks that this is the beginning of the world coming to a end.

8 February 1812 -- "If we do not get away from here the ground is going to eat us alive. We had another one of them earth quakes yesterday and today the ground still shakes at times. We are all about to go crazy - from pain and fright. We can not do anything until we can find our animals or get some more. We have not found enough to pull the wagons.



from: The Virtual Times, Huntsville Edition
<http://hsv.com/genlintr/newmadr/acnt3.htm>
 reprinted with permission

20 March 1812 -- "I do not know if our minds have got bad or what. But everybody says it. I swear you can still feel the ground move and shake some. We still have not found

enough animals to pull the wagons and you can not find any to buy or trade.

14 April 1813 -- "We lived to make it to Pigeon Roost. We did not lose any lives but we had aplenty troubles. As much as I love my place in Kentucky - I never want to go back. From December to April no man - woman or animal if they could talk would dare to believe what we lived through. From what people say it was not that bad here - They felt the ground move and shake but it did not destroy cabins and trees like it did in Kentucky.

Lorenzo Dow

(This describes the earthquake, aftershocks, sand blows and a seiche. It is from "Lorenzo Dow's Journal," published by Joshua Martin, printed by John B. Wolff, 1849, p. 344 - 346.)

New Madrid, Territory of Missouri, March 22, 1816

Dear Sir,

In compliance with your request, I will now give you a history, as full in detail as the limits of the letter will permit, of the late awful visitation of Providence in this place and vicinity.

On the 16th of December, 1811, about two o'clock, a.m., we were visited by a violent shock of an earthquake, accompanied by a very awful noise resembling loud but distant thunder, but more hoarse and vibrating, which was followed in a few minutes by the complete saturation of the atmosphere, with sulphurous vapor, causing total darkness. The screams of the affrighted inhabitants running to and fro, not knowing where to go, or what to do - the cries of the fowls and beasts of every species - the cracking of trees falling, and the roaring of the Mississippi - the current of which was retrograde for a few minutes, owing as is supposed, to an irruption in its bed -- formed a scene truly horrible.

From that time until about sunrise, a number of lighter shocks occurred; at which time one still more violent than the first took place, with the same accompaniments as the first, and the terror which had been excited in everyone, and indeed in all animal nature, was now, if possible doubled. The inhabitants fled in every direction to the country, supposing (if it can be admitted that their minds can be exercised at all) that there was less danger at a distance from, than near to the river. In one person, a female, the alarm was so great that she fainted, and could not be recovered.

There were several shocks of a day, but lighter than those already mentioned until the 23d of January, 1812, when one occurred as violent as the severest of the former ones, accompanied by the same phenomena as the former. From this time until the 4th of February the earth was in continual agitation, visibly waving as a gentle sea. On that day there was another shock, nearly as hard as the proceeding ones.

Next day four such, and on the 7th about 4 o'clock a.m., a concussion took place so much more violent than those that had proceeded it, that it was dominated the hard shock. The awful darkness of the atmosphere, which was formerly saturated with sulphurous vapor, and the violence of the tempestuous thundering noise that accompanied it, together with all of the other phenomena mentioned as attending the former ones, formed a scene, the description of which would require the most sublimely fanciful imagination.

At first the Mississippi seemed to recede from its banks, and its waters gathering up like a mountain, leaving for the moment many boats, which were here on their way to New Orleans, on bare sand, in which time the poor sailors made their escape from them. It then rising fifteen to twenty feet perpendicularly, and expanding, as it were, at the same moment, the banks were overflowed with the retrograde current, rapid as a torrent - the boats which before had been left on the sand were now torn from their moorings, and suddenly driven up a little creek, at the mouth of which they laid, to the distance in some instances, of nearly a quarter of a mile. The river falling immediately, as rapid as it had risen, receded in its banks again with such violence, that it took with it whole groves of young cotton-wood trees, which ledged its borders. They were broken off with such regularity, in some instances, that persons who had not witnessed the fact, would be difficultly persuaded, that it has not been the work of art. A great many fish were left on the banks, being unable to keep pace with the water. The river was literally covered with the wrecks of boats, and 'tis said that one was wrecked in which there was a lady and six children, all of whom were lost.

In all the hard shocks mentioned, the earth was horribly torn to pieces - the surface of hundreds of acres, was, from time to time, covered over, in various depths, by the sand which issued from the fissures, which were made in great numbers all over this country, some of which closed up immediately after they had vomited forth their sand and water, which it must be remarked, was the matter generally thrown up. In some places, however, there was a substance somewhat resembling coal, or impure stone coal, thrown up with the sand. It is impossible to say what the depths of the fissures or irregular breaks were; we have reason to believe that some of them are very deep.

