TsuInfo Alert

prepared on behalf of the

National Tsunami Hazard Mitigation Program

by the Washington State Department of Natural Resources

Contents **Volume 3, Number 4, August, 2001**

TSUNAMI PROGRAM NEWS

Draft Summary Report of the Tsunami Hazard Mitigation Steering Group Meeting May 16-17, 2001 Portland, Oregon

Attendees

Steering Group

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

Guests

Frank González - NOAA
Ed Myers - OSU
Tom Sokolowski - WC/ATWC
Jim Kennard - OR DLCD
Charles McCreery - PTWC
Ed Henry USDOT Region IX
Michael Hornick - FEMA IX
Aurelio Mercado - U of Puerto Rico
Lt Alan Yelvington - USCG
Solomon Yim - OSU
David Oppenheimer - USGS
Curt Peterson - PSU

Old Business: **Review of action items from the previous meeting**:

1. ACTION ITEM: There was considerable discussion on how to confirm the availability of resources after a disastrous event. The group formed an ad hoc subcommittee to formalize the next steps. The subcommittee consists of: Richard Przywarty, Frank González, Eddie Bernard, George Priest, and Costas Synolakis. Three new members were added to the subcommittee: Mike Hornick, Chris Jonientz-Trisler, and Richard Eisner. There was a discussion of what role the National Tsunami Hazard Mitigation Program Steering Group would have in tsunami disaster response. NOAA currently has no input in times of disaster. The current National Post-Storm Data Acquisition Plan provides only for data collection. Mike Hornick, FEMA Region IX proposed a 2-step action plan: 1) The Federal Response Plan needs a tsunami action plan. Mike Hornick and Chris Jonientz-Trisler and FEMA HQ need to develop this plan, and 2) the States need defined data collection activities. The subcommittee will review the NOAA Response Plan document and how it interacts with the states and report at the next meeting.

ACTION: Subcommittee members named

STATUS: ONGOING

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

ACTION: Chris Jonientz-Trisler

STATUS: Survey has been conducted and data is being compiled and analyzed for the report

continued, p. 3

TsuInfo Alert

is published bi-monthly by the Washington Department of Natural Resources, Division of Geology and Earth Resources.
This publication is free upon request and is available in print (by surface mail),
electronically (by e-mail), and at http://www.wa.gov/dnr/htdocs/ger/tsuinfo/index.html

TsuInfo Alert and the TsuInfo document delivery program are made possible by a grant from the Federal Emergency Management Agency via the Washington Military Department, Division of Emergency Management.

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: connie.manson@wadnr.gov or lee.walkling@wadnr.gov

prepared by
Connie J. Manson, Senior Library Information Specialist
and
Lee Walkling, Library Information Specialist

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

(continued from p. 1)
3. ACTION ITEM: The Subcommittee Activities Matrix and Program Gaps were discussed as well as the FY 01 budget. The budget discussion was incomplete. The Subcommittee Coordinator indicated the budget discussion would be finalized during a conference call with all subcommittee members as soon as possible.

ACTION: All Mitigation Subcommittee members

STATUS: CLOSED Conference call was held and matrix updated

4. ACTION ITEM: Steering Group members were asked to send any final comments on the Local Tsunami Warning Systems and Procedures: Guidance for Local Officials document to him not later than January 1, 2001.

ACTION: Each Steering Group Member

STATUS: CLOSED

5. 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: OPEN

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

ACTION: All Steering Group Members, Mark Darienzo

STATUS: CLOSED workshop was held May 14-15

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

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

STATUS: CLOSED IMPLEMENTING

8. ACTION ITEM: Each State is to recommend one pilot community for the Tsunami Ready Community Program by January 1, 2001.

ACTION: Each State

STATUS: CLOSED Tsunami Ready Communities have been named in California, Washington, Oregon, and Alaska

9. ACTION ITEM: In preparation for the review in August 2001 and keeping in mind the original Tsunami Hazard Mitigation Plan, each Steering Group member should prepare a presentation of their program review of the past 5 years for the May 2001 Steering Group Meeting that focuses on 1) what did you promise to do? 2) what did you do? and 3) what impact did it have?

ACTION: Each Steering Group Member

STATUS: OPEN IN PROGRESS Mitigation and Mapping are in draft form, others are complete.

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

ACTlON: Each Steering Group Member

STATUS: CLOSED

11. ACTION ITEM: For FY 2001, $2.3 million has been appropriated for the Program. There is an add-on of $1 million for the Tsunami Warning and Environmental Observatory for Alaska (TWEAK), a letter of intent by Ray Highsmith at the University of Alaska. It was suggested that Ray Highsmith include Roger Hansen and Zygmunt Kowalik in writing the proposal for TWEAK.

ACTION: Ray Highsmith, Roger Hansen, and Zygmunt Kowalik to write a proposal for TWEAK.

STATUS: OPEN Proposal has been written and distributed to Steering Group members. Discussion was held via conference call with Ray Highsmith on May 17. Steering Group members are to review proposal and meet via conference call on May 30 at 2 p.m. PDT.

12. ACTION ITEM: A discussion of the question of how to report the mapping effort pointed out the difficulties of this issue and a method agreeable to all must be developed. Frank González and the States were asked to discuss and agree on the method of reporting the inundation mapping effort no later than March 2001.

ACTION: Frank González and States

STATUS: IN PROGRESS

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

ACTION: States and TIME

STATUS: CLOSED

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

ACTION: Hal Mofjeld

STATUS: CLOSED Tutorial was completed. There are two main categories: Hawaiian type where the first wave is the highest with little tide effect--less concern for flooding in successive waves, and the Crescent City type with a long wave train and danger lasting many hours due to later waves being higher than the first wave and strong tidal effects. Hal Mofjeld will be happy to advise. States need to develop and put in place their warning strategies. Warning centers have the algorithms to use as tools in determining warnings.

New Business:

Develop NOAA/State Coordination and Technical Support

Richard Hagemeyer reported that the tsunami database has been completed and is available to all on his ftp site. He will send messages to all tsuhaz members when the database is upgraded.

EMWIN worked very well in the Nisqually earthquake

in Washington in February 2001. Warning centers had their data out in about 2 minutes using EMWIN.

ACTION ITEM 1. 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 so there will be a clarification of procedures and better coordination of warnings. Dick Hagemeyer suggested the following 4 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 will put the messages on NOAA Weather Radio and EMWIN.

ACTION: Oppenheimer, Hagemeyer, Hansen

Improve Seismic Networks

Thirty to forty broadband seismic sites should be installed by August 7. Sites are done except for final equipment installation. Communications: All links are up and continue to function.

Deploy Tsunami Detection Buoys

In June 2001, the NOAA ship Ronald H. Brown is scheduled to service the 4 DART buoys that are operational in the North Pacific Ocean. The surface buoys at D171, D165, D157, and D130 will each be inspected, serviced, and subsequently re-deployed for another year of service. A new DART site, D128, will be occupied off of the U.S Washington coast at approximately 128.5 degrees North latitude, 47 degrees West longitude. The sixth buoy is scheduled for deployment in the Equatorial Pacific in August.

D157 unexpectedly failed to return to normal tide reporting mode following the January 10 event trigger and continued to report 1-minute data for real-time transmission via the GOES satellite during the 3 months that followed. As a result, the surface buoy power supply has been deplted and is no longer relaying BPR data to ground stations. The PMEL Engineering Development Division has successfully reproduced a possible cause of the failure in D157.

ACTION ITEM 2: Update WC/ATWC, PTWC, and PMEL web sites showing buoy locations for better indication of events.

ACTION: WC/ATWC, PTWC, PMEL

ACTION ITEM 3: Frank González to check on DART web site vulnerability to too many hits at one time.
ACTION: Frank González

Produce Inundation Maps

The Puget Sound Tsunami/Landslide Workshop was held January 23-24, 2001, in Seattle at the NOAA Sand Point campus (Bldg. 9). The Workshop, a partnership of NOAA/ PMEL, USGS, and Washington State Emergency Management, whose goal is to develop an action plan to generate tsunami inundation maps and other tsunami/landslide mitigation products for Puget Sound communities. The workshop arose from discussions at the May 2000 Steering Group Meeting. A Summary Report of the workshop has been published and distributed to all attendees.

Frank González gave a brief review of the various funding sources for inundation mapping and gave the highlights of the his mapping status report.

Based on the discussion at the Hilo Meeting last year, a comparison of 1-D and 2-D models was done. FACTS was developed as a tool to do 1-D runup estimates, however, the 1-D approach is limited.

ACTION ITEM 4: Each state is to plan their mapping strategy using either coarse grid or fine grid. The TIME Center is available to help with this process.

ACTION: George Priest, Frank González to determine the grid issue

Mitigation

The Tsunami Warning Workshop was held in Portland, Oregon, on May 14 and 15. The workshop was organized by Mark Darienzo and generated fruitful discussions on many issues related to tsunami evacuation notification systems including telephones, NOAA Weather Radio, EMWIN, sirens, etc.

Chris Jonientz-Trisler reported the highlights from the Mitigation Subcommittee discussions yesterday. Lori Dengler said that the fifth tsunami awareness survey was recently completed in Humboldt County. Results of the survey showed a steady progression in positive responses to the main questions.

During Subcommittee disucussions on mapping, particularly for Alaska, the need for bathymetry surveys was raised. Some support for bathymetric surveys might be available from the National Ocean Service.

ACTION ITEM 5: The Subcommittee suggested that a dialog with NOS on bathymetry/ coastal zone managements issues was needed. ACTION: Eddie Bernard will contact the Acting Assistant Administrator for Ocean Services and Coastal Zone Management and initiate a dialog on this.

Preparation for August Program Review

Eddie Bernard asked all Steering Group members to submit their review papers if not already submitted. The plan for the Program Review is to conduct the technical part of the review from 8 a.m. to 3 p.m. The review will consist of reports from each of the state and Federal partners on their accomplishments of the past 5 years as well as a presentation of plans for the next 5 years. Beginning at 3 p.m. there will be a public forum beginning with a 1-hour powerpoint overview of the program and folled by a poster session and reception. Members of Congress as well as state and local emergency planners have been invited to the public forum and the poster session/reception. International tsunami scientists attending the IUGG Tsunami Commission ITS 2001 being held on August 8-10 have also been invited to attend the August 7 review and reception.

The media plan is to provide a b-roll and press package.

ACTION ITEM 6: States were asked for video and photos of the National Tsunami Hazard Mitigation Program in action including captions or explanations, as needed.

ACTION: states to send video and photos to Eddie Bernard NLT May 30, 2001. (Oregon to provide video clip on school evacuation)

For thepPoster session/reception States, Warning Centers, USGS, FEMA will have separate tables and poster display boards. Posters will be grouped by state, etc. Individuals will ship materials for their displays to PMEL and will pick up the items on August 6 following a dry run of all technical presentations. On the morning of August 7, individuals will bring their display materials to the Walker Ames Room in Kane Hall on the University campus. Individuals will set up their displays by noon on August 7. (No overnight storage is available at Kane Hall)

ACTION ITEM 7: States requested use of large monitors with their laptops for the poster session. ACTION: PMEL to check with their Computer Services Division on availability of monitors for use at the review.

ACTION ITEM 8: States, Warning Centers, USGS, and FEMA were asked for logistical requests for tables, TV/VCR's, power, etc. for use at the poster session/reception.

ACTION: States Warning Centers, USGS, FEMA to send their requests to Eddie Bernard via e-mail NLT May 25.

ACTION ITEM 9: PMEL will check on availability of logistical items for booths for poster session. ACTION: PMEL will check on availability of items requested and fill as many requests as possible.

Tsunami Warning and Environmental Observatory for Alaska (TWEAK)

The TWEAK proposal was discussed during a conference call with Dr. Ray Highsmith, School of Fisheries and Ocean Sciences, University of Alaska Fairbanks. A TWEAK Review Panel was named to review and comment on the proposal

ACTION ITEM 10: Chris Jonientz-Trisler, Laura Kong, Frank González, Scott Simmons, David Oppenheimer, Richard Hagemeyer, Eddie Bernard, and Mike Hornick were named as the TWEAK Review Panel to review the proposal.

ACTION: TWEAK Review Panel to send their comments via e-mail to Eddie Bernard NLT May 25. A conference call with all Panel members is planned for 2 p.m. on May 30.

The Next 5 Years (Phase II)

Eddie Bernard led the group in a discussion of the Program's funding history over the past 5 years. Special attention was given to the matching funds section. It was determined that the matching funds section should be further divided into mapping and mitigation categories. A discussion was held on why the original 5-year budget request was too low: the great number of unknowns and uncertainties at the time the orginal budget was developed.

ACTION ITEM 11: Develop defendable matching funds divided into two categories: mapping and mitigation.

ACTION: States are to E-mail their figures to Eddie Ber-nard, Frank González, and Chris Jonientz-Trisler NLT May 25, 2001.

Eddie Bernard announced that the Program has been included in the NOAA portion of the FY 2002 Presidential Budget Request. If this line item is not dropped in the later stages of the budgeting process, we would be in the FY 2002 NOAA budget for $2.3 million.

Budget requests for the next 5 years (based on recommendations found in the review papers submitted) were discussed. Requests in some areas, especially mapping, DART buoys, and seismic greatly exceed the anticipated level-funding amount of $2.3 million per year. Eddie Bernard said the best approach to increase the budget is to get constituents to write NOAA. Using lessons learned during the first 5 years, the group agreed to present a budget that represents what is needed for the Program knowing that, in reality, not all of the request will be funded. Bathymetry survey costs and mapping costs will be separate line items in the new budget. A strawman for distribution of funds with some minor changes was presented. The group agreed to start with last year's budget allocations as a starting point for determining future allocations. The next 5 years calls for keeping the operational parts of the program plus working toward more mapping and mitigation efforts.

The group held a multifaceted discussion on how the data from the DART buoys can be combined with the other data coming into the Warning Centers to formulate tsunami warnings given that the end-to-end warning system is not yet complete. Currently, there is a web site that can be used by the Warning Centers to model various scenarios for various areas based on data previously collected. Following the discussion, it was decided that procedures for use of buoy data by the Warning Centers needed to be developed.

ACTION ITEM 12: Develop procedures for use of buoy data by warning centers by July 1, 2001.

ACTION: Tom Sokolowski, Frank González, Eddie Bernard, PTWC/ Chip McCreery

ACTION ITEM 13: Produce isocrons prototype with elevations for likely events by July 1, 2001.

ACTION: Tom Sokolowski

Presentations

Professor Aurelio Mercado from the University of Puerto Rico briefed the Steering Group on the tsunami program in Puerto Rico. He said that Puerto Rico received $900,000 to do a Lidar survey of the island, $100,000 to

start a bathymetry survey, and $500,000 over 2 years for a Puerto Rican Warning and Tsunami Program. The Program is tasked with flood mapping, education and outreach, seimic signal analysis, establishing protocols for communication with other Caribbean islands, creating a tsunami database, and attending the National Tsunami Hazard Mitigation Program Steering Group meetings.

Dr. Solomon Yim, Oregon State University, gave a presentation on the NEES OSU Tsunami Basin Project. OSU has received a $4.8 million grant to develop this project. The goals of the project are: 1) Develop a facility for tsunami/coastal community by leveraging the existing facility and expanding its capacity to do tsunami waves and 3-D bathymetry, and 2) enhance the effectiveness of tsunami researchers by reducing the requirement for on-site presence (future vision is to host a web-based forum on research with real-time interaction of researchers with the research community during model tests), facilitating re-use of previous experience, and supporting integration of simulation and experimentation. Some examples of experiments that could be run using the new facility which should be operational in October 2004 are scale effects in tsunami runup and velocity, macro-roughness of effects on tsunami behavior, and tsunami wave forces on structures. A suggestion was made that the Steering Group hold their 2004 meeting in Corvallis in order to see the new wave facility.

Dr. Curt Peterson, Portland State University, discussed the projects his graduate students have been working on. He described the mapped coastal inundation plan in detail.

Public Affairs Report

Ann Thomason distributed the PAWG report of activities and media attention since the last Steering Group meeting.

Remaining Meeting Dates and Locations for 2001

August 7-10 International Tsunami Symposium, University of Washington, Seattle, Washington

November 6-8 Steering Group Meeting, PMEL, Seattle, Washington

Eddie Bernard proposed a new meeting schedule that would begin next year: only one face-to-face meeting per year to be held at PMEL. The meeting would allow travel on Monday and Friday with the Mitigation Subcommittee meeting for 1/2 day and Mapping meeting 1/2 day on Tuesday. The Steering Group would meet for two full days on Wednesday and Thursday. All budget and other proposals would be prepared in advance and brought to the meeting for discussion. Additional conference calls, small group meetings, or e-mails would be used during the rest of the year to transact any business necessary. The majority of the group endorsed this plan.

