TsuInfo Alert

prepared on behalf of the

National Tsunami Hazard Mitigation Program

by the Washington State Department of Natural Resources

Contents

Volume 4, Number 4, August 2002

TSUNAMI PROGRAM NEWS

Program Funding Status

A press release from Senator Daniel K. Inouye (Dem.-HI) announced that the Senate subcommittee on Commerce, Justice, State, and the Judiciary has approved $71 million for Hawaii and Pacific projects. The bill was sent to the full Committee July 16, 2002.

Tsunami Hazard Mitigation: $6.3 million funding (shared with west coast states). This program benefits Alaska, California, Oregon, and Washington and focuses on efforts to reduce tsunami risks to coastal residents. This national program's accomplishments include deploying tsunami detection buoys, producing tsunami inundation maps, and upgrading seismic networks.

Note from Eddie Bernard: "This is just a Senate subcommittee recommendation, but it represents a favorable, tangible reaction to our August 2001 review."

To track the status of the FY03 appropriations bills, go to http://thomas.loc.gov/home/approp/app03.html

Nominations Sought for the Hagemeyer Award

The National Tsunami Hazard Mitigation Program has announced The Richard H. Hagemeyer Tsunami Mitigation Award and is seeking nominations of individuals or groups concerned with tsunami mitigation. Each year the Richard H. Hagemeyer Award will recognize the project or program that best exemplifies the establishment of tsunami-resistance in U.S. coastal communities. Nominations are encouraged for projects and programs that address one or more of these areas:

- Improving tsunami education
- Providing tools and training for construction, land-use planning, and/or emergency planning and response in tsunami inundation zones
- Creating and strengthening links within and among coastal communities and states to support long-term tsunami mitigation
- Improving the tsunami mitigation science infrastructure
- Encouraging local innovation and sponsorship of tsunami mitigation programs

For information on the award and how to apply, see: http://www.pmel.noaa.gov/tsunami-hazard/Hagemeyer_main.html.

Nominations must be received by September 1, 2002.

TIME Inundation Mapping

The Center for Tsunami Inundation Mapping Efforts (TIME), a project of the National Tsunami Hazard Mitigation Program, was created to assist the Pacific States in the development and maintenance of maps which identify areas of potential tsunami flooding.

Puget Sound Tsunami Sources Workshop

NOAA, USGS, and the Washington State Emergency Management Division organized a workshop on 10 June 2002 to discuss possible tsunami sources in Puget Sound. Source scenarios, including earthquakes, delta failures, and subaerial/subaqueous landslides were discussed.

continued, p. 3

TsuInfo Alert

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Natural Resources
Doug Sutherland - Commissioner of Public Lands

(continued, from p. 1)

The TIME Workshop is a new effort to provide emergency managers and inundation modelers with online GIS analysis tools inundation modeling and maps. This site (http://www.pmel.noaa.gov/tsunami/time/workshop/index.shtml) is currently under construction.

Data Grids for California

TIME is working with USC to develop 3-arcsecond data grids for the state of California. The data grids will cover the entire coastal state region. TIME is working from south to north. Initial grids will be used to model Orange and Ventura counties.

Inundation Modeling in Washington

TIME is currently modeling the eastern Strait of Juan de Fuca in Washington. This mapping project will include the communities of Bellingham, Anacortes, and northwestern Whidbey Island.

Alaska's Inundation Mapping Projects

Work is underway in Alaska for the communities of Homer and Seldovia. TIME is working with Alaska's modelers to develop bathymetric/topographic data grids for this area. TIME is also collecting bathymetry and topography for Seward.

Oregon Assessment

Oregon began creating inundation maps for its coastal regions in 1997. 39 communities will be covered in 9 mapping efforts.

Hawaii Assessment

Hawaii began creating new inundation maps for its coastal regions in 1999. 28 communities will be covered in 9 mapping efforts.

from: http://www.pmel.noaa.gov/tsunami/time/index.shtml
http://www.pmel.noaa.gov/tsunami/time/or/index.shtml
http://www.pmel.noaa.gov/tsunami/time/hi/index.shtml

Quinault Indian Nation TsunamiReady/StormReady ceremony May 30, 2002

The Quinault Tribal Nation became the first Native American community to receive the TsunamiReady and StormReady designations at a ceremony conducted by Grays Harbor County Sheriff Michael J. Whelan. Speakers included Chris Jonientz-Trisler (FEMA, Region X), Craig Weaver (USGS), John Pennington (FEMA), Chris Hill (NWS), Gene Woodbury (WA. EMD), and Pearl Capoeman-Baller (President of the Quinault Nation). Chris Hill and Ted Buehner presented Pearl and other attending council members with the TsunamiReady and StormReady signs. Pearl thanked the agencies that partnered with the Quinaults: FEMA, NOAA, NWS, USGS, Washington Emergency Management Division, and the Grays Harbor Emergency Management.