The site of this town was evidently settled down at least fifteen feet, and not more than a half a mile below the town

there does not appear to be any alteration on the bank of the river, but back from the river a small distance, the numerous large ponds or lakes, as they are called, which covered a great part of the country were nearly dried up. The beds of some of them are elevated above their former banks several feet, producing an alteration of ten, fifteen to twenty feet, from their original state. And lately it has been discovered that a lake was formed on the opposite side of the Mississippi, in the Indian country, upwards of one hundred miles in length, and from one to six miles in width, of the depth of ten to fifty feet. It has communication with the river at both ends, and it is conjectured that it will not be many years before the principal part, if not the whole of the Mississippi, will pass that way.

We were constrained by the fear of our houses falling to live twelve or eighteen months, after the first shocks, in little light camps made of boards; but we gradually became callous, and returned to our houses again. Most of those who fled from the country in the time of the hard shocks have since returned home. We have, since the commencement in 1811, and still continue to feel, slight shocks occasionally. It is seldom indeed that we are more than a week without feeling one, and sometimes three or four in a day. There were two this winter past much harder than we had felt them for two years before; but since then they appear to be lighter than they have ever been, and we begin to hope that ere long they will entirely cease.

I have now, sir, finished my promised description of the earthquake - imperfect it is true, but just as it occurred to my memory; many of, and most of the truly awful scenes, having occurred three or four years ago. They of course are not related with that precision which would entitle it to the character of a full and accurate picture. But such as it is, it is given with pleasure - in the full confidence that it is given to a friend. And now, sir, wishing you all good, I must bid you adieu.

Your humble servant,
Eliza Bryan

There is one circumstance which I think worthy of remark. This country was formerly subject to very hard thunder; but for more than twelve months before the commencement of the earthquake there was none at all, and but very little since, a great part of which resembles subterraneous thunder. The shocks still continue, but are growing more light, and less frequent. -E.B.

TECUMSEH PREDICTS THE NEW MADRID EARTHQUAKE

From Allan W. Eckert's 1967 book, *The Frontiersmen--A Narrative* (Little, Brown and Company, 626 p.)

It concerns Tecumseh's (Shawnee) attempt to build an Indian confederacy to break the westward expansion by whites.

[August 11, 1802 --- Wednesday] p. 444

Each time he addressed one of these councils, Tecumseh felt a great exaltation as he saw how his words caught and held his listeners; how easily, with the proper turn of phrase, he could stir in them emotions of anger and hate, love and pleasure, regret and sorrow. Each time he began to speak he was never really sure exactly what he would say, but then the words came to him, rolling fluently from his tongue and never failing to stir deeply all who listened.

He was much pleased with the way things had gone thus far. All during spring, summer and fall of last year he had gone from village to village, journeying as far eastward as western Vermont and Massachusetts. This past spring, as soon as he had concluded the laughable treaty with the *cut-ta-ho-tha**, he had ranged across upper and western New York State and northwestern Pennsylvania. All of the remaining Iroquois Confederacy had been deeply inspired by the plan and they looked upon the speaker with something very akin to reverence. They had pledged their faith and their secrecy and, most important, their help when the great sign should be given.

This great sign that Tecumseh spoke of wherever he went always remained the same, and his telling of it never failed to awe his audiences. When the period of waiting was over, he told them, when tribal unification had been completed, when all was in readiness, then would this sign be given: in the midst of night the earth beneath would tremble and roar for a long period. Jugs would break, though there be no one near to touch them. Great trees would fall, though the air be windless. Streams would change their courses to run backwards, and lakes would be swallowed up into the earth and other lakes suddenly appear. The bones of every man would tremble with the trembling of the ground and they would not mistake it! No! There was not anything to compare with it in their lives nor in the lives of their fathers or the fathers before them since time began; when this sign came, they were to drop their mattocks and flesh scrapers, leave their fields and their hunting camps and their villages and join together and move to assemble across the lake river from the fort of Detroit. And on that day they would no longer be Mohawks or Senecas, Oneidas or Onondagas or any other tribe. They would be Indians! One people united forever where the good of one would henceforth become the good of all.

So it would be!

[July 18, 1811 --- Thursday] p. 525

... Within another five moons the amalgamation would be powerful enough to stand by itself and make its demands. The great sign would be given then and this would be the

turning point in the fortunes of all the Indians of this great land.