CONFERENCES

October 16-18, 2001

14th Annual Emergency Preparedness Conference. Hosts: British Columbia Ministry for Children and Families, City of Vancouver, Insurance Bureau of Canada, and others. Location: Vancouver, B.C. , Canada.

The purpose of this annual event is to "raise the level of emergency preparedness and make the world a better, safer place by: promoting awareness; providing information, tools, and solutions to problems; sharing experiences; show-casing technologies; and creating networking opportuni-ties." The conference includes tours, plenary talks, work-shops, exhibits, and dozens of concurrent sessions covering everything from dealing with children in disasters to com-munity emergency management planning, disaster educa-tion, warning systems, and much more. For the complete program and registration information, contact Emergency Preparedness Conference, 700 West 57th Avenue, Vancou-ver, British Columbia, Canada V6P 1S1. Phone: (604) 322-8365; fax (604) 322-8359; e-mail: mrogan@vanhosp. bc.ca. Internet: www.epma.bc.ca/epc/

from: Natural Hazards Observer, v. 25, no. 6, July 2001, p. 21

November 27-28, 2001

Nonstructural Seismic Hazards Training Workshop. Host: U.S. Department of the Interior Seismic Safety Program. Portland, Oregon: Contact: Tyna Petersen, Workshop Registrar, (303) 445-2573; e-mail: tpetersen@do.usbr.gov.

from: Disaster Research 350, July 13, 2001

THE IMPACT OF PROJECT IMPACT ON THE NISQUALLY EARTHQUAKE--AN INVITED COMMENT

by
Robert Freitag, Director
Institute for Hazard Mitigation Planning and Research
University of Washington

Reprinted with permission from: Natural Hazards Observer, v. 25, no. 5, May 2001
Also available online at: http://www.Colorado.EDU/hazards/o/mayo01/mayo01a.htm#nisqually

On February 28, a magnitude 6.8 earthquake occurred 32 miles below the Nisqually wetland north of Olympia, the Washington state capitol. Ironically, the quake occurred as the Seattle Project Impact Steering Committee was preparing to celebrate the initiative's third anniversary with several hundred of its partners. Had the quake occurred one hour later, all of the region's emergency managers would have been gathered at the Phinney Ridge Neighborhood Center in Seattle. Instead, committee members and a few early birds guided children from the center's two daycare programs to safety.

Members of the response and recovery community were not fully tested by the earth-quake, largely because it was deep and drought conditions in the Puget Sound region reduced the number of landslides and amount of liquefaction that would normally be caused by a quake of that magnitude. There was only one significant aftershock and few secondary impacts (one fire and several major landslides). However, the quake did interrupt business operations and damaged numerous building components, such as chimneys, facades, water pipes, and equipment.

Many historic, commercial, and manufacturing facilities were damaged, including key government structures such as the state legislative building and the regional airport control tower. Additional damage is being uncovered as engineering teams complete their inspections, although structural losses (i.e., damage to components essential to a building's structural integrity) will undoubtedly be a fraction of non-structural losses (i.e., damage to nonessential building structural elements, such as architectural features and heating and electrical systems, and losses due to lost productivity, etc.).

What effect did the Federal Emergency Management Agency's Project Impact have, if any, in reducing damage from the Nisqually earthquake? In short, the program has transformed the way residents deal with disasters and established an organizational structure that takes advantage of this change.

Project Impact has the broad goal of reducing risks by changing the way communities think about and deal with disasters. More importantly, it asks communities to be farsighted, to assess hazards rather than just respond to them, to protect themselves, and to become disaster-resistant.

The program is based on three simple principles:
-- Preventive actions must be decided at the local level and must be responsive to local hazards.
-- Private sector participation is vital.
-- Long-term efforts and investments in prevention are essential.

The Seattle/Tacoma metropolitan area, which includes King, Pierce, and Kitsap counties, has been heavily involved in Project Impact, and Seattle is a pilot participant in the program. It is useful to examine Project Impact's effectiveness by assessing how well its stated goals were met in the context of the Nisqually earthquake.

Change in the Way We Think About and Deal with Disasters

Perhaps the most significant (and most difficult to measure) effect the initiative had is in demystifying and personalizing earthquake risk reduction for thousands of individuals, small businesses, and corporate partners.

Preventive Actions Must be Decided at the Local Level

The Seattle and King, Pierce, and Kitsap County Project Impact programs were essentially collective actions taken by hundreds of partners. Seven programs can be linked directly to Project Impact, including efforts in home and school retrofitting, hazard mapping, transportation corridor vulnerability mitigation, office and home nonstructural retrofitting, and small business resumption planning. It is too early to assess the full impact of these programs; however, here are some very early conclusions. (For a description of individual programs, see the FEMA web site: http://www.fema.gov/impact.)

The most significant benefit of Project Impact might be the reduction (or minimalization) of structural damage in retrofitted buildings.

Project Impact decommissioned very heavy and hazardous water tanks located in the attics of seven Seattle schools, and one of these schools was damaged significantly by the quake. Had the water tank been in use, the building would have would have failed. The school program also included extensive nonstructural retrofitting. No losses were reported in participating schools, and, more importantly, evacuation was not impeded. Other schools were not so fortunate.

Over 1,000 homeowners attended home retrofitting workshops, and over 300 had retrofitted their homes before the quake. None of these retrofitted residences were

damaged.

Each of the four Project Impact jurisdictions had implemented long-range transportation corridor and hazard mapping programs. Information generated through these programs is greatly aiding the inspection process and helping to jump-start discussion on mitigation alternatives. In addition, these projects brought together public road managers who created "tool kits" for contingency routing that will be useful in other kinds of disasters. The quake elevated the priority of these initiatives and funding is expected.

Private Sector Participation is Vital

All four Project Impact jurisdictions and their private sector partners had developed aggressive business resumption programs. Over 100 large businesses and more than 500 small businesses were involved in Project Impact, and tens of thousands of earthquake safety products were in their offices. Business hazard reduction programs had been created by partners such as Washington Mutual, Bank of America, PEMCO, SAFECO, the Boeing Company, Bartell, the Russell Corporation, the King County Labor Council, and Home Depot, and early indications are that employees of these partners had implemented earthquake safety measures in their homes as well.

Project Impact communities and their partners ambitiously pursued risk-reduction outreach prior to the earthquake. Home Depot stores displayed home retrofitting techniques. Grocery and drug stores displayed earthquake safety products. Informational flyers accompanied utility bills, paychecks, and insurance renewal forms. A computer tie-down campaign attracted funding partners and garnered donations of computer tie-downs for area schools. The Project Impact logo was prominently displayed along with the message "Creating Disaster Resistant Communities" during hundreds of newscasts.

Effects Not Directly Related to Specific Programs

During and immediately following the earthquake, participating news organizations provided a consistent message about the earthquake hazard and described methods for preventing damage. Since its inception, Project Impact has worked regularly with the press, and the ABC and CBS local affiliates are formal Project Impact partners.

Shortly after the quake, homeowners were able to obtain lists of area contractors trained in seismic retrofitting. This information is particularly useful immediately after a disaster, when unscrupulous contractors can prey on disaster victims.

Long-Term Efforts and Investments in Prevention are Essential

Research is currently underway to assess the more indirect long-term impacts of the Nisqually quake. FEMA and the University of Washington have established a clearing-house to facilitate research, but an examination of efforts that are directly attributable to Project Impact indicates that Puget Sound residents are accepting responsibility for their hazard vulnerability and focusing on protecting themselves. Here are three examples:

-- "SecureIt" was a Pierce and King County Project Impact program; however, all four project participant areas have noted increased availability of computer tie-downs and other office-related items that were difficult to obtain when the programs began. Following the earthquake, every contacted vendor saw a very dramatic increase in orders for these products.

-- Home retrofitting activities have increased substantially. Roger Faris of the Phinney Ridge Neighborhood Center Home Improvement program indicated that the program cannot keep up with the demand for the Project Impact home retrofitting course. Before the quake, he scheduled one course per month with 20 to 30 attendees. He has now scheduled four per month with 60 participants per class. Similarly, private contractors cannot keep up with the substantially increased demand for retrofitting services. Homeowners are having difficulty hiring the 60 contractors who have taken the University of Washington (a Project Impact Partner) earthquake retrofitting course. Moreover, due to increased interest among contractors, additional courses have been scheduled.

-- The Project Impact coordinator for the Seattle school district received the following comment by a school principal: "Just wanted to let you know the good news on how well the building did during the earthquake--and a big thanks for the retrofitting. We did not even have a single light cover come down, a computer fall over, a book come off a shelf. Now, ... how do we get more straps to do the new things we have installed since retrofitting was done here? Thank you. You made believers out of us!"

Performance Measures

Were there fewer property losses, lower costs for repairs, and less time lost from productive activity as a result of Project Impact? It depends on how one measures the costs of repairing a school that did not decommission a water tank to prevent damage, the injuries or deaths of children in classrooms directly under such a tank, the loss of homes that were not retrofitted, and the closure of firms that had not implemented business resumption measures. Whatever the savings, it looks like we will be even better prepared when the next quake occurs, and isn't that, after all, the goal of Project Impact?

For more information on the earthquake in Seattle, view the Clearinghouse on the Nisqually Earthquake web site: http://maximus.ce.washington.edu/~nisqually.

OCEAN SHORES LAUDED FOR TSUNAMI READINESS

by

John Dodge, the Olympian, June 29, 2001

Reprinted with permission of The Olympian

(This article, with links, is available online at http://news.theolympian.com/stories/20010629/SouthSound/63727.shtml)

OLYMPIA -- Federal officials Saturday will certify Ocean Shores as the first community in the nation with an approved plan for responding to a tsunami.

Residents and businesses in the coastal town have developed evacuation routes, a radio warning system and increased public awareness about what to do if a tidal wave or series of tidal waves triggered by an earthquake hits the beach resort.

"They are much more prepared than most communities," said Ted Buehner, a National Weather Service meteorologist based in Seattle.

Disaster planning for a tsunami has been ongoing in Ocean Shores since 1994, said Karin Frinell-Hanrahan, deputy director of the Grays Harbor Department of Emergency Management. Grays Harbor County also will be recognized Saturday for its disaster planning efforts.

History shows that the threat of a tsunami striking the Washington coast is real, state Department of Natural Resources geologist Tim Walsh said.

In 1700, tidal waves washed over the Washington coast following a magnitude-9 earthquake along the Cascadia Subduction Zone.

The subduction zone is a 750-mile fault line off the coast where the oceanic Juan de Fuca Plate dips under the continental North American Plate.

The geologic record suggests there's a 10 percent to 20 percent probability of a similar event in the next 50 years, Walsh said.

And in 1964, the Washington coast was hit by tidal waves generated by an earthquake in the Aleutian Islands of Alaska. Waves 2 to 12 feet tall caused more than $100,000 damage to bridges and buildings, according to a DNR report.

Tsunamis generated by faraway earthquakes can be predicted hours in advance, thanks to sensing buoys stationed in the ocean.

The city of Ocean Shores has established major evacuation routes to higher ground for those events.

But the citizenry would have very little time to react to a major earthquake in the subduction zone 60 to 150 miles off the coast.

The tsunami plan for that type of disaster calls on families and neighbors to immediately head inland to higher ground, perhaps on foot, Frinell-Hanrahan said.

All coastal communities, including Aberdeen and Hoquiam in Grays Harbor, are vulnerable to a tsunami from a coastal quake, according to a DNR tsunami hazard map.

If you go

A ceremony honoring Ocean Shores and Grays Harbor County for their efforts to prepare for tsunami disasters is set for 5 p.m. Saturday at the Ocean Shores Sand Festival headquarters next to the Shilo Inn.

Scott Gudes, acting administrator of the National Oceanic and Atmospheric Administration, will be on hand to declare the city and county "tsunami ready."

On the web:

National Oceanic & Atmospheric Administration (NOAA). http://www.noaa.gov/

City of Ocean Shores. http://www.oceanshores.net/

Ocean Shores Chamber of Commerce. http://www.oceanshores.org/

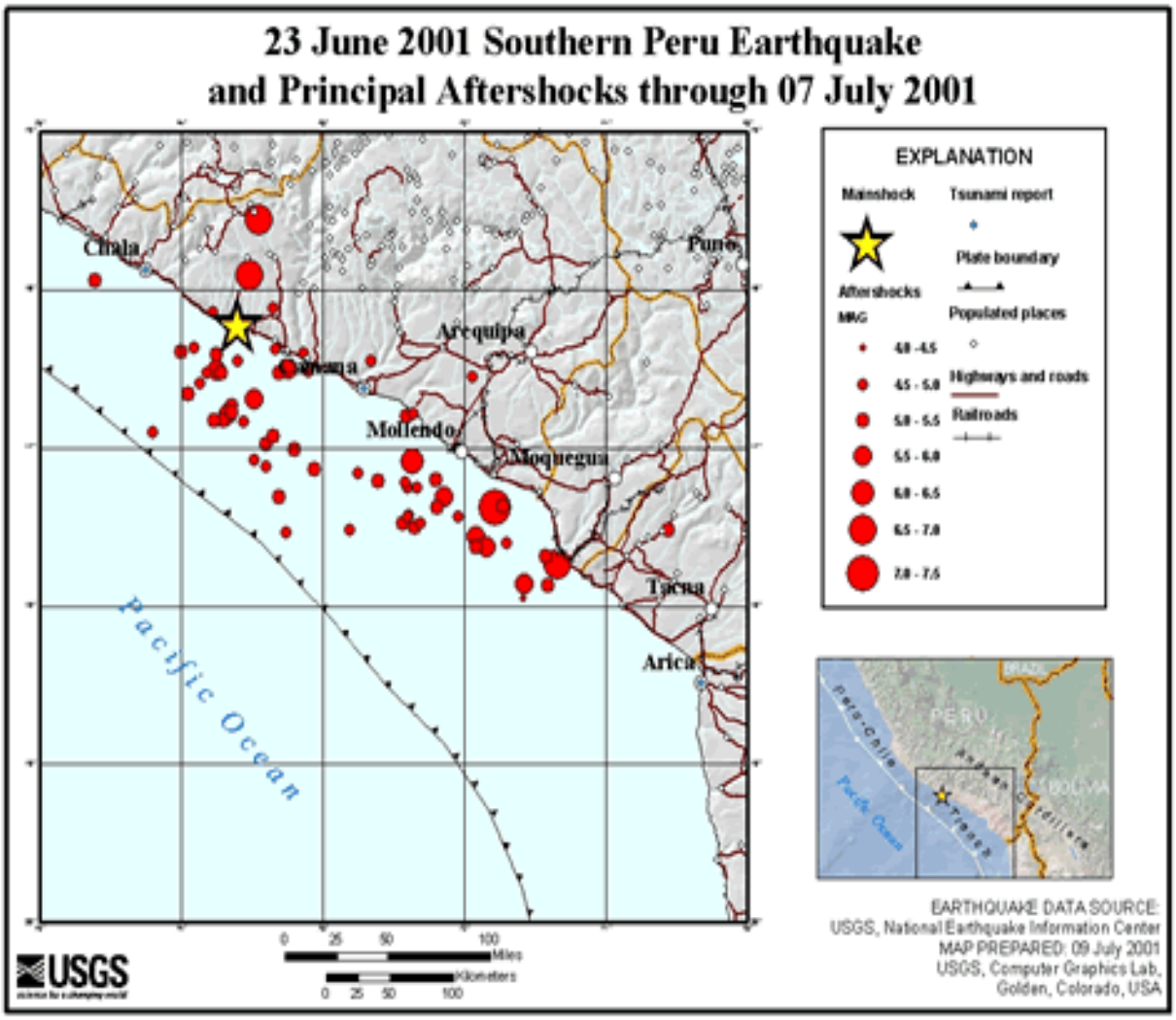
Emergency Preparedness. http://news.theolympian.com/emercheck/index.shtml

NOTES AND UPDATES ON THE JUNE 23, 2001 EARTHQUAKE AND TSUNAMI, PERU

(*Editors' note:* This is only a sampling of the information available about this event. For more, consult the various websites.)

An earthquake of magnitude 8.4 occurred near the coast of southern Peru, about 110 miles west of Arequipa, at 3:33 pm local time on June 23, 2001. Jose Borrero e-mailed that tsunamis struck the coast at Camana in about 15 minutes. Five waves were reported there, with the second being the strongest, able to topple concrete and brick buildings. The second wave came in with great force and velocity.

There were many large aftershocks in the following weeks. To date, hundreds of people have been killed, either in the earthquake or in the tsunami.