Washington Division of Geology and Earth Resources provided a poster, NWS provided brochures and handouts, Washington State EMD brought handouts and educational items.

For details on the TsunamiReady program, go to http://www.pmel.noaa.gov/its2001/Separate_Papers/Tsunami_Ready_Form.pdf

From left to right, Tribal President Pearl Capoeman-Baller, FEMA Regional Director John Pennington, and Washington Emergency Management Division Director Glen Woodbury (photo by Chris Jonientz-Trisler/FEMA. News Photo at http://www.fema.gov/regions/x/ph_regx.shtm

Cannon Beach, Oregon will become Oregon's first TsunamiReady Community in a ceremony on August 12, 2002!

TSUNAMI HAZARD MAPPING OF ALASKA COASTAL COMMUNITIES

by
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***Bolded words are defined in glossary.**

Introduction

Alaska has the greatest earthquake and **tsunami** potential in the entire United States. The communities of south-coastal Alaska occupy one the most seismically active regions of the world, where the Pacific Plate is subducting under the North American Plate. This subduction zone, the Alaska Aleutian megathrust zone, creates high tsunami hazards for the adjacent coastal areas. The **coseismic** crustal movements that characterize this area have the potential for producing vertical sea-floor displacements, which are highly **tsunamigenic**. Historic tsunamis that were generated by earthquakes in the Alaska Aleutian subduction zone have resulted in widespread damage and loss of life along the Alaskan Pacific coast and other exposed locations around the Pacific Ocean. Large seismic events occurring in the vicinity of the Alaska Peninsula, Aleutian Islands, and Gulf of Alaska have a very high potential for generating both local and Pacific-wide tsunamis. Seismic water waves originating in Alaska can travel across the Pacific and destroy coastal towns hours after they are generated. However, they are considered to be a near-field hazard for Alaska, and can reach Alaskan coastal communities within minutes after the earthquake. Therefore, saving lives and property depends on how well a community is prepared, which makes it essential to estimate the potential flooding area of the coastal zones in case of a local or distant tsunami.

To help mitigate the risk these earthquakes and tsunamis pose to Alaskan coastal communities, the Geophysical Institute (GI) of the University of Alaska Fairbanks and the Alaska Division of Geological & Geophysical Surveys (DGGS) participate in the National Tsunami Hazard Mitigation Program (NTHMP) by evaluating and mapping potential inundation of selected parts of Alaska coastlines using **numerical modeling** of tsunami wave dynamics. The communities for inundation modeling are selected in coordination with the Alaska Division of Emergency Services (ADES) with consideration to location, infrastructure, availability of bathymetric and topographic data, and willingness for a community to incorporate the results in a comprehensive mitigation plan (table 1).

The production of tsunami evacuation maps consists of several stages. First, we construct hypothetical tsunami scenarios on the basis of the parameters of potential underwater earthquakes. Then we perform model simulations for each of the earthquake source scenarios. The results are compared with any observations from historical tsunamis in the region, if such data exist. Finally, numerical results and historical observations are combined to develop a worst case scenario for a tectonically generated tsunami for every community on a map. The inundation line produced by this scenario becomes a basis for local tsunami hazard planning and construction of evacuation maps.

Tsunami Hazard Mapping of Kodiak and Vicinity

The Kodiak area was identified as a high-priority region for Alaska inundation mapping. Kodiak's vulnerability to tsunamis was demonstrated by the 27 March 1964 earthquake (**moment magnitude** 9.2). In the city of Kodiak, the tsunami caused six fatalities and about $30 million in damage. Since then, the harbor and waterfront area of the city that was destroyed by the 1964 tsunami have been rebuilt and significantly expanded, and substantial additional growth of the city of Kodiak and other nearby communities has occurred. The preferred sites for runup modeling were determined by ADES and Kodiak local government officials to be the three communities of metropolitan Kodiak: the city of Kodiak, U.S. Coast Guard Reservation (USCGR) and Womens Bay (fig. 1). Local and state emergency managers have requested maps showing the extent of inundation with respect to human and cultural features as a basis for preparing evacuation maps for these communities.