[November 10, 1811 --- Sunday] p. 536

... All of the tribes, he told these followers, who had received bundles of red sticks, had but one of these sticks left. In six days a preliminary sign would be given to the tribes. It would be the sign under which he had been born and named. A great star would flash across the heavens and this would indicate that Tecumseh was still guided by the hand of the Great Spirit. The sign would be clearly visible to all the tribes and when it came they were to take that last red stick and cut it into thirty equal pieces. Each day thereafter one of these pieces was to be burned in the midst of the night and when the last of these had been burned, then would come the great sign of which he had personally told them all. And when this sign came, all who believed in Tecumseh and in the future of the Indian nation would take up their weapons and strike out at once for the British fort that was called Malden, located on the north side of the head of the lake that was called Erie.

[November 16, 1811 --- Saturday] p. 537

... Just before the midpoint of night it came--a great searing flash from out of the southwest; incredibly bright with a weird greenish-white light, incredibly swift, incredibly awe-inspiring. and the heads of a thousand, ten thousand, a hundred thousand Indian swiveled to watch its fiery progress across the heavens until it disappeared in the northeast. And they were deeply moved by it.

[December 16, 1811 ---Monday] p. 538-540

At 2:30 A.M. the earth shook.

In the south of Canada, in the villages of the Iroquois, Ottawa, Chippewa and Huron, it came as a deep terrifying rumble. Creek banks caved in and huge trees toppled in a continuous crash of snapping branches.

In all the Great Lakes, but especially Lake Michigan and Lake Erie, the waters danced and great waves broke erratically on the shores, though there was no wind.

In the western plains there was a fierce grinding sound and a shuddering, which jarred the bones and set teeth on edge. Earthen vessels split apart and great herds of bison staggered to their feet and stampeded in abject panic.

To the south and west tremendous boulders broke loose on hills and cut swaths through the trees and brush to the bottoms. Rapidly rushing streams stopped and eddied and some of them abruptly went dry and the fish that had lived in them flopped away their lives on muddy or rocky beds.

To the south whole forests fell in incredible tangles. New streams sprang up where none had been before. In the

Upper Creek village of Tuckabatchee every dwelling shuddered and shook and then collapsed upon itself and its inhabitants.

To the south and east, palm trees lashed about like whips and lakes emptied of their waters, while ponds appeared in huge declivities which suddenly dented the surface of the earth.

All over the land birds were roused from their roosting places with screams of fright and flapping wings. Cattle bellowed and kicked, lost their footing and were thrown to the ground where they rolled about, unable to regain their balance.

In Kentucky and Tennessee and the Indiana Territory, settlers were thrown from their beds and heard the timbers of their cabins wrench apart and watched the bricks crumble into heaps of debris masked in choking clouds of dust. Bridges snapped and tumbled into rivers and creeks. Glass shattered, fences and barns collapsed and fires broke out. Along steep ravines the cliffside slipped and filled their chasms, and the country was blanketed with a deafening roar.

In the center of all this, in that area where the Ohio River meets the Mississippi, where Tennessee and Kentucky, Arkansas and Missouri and Illinois come together, fantastic splits appeared in the ground and huge tracts of land were swallowed up. A few miles from the Mississippi, near the Kentucky-Tennessee border, a monstrous section of ground sank as if some gigantic foot had stepped on the soft earth and mashed it down. Water gushed forth in fantastic volume and the depression became filled and turned into a large lake, to become known as Reelfoot Lake. The whole mid-section of the Mississippi writhed and heaved and tremendous bluffs toppled into the muddy waters. Entire sections of land were inundated and others that had been riverbed were left high in the air. The Mississippi itself turned and flowed backwards for a time. It swirled and eddied, hissed and gurgled, and at length, when it settled down, the face of the land had changed. New Madrid was destroyed and tens

of thousands of acres of land, including virtually all that was owned by Simon Kenton, vanished forever; and that which remained was ugly and austere.

Such was the great sign of Tecumseh.

This was the earthquake which occurred where no tremor had ever been recorded before; where there was no scientific explanation for such a thing happening; where no one could possibly have anticipated or predicted that an earthquake would happen. No one except Tecumseh.

And although they were only a small percentage of those who had pledged themselves to do so, nevertheless quite a number of warriors of various tribes gathered up their weapons and set out at once to join the amazing Shawnee chief near Detroit.

[April 1, 1812 ---Wednesday] p. 540

The earthquake of December 16 was only a starter. It lasted, intermittently, for two terror-filled days; and at the end of that time the atmosphere was so choked with dust and smoke that for a week afterwards the sun shone sickly reddish-bronze through an ugly haze.

The second earthquake struck on January 23 and the third hit four days later. And finally, on February 13, came the last and worst of them--a hideous grinding and snapping which lasted for only an hour but caused about as much damage as the other three combined.