Recorded Tsunamis from the June 23, 2001 Peru Earthquake

The West Coast/Alaska Tsunami Warning Center (WC/ATWC) has summarized recorded tsunamis from the 6/23/01 Peru event on our their page at http://wcatwc.gov/06-23-01.htm. The summary includes arrival times, wave heights, estimated times of arrival, graphics displaying each wave, and data from some National Ocean Service gages. The gages are operated by many different organizations (NOAA/National Ocean Survey, the University of Hawaii, the Hydrographic and Oceanographic Service of the Chilean Navy (SHOA), the Pacific Tsunami Warning Center, the Japanese Meteorological Agency, and the National Tidal Facility of the Flinders University of South Australia), and are recorded in real-time or near real-time at the WC/ATWC.

from: Tom Sokolowski, West Coast & Alaska Tsunami Warning Center

e-mail from Marco Cisternas Vega to Lori Dengler on June 25, 2001:

In Chile (Arica and Iquique) all is quiet. Actually, today the lead story is the capture of Montecinos (The Fujimori's assistant). According with the authorities, "there wasn't any tsunami in Chile". The phenomenon was described as "some little tide variations", no coastal damage attributed to the "tsunami". But in Camana (southern Peru) there were 10 deaths by a tsunami that had a 1 km-inland run-up.

According to the Chilean authorities the earthquake was 7.8 in Arica, with a continental (near the coast) epicenter. The earthquake caused some fatalities in southern Peru (55 people; mainly in Arequipa). No fatalities in Chile, only 30 injured of which 3 are serious.

Marco Cisternas Vega, Concepcion, CHILE

e-mails from Jose Borrero

June 25, 2001

We made a call to a resident of Camana, and spoke with him at length. He reported essentially the same information as above but added that there were still 60 people missing and their disappearance is attributed to the wave. The extreme inland inundation is over agricultural fields and there was extensive sand deposition in the fields.

He reported that there were 5 waves in Camana with the second being the strongest, able to topple concrete and brick buildings. The second wave came in with great force and velocity. The waves started some 15 minutes after the earthquake.

July 20, 2001

The International Tsunami Survey Team has recently returned from its trip to the coast of Peru to investigate the effects of the June 23, 2001 earthquake and tsunami. We have recently completed a web page detailing the survey. You can access it through the USC tsunami webpage: http://www.usc.edu/dept/tsunamis Off of the worldmap page (click on Peru, 2001), http://www.usc.edu/dept/tsunamis/worldmappage.htm or go directly to it: http://www.usc.edu/dept/tsunamis/peru01/

Special thanks to Matt Swensson (USC Grad student and 1st time ITST participant) for hours of tedious graphics and HTML layout work.

Jose Borrero, USC Tsunami Research Group
http://www.usc.edu/dept/tsunamis

e-mail from Vasily Titov, titov@pmel.noaa.gov

I thought you may find preliminary results of propagation model for the Peru 2001 tsunami of interest. The revised Harvard solution has Mw = 8.4 (!). Maximum computed tsunami amplitudes for this source at Hilo (computed on 30m grid of Hilo bay with nonlinear inundation model) show good agreement with NOS tide gage maximum.

Short overview of the results are among PMEL's Peru 2001 compilation links http://www.pmel.noaa.gov/tsunami/peru20010623.html , or you can get to the results directly at http://www.pmel.noaa.gov/tsunami/most_ 010623.html

Full propagation solution for this source is available via PMEL's FACTS server at www.ferret.noaa.gov/FACTS/

With the FACTS server, one can look at travel time, max wave heights, snapshots, time series at any location etc. Please, be patient, it may take some time to get a plot for large areas, especially for derived functions like maximum wave height or travel time.

Peru earthquake websites

http://www.usc.edu/dept/tsunamis
http://www.usc.edu/dept/tsunamis/peru/
http://www.usc.edu/dept/tsunamis/peru/ptsu_hist.html
http://www.pmel.noaa.gov/~koshi/peru/

from: USC Tsunami Research Group and NOAA

Small Tsunamis Observed on Sanriku Coast

(a) Miyagi-Enoshuma (141.6E 38.4N) Radiowave tsunami sensor. Sea surface oscillation of double amplitude of 20 cm and of the period of 30-40 minutes was observed from 4:30 AM (Japan time, 19:30, 24th June GMT) up to now(15:30 Japan time, 6:30GMT)

Report from the Enoshima Tsunami Observatory, ERI

(b) Cape Todo (Chikei Port, 142.1E 39.5N) Ultrasonic tsunami sensor. Small waves of double amplitude of 10-20 cm, and of period of 15 minutes were observed from 3 AM(Japan time 18h 24th in GMT). The period of the waves was 20-30 minutes, and double amplitude 5-10cm at 12h (3h GMT). Sea surface oscillation is still observed up to now (16:00, 7h GMT).

Report from the Central fire station of Miyako City.

(c) Suginoshita Fishery Port, Kesen-numa City (141. 6E, 38.3 N) Ultrasonic tsunami sensor. Mr. Ken-Ichi Sato, an officer of Kesennnuma City Hall reported: Unusual sea surface oscillation began at 4:00 AM (19:00 GMT) , the half amplitude was 10cm, and the maximun double amplitude was 28cm (up to 14h). The period was about 30 minutes. The oscillation is still obserbable up to nou (16:30, 7:30GMT).

(d) Onagawa Town (141.5E, 38.4N) Ultrasonic tsunami sensors. They have 4 sensors inside and out side of Onagawa bay, but no evidence was recognized.

Report from the diasater prevention section, Onagawa Town Hall

(e) Otanabe Fishery Port, Fudai Village (141.9E, 40.0N) Ultra-sonic sensor. No evidence was observed.

Report from Fudai fire tation.

from: Yoshinobu TSUJI, reprinted with permission. Earthquake Research Institute, University of Tokyo, Yayoi 1-1-1, Bunkyo-ku, Tokyo, 113-0032, Japan. June 25, 2001.

Peru's Coast Drowns in Sorrow After Quake's Waves

Tue Jun 26 22:13:31 2001 GMT

CAMANA, Peru (Reuters) - Moises Noda was working in his squash fields by Peru's Pacific coast when the earth began to shake and he was swallowed by the sea.

"I can't find my son," a grieving Carlos Noda told Reuters on Tuesday as he lined up to add his son's name to a growing list of people who disappeared from this picturesque coastal town, some 560 miles (900 km) south of the capital Lima.

"He was bringing crops in when the sea rose up, but I think he's alive because no one has found his body," Noda said.

Three days after Saturday's 8.1 magnitude earthquake, which killed more than 100 people and injured hundreds more across southern Peru, Camana is just one of the towns combing through the rubble and scrambling for scant food, medicine and tents.

Some 20 minutes after the powerful temblor, residents said, three successive waves more than 10 feet (4 meters) high burst a sea wall protecting fields and carried away lines of houses that fell like "a pack of cards," one witness said.

"We were terrified. We ran to a hill but the sea came up and many drowned, most of them old people who come here to rest," said farmer Mario Alvarado as he peered at the scene of wreckage that had been a field sown with his onion crop.

Across the seaside town of around 20,000 -- a popular summer resort for tourists from Arequipa, Peru's second-largest city -- residents wandered streets resembling a war zone.

In one chapel, family members mourned a fallen relative. At their feet, the floor of the church was awash with mud brought in by the quake-stirred sea.

Help Hard to Find

In Camana, like other quake-damaged towns in this poor Andean nation, victims said relief supplies were too few to go around, and too slow in coming.

By Tuesday, only three civil defense officers were inspecting damage in Camana while some 20 firemen looked for bodies in fields, where rotting cattle carcasses drew flies.

"Even the 92 tons (of aid) we've already sent out is not enough," a civil, defense official in Lima admitted to Reuters.

"There's been immense devastation," said Education Minister Marcial Rubio after a visit to Arequipa, adding the government was working to deliver food and prevent the spread of disease.

Interim President Valentin Paniagua declared a state of emergency for the entire region on Sunday but Red Cross officials have said they lacked funds to get building supplies, tents and warm clothes for victims, many braving winter cold as they slept in the streets.

Periodic aftershocks, meanwhile, struck fear into already terrified residents. On Monday, another tremor measuring 5.5 on the Richter scale hit, Peru's Geophysical Institute said.

"The only thing I have left is what I have on my back," said Nadia Morzan, 57, sifting through mud, sand and patches of wrecked housing in search of her belongings. She said she was caught off guard after the quake, unaware the ocean could send the surging waves that carried away much of her home.

Meanwhile Noda clung to faint hope his son Moises would eventually turn up. "I'm still waiting for him," he said.

1755 Lisbon Earthquake/Tsunami Update

The cover story on the June 26, 2001 issue of Eos (American Geophysical Union Transactions), v. 82, no. 26, is "Source of 1755 Lisbon Earthquake and Tsunami Investigated." A new study done in 1998 suggests the epicenter of the earthquake might not be the Gorringe Bank, but closer to a feature (thrust fault) called Marques de Pompal in honor of the secretary of state at the time of the 1755 earthquake.

FEMA Seeks Hazards Risk Management Course Developers

We at the Federal Emergency Management Agency (FEMA) Higher Education Project are investigating the development of an upper-division or graduate-level college course on "Hazards Risk Management" and are soliciting suggestions on content coverage, texts, and potential course development team members. Please respond to the FEMA HiEd Project Manager, Dr. Wayne Blanchard; e-mail: wayne.blanchard@fema.gov. For more information about the Project, see: http://www.fema.gov/emi/edu

from: Disaster Research 348, June 14, 2001

Introducing the Center for Hazards and Risk Research

With the establishment of its new Center for Hazards and Risk Research, Columbia University's Earth Institute hopes to revolutionize the ways in which hazards are defined and analyzed and to help communities around the world protect against hazards.

Drawing upon the long history of earth science research at Columbia's Lamont-Doherty Earth Observatory, the new center will unite basic earth scientists with sociologists and economists, who will work together to produce newly integrated and effective assessments of hazards risk. The center will concentrate on natural processes such as earthquakes, floods, landslides, and extreme weather, and on environmental hazards, such as air and water pollution and climate change.

Recognizing that "massive investments in scientific research, regulatory mechanisms, and financial risk management tools, have failed up until now to substantially reduce losses," the center intends to expand the range of approaches to hazards mitigation by also addressing such issues as communication and knowledge dissemination, public awareness, economics and wealth distribution, policy development and political issues, development, land-use planning, and community resilience.

Indeed, one of the first projects on the Center's agenda will be the design of a Multi-Hazard Vulnerability Index - a composite measure of disaster risk. This index, researchers believe, will be a useful tool in focusing necessary attention on slowly developing hazards, such as the massive earthquake scientists now predict will topple Istanbul within thirty years.

A virtual center, the Center for Hazards and Risk Research will combine the talents of several Columbia schools, institutes, and centers, such as Columbia's Lamont-Doherty Earth Observatory, School of Engineering, School of International and Public Affairs, Center for Science Policy Outcomes, Center for Decision Sciences, and Center for International Earth Science Information Networks. The center will also collaborate with other academic, government, and international institutions and agencies around the world whenever possible.

More information about Columbia's new Center for Hazards and Risk Research can be found at: http://www.ldeo.columbia.edu/CHRR/ Interested persons can also contact: Center for Hazards and Risk Research, Lamont-Doherty Earth Observatory, Columbia University, 230 Seismology, Route 9W, Palisades, NY 10964; (845) 365-8909; fax: (845) 365-8150; e-mail: Art Lerner-Lam, Interim Director, lerner@ldeo.columbia.edu -or- Kathleen Boyer, Program Coordinator, kb42@columbia.edu.

from: Disaster Research 348, June 14, 2001

FEMA Issues Interim Rule on Public Assistance and Disaster Loan Programs

In an effort to reduce the growing demand for federal disaster assistance, Congress passed the Disaster Mitigation Act of 2000 (see DR #335) . Recently, the Federal Emergency Management Agency issued an interim final rule to implement portions of that legislation that affect various aspects of both the agency's Public Assistance Program and its Community Disaster Loan Program.

Specifically, the Disaster Mitigation Act amended the federal contribution for "alternate projects" under the Robert T. Stafford Disaster Relief and Emergency Assistance Act - repairing, restoring, reconstructing, or replacing a public facility - from 90% to 75% of the cost. However, the legislation allowed an exception; where unstable soil at the site of a damaged facility makes repair or restoration unfeasible, the federal contribution remains 90%.

Nonprofit organizations are no longer required to first apply for a disaster loan from the Small Business Administration for restoration work of critical facilities and services. The act defines critical services as water, sewer, and wastewater treatment; communications; and emergency medical care. All other private, nonprofit organizations are still required to apply to the SBA before receiving funding from the Disaster Assistance Program. FEMA proposes adding fire services, emergency rescue, and nursing homes to the list of critical facilities that may qualify for assistance under the Stafford Act.

The Disaster Mitigation Act of 2000 also capped the

amount of any loan made by FEMA under the Community Disaster Loan program at $5 million and states that a local government will not be eligible for future disaster loans if the community is behind in payments on a previous community disaster loan. For a community to be eligible to receive such a loan, it must show that it may suffer or has suffered a substantial loss of tax and other revenues as a result of a major disaster or emergency and must demonstrate a need for financial assistance in order to perform its government functions.

The interim final rule was published in the May 4, 2001 "Federal Register" (Vol. 66, no. 87, p. 22443-22445). For further information, contact Margaret Earman, Response and Recovery Directorate, FEMA, 500 C Street, S.W., Washington, DC 20472; (202) 646-4172; e-mail: margie.earman@fema.gov.

For specific information on program policies, an "Updated Policy Manual" is available from the FEMA web site: http://www.fema.gov/r-n-r/pa/9500toc.htm.

from: Disaster Research 348, June 14, 2001

FEMA's First National HAZUS Scenario Map Book

The Federal Emergency Management Agency is pleased to announce the first compilation of HAZUS maps highlighting user applications from around the nation. HAZUS is a computer-based methodology developed by FEMA to aid jurisdictions in assessing the nature and scope of hazards to which they are at risk. The purpose of the first "National HAZUS Scenario Map Book" is to demonstrate to policy and decision makers the power of HAZUS and the importance of risk assessment in the mitigation process.

FEMA would like to display the best HAZUS map examples from the public and private sector. The map book will be used at local and national conference exhibits, during training workshops, as well as at high-level mitigation meetings where HAZUS is being presented. It will also serve as a marketing tool.

FEMA envisions periodic updates to this document to maintain currency, including future multihazard application products. Each contributor will receive a complimentary copy of the book. The deadline for submissions is June 18, 2001. Please submit notices of intent to contribute to jcaplan@mediaone.net.

from: Disaster Research 348, June 14, 2001

Fannie Mae Expands Project Impact Prevention Loan Program

[Adapted from "Watermark," the National Flood Insurance Program newsletter (Fall 2000/Winter 2001)]

Protecting a home from future natural disasters just got a little easier for homeowners in several states. Recently, Fannie Mae, the national home ownership financial institution, joined with FEMA's Project Impact and several states to offer consumer installment loans at competitive interest rates to homeowners for making disaster prevention improvements. The Prevention Loan Program began in Florida in June 2000, and Fannie Mae expects to make it available throughout the U.S. Additional programs have already been launched in the San Francisco Bay area, Georgia, Kansas, and Oklahoma.

The Prevention Loan Program, which includes a quick approval process, requires that work be performed by certified contractors who are qualified to make disaster-resistant improvements to residences. Unsecured, fixed-rate loans of up to $20,000 are available with repayment terms of up to 10 years. Interest rates are based upon market conditions for the terms of the loan, and there are no income limitations for borrowers. Projects that may be covered under this program include strengthening a home's roofing system, installing hurricane shutters, constructing an in-home safe room, elevating a structure above base flood elevation, and bracing a chimney.

For more information about the Prevention Loan Program contact Fannie Mae; (800) 732-6643. Additional information can be obtained from the FEMA Project Impact web site: http://www.fema.gov/impact/partners/fanniemae.htm.

from: Disaster Research 348, June 14, 2001

Natural Hazards Center's Newest Working Paper #106

In the Natural Hazard Center's newest Working Paper (#106), the author, California State University-Long Beach geographer Christine M. Rodrigue, examines how the public's understanding of hazards and risks is being shaped by the Internet. In *Construction of Hazard Perception and Activism on the Internet: Amplifying Trivial Risks and Obfuscating Serious Ones*, she states that "social construction of hazard policy entails a risk assessment dialogue between technical experts and public interest activitists and between each of these and elected risk management policy makers. These dialogues have traditionally taken place in the frequently distorting presence of broadcast and print media…The advent of the Internet has fundamentally altered these discussions…Early results have included an impressive empowerment of individial activists vis-à-vis the corporate interests that dominate traditional media, as well as tremendous citizen pressure on risk management decision makers. This is a blade that cuts both ways, however, with new opportunities for demagoguery and for hijacking the… trust by which most people make political decisions on issues far beyond their training." This paper illustrates both the advantages and dangers of Internet political organizing through case studies of a technological and a natural hazard controvery. The paper is available online at: http://www.colorado.edu/hazards/wp/wp106/wp106.html

from: Natural Hazards Observer, v. 25, no. 5, May 2001, p. 13

A Student Opportunity: Natural Hazards Mitigation Research and Field Work Position in Oregon

Are you looking for a chance to gain professional experience? Do you want to continue natural hazards mitigation

research? Do you want to work with state agencies, nonprofit and private-sector groups currently engaged in statewide natural hazards mitigation planning and programs? The Oregon Natural Hazards Workshop (ONHW) and Resource Assistance for Rural Environments (RARE) are coordinating the year-long placement of one participant in Clackamas County, Oregon, to aid the development and implementation of a local natural hazards mitigation plan. Clackamas County is a Project Impact community.