Tsunami hazard maps that we recently prepared for the Kodiak area (Report of Investigations 2002-1) represent the first step in the State of Alaska tsunami hazard evaluation and production of inundation maps for many Alaskan coastal communities. Two 1:12,500-scale maps show inundation lines calculated for seven different tsunami scenarios, one map for the city of Kodiak and the other for USCGR and Womens Bay. A sample of the inundation map for the city of Kodiak appears in figure 2. Two corresponding maps show the estimated extent of inundation in the same communities resulting from the "worst case scenario," which is the maximum inundation of all modeled scenarios as well as areas of observed 1964 tsunami effects that extended farther inland than all of the modeled inundations.

We calculated the extent of inundation caused by tsunami waves using numerical modeling of tsunami wave runup. We ran the models at the Arctic Region Supercomputing Center at the University of Alaska Fairbanks. To propagate the wave from a source to various coastal locations we used

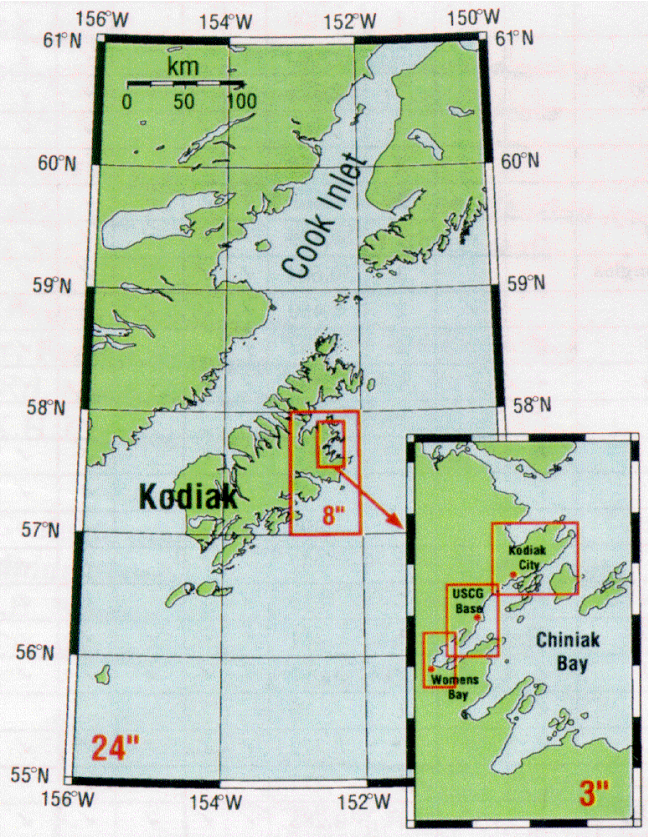

Figure 1. Large rectangle encompasses Kodiak Island grid area of 24-arc-second resolution. The two small rectangles delineate the 8-second and the 3-second grids. Inset figure shows the 3-second grid, which includes 1-second grids for the Kodiak Island communities of Kodiak city, USCGR, and Womens Bay, where runup calculations were performed.

four embedded bathymetric and topographic data grids, increasing in resolution from 2 arc minutes (2 km x 3.7 km at 55EN latitude) in the Gulf of Alaska to 1 arc second (21.8m x 27.5m at 57E47′ latitude) in the three grids that cover communities selected for inundation modeling. Areas covered by the embedded grids are shown in figure 1.

We conducted all model runs using bathymetric data that correspond to Mean Higher High Water (MHHW). For the generation mechanism, we modeled only earthquakes as potential sources of tsunami waves. In 1964, there were about 20 local submarine and subaerial landslide-generated waves that were limited to the bays of generation and caused substantial damage. Because inundation in the Kodiak area in 1964 was caused primarily by **tectonically generated tsunamis**, landslide wave sources were not considered within the scope of this generation model.