This was powerful medicine---more powerful than the Indians have ever seen. Those who had deserted Tecumseh now began to reconsider. Although most were in no hurry to rejoin the Shawnee chief, the inclination was there; if, as Tecumseh had predicted, there would definitely be war with the whites, why not make the most of it right where they were?

And so began the hostilities....

*defined in the glossary as any man condemned to death, especially by burning at the stake.

CORRECTION

A small correction to an article in the last issue [October 2002, page 12, second column]:

In the Oct. 2002, an article about landslide earthquakes says that the Governor's OES produced inundation maps in a joint effort with "the Seismic Safety and State Lands Commissions." The article refers to the first round of maps: San Diego, Santa Barbara, LA, SM/SF.

The Tsunami Mitigation Program in California is an activity of the Governor's Office of Emergency Services in cooperation with California's 15 coastal counties, the California Geological Survey, the California Coastal Commission, the State Department of Parks and Recreation, and the State Department of Transportation. We look forward to the participation of the California Seismic Safety Commission and State Lands Commission in the State's mitigation efforts.

from,

Richard K. Eisner, California Governor's Office Of Emergency Services

WEBSITES/LISTSERVS

http://www.pep.bc.ca/hazard_preparedness/Tsunami_Brochure/Prepare_for_Tsunami.html

British Columbia's "Prepare for Tsunamis in Coastal British Columbia" brochure is now available online.

<http://rathbun.si.edu/gvp/>

The Smithsonian's National Museum of Natural History has launched a newly renovated web site about its Global Volcanism Program. The site has information about more than 1,500 Holocene volcanoes and more than 8,500 eruptions, and features both weekly and monthly reports concerning current activity. Much of the data, photos, and first-hand accounts have never before been available to the public.

from: Disaster Research 377, November 1, 2002

<http://www.world-housing.net/>

Wondering about the kinds of houses that are built in earthquake zones? The Earthquake Engineering Research Institute (EERI) encyclopedia describes the types of housing used in several different countries which are susceptible to earthquakes.

To use this site you'll have to use IE, enable ActiveX, and have Shockwave player installed. The front page has a Shockwave world map. Click on an area of the map and that area comes into focus with a list of countries available. (Areas include Asia, North America, etc.)

Click on a country and you'll get detailed information on it, including a hazard map (possibilities of earthquakes across that country), general country information (such as urban indicators and human settlement indicators) housing reports (available in PDF and HTML format) and a list of country specific links. The housing reports provide extensive information on housing types in the country, though each country varies on how many reports it has. India is a good country to look at--a report on the bhonga, a traditional construction type of the Kutch district of Gujarat state in India, provides pictures and background on how such structures did during the 7.6 Bhuj earthquake in 2001. There are several other housing reports for India in addition to this one.

If you don't want to browse this site, you can also use the search engine to search by geographical area, building function, urban or rural construction, period of practice (how long that kind of building has been built), load bearing of structure, building materials, and other variables.

from: ResearchBuzz #201, October 3, 2002
<http://www.researchbuzz.com/> (copyright 2002)

<http://www.gns.cri.nz/hazardwatch/latest/gweektsu.htm>

New Zealand Hazard Watch website gives a weekly listing of reported tsunamis, earthquakes, volcanoes, landslides, floods, and solar activity.

Hazard Watch provides weekly reviews of natural haz-

ard events reported in New Zealand. Hazard Watch is a service of the Institute of Geological & Nuclear Sciences (GNS). Hazard Watch uses information from the GNS Seismological Observatory, Volcanological observatory, and Landslide Response Team. Additional information is supplied by a national network of reporters.

<http://earthobservatory.nasa.gov/>

The National Aeronautics and Space Administration (NASA) has begun a successful listserv under the auspices of the Earth Observatory (which we've mentioned before: <http://earthobservatory.nasa.gov/>). Since its inception, there has been a lot of interest from educators, media, and the public. In response to this, NASA has made some changes to the number and topics of individual lists. The electronic lists below differ in their frequency and whether or not they include natural hazards information.

The "EO-Announce" listserv will continue to provide weekly updates from the Earth Observatory web site, although soon they will be sent *without natural hazards information*. To sign up, send an e-mail to: eo-announce-subscribe@eodomo.gsfc.nasa.gov.

The "NH-Announce" listserv will provide daily updates from the natural hazards portion of the Earth Observatory web site, for those who wish timely imagery. To sign up, send an e-mail to: nh-announce-subscribe@eodomo.gsfc.nasa.gov.