The participant will be involved with all tasks related to completion of the county's mitigation plan, including:

- Reviewing the county's hazard assessment (already completed) through available data and public outreach;
- Analyzing requirements for sustainability of the county's Hazard Mitigation Program;
- Determining implementation requirements;
- Identifying action items;
- Conducting public outreach sessions; and
- Finalizing the plan for Board of Commissioners approval.

The participant will see first hand the value of disaster mitigation in reducing loss of life and property, as well as the need for coordination and cooperation within and outside county government to develop effective policies, programs, and plans to deal with disaster mitigation, preparedness, response, and recovery. The participant will also have the opportunity to interact with a wide variety of agencies and the public. Partner organizations in the development of the Clackamas County mitigation plan include county government, the Federal Emergency Management Agency, and various state agencies within Oregon.

ONHW assists communities in reducing risk and preven-ting loss due to natural hazards and is currently coordinating the Oregon Showcase State/Partnership for a Disaster Resil-ent State Program sponsored by the Institute for Business and Home Safety. For more information on ONHW see http://darkwing.uoregon.edu/~onhw.

RARE is an AmeriCorps*VISTA Program and Peace Corps Fellows Program that is working to increase the capac ity of Oregon's rural communities to improve their economic, social, and environmental conditions. For RARE program information and an application packet, see http://arkwing.uoregon.edu/~rare. Interested persons may also call (541) 346-2879 or e-mail rare@darkwing.uoregon.edu.

ONHW and RARE are programs within the Community Service Center (CSC), a consortium of programs providing community service through partnerships between Oregon universities and communities. For more information on the CSC, see http://darkwing.uoregon.edu/~csco.

For a complete position description or additional information, contact Andre LeDuc, Program Director, ONHW, 1209 University of Oregon, Eugene, OR 97403-1209, (541) 346-5833, e-mail: crux@darkwing. oregon.edu; WWW: http://www.uoregon.edu/~onhw.

from: Disaster Research 350, July 13, 2001

A Partial EENET Schedule - August-September, 2001

Below is a calendar of satellite broadcasts scheduled by the Federal Emergency Management Agency's Emergency Education Network (EENET). (All times are Eastern time.)

Aug. 15	2:00-3:00 p.m.	National Alert Broadcast
Aug. 22	2:00-3:00 p.m.	Consequence Management News, Equipment, and Training (CoMNET) Magazine
Aug. 29	2:00-3:00 p.m.	Highlights from - "Picking Up the Pieces: Responding to School Crises" Conference
Sept. 5	2:00-3:00 p.m.	"Meet the USA" - Pilot. This new series takes advantage of the expertise offered by local officials by concentrating on particular jobs and incidents and focusing on specific topics. In this first program, the producers spend time with officials at UCLA to look at the impact of the Northridge Earthquake on that school's facilities, as well as the participation of UCLA's EOC in managing the event.
Sept. 12	2:00-3:00 p.m.	The International Critical Incident Stress Foundation Presents: "Highlights from the Sixth World Congress" - Part II
Sept. 19	10:00 a.m-3:30 p.m	Sixth Annual Emergency Preparedness Satellite Seminar - Day 1. This program is the 3rd two-day seminar that USDA, DOD, and FEMA have jointly sponsored on animal and human issues. It will focus on the threat of animal-borne diseases spreading through-out the U.S.
Sept. 20	10:00 a.m-3:30 p.m.	Sixth Annual Emergency Preparedness Satellite Seminar - Day 2. To register for this seminar, or for more information, see their web site: http://www.aphis.usda.gov/vs/ training
Sept. 26	2:00-3:00 p.m.	Weapons of Mass Destruction - "Live Response"

Additional broadcasts are continually being added to the schedule. For the most current listing of programs and satellite information, check EENET's Web Page: http://www.fema.gov/emi/eenet.htm. *from:*Disaster Research 348, June 14, 2001

Call for Email Newsletters

Icoast, the electronic newsletter from coastalmanagement.com, is enjoying the coastal zone management email newsletters they receive from around the world, and would like to compile a list of all CZM email newsletters, together with brief 2-3 line descriptions of their aims, target readership and contact details. If you publish an email CZM newsletter or have a favorite, please contact feedback@coastalmanagement.com. This could become a valuable resource to the coastal zone management community.

from: icoast newsletter, version 3.06, June 15, 2001

Grant to Study Coastal Effects of Tsunamis

Funding: National Science Foundation, $195,579, 36 months. Principal investigator: Costas E. Synolakis, University of Southern California, Los Angeles, CA 90089-1147; e-mail: costas@usc.edu.

This group research project will focus on specific aspects of tsunami hazards mitigation. Recently, the National Oceanic and Atmospheric Administration (NOAA) established a program to improve identification of tsunami inundation zones along the western coastal areas of the U.S. (*See* www.pmel.noaa.gov/tsunami/time). The next step is to evaluate tsunami run-up in more detail, and this project will research flow patterns, induced forces, the impact of debris and floating objects, and their implications for improved design of waterfront structures and decisions concerning land use. The project involves researchers from Cornell University, Southern Methodist University, the University of Southern California, the University of Washington, Japan's Public Works Research Institute, GeoEngineers, Inc, and others.

from: Natural Hazards Observer, v. 25, no. 6, July 2001, p. 12

Risk Preparedness: A Management Manual for World Cultural Heritage

This manual discusses the principles and benefits of risk preparedness for world cultural heritage sites. It focuses on developing property-specific strategies for risks such as fire, earthquake, flood, armed conflict, tsunami, avalanche, mudslide, and tropical storm. It also includes a list of technical and planning sources.

Herb Stovel, 1998. 145 p. $16.00. To obtain a copy, contat the International Centre for the Study of the Preservation and Restoration of Cultural Property (ICCROM), Via di San Michele 13, I-00153, Rome, Italy; phone: +39-0658553 1; fax: +39-068553 349; e-mail: iccrom@iccrom.org. Internet: www.iccrom.com

from: Natural Hazards Observer, v. 25, no. 6, July 2001, p. 24.

WEBSITES

http://www.hazpac.org
http://www.crowdingtherim.org

HAZPAC, short for "Hazards of the Pacific," is a GIS database that allows users to search and use the historic disaster record for the entire Pacific region. The database contains information regarding earthquakes, tsunamis, volcanic eruptions, and tropical storms, as well details about human infrastructure systems such as cities, roads, utilities, railroads, and major air routes. Users can specify the type and location of disaster information to be displayed, thus permitting both detailed (city-specific) and broad-scale investigations of the disaster record. Because HAZPAC is a GIS database, specific information about each data set is available, allowing users to request, for instance, the population of a particular city or the date and magnitude of an earthquake. HAZPAC is intended to aid anyone investigating the natural hazards of the Pacific. It was developed as part of the "Crowding the Rim" initiative, a partnership among the U.S. Geological Survey, Circum-Pacific Council, American Red Cross, and Stanford University.

from: Disaster Research 350, July 13, 2001

http://www.pmel.noaa.gov/vents/acoustics/seismicity/nepac/gordaridge01.html

Want to *hear* an earthquake. From this web site, you can listen to seismic rumblings that followed an April 3 volcanic eruption off the coast of Oregon - brought to you by NOAA's Pacific Marine Environmental Laboratory. (This is but a small corner of the excellent PMEL Web site, which hosts much information about earthquakes, volcanoes, tsunamis, and other hazards of the Pacific Rim.)

from: Disaster Research 350, July 13, 2001

http://forums.about.com/FEMA/start

Emergency manager Lloyd Colston has created a new forum for emergency management at the URL above, and he invites all interested persons to visit and participate. For details, see the site or contact Lloyd Colston, Director, Mayes County Emergency Management, Pryor, Oklahoma; e-mail: colston@yahoo.com; WWW: http://www.geocities.com/mccem.

from: Disaster Research 350, July 13, 2001

http://www.incident.com

About four years ago, we (Disaster Research) mentioned this nifty site assembled by Internet pioneer Art Botterell, and, well, it's time to mention it again. The site allows users to sign up for e-mail disaster information from the State of California's "Emergency Digital Information Service" (EDIS), and, perhaps more importantly for the rest of us out here in Hicksville, it also provides a "Recent Events Map" of earthquakes, severe weather, and other hazards, as well as several other national and international near-real-time maps of hazard happenings - from tropical storms to

drought and other hazards. All maps are created on-the-fly from data harvested on an ongoing basis by the web site.

from: Disaster Research 348, June 14, 2001

http://www.hah-emergency.net/

Early in May, the Healthcare Association of Hawaii (HAH) launched this emergency management program web site designed to support hospitals and other health care organizations in the state of Hawaii. The site includes content for the general public and restricted content available only to health care emergency managers in Hawaii. It also provides a brief description of the program, which could serve as a model for other health care organizations and associations across the nation. Comments and suggestions are welcome.

from: Disaster Research 348, June 14, 2001

Emergency_Wires-subscribe@yahoogroups.com
http://groups.yahoo.com/group/Emergency_Wires

"EM News" (JAGWA International) has started a new site and e-mail list to provide, as close as possible, near-real-time emergency/disaster news and a notification service from a number of sites around the world. The site will cover:

- Earthquake notification worldwide
- Weather satellite images of interest
- Air disaster notifications
- Emergency and disaster news
- Situation reports
- Technology updates

and any other areas in which the developer can obtain special or critical information or notifications. Information will be submitted directly to the site via automated services, and new information will be posted as it becomes available. For more information or to submit comments, contact JAGWA International, Emergency/Disaster Management, Australia; tel: +618 9375 1567; fax: +61 8 9331 7949; e-mail: rguy@wn.com.au; WWW: http://www.geocities.com/emnewswa/indextest.html.

from: Disaster Research 349, June 29, 2001

http://www.tsunamicommunity.org

Created by an ad hoc committee of 14 tsunami researchers, this web site is intended to be a stage for research-in-progress and data exchange. As listed on its introductory page, the site's goals are:

- To describe tsunami generation
- To facilitate tsunami hazard mitigation
- To document historical tsunamis
- To provide tsunami benchmark problems
- To distribute seafloor bathymetry
- To showcase community models
- To provide tsunami case studies
- To simulate future tsunami scenarios
- To gather tsunami links and tsongs [sic]

The site includes sections addressing each of these areas. Contributions and comments are encouraged.

from: Disaster Research 349, June 29, 2001

http://www.geocities.com/capecanaberal/lab/1029

Longtime tsunami researcher Dr. George Pararas-Carayannis has assembled this colorful site, which includes bulletins about recent events, conference announcements and reviews, tsunami FAQs, a section on societal effects, a section on physical properties, a database of historical tsunamis, a list of relevant bibliographies, descriptions of tsunami warning systems, a section on prediction and evaluation, a glossary, and links to other tsunami information on the web.

from: Disaster Research 349, June 29, 2001

http://www.tsunami.org/

This is the new web site of the Pacific Tsunami Museum, with information about the latest exhibits and events, the museum's purpose and goals, frequently asked questions about tsunamis, programs, archived information, and more. The site also offers a live picture of Hilo Bay and a "Tsunami Picture of the Month." More information is available by contacting the Pacific Tsunami Museum, P.O. Box 806, Hilo, HI 96721; (808) 935-0926; fax: (808) 935-0842; e-mail: tsunami@tsunami.org.

from: Disaster Research 349, June 29, 2001

* * * * * * *

Port Royal on the island of Jamaica

Dotted line shows shoreline before the June 7, 1692 earthquake. (reprinted with permission)

THE PORT ROYAL, JAMAICA EARTHQUAKE AND TSUNAMI OF JUNE 7, 1692

from: http://library.thinkquest.org/C003603/english/earthquakes/casestudies.shtml#11

Port Royal, known as the Treasury of the West Indies and the Wickedest City in the World, was at the time frequented by pirates, prostitutes, and privateers like Henry Morgan, who stole from the Spanish fleet. On a hot, muggy morning, three earthquakes rocked this Caribbean island, moving two mountains nearly a mile from their original positions. The greatest damage occurred in the British colonial city of Port Royal because it was built on an unstable jut of land, and the city slid into the ocean when the shaking began. Within three minutes it lay beneath fifty feet of water. Almost 2,000 people (1/3 of the population) perished, while 1,800 houses were destroyed. A subsequent seismic sea wave then flooded streets and houses, killing hundreds more people. At the same time, the Swan, a frigate boat, was carried into the city on a large wave. Drowning citizens escaped death by clinging to its dangling ropes. A merchant named Lewis Galdy had been swallowed alive by a fissure that opened beneath his feet, but was shot out like a bottle cork by the force of the third earthquake. Countless more people were buried alive in the cracks, and their decomposing corpses created a noxious odor that permeated the island for months. Another 1,000 people died from disease and injuries after the disaster. The city was abandoned forever, but visitors could still see the higher-story homes covered by up to 40 feet of water for the next hundred years. Layers of silt submerged much of the town, which lay forgotten and intact for centuries before it was dug up in 1959.

Contemporary Reports of the Port Royal Earthquake

from: Tomblin, J. M.; Robson, G. R., 1977, A catalogue of felt earthquakes for Jamaica, with references to other islands in the Greater Antilles, 1564-1971: Ministry of Mining and Natural Resources Mines & Geology Division Special Publication 2, p. 2-3.

PORT ROYAL, Jamaica, (X)11.40 h. - An earthquake shook down nine-tenths of the buildings in the town and killed about two thousand of the inhabitants. Fissures opened in the streets, engulfing people, and some ejected water. A few acres of semi-consolidated sandy land at the wharfside subsided by some tens of feet into the sea taking with it many of the most important buildings, and a further few hundred acres east of Port Royal also subsided causing the disappearance of a 1/4 mile neck of land. Several ships were capsized in the harbour andother stranded on the shore. A six-foot tidal [sic] wave crossed the bay north of Port Royal. Almost half the people who escaped in Port Royal died during the fever epidemics which followed the earthquake. The main earthquake was followed by aftershocks, which occurred at intervals of one or two hours at first and were still occurring almost daily in September 1692. ...Sloane

Jamaica, Port Royal (X) Three-fourths of the houses were thrown down and 3,000 persons perished. A frigate was wrecked in the port. ....Mallet

Jamaica, Liguanea (X) At Liguanea all the houses were destroyed, and in the vicinity water was ejected from wells up to 40 feet deep. At Liguanea and at Yallhouse (Yallahs) the sea level withdrew several hundred yards and then returned to flood the shore. ....Sloane

Jamaica, St. Jago (Spanish Town) (IX) All but a few lot houses were destroyed. ...Sloane

Jamaica, Saltpans Hills (VIII) Water issued in 20 or 30 places and flowed until dawn next day. ...Sloane

Jamaica, Clarendon (IX) In Clarendon precinct, over 12 miles from the sea, water spouted from fissures in the ground. ...Sloane

Jamaica, Sixteen Mile Walk (IX) Landslides dammed up the river for a day. Many landslides occurred in the mountains. ....Sloane

Jamaica, Yellows (IX) Several settlements were overwhelmed by a landslide, which killed nineteen people and displaced Mr. Hopkins' plantation by half a mile. ....Sloane

Jamaica, Passage-Fort (X) Hardly a planter's house was left standing. ....Sloane

Jamaica, Port Morant (X) Reports are cited that a large high mountain near Port Morant had been swallowed-up, and in its place was a great lake of four or five leagues over. ...Sloane

Jamaica, Northside (X) On the north side (another report says at the north) a lake of 1,000 acres was said to cover the former...of houses and fields. ....Sloane

References

Mallet, Robert, 1852-1954. Report on the facts of earthquake phenomenon: British Assoc. Adv. Sci., London, Reports, 1850, p. 1-89; 1851, p. 272-320: 1852, p. 1-176; 1853, p, 118-212;1854, p. 1-326. (The listed parts 1852, p. 1 onwards constitute the "Catalogue of recorded earthquakes from 1606 B.C. to A.D. 1850.")

Sloane, Hans, 1809. A letter from Hans Sloane, M.D. and S.R.S. with several accounts of the earthquake in Peru, October 20, 1687, and at Jamaica, February 19, 1687-8; and June 1, 1692. Phil. Trans. Roy. Soc. London, 1665-1800, vol. III, p. 625-632.