Modeling of the 1964 Tsunami

We initiated this project with the modeling of the Alaska 1964 tsunami, because this event is probably the worst-case scenario of a tsunami for the Kodiak Island communities and is useful for testing the results of our modeling on the basis of a well documented historical event. The 1964 Prince William Sound earthquake generated one of the most destructive tsunamis observed in Alaska and the west coast of the U.S. and Canada. This major tectonic tsunami was generated in the trench and upper plate fold and thrust belt area of the subduction zone (Plafker and others, 2000) and affected all the communities in Kodiak and the nearby islands. On Kodiak Island the 1964 tsunami was studied in depth by several investigators (for example, Kachadoorian and Plafker, 1967; Wilson and Torum, 1968), and their observed inundation patterns are available for calibration of the model. Christensen and Beck (1994) demonstrated that there were two areas of high **seismic moment** release, representing the two major **asperities** of the 1964 rupture zone: the Prince William Sound asperity and the Kodiak Island asper-ity. A detailed analysis of the 1964 rupture zone was pre-sented by Johnson and others (1996), who derived a slip distribution for the 1964 earthquake as shown in figure 3.

To construct a source function for the 1964 event, we used the fault dislocation model developed by Johnson and others (1996), with eight subfaults representing the Kodiak asperity, and nine subfaults in the Prince William Sound asperity. We used the equations of Okada (1985) to calculate the distribution of coseismic uplift and subsidence resulting from the given slip distribution. Then, the derived surface deformation was used as the initial condition for tsunami propagation. During a model run, the initial topog-

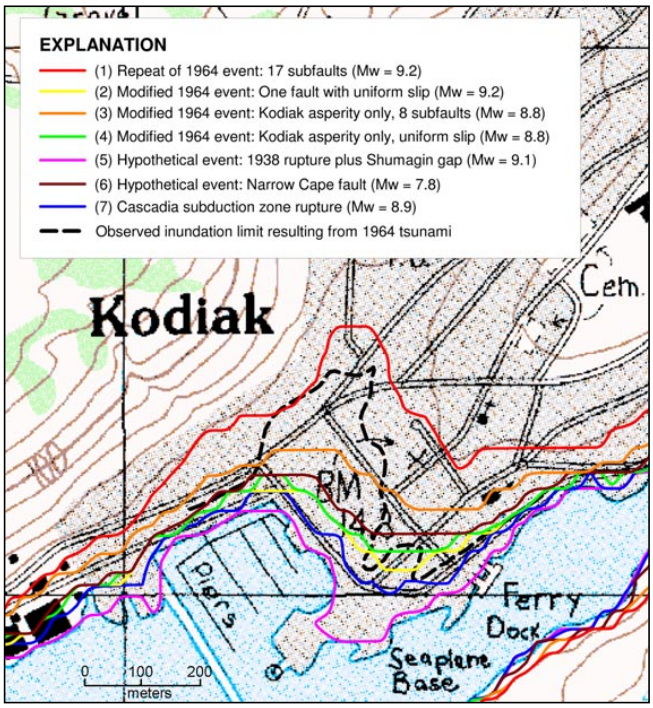

Figure 2. Sample of tsunami-inundation map for the area of downtown Kodiak. Base is from U.S. Geological Survey topographic map of Kodiak D-2 SE Quadrangle.

raphy was modified to account for residual seismic deformation of land due to the earthquake.

We modeled the 1964 tsunami wave using two different source functions for comparison. The first one, described above, consists of 17 subfaults, each having its own parameters. The second source function represents a simple single fault with uniform slip distribution (scenario 2). The amount of slip on the single fault was calculated in a way that preserves the seismic moment corresponding to the moment magnitude of 9.2. For both scenarios, the model propagates the initial displacements from the source to coastal locations through the set of embedded grids of increasing resolution.

In figure 2, the broken black line delineates the area inundated in 1964 on the basis of data collected after the event. The solid red line shows the inundation limit computed using the complex source function of 17 subfaults (scenario 1). The yellow line is the computed inundation limit that corresponds to the simple one-fault source model for the 1964 event (scenario 2). The results show that the wave generated by the complex source model with detailed slip distribution produces inundation close to that observed in 1964. Similar results were obtained for the USCGR area. The one-fault model greatly underestimates the extent of flooding caused by the 1964 tsunami wave.