The "NH-Weekly" will provide weekly updates from the Natural Hazards site. To sign up, send an e-mail to: nh-weekly-subscribe@eodomo.gsfc.nasa.gov.

Confused? Visit Earth Observatory's sign-up page at <http://earthobservatory.nasa.gov/subscribe.php3>.

from: Disaster Research 376, October 14, 2002

<http://www.all-hands.net/pn/index.php>

All-Hands.net is a new virtual community of emergency managers and business continuity professionals. It is designed as a user-supported community, and all of the site's content is provided by members and participants. Users can easily post articles, share files, and communicate with others. To register, submit the membership request form at the URL above.

from: Natural Hazards Observer, v. 27, no. 2, p. 21

<http://muweb.millersville.edu/~cdr/>

Contemporary Disaster Review--an international journal reviewing books, films, web-based and multi-media materials--is an official publication of the International Sociological Association's International Research Committee on Disaster. The inaugural edition is coming in February 2003. Submissions are currently being solicited; information is available on the web site.

from: Disaster Research 378 November 15, 2002

<http://www.partnershipforpublicwarning.org/ppw/newsletter/>

The Partnership for Public Warning announces the first edition of its new on-line newsletter. The newsletter provides current information about PPW activities and other items of interest to the public warning community. All feedback and comments are welcome!

from: Disaster Research 378 November 15, 2002

<http://www.disabilitypreparedness.com/>

The National Center on Emergency Preparedness for People with Disabilities (NCEP) web site is focused on ensuring that all individuals are included in the development of and inclusion in plans for protection from both natural and human-made emergencies. In almost all cases, emergen-

cy planning has not taken into consideration the communication, transportation, and medical needs of persons with disabilities and other special populations. The site includes training resources and related links.

from: Disaster Research 378 November 15, 2002

<http://www.disabilityresources.org/DISASTER.html>

The Disability Resources monthly guide to resources on the Internet includes a section on disaster preparedness for people with disabilities that has a list of resources for disaster preparedness, emergency plans and procedures, fire safety, and other topics that impact those with disabilities during disasters.

from: Disaster Research 378 November 15, 2002

CONFERENCES

January 6-9, 2003

Coastal GeoTools-2003. Description: "Possible focus areas include hazard mitigation, land use and community development, remote sensing, watershed planning, and other hazards-related topics." Location: Charleston, South Carolina. Host: National Oceanic and Atmospheric Administration (NOAA), Coastal Services Center (CSC)

For more information: Mark Jansen, NOAA Coastal Services Center, (843) 740-1200; e-mail: Geo.Tools@noaa.gov. URL: <http://www.csc.noaa.gov/GeoTools>

from: GWU Crisis and Emergency Management, v. 3, no. 4, Nov. 1, 2002

January 27-29, 2003

Disaster Management 2003: Solutions to Enhance Your Preparation, Response and Recovery Efforts. Sponsors: National Institute for Government Innovation and Institute for International Research (IIR). Las Vegas, Nevada. This conference has special focus sessions on emerging technologies in disaster management, legal and practical blueprints for emergency operations, and a variety of table-top emergency management exercises. To register, contact IIR, 708 Third Avenue, 4th Floor, New York, New York, 10017; (888) 670-8200; e-mail: registration@nigi.org; <http://www.nigi.org/conf.cfm>.

from: Disaster Research 377, November 1, 2002

February 6-9, 2003

2003 International Disaster Management Conference: "Disaster 2003." Description: "Disaster 2003 has been designed to meet the educational needs of all persons and agencies involved with emergency preparedness, response, and disaster recovery. This year's Planning Committee acknowledges the unique role that the myriad of first responders, response agencies and communities play in planning for, responding to, and mitigating disasters. The conference theme "Prepare Freedom's Lifelines..." is evident throughout all of this year's educational programs and tracks." Loca-

tion: Orlando, Florida. Host: Florida Emergency Medicine Foundation. For more information: info@fcep.org

URL: <http://www.femf.org/conferences/disaster2003.html>

from: GWU Crisis and Emergency Management, v. 3, no. 4, Nov. 1, 2002

February 17-21, 2003

2003 Government Risk Management Seminar. Sponsor: The Public Risk Management Association (PRIMA). Las Vegas, Nevada. This seminar will provide different educational tracks relating to risk management, ranging from foundations to emerging issues, to completion of a certificate program. For more detailed information contact PRIMA at 1815 North Fort Myer Drive, Suite 1020, Arlington, VA 22209; (703) 528-7701; e-mail: pwolfe@primacentral.org; <http://www.primacentral.org/meetings/grms2003/grms2003.php>.