Eyewitness Reports of the Port Royal Earthquake, June 7, 1692

from: Marx, R. F., 1967, Pirate port: The World Publishing Company

By a merchant:

"Betwixt eleven and twelve at noon, I being at a tavern, we felt the house shake and saw the bricks begin to rise in the floor, and at the same instant heard one in the street cry, 'An earthquake!' Immediately we ran out of the house, where we saw all people with lifted up hands begging God's assistance. We continued running up the street whilst on either side of us we saw the houses, some swallowed up, others thrown on heaps; the sand in the streets rise like the waves of the sea, lifting up all persons that stood upon it and immediately dropping down into pits; and at the same instant a flood of water breaking in and rolling those poor souls over and over; some catching hold of beams and rafters of houses, others were found in the sand that appeared when the water was drained away, with their legs and arms out. The small piece of ground whereon sixteen or eighteen of us stood (praised be to God) did not sink. As soon as the violent shake was over, every man was desirous to know if any part of his family were left alive. I endeavored to go to my house upon the ruins of the houses that were floating upon the water, but could not. At length I got a canoe and rowed upon the great sea towards my house, where I saw several men and women floating upon the wreck [possibly the H.M.S. *Swan*] out to sea; and as many of them as I could I took into the boat and still rowed on till I came to where I thought my house stood, but could not hear of either my wife nor family; so returning again to that little part of land remaining above water. But seeing all the people endeavoring to get to the island, I went amongst them in hopes I might hear of my wife or some part of my family, but could not." (p. 16.)

Another merchant:

"Those houses which but just now appeared the fairest and loftiest in these parts were in a moment sunk down into the earth, and nothing to be seen of them; such crying, such shrieking and mourning I never heard, nor could anything in my opinion appear more terrible to the eye of man: Here a company of people swallowed up at once; there a whole street tumbling down; and in another place the trembling earth, opening her ravenous jaws, let in the merciless sea so that this town is becoming a heap of ruins...Dr. Trapham, a physician of this place, was miraculously saved by hanging by his hands upon the rack of a chimney, and one of his children about his neck, were both saved by a boat, but his wife and the rest of his children and family were all lost. Several people were swallowed up of the earth, when the sea breaking in before the earth could close, were washed up again and miraculously saved from perishing; others the earth received up to their necks and then closed upon them and squeezed them to death with their heads above ground, many of which the dogs eat. Multitudes of people floating up and down, having no burial. The burying place at Palisadoes is quite destroyed, the dead bodies being washed out of their graves, their tombs beat to pieces." (p. 17)

By Dr. Heath, rector of St. Paul's Church:

"I had been at church reading prayers, which I did every day since I was rector of this place to keep some show of religion among a most ungodly and debauched people, and was gone to a place hard by the church, where the merchants meet, and where the President of the Counci [John White, the acting governor] was, who came into my company and engaged me to take a glass of wormwood wine with him as a whet before dinner. He being my very good friend, I stayed with him, upon which he lighted a pipe of tobacco which he was pretty long in taking; and not willing to leave him before it was all out, this detained me from going to dinner with one Captain Ruden...whose house, upon the first concussion, sank into the earth, and then into the sea, with his wife and family and some that were come to dine with him: had I been there, I had been lost.

But to return to the President and his pipe of tobacco. Before that was out, I found the ground rolling and moving under my feet, upon which I said to him, 'Lord, Sir, what is that?' He replied, 'It is an earthquake. Be not afraid,it will soon be over.' But it increased, and we heard the church and tower fall, upon which we ran to save ourselves. I quickly lost him and made towards Morgan's Line, because being a wide, open place, I thought to be there securest from falling houses. But as I made towards it, I saw the earth open and swallow up a multitude of people, and the sea mounting in upon them over the fortifications. I then laid aside all thoughts of escaping and resolved to make my way towards my own lodging, and ther to meet death in as good posture as I could. From the place where I was, I was forced to cross and run through two or three very narrow streets. The houses and walls fell on each side of me, some bricks came rolling over my shoes, but none hurt me. When I came to my lodging I found all things there in the same order I left them, not a picture, of which there were several fair ones in my chamber, being out of its place. I went to the balcony to view the street in which our house stood, and saw never a house down there nor the ground so much as cracked. ...there came some merchants to me of the place, who desired me to go aboard some ship in the harbor and refresh myself, telling me they had got a boat to carry me off. So coming to the sea, which had entirely swallowed up the wharf with all those goodly brick houses upon it, most of them as fine as those in Cheapside, and two entire streets beyond that, I upon the tops of some houses which lay

leveled with the surface of the water got first into a canoe, and then into a long boat, which put me aboard a ship called the *Storm Merchant*, where I found the President safe, who was overjoyed to see me." (p. 17-19.)

"There were three strong quakes in a matter of minutes; the third and most severe was followed by a huge tidal wave [sic] that broke the anchor cables of ships in the harbor, wrecked the ships near the wharves, and flung the H.M.S. *Swan* into the middle of town, where it came to rest on top of some houses and served as Noah's Ark for more than two hundred people." (p.16-17)

"By the time the sun went down on Port Royal, all that remained was a mere ten acres of land, once again separated from the Palisadoes by water. Fewer than a tenth of the houses remained standing, most of those in no condition for habitation. Fort Carlisle and Fort James were nowhere to be seen, nor were a good number of ships. The toll of property taken by the upheaval was incalculable, but not the toll of life---more than 2000 people perished." (p. 19)

"Earth tremors kept recurring (they continued for two months)..." (p. 77)

A Tombstone Tells of the 1692 Port Royal Earthquake in Jamaica

DIEU SUR TOUT

Here Lyes the Body of Lewis Galdy, Esq. who departed this Life at Port Royal the 22 December 1739 Aged 60. He was Born at Montpelier in France but left that Country for his Religion & came to settle in the Island where He was swallowed up in the Great Earthquake in theYear 1692 & by the Providence of God was by another Shock thrown into the Sea & Miraculously saved By swimming until a Boat took him up. He Lived many Years after in great Reputation Beloved by all that knew him and much Lamented at his Death.

The June 7, 1692 Port Royal earthquake had an estimated magnitude of 7.7. Approximately 2,000 people were killed by the mid-day earthquake as the fragile sand spit that supported the then-capital city slipped seaward. Major portions of the city (about two-thirds of its settled area) subsided below sea level. A legible photograph of the tombstone quoted above is shown in the February 1960 edition of The National Geographic. Also included in that edition is the following quote from a contemporary account of the quake: "Several Ships and Sloops were over-set and lost in the Harbour. Amongst the rest the Swan Frigot . . . was forced over the tops of many Houses . . . She did not over-set but helped some Hundreds, in saving their Lives." Did the Swan perhaps save Lewis Galdy?

from: http://www.eeri.org/News/Dec98/Dec98.html
EERI Newsletter, Editor, Diana Todd

"The old 17th-century cemetery was adjacent to the present cemetery and it is located off to the upper right of the map a little more than a quarter of a mile east out of town...This is where Morgan was originally buried. Now the oldest areas are partially submerged in a mangrove swamp. Off to the north end of the present cemetery, next to the water's edge there are a few graves dating to the early 1700's. There are a few poorly marked graves that may be a little earlier." (e-mail from Donny Hamilton, 3-20-2001)
(Editor's note: that map follows on p. 21 of this issue)

Port Royal, Jamaica earthquake, June 7, 1692. Copper engraving, France(?), 17th century? From the Kozak Collection, Earthquake Engineering Research Center, University of California, Berkeley. Image no. KZ565. http://www.eerc.berkeley.edu/cgi- bin/kozak_ detail? id = 9127

Port Royal, Jamaica after June 7 1692 earthquakes and tsunami.

Map of Port Royal, Jamaica
by Donny Hamilton, Director, Port Royal Project, Texas A&M University
(reprinted with permission)

This map, in color, is full screen and clearer at http:// nautarch.tamu.edu/portroyal/prmap-x2.html

For the history of Port Royal, visit http:// nautarch.tamu.edu/PROJECTS/PR-project/PRhist.htm

Information from that site: "As Jamaica's economy grew and changed between 1655 and 1692, Port Royal grew faster than any other town founded by the English in the New World, and it became the most economically important English port in the Americas....Only Boston, Massachusetts, rivaled Port Royal in size and importance. In 1690, Boston had a population of approxi-mately 6000...while population estimates for Port Royal in 1692 range from 6500to 10,000."

Tsunami or seiche

"Another trivial point, technically the waves that contributed to the destruction of Port Royal during the earthquake were seiche waves ('coffee cup waves') formed within Kingston Harbor as the shock waves reverberated southward through the island. A major tsunami wave struck the north coast causing major destruction. It is believed that the earthquake originated in the Cayman Trough located between Cuba and Jamaica. The reports are that there were three oscillations of the tsunami as it bounced back and forth between Cuba and the north shore of Jamaica. Likewise, there were three or so oscillations of the seiche waves that bounced from one side of Kingston Harbor to the other. The seiche waves, combined with the liquefaction of the waterlogged sand underlying most of the town, submerged two thirds of the town, which was the largest English town in the New World in 1692." (Information provided by Donny Hamilton, Director, Port Royal Project, Nautical Archaeology Program, Texas A&M University, e-mail 3-20-2001). For more information on Port Royal: http://nautarch.tamu.edu/projects/prhome.htm

"However, earthquakes may also trigger landslides both onshore and in the submarine environments that are respon-sible for many known destructive tsunami occurrences worldwide. The submarine landslides, variety lateral spreads, are believed to be responsible for many of the localized tsunami in Jamaica. The best example of this is the submarine landslide that took with it a part of Port Royal to the bottom of the Kingston Harbour on Tuesday, 7th June 1692 at about 11.40 a.m."
from: http://isis.uwimona.edu.jm/uds/Tsunami_Jam_letter-1999.html (a Letter by Rafi Ahmad to the Editor of The Daily Observer dated August 14, 1998)

There is a well-illustrated article about Port Royal in the February 1960 issue of *National Geographic*, "Port Royal, City Beneath the Sea" (p. 166-183), with a emphasis on the recovery of archaeological artifacts. The first two pages contain a detailed map of Port Royal with lines to indicate the shoreline before the 1692 earthquake, the shoreline after the earthquake and the shoreline in 1960. Bathymetry is given, to show how deep the old parts of the city are now under water.

The Earthquake of Jamaica, Describ'd in a Pindarick Poem

by

Mr. Tutchine

London, Printed 1692

Well may our Lives bear an uncertain date;
Disturbed with Maladies within,
Without by cross Events of Fate,
The worst of Plagues on Mortals wait,
Pride, Ignorance and Sin.
If our ancient Mother Earth,
Who gave us all untimely Birth,
Such strong Hysterick Passion feels
If Orbs are from their Axles torn,
And Mountains into Valleys worn,
All in a moments space,
Can humane Race
Stand on their Legs when Nature Reels?
Unhappy Man! in all things cross'd,
On every giddy Wave of Fortune toss'd:
The only thing that aims at Sway,
And yet capricious Fate must still Obey;
Travels for Wealth to Foreign Lands,
O're scorching Mountains, and o're desart Sands,
Laden with Gold, when homeward bound,
Is in one vast impetuous Billow drown'd:
Or if he reaches to the Shoroar,
And there unlades his Oar,
Builds Towns and Houses which may last and stand,
Thinking no Wealth so sure as firm Land;
Yet Fate the Animal does still pursue;
This slides from underneath his Feet, and leaves him too.

Environ'd with Ten Thousand Fears we live,
For Fate do's seldom a just warning give;
Quicker than Thought its dire Resolves are made,
And swift as Lightning flies,
Around the vast extended Skies:
All things are by its Bolts in vast Confusion laid.
Sometimes a Flaming Comet does appear,
Whose very visage does pronounce,
Decay of Kingdoms, and the Fall of Crowns,
Intestine War,or Pestilential Year;
Sometimes a Hurricane of Fate,
Does on some great Mans Exit wait,
A murder'd *Cornish*, or some *Hercules,*
When from their Trunks Almighty Jove,
Who breaks with Thunder weighty Clouds above,
To Honour these
Large Pines and Oaks does Lop,
And in a Whirlwind lays 'em upon *Oeta*'s Top.
E're this vast Orb shall unto Chaos turn,
And with Consuming Flates shall burn,
An Angel Trumpeter shall come,
Whose Noise shall shake the Massie Ground,
In one short moment shall express,
His Notes to the whole Universe;
The very Dead shall hear his Sound,
And from their Grves repair,
To the impartial Bar,
Those that have been in the deep Ocean drown'd,
Shall at his Call come to receive their Doom.

But here, alas! no omens fly,
No secret Whisper of their Destiny
Was heard; none cou'd divine
When Fate wou'd spring the Mine:
Safe and secure the Mortals go,
Not dreaming of a Hell below;
In the dark Caverns of the gloomy Earth,
Where suffocating Sulphur has its Birth,
And sparkling Nitre's made,
Where *Vulcan* and his *Cyclops* prove;
The Thunderbolts they make for *Jove*;
Here *Aeolus* his Winds has laid,
Here is his Windy Palace, here 'tis said
His Race of little puffing Gods are bred,
Which serve for Bellows to blow up the Flame,
The dire Ingredients are in order plac'd,
Which must anon lay Towns and Cities waste.
Strait the black Engineer of Heaven came,
His Match a Sun-beam was,
He swift as Time unto the Train did pass,
It soon took Fire; The Fire and Winds contend,
But both concur the Vaulted Earth to rend;
It upwards rose, and then it downwards fell,
Aiming at Heaven, it sunk to Hell:
The Neighboring Seas now own no more,
The sturdy Bulwarks of the Shoar,
The gaping Earth and greedy Sea,
Are both contending for the Prey;
Those whom the rav'nous Earth had ta'ne,
Into her Bowels back again
Are wash't from thence by the insulting Main..

The Old and Young receive alike their Doom,
The Cowards and the Brave,
Are buried in one Grave;
For Fate allows 'em all one Common Tomb.
The Aged and the Wise
Lose all their Reason in the great Surprise.
They know not where to go,
And yet they dare not stay,
There's Fire and Smoak below,
And the Earth gaping to receive the Prey:

If to the Houses Top they Crawl,
These tumble too, and downwards fall:
And if they fly into the Street,
There grizly Death they meet;
All in a hurry dye away,
The wicked had not time to pray.
The Soldier once cou'd teach grim Death to kill,
In vain is all his Skill,
In vain he brandisheth his Steel:
No more the Art of War must teach,
But lyes Fates Trophy underneath the Breach:
The good Companions now no more Carouse,
They share the Fate of the declining House,
Healths to their Friends their Bumpers Crown'd:
But while they put the Glases round,
Death steps between the Cup and Lip,
Nor would it let 'em take one parting Sip.

The Mine is sprung, and a large Breach is made,
Whereat strong Troops of Warring Seas invade;
These overflow;
Where Houses stood and grass did grow,
All sorts of Fish resort:
They had Dominions large enough before,
But now unbounded by the Shoar,
They o're the Tops of Houses sport.
The Watry Fry their Legions do extend,
And for the new slain Prey content;
Within the Houses now they roam,
Into their Foe, the very Kitchen, come.
One does the Chimney-hearth assail,
Another flaps the Kettle with his slimy Tail.
No Image there of Death is seen,
No Cook-maid does obstruct their Sway,
They have entirely got the day.
Those who have once devour'd been
By mankind, now on Man do Feed:
Thus Fate decides, and steps between,
And sometimes gives the Slave the Victors meed.
The Beauteous Virgins whom the Gods might love,
Cou'd not the Curse of Heav'n remove;
Their goodness might for Crimes Atone,
Inexorable Death spares none.
Their tender Flesh lately so plump and good,
Is now made Fishes and Sea-monsters food;
In vain they cry,
Heav'n is grown Deaf, and no Petition hears,
Their Sighs are answer'd like their Lovers Pray'rs,
They in the Universal Ruin lye.

Nor is inexorable Fate content
To ruine one poor Town alone;
More Mischief by the Blow is done:
Death's on a farther Message sent.
When Fate a Garrison does Sack,
The very Suburbs do partake
Of Martial Law,
Its Forces draw
To every Mountain, Field and Wood,
They Ravage all the Neighborhood.
Worse than the weak Assaults of Steel,
Its Instruments of Death all places feel.
They undiscover'd, like fell Poison kill,
Its Warriors fierce,
The Earth, the Air, and Men do pierce;
And mounted, fight upon the winged Winds.
Here a great Mountain in a Valley's thrown,
And there a Valley to a Mountain grown.
The very Breath of an incensed God,
Makes even proud *Olympus* Nod.
Chang'd is the Beauty of the fruitful Isle,
And its fair Woods lopp'd for its Funeral Pile.
The moving Earth forms it self in Waves,
And Curls its Surface like the Rowling Seas;
Whilst Man (that little thing) so vainly Raves;
Nothing but Heaven can its own Wrath appease.

But Fate at length thought fit to leave its Toil,
And greedy Death was glutted with the Spoil.
As weary Soldiers having try'd their Steel,
Half drown'd with Blood, do then desist to kill.
More Ruin wou'd a second Deluge make,
Blot out the Name of the unhappy Isle.
It fares with her as when in Marial Field,
Resolv'd and Brave, and loath to yield,
Two num'rous Armies do contend,
And with repeated Shouts the Air do Rend.
Whilst the affrighted Earth does shake,
Some large Battalions are entirely lost,
And Warring Squadrons from the might Host:
Here by a Shot does fall
Some Potent General;
And near to him,
Another loses but a Limb.
Part of the Island was a Prey to Fate,
And all the rest do's but prolong its date,
Till injur'd Heav'n finds,
Its Bolts a Terror strike on humane Minds;
Sure we may hope the Sinners there Repent,
Since it has made their lewdest Priest Relent.

FINIS

COMMENT AND REPLY

"Geological records of tsunami events," by Simon Day—
Comment

by
James R. Goff
GeoEnvironmental Consultants, Lyttelton, New Zealand
geoenv@xtra.co.nz, http://www.naturalhazards.co.nz

I was a bit disappointed with the small article by Simon Day about geological records of tsunami events *[TsuInfo Alert*, v. 3, no. 3, p. 6-7] although I appreciate that it may simply be a short summary. At the risk of putting noses out of joint, he appears to suffer from the usual Northern Hemisphere (NH)-centric knowledge base about past tsunami, although I must give him credit for putting in Ted Bryant's and Jon Nott's stuff

However, when I read Simon Day's article (I do not mean to pick on one article in particular, let me just say that it appears to be representative of many papers and articles I read) I often wonder whether people up there (NH) ever bother to read anything about tsunami anywhere other than Europe and the Pacific Northwest, with Hawaii thrown in for good measure (OK – and the Canary Islands, but I hope you get my point)! Fortunately, and hopefully, this might be solved by giving all you NH people a simple-to-read paper with lots of references in it:

Goff, J. R.; Chagué-Goff, Catherine; Nichol, S. L., 2001, Palaeotsunami deposits–A New Zealand perspective: Sedimentary Geology, v. 143, p. 1-6.

This is a short paper, but it provides a good idea of what past tsunami deposits are like down here and elsewhere. To say that they fall into two main categories is wrong and Simon Day is wrong–they probably only fall into two main categories in the works he has read. The first tsunami deposit we ever found here was a mud layer in sand! It sounds counter-intuitive at first, but think about it. A tsunami deposit *fines inland*, so, depending where you are looking at it, the deposit must vary–*unless* the only material the tsunami had to work with was sand or boulders or mud, etc. In the case of the mud in sand, the deposit was 3.5 km inland–the last gasp of the tsunami so to speak, so all we found was mud.

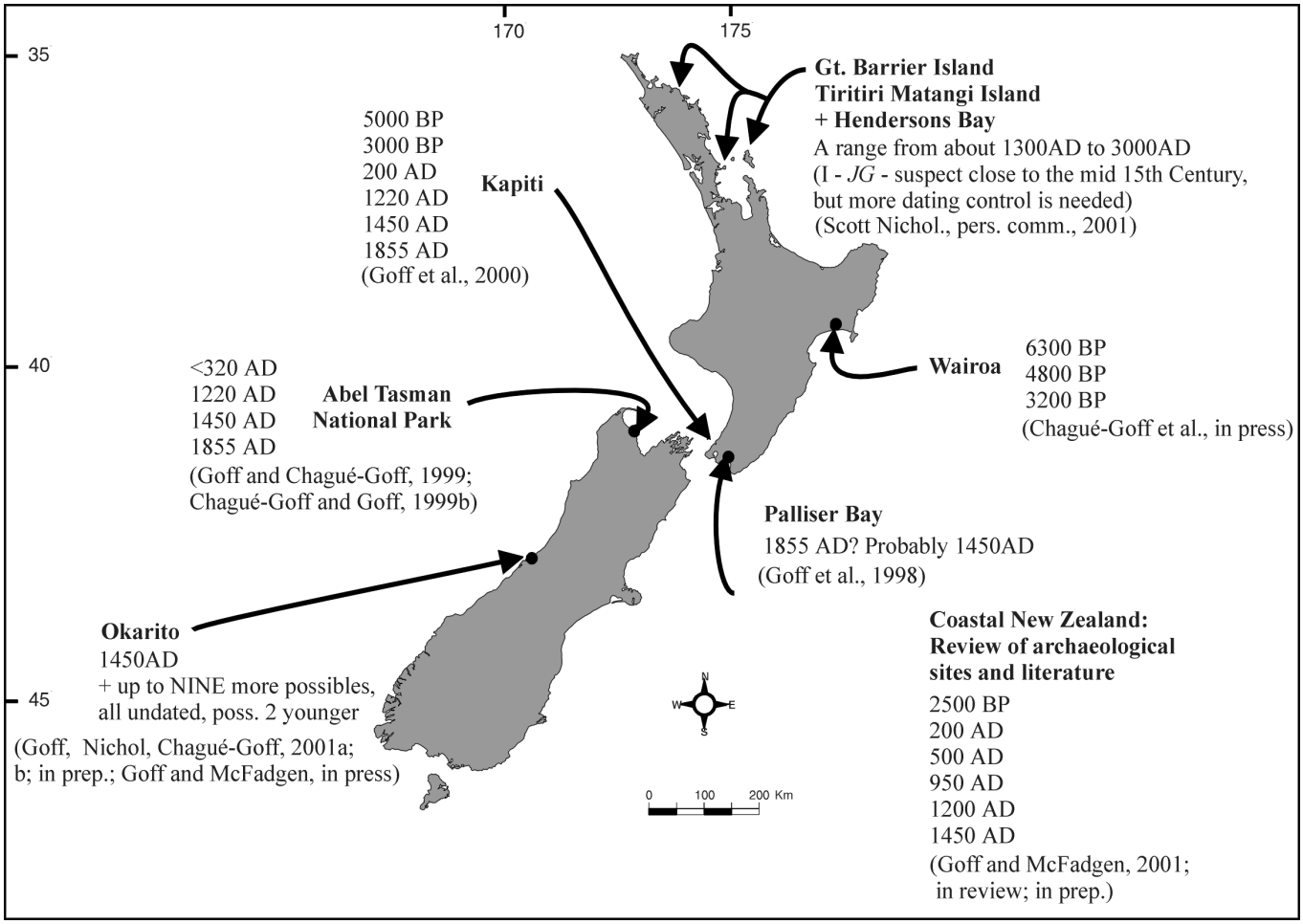
Sadly, Simon day's short paper does a grave injustice to past tsunami deposits. The deposits *cannot* be defined based solely on their sediment characteristics–if that were the case, we would probably have hundreds of 'misdiagnosed' depos-its here. There is a lot more than just sediment to determining a past tsunami deposit. Here, we use a suite of what we call "Diagnostic Criteria", the more you have, the more positive the identification.

Day mentions village abandonment, too. Yup, we have that as well (Goff and McFadgen, 2001; one in review listed below, one in preparation; and the upcoming paper in the ITS 2001 symposium). We also may well be able to challenge Oregon/Washington sites for the best record of deposits, but I wouldn't want to go that far quite yet! How-ever, one site we have recently worked on may have up to **ten** events (Goff and others, 2001a, 2001b). If that one site fails to win, then I reckon we can take the biscuit with our mid-15th Century event which we find on both the east and west coasts of both islands–in other words, Nationwide. I bet you don't have one of those–yet!!

Figure 1 (modified from the figure in Goff et al., 2001, Sedimentary Geology), is an updated summary of dates, places, and references. It is not exhaustive, but might prove useful to you unfortunate Northern Hemisphere people who forget that we have all the real action going on down here! I mean ONE tsunami around the UK and everybody gets excited–even the 1755AD Lisbon one is a bit patchy and dull. Hells' teeth, we have one here that is more than three feet thick at 1.5 km inland, and it even has cobbles in it at that point!

I must admit that we have not as yet found the "Mega-tsunami" ones. I think this is simply because we haven't been looking for them–there is too much to do, no money, and too few of us around. (This is a big hint for some international collaboration!) Having said that, colleagues and I have briefly looked at several sites with 'unusual deposits' up to 160 m above sea level. Although I suspect that while the highest ones are probably aolian, some would need some serious wind to get them where they are.

One of the key things about a tsunami deposit, in the simplest of terms, is that it is a "deposit out of place". In other words, in most cases it is a layer that you don't expect to find where you find it, be it mud, sand, pebbles, cobbles, boulders, or even just ripped up material (we have nearly all of these). How-ever, life is never quite that simple. For example, if you are working on sand dunes, and the tsunami only had sand to work with, then the deposit will be sand in sand. That is hard to find unless it has just happened (e.g. PNG 1998), and even harder to convince people about. As another exam-ple, Scott Nichol found a veneer of pebbles that can be traced to at least 13 m above sea level and extending more than a mile along the beach. It is visible as a lag deposit overlying sand dunes and is not winnowed by the wind. Actually this is now the smaller brother of a similar deposit he has just found. We are not sure how big that is, but it is probably up to 18m above sea level, stretching for many miles along the coast. Hey ho–it never ends and he has graciously included me in his on-going work.



Simon Day's short article was a bit frustrating because it seemed to trivialise the work we paleotsunami people do here, and his examples got me a bit miffed. We have plenty in New Zealand, we have published a fair bit on them, ours are as interesting as any others I have seen around the world (haven't seen Brian Atwater's yet, but I suspect his are just a bit more accessible than ours, and quite stunning!). I also note than Day didn't mention the brilliant work done in Canada by the likes of John Clague and Ian Hutchinson, but then since this is also really the "Pacific Northwest" I guess that is understandable.

Day also says that these tsunami deposits are only found on flat land–NO! Also that they give no help in estimating runup–NO! They are actually quite useful for that because one can work out a relationship between the distance the sediment can be traced inland and the distance that water went inland based upon historically documented events. While not perfect, it gives an idea of the kind of runup height you might expect in an area if you find a tsunami deposit. Also, they do not all occur on flat land but instead are often draped over a series of uplifted beach ridges, or runup inland, or are in flat areas behind some form of coastal barrier that was overtopped. All of these give an indication of a minimum runup height. For some parts of New Zealand we now have a general rule that a tsunami wave has to be over 5.0 m high to leave a recognisable deposit–a sand sheet or something like that. If it is less than that, you have to resort to microscopic analysis and hope you find it. And finally, we have recently produced the first report of its type in New Zealand (don't know about the rest of the world) which uses tsunami modelling, the historical database, *and* paleotsunami data to produce a tsunami hazard/risk assessment for one of our regional councils (the New Zealand equivalent of a U.S. state I guess). This is innovative for New Zealand, and hopefully it is an improvement; we will wait and see how much flak it gets. As an example though, prior to this work, there was an estimated return period for a 5 m tsunami of about once every 270 years, based on historical data. The modelling only really showed what would happen in a particular scenario if one of the many faults off New Zealand's coast ruptured and therefore gave no indication of return period and was limited by the parameters set. The models give an approximation, but that ain't good enough. The paleo stuff brought the return period down to

about once every 85 years! It also provided data about events that people did not believe (typical) but then the modellers gave it a try and found out that the paleo data were correct. So we now have a situation where we want to iterate modelling and paleotsunami work to improve the modelling *and* our records of past events.

I was rather interested to find out that Hawaii and New Zealand have about the same return periods for tsunami. So you can imagine my surprise when I found out that (other than the Moore and Moore stuff which is a little old) as far as I am aware, *no* paleotsunami work has been done on Hawaii. There must be a huge repository of deposits there that can help in understanding the tsunami hazard, so I plan to visit and have a quick look after the symposium! Anyone interested?

References and Suggested Readings

Chagué-Goff, Catherine; Dawson, Sue; Goff, J. R.; Zachariasen, Judith.; Berryman, K. R.; Garnett, D. L.; Waldron, H.M.; Mildenhall, D. C., in press, A mid-Holocene (c. 6300 years BP) catastrophic saltwater inundation (tsunami) in Northern Hawke's Bay, New Zealand: Sedimentary Geology.

Chagué-Goff, Catherine; Goff, J. R., 1999b, Geochemical and sedimentological signature of catastrophic saltwater inundations (tsunami), New Zealand: Quaternary Australiasia, v. 17, p. 38-48.

Goff, J. R.; Chagué-Goff, Catherine, 1999, A late Holocene record of environmental changes from coastal wetlands, Abel Tasman National Park, New Zealand: Quaternary International, v. 56, p. 39-51.

Goff, J. R.; Chagué-Goff, Catherine, 2001, Catastrophic events in New Zealand coastal environments: CAS Note 333, Department of Conservation Report, Science and Research Unit, Wellington, 16 p.

Goff, J. R.; Chagué-Goff, C.; Nichol, S. L., 2001, Palaeotsunami deposits–A New Zealand perspective: Sedimentary Geology, v. 143, p. 1-6.

Goff, J. R.; Crozier, Michael; Sutherland, Venus; Cochran, Ursula; Shane, Phil, 1998, Possible tsunami deposits of the 1855 earthquake, North island, New Zealand. *In* Stewart, I. S.; Vita-Finzi, C., editors, Coastal tectonics: Geological Society Special Publication 133, p. 353-374.

Goff, J. R.; McFadgen, B. G., in prep., 2001, Seismic driving of nationwide change in geomorphology, vegetation and prehistoric settlement–A stratigraphic analysis: [to be submitted to Science].

Goff, J. R.; McFadgen, B. G., (in review, 2001), Large earthquakes and the subsequent abandonment of prehistoric coastal settlements, New Zealand: Marine Geology.

Goff, J.R.; McFadgen, B.G., 2001, Catastrophic seismic-related events and their impact on prehistoric human occupation in coastal New Zealand: Antiquity, v. 74, p. 155-162.

Goff, J. R.; Nichol, S. L.; Chagué-Goff, Catherine, 2001, Evidence for catastrophic inundation of the West Coast–Okarito Lagoon: Report for West Coast Regional Council, Hokitika, 34 p.

Goff, J. R.; Nichol, S. L.; Chagué-Goff, Catherine, in press, Environmental changes in Okarito Lagoon, Westland: GeoEnvironmental Consultants Client Report 20003; Conservation Advisory Sciences Notes, Department of Conservation, Wellington, 34 p.

Goff, J. R.; Nichol, S. L.; Chagué-Goff, Catherine; Devoy, R. J.; Hayward, Bruce.; James, I., in prep., Subsidence and tsunami on the West Coast of New Zealand: [to be submitted to Marine Geology].

Goff, J. R.; Rouse, H. L.; Jones, Sarah; Hayward, Bruce; Cochran, Ursula; McLea, Bill; Dickinson, W. W.; Morley, M. S., 2000, Evidence for an earthquake and tsunami about 3100-3400 years ago, and other catastrophic saltwater inundations recorded in a coastal lagoon, New Zealand: Marine Geology, v. 171, p. 233-251.

Editor's note: We have requested copies of these papers from Dr. Goff, and hope to announce their availability in the next issue.

"Geological records of tsunami events"-- Reply to James R. Goff

by

Simon Day

I was most interested to read Dr. Goff's comments on the section of the TSUNAMI website http://www.nerc-bas.ac.uk/tsunami- reprinted in *TsuInfo Alert* (v. 3, no. 3, p. 6-7, June 2001). I'd like to take this opportunity to congratulate him and his colleagues on their recent work and to recommend application of their methods in regions where tsunami deposits are as abundant and well-preserved as they appear to be in New Zealand.

I emphasise the word "recent" in the above because, in extenuation of my omission of mention of the work of Goff and co-workers, I would point out that the section of the website from which the article in *TsuInfo Alert* was taken was written in late 1999 under a contract that ended in early 2000, so it doesn't reflect the most recent work on tsunami deposits. I hope he and his colleagues will accept my apologies in this respect.

However, I do feel that there are a number of significant points made in the article and in Dr. Goff's reply on which I beg to differ.

First, it is evident that Dr. Goff and his colleagues, along with Atwater, Hemphill-Haley, Clague and others working along the Cascadia margin from Oregon to British Columbia are much more fortunate than most "tsunami geologists" in working in regions in which tsunami deposits are initially thick and well-developed and subsequently well-preserved. This is most likely due to high sediment supply rates to coastal areas offshore from the mountainous and volcanic regions of the Cascades and New Zealand

(hence an abundance of available loose or unconsolidated sediment that can be reworked by tsunamis), coupled with tectonic conditions (slow regional uplift) that favour the preservation of the deposits on raised beaches or within uplifted coastal lagoon deposits. This same combination of environmental factors may have also contributed to the occurrence and preservation of the unusual mud-rich tsunami deposit mentioned by Dr. Goff. Its occurrence would, I think, require a very high-concentration suspended sediment load in the tsunami as it spread over the coast: ripped-up fragments of cohesive mud do occur as a minor component of sand-dominated tsunami deposits but mud-dominated deposits really are rare. I did say "two *main* categories" of tsunami deposit ……

The rest of us are not so lucky: lower sediment supply rates, active coastal erosion and steep, rocky shorelines conspire to reduce the potential for tsunami deposit preservation. Dr. Goff mentions the 1755 Lisbon tsunami, a very large tsunami that has left very patchy deposits in areas that are known, from the historical accounts of damage, to have been extensively inundated. In this type of situation it is possible that the characteristic signature of a tsunami is an *erosion* event rather than a *deposition* event. This may well be the case in Hawaii, for example, where the coastlines are very sediment poor, subject to active erosion by normal ocean waves, and for the most part very steep and rocky. Historic and sub-historic tsunami deposits are certainly very limited in extent there. Erosion events are inherently more difficult to work with, although Ted Bryant (an inhabitant of the Southern Hemisphere) and colleagues have shown that this is not impossible. When you have to base a tsunami hazard estimate on deposits that are only patchily present in areas that are known to have been inundated by tsunamis from historical evidence (as in the case of the 1755 Lisbon tsunami deposit), or (even worse) on deposits that are very obviously only remnants left by erosion, you have to be cautious and adopt a minimum-inundation principle. New Zealand may be an exception to this, but I would argue that it is the exception that proves the rule. As I put it: "The extent of the remaining deposits only provides a minimum value for the inundation distance of the source tsunami waves".