from: Disaster Research 376, October 14, 2002

February 22-26, 2003

NEMA Mid-year Conference. Description: "More information and conference materials will be available in December 2002" Check URL for future updates. Location: Washington, DC at the Grand Hyatt Washington at Washington Center. Host: National Emergency Management Association (NEMA)

For more information, contact NEMA; (859) 244-8162; e-mail: nema_admin@csg.org; URL:

<http://www.nemaweb.org/Meetings/Conference.cfm>

from: GWU Crisis and Emergency Management, v. 3, no. 4, Nov. 1, 2002

February 23-26, 2003

International Disaster Recovery Association (IDRA) Annual Meeting. Description: "The theme for the 13th annual conference is "readiness, resilience, recovery, and reassessment," and all topics focus on telecom contingency planning. Location: Providence, Rhode Island. Host: International Disaster Recovery Association

For more information: (508) 845-6000; e-mail: 2003@idra.com. URL: www.idra.com
from: GWU Crisis and Emergency Management, v. 3, no. 4, Nov. 1, 2002

March 2003

7th Annual U.S.-Japan Workshop on Urban Earthquake Reduction. The Earthquake Engineering Research Institute (EERI), Committee on Urban Earthquake Hazard Reduction and the Japan Institute of Social Safety Science (ISSS) are in the planning stages for the seventh in a series of U.S.-Japan workshops that began in 1984.

The upcoming workshop in Maui, Hawaii, sometime in late March 2003, will continue to build cooperative research and practice; focus on changes in mitigation and emergency management practice; examine longitudinal reconstruction assessments in a variety of settings; and explore recent technology innovations in risk communication, loss estimation, and mapping.

from: Disaster Research 376, October 14, 2002

April 22-23, 2003

WWEM Partners in Preparedness Conference
Bellevue, WA

May 29-June 1, 2003

2003 Structures Congress and Exhibition: "Engineering

Smarter". Host: American Society of Civil Engineers (ASCE). Seattle, WA. This congress will engage engineers and researchers in discussions on how to make better use of existing materials and structural concepts as well as developing new methods and materials. For more information, contact Charles W. Roeder, Structures Congress 2003, University of Washington, 233B More Hall, Seattle, WA 98195-2700; (206) 543-6199; e-mail: croeder@u.washington.edu; <http://www.asce.org/conferences/structures2003>.

from: Natural Hazard Observer, v. 27, no. 2, p. 19

June 22-25, 2003

13th World Conference on Disaster Management. Spon-sor: Canadian Center for Emergency Preparedness (CBCP). Toronto, Canada. The conference emphasis is on "emerging trends in disaster management: new threats, new approaches," and is aimed at bringing professionals from a variety of emergency response, risk, information technology, and health fields together. Abstracts are due by December 16, 2002. Further submission and conference details are available from Adrian Gordon, CBCP, 1005 Skyview Drive, Suite 202, Burlington ON L7P 5B1 Canada; (905) 319 4034; e-mail: agordon@ccep.ca; <http://www.wcdm.org/>.

from: Disaster Research 378 November 15, 2002

PUBLICATIONS

Summary of State Land Use Planning Laws

The Institute for Business and Home Safety (IBHS) has updated its *Summary of State Land Use Planning Laws* and released an updated and expanded 2002 edition. The publication will help promote the premise that no planning is truly comprehensive until mitigation of natural hazards where development occurs is addressed, and a plan for recovery from major natural disasters is in place where appropriate. The first edition was issued in 1998 and since then the IBHS has been looking at ways to heighten the priority of hazard mitigation in state planning legislation. This edition focuses more directly on natural hazards and benefits from input from the American Planning Association. The new edition was written by Jim Schwab of the American Planning Association for IBHS. Ordering information can be obtained from IBHS, 4775 East Fowler Avenue, Tampa, Florida 33617; (813) 286-3400; fax: (813) 286-9960; e-mail: info@ibhs.org. A brief overview of the document, along with an on-line form to request a copy, can be found at http://www.ibhs.org/research_library/view.asp?id=302.
from: Natural Hazards Observer, v. 27, no. 2, p. 4

Hazard Mitigation Planning

This report, designed for county-level hazard mitigation planning, outlines planning requirements, the planning process, and potential strategies for multiple hazards preparedness. It offers practical guidelines for determining hazard

mitigation activities and discusses the issues involved in developing a local hazard mitigation process and strategy.