Dr. Goff correctly points out that the recent work by him and his colleagues can be used as the basis for calibrating empirical equations relating inundation distance over flat ground to maximum runup heights. However, I would urge caution because inundation distance depends in part on the roughness of the ground being flooded by the tsunami waves. Simply put: trees, lava flows and buildings impede the onward rush of water, so it penetrates less far inland (by factors of up to 10) than it would penetrate over flat open ground, before the crest of the wave passes and the water drains back before the next wave arrives. So, the equations may not be all that accurate unless applied with care.

In respect of Dr. Goff's point about not using sedimentological criteria alone, again I would suggest that this again reflects the advantages that he and his colleagues enjoy in looking at frequently-formed and well-preserved deposits. When all you have is a remnant "deposit out of place" as Dr. Goff puts it, sedimentological criteria may be all that you have to work with. There is an urgent need (another area for international collaboration?) for sedimentological characterisation of these clear examples of tsunami deposits as a toolkit of sedimentological criteria to apply in areas of poor tsunami deposit preservation. While regions such as New Zealand and the Cascadia margin of North America are obviously excellent places for such studies, I would urge caution in applying the results uncritically to other regions where the sedimentological and tectonic circumstances are different.

There is also the nasty problem, most acute in Hawaii but applicable to other regions of active deformation, that a recent marine deposit may not actually be "out of place" even though it is tens or even hundreds of metres above present sea level. Contrary to Dr. Goff's comment, the deposits originally described by Moore and Moore (1984) have indeed been the subject of much recent work, but most of it has been aimed at proving that these are beach and shallow marine deposits raised to their present position by rapid uplift of the island of Lanai (for example: Grigg and Jones, 1997; Rubin and others, 2000). My own view is that the jury is still out on this one, since the raised beach interpretation also has its problems (in particular, the ages of the deposits don't quite follow the sequence of interglacial sea level highstands that they should, but instead more closely match the ages of volcano collapses on Hawaii determined by McMurtry and others, 1999. Mostly, though, I'm just glad to be working on--amongst other things--potential tsunami deposits in islands that are much more tectonically stable, have well-defined sea level curves, and so are places where it is possible to prove that the deposits concerned are significantly higher than deposits associated with sea level high stands and so are indeed "out of place".

As a final thought, I would like to respond to Doctor Goff's comments on the separation of northern and southern hemispheres. I would suggest that a more fundamental division exists between the Pacific rim (and certain geologically comparable areas, such as the Caribbean and Indonesia) where earthquake-generated tsunamis are frequent and circumstances are often such that the resulting relatively recent tsunami deposits are well-preserved; and oceans with so-called passive margins, most especially the Atlantic but also much of the Indian ocean.

In the latter oceans, the dominant tsunami hazards are due to the rarer but much larger tsunamis produced by continental slope sediment failures, such as the Storegga landslide; impacts of asteroids and comets; and collapses of ocean island volcanoes, such as those that have occurred in

the geologically recent past on Hawaii; Reunion in the Indian Ocean; and the Canaries and Cape Verde Islands in the Atlantic. The comparative rarity of these events means that deposits from them-- although such deposits are now being recognised--are much less likely to survive the ravages of erosion with anything like the completeness of the recent tsunami deposits in Cascadia and New Zealand. On the other hand, in the case of tsunamis caused by sediment slides and volcano collapses (but NOT impacts, unfortunately) it is easier to identify, date and characterise the source events than is the case with prehistoric earthquakes. Thus, the "toolkits" of scientific methods used to study them will have to be rather different, with perhaps more emphasis being placed on sedimentological and historical studies around the Pacific rim, whilst in the Atlantic and similar oceans more reliance will likely have to be placed on suitably calibrated and tested theoretical models of tsunami generation and propagation. Nevertheless, much potential exists for collaboration and exchanges of ideas and techniques between scientists working on tsunamis in different parts of the world, and I await the results of the ongoing work by Dr. Goff and his colleagues with much interest.

Additional references

Grigg, R. W.; Jones, A. T., 1997, Uplift caused by lithospheric flexure in the Hawaiian archipelago as revealed by elevated coral deposits: Marine Geology, v. 141, no. 1-4, p. 11-25.

McMurtry, G. M.; Herrero-Bervera, Emilio; Cremer, M. D.; Smith, J. R.; Resig, Johanna; Sherman, Clark; Torresan, M. E., 1999, Stratigraphic constraints on the timing and emplacement of the Alika 2 giant Hawaiian submarine landslide: Journal of Volcanology and Geothermal Research, v. 94, no. 1-4, p. 35-58.

Moore, J. G.; Moore, G. W.; Szabo, B. J., 1984, Age of debris from a huge Pleistocene wave on Lanai, Hawaii [abstract]: Eos (American Geophysical Union Transactions), v. 65, no. 45, p. 1082.

Rubin, K. H.; Fletcher, C. H., III; Sherman, Clark, 2000, Fossiliferous Lana'i deposits formed by multiple events rather than a single giant tsunami: Nature, v. 408, no. 6813, p. 675-681.

NEW TSUNAMI MITIGATION MATERIALS

Added to the DGER Library, February through March, 2001

compiled by

Connie J. Manson

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

articles in the new issue of
Science of Tsunami Hazards, v. 19, no. 2

Current tsunami research

Heinrich, Philippe; Piatanesi, Alessio; Okal, E. A.; Hebert, Helene, 2000, Near-field modeling of the July 17, 1998 tsunami in Papua New Guinea: Geophysical Research Letters, v. 27, no. 19, p. 3037-3040.

Geist, E. L., 2001, Reply to comment by E. A. Okal and C. E. Synolakis on 'Origin of the 17 July 1998 Papua New Guinea tsunami--Earthquake or landslide?' by E. L. Geist: Seismological Research Letters, v. 72, no. 3, p. 367-372.

Mofjeld, H. O.; Gonzalez, F. I.; Bernard, E. N.; Newman, J. C., 2000, Forecasting the heights of later waves in Pacific-wide tsunamis: Natural Hazards, v. 22, no. 1, p. 71-89.

Okal, E. A.; Synolakis, C. E., 2001, Comment on 'Origin of the 17 July 1998 Papua New Guinea tsunami--Earthquake or landslide?' by E. L. Geist: Seismological Research Letters, v. 72, no. 3, p. 362-366.

Phipps, J. B.; Jol, H. M.; Peterson, C. D.; Vanderburgh, Sandy, 2001, Sand dune reactivation and subduction zone earthquakes in the Grayland area: Washington Geology, v. 28, no. 3, p. 31-33.

Rudolph, Megan, 2001, Silent earthquakes: Geotimes, v. 46, no. 6, p. 8.

Shennan, Ian; Long, A. J.; Rutherford, M. M.; Innes, J. B.; Green, F. M.; Walker, K. J., 1998, Tidal marsh stratigraphy, sea-level change and large earthquakes--II; Submergence events during the last 3500 years at Netarts Bay, Oregon, USA: Quaternary Science Reviews, v. 17, no. 4-5, p. 365-393.

Tappin, D. R.; Watts, Philip; McMurtry, G. M.; Lafoy, Yves; Matsumoto, T., 2001, The Sissano, Papua New Guinea tsunami of July 1998--Offshore evidence on the source mechanism: Marine Geology, v. 175, no. 1-4, p. 1-23.

Tsuboi, Seiji, 2000, Application of Mwp to tsunami earthquake: Geophysical Research Letters, v. 27, no. 19, p. 3105-3108.

Tsuji, Yoshinobu; Ueda, Kazue; Satake, Kenji, 1998, Japanese tsunami records from the January 1700 earthquake in the Cascadia subduction zone: Zisin (Seismological Society of Japan Journal), v. 51, p. 1-17.

Ward, S. N., 2001, Landslide tsunami: Journal of Geophysical Research, v. 106, no. B6, p. 11,201-11,215.

Ward, S. N.; Asphaug, Erik, 1999, Asteroid impact tsunami--A probabilistic hazard assessment: [Privately published by the authors; accessed June 19, 2001 at www.es.ucsc.edu/~asphaug/WardAsphaugTsunami.pdf].

Papers presented at the Puget Sound tsunami/landslide workshop, January 23 and 24, 2001

Crawford, G. L.; Mofjeld, H. O.; Weaver, C. S., organizers, 2001, Summary--Puget Sound tsunami/landslide workshop, January 23 and 24, 2001: Washington State Military Department, 30 p. [accessed June 25, 2001 at http://www.pmel.noaa.gov/tsunami/Ws20010123].

Includes:

Atwater, B. F., 2001, Tsunami tutorial--Nature of the threat. p. 13-14

Best, M. E., 2001, State hazard mitigation. p. 5-6

Crawford, G. L.; Bernard, E. N.; Winterfield, Trudy, 2001, Introduction--'Preparedness requires cooperation.' p. 5

Goodwin, R. F.; Wood, Nate, 2001, Reducing earthquake/tsunami hazards in Pacific Northwest ports and harbors. p. 12-13

Jonientz-Trisler, Chris, 2001, Tsunami mitigation. p. 7-8

Langhelm, Ron; Graettinger, George; Wayne, Chris; Vance, Tiffany, 2001, HAZUS/GIS systems. p. 22-23

Mofjeld, H. O., 2001, Tsunami tutorial--Emergency management issues. p. 14-15

Parsons, Chris, 2001, Growth management. p. 6

Titov, V. V.; Atwater, B. F.; Koshimura, Shun-ichi; Myers, E. P., III; Rabinovich, A. B.; Yeh, Harry, 2001, Tsunamis. p. 20-21

Weaver, C. S., 2001, Earthquake tutorial. p. 15-16

Weaver, C. S.; Geist, E. L.; Brocher, T. M.; Booth, D. B., 2001, Earthquakes/faults. p. 18-19

Classic Tsunami Research Materials

Bernard, E. N.; Gonzalez, F. I., editors, 1994, Tsunami inundation modeling workshop report; (November 16-18, 1993): U.S. National Oceanic and Atmospheric Administration Technical Memorandum ERL PMEL-100, 119 p.

Includes:

Cho, Y.-S.; Seo, S. N.; Liu, P. L.-F., 1994, A leap-frog scheme for linearized Boussinesq equations. p. 75-102.

Curtis, G. D., 1991, repr. 1994, Hawaii tsunami inundation/evacuation map project; Final report. p. 29-56.

Kowalik, Zygmunt; Murty, T. S., 1993, repr. 1994, Numerical simulation of two-dimensional tsunami runup. p. 117-130.

Liu, P. L.-F.; Yoon, S. B.; Seo, S. N.; Cho, Y.-S., 1994, Numerical simulations of tsunami inundation at Hilo, Hawaii. p. 103-115.

Mader, C. L.; Curtis, G. D., 1994, Modeling Hilo, Hawaii tsunami inundation. p. 57-66.

Mader, C. L.; Curtis, G. D.; Nabeshima, George, 1994, Modeling tsunami flooding of Hilo, Hawaii. p. 67-74.

Titov, V. V.; Synolakis, C. E., 1993, repr. 1994, A numerical study of wave runup of the September 1, 1992 Nicaraguan tsunami. 131-139.

Hwang, L.-S.; Lee, Y. K., editors, 1979, Tsunamis--Proceedings of the National Science Foundation workshop, May 1979: Tetra Tech, Inc., 328 p.

Includes:

Carrier, G. F., 1979, Coastal transformations. p. 153-155.

Houston, J. R., 1979, Tsunami numerical modeling--an overview. p. 231-248.

Hwang, L.-S., 1979, Summary and discussions. p. 299-309.

Kajiura, Kinjiro, 1979, Tsunami generation. p. 15-40.

Kanamori, Hiroo, 1979, Characteristics of ground motions. p. 10-12.

Lee, Y. K., 1979, Tsunami risk analysis. p. 254-277.

LeMehaute, Bernard, 1979, Engineering methods--Run-up, surge on dry bed, energy dissipation of tsunami waves. p. 156-181.

Liu, S. C., 1979, Inaugural address. p. 3-4.

Mei, C. C., 1979, Aspects of numerical method for long wave diffraction. p. 225-230.

Plafker, George, 1979, Fault mechanisms and frequencies of occurrence. p. 7-9.

Raichlen, F., 1979, Bay and harbor response to tsunamis. p. 188-221.

Reid, R. O., 1979, Island response to tsunamis. p. 182-185.

Tuck, E. O., 1979, Models for predicting tsunami propagation. p. 43-109.

Van Dorn, W. G., 1979, Instrumentation and observations. p. 281-295.

Wiegel, R. L., 1979, Shore protection and flood plain management. p. 251-253.

Wu, T. Y., 1979, On tsunami propagation--Evaluation of existing models. p. 110-149.

Intergovernmental Oceanographic Commission, 1989, IOC workshop on the technical aspects of tsunami warning systems, tsunami analysis, preparedness, observation and instrumentation: UNESCO, 1 v.

Includes:

Bobkov, A.; Go, C. N.; Zhigulina, N.; Simonov, K. V., 1989, An automated tsunami catalog [abstract].

Burton, G., 1989, Hawaii regional tsunami warning system [abstract].

Burton, G., 1989, Pacific Tsunami Warning Center [abstract].

Dewey, J., 1989, Operative seismic data processing in the NEIC and plans for the new U.S. National Seismic Network [abstract].

Gonzalez, F. I.; Bernard, E. N.; Milburn, H. B.; Mattens, D., 1989, A long-term deep ocean tsunami measurement program--Strategy and instrumentation [abstract].

Gusiakov, V. K.; Marchuk, A. G.; Titov, V. V., 1989, Application of new numerical methods for mear-real time tsunami height prediction [abstract].

Hamada, N., 1989, Japan Tsunami Warning Center [abstract].

Ivashchenko, A. I.; Poplavsky, A. A.; Soloviev, S. L., 1989, On earthquake tsunami generation criteria [abstract].

Iwasaki, S., 1989, The feasibility of measuring the low frequency T phase for tsunami warnings [abstract].

Kuzminykh, I.; Malyshev, M.; Metalinkov, A., 1989, The goal and efficiency of the automated tsunami warning system project in the far east of the USSR [abstract].

Kuznetsov, B., 1989, USSR Tsunami Warning Center [abstract].

Lander, J. F., 1989, Historical approach to the study of tsunamis--Recent U.S. results [abstract].

Lorca, E. E., 1989, Chile Tsunami Warning Center [abstract].

Murty, T. S.; Rapatz, W., 1989, Tsunami data base for British Columbia tsunami warnings [abstract].

Okada, Masami; Katsumata, M., 1989, Tsunami observations using ocean bottom pressure gauge [abstract].
Pararas-Carayannis, George, 1989, International cooperation in the field of tsunami research and warning [abstract].
Pararas-Carayannis, George, 1989, Tsunamis of the 21st Century [abstract].
Prasad, Gajendra, 1989, Tsunami watches and warnings in Fiji [abstract].
Rybin, G., 1989, Offshore tsunami warning station--MEGA [abstract].
Shokin, Y. I.; Chubarov, L. B.; Novikov, V. A.; Sudakov, A. N.; Simonov, K. V., 1989, The development of numerical simulation of tsunami waves at the computing center at Krasnoyarsk [abstract].
Sokolowski, T. J., 1989, Alaska regional tsunami warning center [abstract].
Talandier, J., 1989, French Polynesia Tsunami Warning Center [abstract].
Tinti, Stefano, 1989, Assessment and mitigation of the tsunami hazard in the Mediterranean area [abstract].
Yang, H., 1989, Integrated warning system for tsunami and storm surges in China [abstract].

Intergovernmental Oceanographic Commission, 1991, International co-ordination group for the Tsunami Warning System in the Pacific; thirteenth session: UNESCO, 1 v.

Intergovernmental Oceanographic Commission, 1993, International co-ordination group for the Tsunami Warning System in the Pacific; fourteenth session: UNESCO, 1 v.

Intergovernmental Oceanographic Commission, 1995, International co-ordination group for the Tsunami Warning System in the Pacific; fifteenth session: UNESCO, 1 v.

Japan Disaster Prevention Bureau, 1994, Disaster countermeasures in Japan: Japan Disaster Prevention Bureau, 23 p.

Japan Disaster Prevention Bureau, 1999, Earthquake disaster countermeasures in Japan: Japan Disaster Prevention Bureau, 33 p.

Japan Meteorological Agency, 1991, Tsunami--Observation and forecasting methods in Japan: Japan Meteorological Agency, 10 p.

Neumann, Frank, 1966, Principles underlying the interpretation of seismograms; rev. ed.: U.S. Coast and Geodetic Survey, 50 p., 6 plates.

Salsman, G. G., 1959, The tsunami of March 9, 1957, as recorded at tide stations: U.S. Coast and Geodetic Survey Technical Bulletin 6, 18 p.

Sokolowski, T. J.; Whitmore, P. M.; Jorgensen, W. J., 1990, The ATWC's automatic and interactive computer processing system: U.S. National Oceanic and Atmospheric Administration Technical Memorandum NWS AR-39, 23 p.

Sokolowski, T. J.; Whitmore, P. M.; Jorgensen, W. J.; Medbery, A. H., 1990, Expert system in tsunami hazard mitigation: U.S. National Oceanic and Atmospheric Administration Technical Memorandum NWS AR-42, 11 p.

Spaeth, M. G.; Berkman, S. C., 1967, The tsunami of March 28, 1964, as recorded at tide stations: U.S. Coast and Geodetic Survey Technical Bulletin 33, 86 p.

U.S. National Oceanic and Atmospheric Administration, 1978, Packaged literature search 78-4--Tsunamis; First edition: U.S. National Oceanic and Atmospheric Administration, 27 p.

U.S. National Oceanic and Atmospheric Administration, 1980, Packaged literature search 80-1--Tsunamis; Second edition: U.S. National Oceanic and Atmospheric Administration, 38 p.

Urban Regional Research, 1982, Land management guidelines in tsunami hazard zones: National Science Foundation, 258 p.

Zerbe, W. B., 1953, The tsunami of November 4, 1952 as recorded at tide stations: U.S. Coast and Geodetic Survey Special Publication 300, 62 p.

Reports about the Nisqually Earthquake, February 28, 2001

Preliminary technical reports:

Bray, J. D.; Sancio, R. B.; Kammerer, A. M.; Merry, Scott; Rodriguez-Marek, Adrian; Khazai, Bijan; Chang, Susan; Bastani, Ali; Collins, Brian; and others, 2001, Some observations and geotechnical aspects of the February 28, 2001, Nisqually earthquake in Olympia, south Seattle, and Tacoma, Washington: Pacific Earthquake Engineering Research Center [accessed June 25, 2001 at http://www.ce.berkeley.edu/~sancio/nisqually], 1 v.
Filiatrault, Andre; Uang, C.-M.; Folz, Bryan; Chrstopoulos, Constantin; Gatto, Kip, 2001, Reconnaissance report of the February 28, 2001 Nisqually (Seattle-Olympia) earthquake: University of California, San Diego Department of Structural Engineering, 62 p. [accessed June 25, 2001 at http://www.structures.ucsd.edu/UCSD%Reconnaissance%20Report.pdf].
Pacific Northwest Seismograph Network, 2001, Preliminary report on the Mw=6.8 Nisqually, Washington earthquake of 28 February 2001: Seismological Research Letters, v. 72, no. 3, p. 352-361.

Preliminary summaries:

from: **Washington Geology, v. 28, no. 3, 2001.**

Earthquake creates gassy mounds in Offut Lake: p. 19.
Lasmanis, Raymond, 2001, Surviving the Nisqually earthquake: Washington Geology, v. 28, no. 3, p. 3-5.
Logan, R. L., 2001, Personal account: Washington Geology, v. 28, no. 3, p. 19.
Ludwin, R. S., 2001, Earthquake prediction: Washington Geology, v. 28, no. 3, p. 27-28.
Mabey, M. A., 2001, The Charlatan game: Washington Geology, v. 28, no. 3, p. 29-30.
Norris, R. D., 2001, Observations during the Nisqually earthquake on Harbor Island, Seattle, Washington: Washington Geology, v. 28, no. 3, p. 25-26.
Phipps, Rich, 2001, Personal account: Washington Geology, v. 28,

no. 3, p. 3.
Smith, Dorian, 2001, Earthquake damage minor at the Natural Resources Building: Washington Geology, v. 28, no. 3, p. 2.
Smith, Dorian, 2001, Natural Resources Building earthquake mitigation: Washington Geology, v. 28, no. 3, p. 24.
Walsh, T. J.; Gerstel, W. J.; Pringle, P. T.; Palmer, S. P., 2001, Earthquakes in Washington State: Washington Geology, v. 28, no. 3, p. 22-23.
Walsh, T. J.; Pringle, P. T.; Palmer, S. P., 2001, Working a geologic disaster: Washington Geology, v. 28, no. 3, p. 6-18.

from: **Seismological Research Letters, v. 72, no. 3, 2001.**

Bakun, W. H.; Ludwin, R. S., 2001, Significant historical Puget Sound earthquakes [abstract]. p. 392.
Barnhardt, W. A.; Kayen, R. E.; Palmer, S. P.; Troost, K. G.; Sherrod, B. L., 2001, Ground deformation at the Port of Seattle during the Nisqually earthquake [abstract]. p. 391.
Booth, D. B.; Wells, R. E.; Givler, Rob; DuRoss, Christopher; Blakely, R. J.; Meeks, Elizabeth; Ebel, Karen; Fryer, Jacob; Troost, K. G.; Booth, Rachel; and others, 2001, Chimney damage patterns in the greater Seattle area from the Nisqually earthquake of February 28, 2001 [abstract]. p. 395.
Bray, J. D.; Sancio, R. B.; Kammerer, A. M.; Merry, Scott; Rodriguez-Marek, Adrian; Khazai, Bijan; Chang, Susan; Bastani, Ali; Collins, Brian; and others, ,2001, Some observations of geotechnical aspects of the February 28, 2001, Nisqually earthquake in Olympia, and south Seattle, Washington [abstract]. p. 395-396.
Campbell, K. W.; Bozorgnia, Y., 2001, Engineering implications of ground motions from the Mw 6.8 Nisqually (Seattle) earthquake of February 28, 2001 [abstract]. p. 392.
Crider, J. G.; Schermer, E. R.; Haugerud, R. A., 2001, Liquefaction of the Issaquah Creek delta during the Nisqually earthquake [abstract]. p. 394.
Crosson, R. S.; Creager, K. C.; Malone, S. D.; Thomas, G. C.; Ludwin, R. S.; Qamar, A. I.; Weaver, C. S.; Pratt, T. L., 2001, The magnitude 6.8 Nisqually earthquake of February 28, 2001--Seismological aspects [abstract]. p. 394.
Dreger, D.; Murray, M. H.; Kaverina, A., 2001, Finite source process of the 28 February 2001 Mw 6.8 Nisqually, WA earthquake [abstract]. p. 391.
Frankel, A. D.; Carver, D. L.; Malone, S. D.; Thomas, G. C.; Weaver, C. S.; Stephens, C.; Porcella, Ron; Benz, H. M.; Filson, J. R.; Wong, I. G.; and others, 2001, Overview of strong-motion recordings of the M6.8 Nisqually, Washington, earthquake [abstract]. p. 390-391.
Haugerud, R. A.; Thomas, G. C.; Palmer, S. P., 2001, Regional map view of instrumentally-determined ground motions, Nisqually earthquake of 28 February 2001 [abstract]. p. 393.
Haugerud, R. A.; Troost, K. G.; Harp, E. L.; Wegmann, K. W.; Sherrod, B. L.; Pratt, T. L.; Powers, P. S.; Kramer, S. L., 2001, Regional map view of ground deformation associated with the Nisqually earthquake, 28 February 2001 [abstract]. p. 392-393.
Hopper, M. G.; Adams, E. R.; Wald, D. J.; Dewey, J. W., 2001, Map of modified Mercalli intensities for the Nisqually (Washington State) earthquake of 28 February 2001 [abstract]. p. 390.
Kirby, S. H., 2001, Aftershock impoverishment of the M6.8 Nisqually earthquake and other intraslab earthquakes--A possible physical explanation [abstract]. p. 395.
Lasmanis, Raymond, 2001, The February 28, 2001 Nisqually earthquake and Natural Resources Building response--A case study for nonstructural mitigation [abstract]. p. 395.
McCrory, P. A.; Walter, S. R.; Crosson, R. S., 2001, Possible discontinuity in Juan de Fuca plate in the vicinity of the 2001 (M6.8) Nisqually earthquake [abstract]. p. 391.
Melbourne, Tim, 2001, An unprecedented topside image of the 410 km discontinuity from the Nisqually earthquake [abstract]. p. 395.
Miller, M. M.; Austin, K. E.; Johnson, D. J.; Miner, A. M.; Rubin, C. M.; Ardoin, Charles; August, Michael; Barson, John; Cawley-Murphree, Althea; and others, 2001, Geodetic signature of the February 28, 2001 Nisqually earthquake--PANGA's earthquake response [abstract]. p. 391.
Nabelek, J. L.; McCaffrey, Robert, 2001, Seismological and geodetic observations of the 28 February, 2001 Nisqually, Washington earthquake [abstract]. p. 393-394.
Palmer, S. P.; Moses, L. J., 2001, Lateral spreading in the Olympia, Washington area during the Nisqually earthquake [abstract]. p. 392.
Perkins, W. J.; Chang, S. W.; Mitchell, R. M.; Nykamp, M. A.; Palmer, S. P., 2001, Comparison of liquefaction and lateral spreading during the 1949 Olympia, 1965 Seattle-Tacoma, and 2001 Nisqually earthquakes [abstract]. p. 394.
Sanli, A.; Akkar, S.; Celebi, Mehmet, 2001, Typical structural damages observed after the Nisqually earthquake [abstract]. p. 392.
Troost, K. G.; Booth, D. B.; Shimel, S. A.; Haugerud, R. A.; Kramer, S. L.; Kayen, R. E.; Barnhardt, W. A., 2001, Geologic controls on ground failures in Seattle and vicinity during the 2001 Nisqually earthquake [abstract]. p. 393.
Troost, K. G.; Haugerud, R. A.; Walsh, T. J.; Harp, E. L.; Booth, D. B.; Steele, W. P.; Wegmann, K. W.; Pratt, T. L.; Sherrod, B. L.; Kramer, S. L., 2001, Ground failures produced by the Nisqually earthquake [abstract]. p. 396.
Villasenor, Antonio; Engdahl, E. R.; Kirby, S. H., 2001, Teleseismic relocations of large intraslab earthquakes beneath the Puget Lowland the Strait of Georgia [abstract]. p. 394-395.
Walsh, T. J.; Baker, L.; Dragovich, J. D.; Dunn, A. B.; Lingley, W. S., Jr.; Logan, R. L.; Magsino, S. L.; McKay, D. T., Jr.; Norman, D. K.; Palmer, S. P.; and others, 2001, Reconnaissance ground failures in the southern Puget Sound lowlands caused by the Nisqually earthquake [abstract]. p. 392.
Williams, C. R.; Windeler, D. S., Jr.; Rahnama, Mohsen; Morrow, G. C.; Rodriguez, A., 2001, Insured loss estimates for the 28 February 2001 Nisqually earthquake [abstract]. p. 393.
Xu, Q.; Creager, K. C.; Li, Qing; Crosson, R. S., 2001, Nisqually earthquake rupture history from strong motion observations [abstract]. p. 394.

VIDEO RESERVATIONS

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

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

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

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

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

___**Disaster Mitigation Campaign** (15 min.) ***NEW***
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.) ***NEW***
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 Okushiri Island, Japan; good graphics, explanations, and safety information. Narrated by Dr. Eddie Bernard, (with Japanese subtitles).

___**Tsunami: Surviving the Killer Waves** (13 min.)
Two version...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 mention of tsunamis.

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

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

DIRECTORIES:NATIONAL TSUNAMI HAZARD MITIGATION PROGRAM STEERING GROUP

FEDERAL
Eddie Bernard, Chairman of National
Tsunami Hazard Mitigation Program
NOAA/PMEL
7600 Sand Point Way NE
Seattle, WA 98115-0070
(206) 526-6800; Fax (206) 526-6815
email: bernard@pmel.noaa.gov

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

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

Richard Hagemeyer
NWS, Pacific Region
Grosvenor Center, Mauka Tower
737 Bishop Street, Suite 2200
Honolulu, HI 96813
(808) 532-6416; Fax (808) 532-5569

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

Clifford Astill
National Science Foundation
4201 Wilson Blvd, Room 545
Arlington, VA 22230
(703) 306-1362; Fax (703) 306-0291
email: castill@nsf.gov

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

Gary R. Brown
Division of Emergency Services
P.O. Box 5750, Suite B-210
Building 49000
Fort Richardson, AK 99505-5750
(907) 428-7036; Fax (907) 428-7009
email: gary_brown@ak-prepared.com

R. Scott Simmons
Mitigation/Earthquake/Tsunami Specialist
Alaska Division of Emergency Services
P.O. Box 5750, Suite B-210, Bldg. 49000
Fort Richardson, AK 99505-5750
907-428-7016; fax 907-428-7009 email:
scott_simmons@ak-prepared.com

CALIFORNIA
Richard Eisner, Regional Administrator
Governor's Office of Emergency Services
Coastal Region
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

Lori Dengler
Department of Geology
Humboldt State University
#1 Harpst Street
Arcata, CA 95521
(707) 826-3115; Fax (707) 826-5241
email:lad1@axe.humboldt.edu

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

Laura Kong
Hawaii State Tsunami Advisor
c/o U.S. Federal Highways Administration
300 Ala Moana Blvd., Rm. 3306
Honolulu, HI 96850
(808) 541-2700, ext. 328; fax (808) 541-2704;
email: laura.kong@fhwa.dot.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
Suite 965
800 NE Oregon Street #28
Portland, OR 97232
503-731-4100, Ext. 225; fax 503-731-4066
email: george.priest@state.or.us

WASHINGTON
George Crawford
Washington State Military Department
Emergency Management Division
Camp Murray, WA 98430-5122
(253) 512-7067; Fax (253) 512-7207
email: g.crawford@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 For general emergency management information, contact:

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

Infrequently Asked Questions

compiled by Lee Walkling

Was Sir Henry Morgan, the famous buccaneer, ever involved in a tsunami?

Yes, a tsunami gave him his final resting place. The British buccaneer was buried in the Palisadoes cemetery at Port Royal, Jamaica, on Sunday, August 26, 1688. Four years later, June 7, 1692, a series of earthquakes dropped most of Port Royal into the sea. "Huge tidal waves rolled over Fort Morgan, tearing ships from their anchor cables and hurling them far inland...Tidal waves also destroyed the cemetery on the Palisadoes and covered miles of sea with floating coffins and corpses....Sir Henry Morgan's lead-lined coffin could not float. A tidal wave tore it from the grave and dragged it out to sea. Now it rests somewhere on the bottom, under tons of coral sand."

from: Terror of the Spanish Main, by Albert Marrin: Dutton Children's Books, New York, 1999, p. 225-227

Why would Sir Harry Morgan have run you through with his sword if you'd called him a pirate?

Pirates were low-life robbers on the high seas who attacked one and all with equal fervor; and they did not share their spoils with monarchs. Buccaneers, by dictionary definition, were freebooters only preying upon Spanish ships and settlements, especially in the West Indies in the 17th century. The term *buccaneers* was originally used to designate French settlers in Haiti (sailors who'd jumped ship in many cases) who hunted wild cattle and swine and dried the meat (buccan) to sell to passing ships. Buccaneers were encouraged by the English crown to plunder Spanish ships; the crown receiving its portion of the booty. Buccaneer Harry Morgan did such a fine job that he served as acting governor of Jamaica and was knighted!

Is a hazard a peril or vice versa?

This answer relates to insurance terms: "The words 'hazard' and 'peril' are often used interchangeably. There is a difference, however. Hazard is a term which refers directly to that which makes the damage worse. When a house is not bolted to the foundation, that is a hazard. The earthquake (a peril) causes the house to shake,but the lack of bolting to the foundation (a hazard) causes the damage to be even greater than it would be otherwise. Mitigation reduces or eliminates hazards, but there is nothing that can be done about perils."

from: Earthquake Basics Brief No. 3 "Insurance": Earthquake Engineering Research Institute, April 1997, p. 3
NOTE: Single copies of Earthquake Basics Brief No. 3 about disaster insurance are free from Earthquake Engineering Research Institute, 499 14th Street, Suite 320, Oakland, CA 94612-1934; phone (510) 451-5411; eeri@eeri.org

Sir Henry Morgan

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