Emergency Management Series Number 3. William D. Wagoner. 2002. 11 pp. \$5.00. Copies can be obtained from the Michigan Municipal Risk Assessment Management Authority (MMRMA), 14001 Merriman Road, Livonia, MI 48154; Attention: Cara. (517) 513-0300. Checks should be payable to MMRMA.

from: Natural Hazards Observer, v. 27, no. 2, p. 23

The Journal of the American Society of Professional Emergency Planners (ASPEP)

The American Society of Professional Emergency Planners (ASPEP) is an organization of certified emergency managers dedicated to the advancement of knowledge of disasters and the improvement of the practice of emergency management. ASPEP works toward these goals through continuing education, professional development, and the annual publication of this journal. The 2002 journal includes papers on the ramification of the immediate impacts of September 11, 2001; local government planning in the event of first contact with extraterrestrials; hot zone rescues; professionalism of the field of emergency management; how emergency management supports local economic development; and many other subjects.

Bruce Binder, editor. 2002. 114 pp. \$19.00. Order from ASPEP, c/o International Association of Emergency Mana-

gers, 111 Park Place, Falls Church, VA 22046-4513.
Checks should be payable to ASPEP.

from: Natural Hazards Observer, v. 27, no. 2, p. 24

Contemporary Disaster Review

This international journal-- reviewing books, films, web-based and multi-media materials--is an official publication of the International Sociological Association's International Research Committee on Disaster. The inaugural edition is coming in February 2003. Submissions are currently being solicited; information is available on the web site: [http:// muweb.millersville.edu/~cdr/](http://muweb.millersville.edu/~cdr/)

from: Disaster Research 378 November 15, 2002

Partnership for Public Warning Newsletter

<http://www.partnershipforpublicwarning.org/ppw/newsletter/>

The Partnership for Public Warning announces the first edition of its new on-line newsletter. The newsletter provides current information about PPW activities and other items of interest to the public warning community. All feedback and comments are welcome!

from: Disaster Research 378 November 15, 2002

NEW TSUNAMI MATERIALS ADDED TO THE LIBRARY

October 1 to November 30, 2002

Note: These, and all our tsunami materials, are included in our on-line catalog at <http://www.wa.gov/dnr/htdocs/ger/washbib.htm>
NTHMP participants are encouraged to request copies of these documents; see p. 2.

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VIDEO RESERVATIONS

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___ Earthquake...Drop, Cover & Hold; Washington Emergency Management Division. 1998. 5 min.

___ Tsunami Evacuation PSA; DIS Interactive Technologies for WA Emergency Management Division. 2000. 30 seconds.

___ Cascadia: The Hidden Fire - An Earthquake Survival Guide; Global Net Productions, 2001. 9.5 minutes. A promo for a documentary about the Cascadia subduction zone and the preparedness its existence demands of Alaska, Oregon and Washington states. Includes mention of tsunamis. (The full documentary is scheduled for broadcasting on a PBS station in April 2002.)

___ Not Business as Usual: Emergency Planning for Small Businesses, sponsored by CREW (Cascadia Regional Earth-quake Workgroup), 2001. 10 min. Discusses disaster prepar-edness and business continuity.

Although it was made for Utah, the multi-hazard issues remain valid for everyone. Web-sites are included at the end of the video for further informa-tion and for the source of a manual for emergency prepared-ness for businesses.

___ 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.

___ Disaster Mitigation Campaign (15 min.)

American Red Cross; 2000 TV spots. Hurricanes, high winds, floods, earthquakes

___ 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.

___ Mitigation: Making Families and Communities Safer (13 min.) American Red Cross

___ Numerical Model Aonae Tsunami - 7-12-93 (animation by Dr. Vasily Titov) and Tsunami Early Warning by Glenn Farley, KING 5 News (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

___ Protecting Our Kids from Disasters (15 min.)
Gives good instructions to help parents and volunteers make effective but low-cost, non-structural changes to child care facilities, in preparation for natural disasters. The Institute provides a booklet to use with the video. Does NOT address problems specifically caused by tsunamis.

___ 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 Oku-shiri 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 expected 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 discussed.

___ 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 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.

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DIRECTORIES: NATIONAL TSUNAMI HAZARD MITIGATION PROGRAM STEERING GROUP

FEDERAL

Eddie Bernard, NOAA/PMEL, Chairman,
National Tsunami Hazard Mitigation
Program

7600 Sand Point Way NE
Seattle, WA 98115-0070
(206) 526-6800; Fax (206) 526-6815
email: bernard@pmel.noaa.gov

Frank González, NOAA/PMEL
7600 Sand Point Way NE
Seattle, WA 98115-0070
(206) 526-6803; Fax (206) 526-6485
email: Gonzalez@pmel.noaa.gov

Michael Hornick
FEMA, Region IX
Building 105, Presidio of San Francisco
San Francisco, CA 94129
(415) 923-7260; Fax (415) 923-7112
email: michael.hornick@fema.gov

Chris Jonientz-Trisler
FEMA, Region X
130 228th Street SW
Bothell, WA 98021-9796
(425) 487-4645; Fax (425) 487-4613
email: chris.jonientz-trisler@fema.gov

Jeff LaDouce, NOAA/NWS
Pacific Guardian Center
737 Bishop St., Suite 2200
Honolulu, HI 96813-3213
(808) 532-6416; Fax (808) 532-5569
email: Jeff.Ladouce@noaa.gov

Richard Przywarty
NOAA/NWS, Alaska Region
222 W. 7th Ave. #23
Anchorage, AK 99513-7575

907-271-5136; fax 907-271-3711 email:
Richard.Przywarty@noaa.gov

David Oppenheimer
U.S. Geological Survey
345 Middlefield Road, MS 977
Menlo Park, CA 94025
(650) 329-4792; Fax: (650) 329-5163
email: oppen@usgs.gov

Craig Weaver
U.S. Geological Survey
Box 351650, University of Washington
Seattle, WA 98195-1650
(206) 553-0627; Fax (206) 553-8350
email: craig@geophys.washington.edu

ALASKA

Roger Hansen
Geophysical Institute, University of Alaska
P.O. Box 757320
903 Koyukuk Drive
Fairbanks, AK 99775-7320
(907) 474-5533; Fax (907) 474-5618
email: roger@GISEIS.alaska.edu

CALIFORNIA

Richard Eisner, Regional Administrator
Governor's Office of Emergency Services
1300 Clay Street, Suite 400
Oakland, CA 94612-1425
(510) 286-0888 or 286-0895;
Fax (510) 286-0853
email: Rich_Eisner@oes.ca.gov

HAWAII

Brian Yanagi, Earthquake Program
Manager
Civil Defense Division
3949 Diamond Head Road

Honolulu, HI 96816-4495
(808) 733-4300, ext.552; Fax (808) 737-8197
email: byanagi@scd.state.hi.us

Dr. Laura S. L. Kong, Director
International Tsunami Information Center
737 Bishop Street, Suite 2200
Honolulu, HI 96813-3213
email: Laura.Kong@noaa.gov

OREGON

Mark Darienzo
Oregon Emergency Management
595 Cottage Street NE
Salem, OR 97310
(503) 378-2911, ext. 237; Fax (503)588-1378
email: mdarien@oem.state.or.us

George Priest
Oregon Dept. of Geology & Mineral
Industries
800 NE Oregon Street #28
Portland, OR 97232
503-731-4100, Ext. 225; fax 503-731-4066
email: george.priest@dogami.state.or.us

WASHINGTON

Dave Nelson
Washington State Military Department
Emergency Management Division
Camp Murray, WA 98430-5122
(253) 512-7067; Fax (253) 512-7207
email: d.nelson@emd.wa.gov

Tim Walsh
Division of Geology and Earth Resources
P.O. Box 47007
Olympia, WA 98504-7007
(360) 902-1432; Fax (360) 902-1785
email: tim.walsh@wadnr.gov

STATE EMERGENCY MANAGEMENT OFFICES

Alaska Division of Emergency Services
Department of Military & Veterans Affairs
P.O. Box 5750
Fort Richardson, Alaska 99505-5750
(907) 428-7039; Fax (907) 428-7009
<http://www.ak-prepared.com/>

California Office of Emergency Services
2800 Meadowview Road
Sacramento, California 95832
(916) 262-1816, Fax (916) 262-1677
<http://www.oes.ca.gov/>

Hawaii State Civil Defense
Department of Defense
3949 Diamond Head Road
Honolulu, Hawaii 96816-4495
(808) 734-2161; Fax (808)733-4287
E-Mail: rprice@pdc.org <http://iao.pdc.org>

Oregon Division of Emergency
Management
595 Cottage Street, NE
Salem, Oregon 97310
(503) 378-2911 ext 225, Fax (503) 588-1378
<http://www.osp.state.or.us/oem/oem.htm>

Washington State Military Department
Emergency Management Division
Camp Murray, WA 98430-5122
(253) 512-7067, Fax (253) 512-7207
<http://www.wa.gov/mil/wsem/>

Provincial Emergency Program
455 Boleskin Road
Victoria, BC V8Z 1E7
British Columbia, Canada
(250) 952-4913
Fax (250) 952-4888 <http://www.pep.bc.ca>

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Department of Natural Resources
Division of Geology and Earth Resources
P.O. Box 47007
Olympia, WA 98504-7007