Other Hypothetical Tsunami Scenarios

We considered several additional hypothetical earthquake scenarios as potential sources of tsunami waves that can affect the Kodiak area. These scenarios represent both distant and local sources, and we modeled several using a simple one-fault source function as well as the multiple fault approach. The published maps show seven different tsunami inundation limits that correspond to these scenarios, including those described above for the 1964 event:

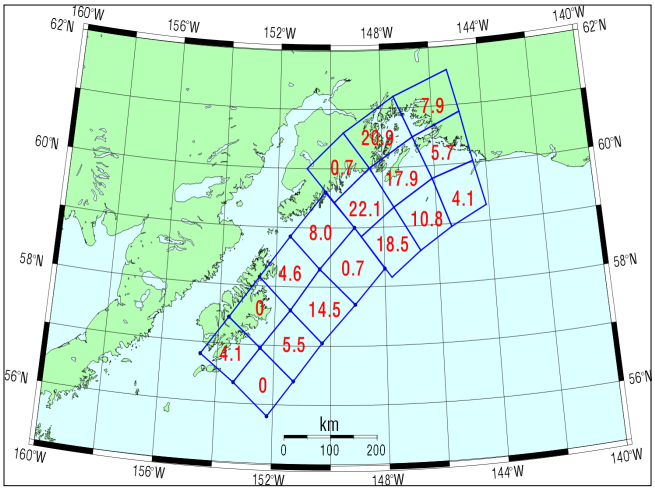

Figure 3. Slip distribution of the 1964 earthquake, from Johnson and others (1996). Numbers represent slip in meters on each subfault.

Scenario 1. Repeat of 1964 event: 17 subfaults. This source model is described in detail in the above section.

Scenario 2. Modified 1964 event: **One fault with uniform slip.** This source model provides a comparison with scenario 1 to show the importance of the detailed slip distribution of the rupture zone for the near-field inundation modeling and hazard assessment. To accomplish that, we constructed another source function for the 1964 event, consisting of a single fault with uniform slip distribution. The amount of slip on the single fault was calculated in a way that preserves the seismic moment.

Scenario 3. Modified 1964 event: Kodiak asperity only, eight subfaults. This source function represents the southern asperity of the 1964 rupture zone. According to Christensen and Beck (1994), the two segments of this zone behaved independently in the past, with the Kodiak Island region rupturing more frequently. That allowed us to consider the Kodiak asperity of the 1964 rupture as an independent source with a potential of generating tsunami waves. We modeled this source using the eight most southwestern subfaults of the 1964 fault mosaic as shown in figure 3.

Scenario 4. Modified 1964 event: Kodiak asperity only, uniform slip. This scenario describes the same hypothetical event as scenario 3, but with uniform slip distribution within the rupture area. Scenarios 3 and 4 have the same seismic moment.

Scenario 5. Hypothetical event: 1938 rupture plus Shumagin gap. To create a hypothetical event in the Alaska Aleutian megathrust zone, we combined the rupture area of the 1938 earthquake with the Shumagin gap area, assuming that the rupture can propagate southwestward into the 1946 rupture zone. This scenario produces the least inundation of all scenarios (purple line in figure 2) because of the oblique incidence angle of wave arrival from the southwest.

Scenario 6. Hypothetical event: Narrow Cape fault. The Narrow Cape fault is part of a series of northeast-trending thrust faults that extend across southeastern Kodiak Island and into the northwestern Gulf of Alaska (fig. 4). The geomorphic expression of this fault at Narrow Cape suggests that its most recent displacement occurred during Holocene time, making it worthy of consideration as a potential source for a local tsunami. We selected the 1999 ChiChi earthquake in Taiwan as a hypothetical analog for displacement on Narrow Cape fault, because the Chenlungpu fault on which that earthquake occurred is in a very similar tectonic setting. Our model uses three steeply dipping subfaults of approximately equal length, with slips of 9.6 m, 4.9 m, and 3 m from southwest to northeast, respectively, to generate an earthquake of moment magnitude 7.8.

Scenario 7. Cascadia subduction zone rupture. This scenario represents one of the distant tsunami sources that can affect the Kodiak Island communities. The source function is based on the occurrence of a moment magnitude 8.9 subduction earthquake off the coast of Washington and Oregon.

Coastal community	High Potential for Distant Tsunamis	Strong community Involvement	Bathym-etry	Popula-tion	Infra-structure	Tourism	Cruise Ships (Tour Bus/Ship)	Special Seasonal Events	Commercial Fishing / Timber	Large Scale USGS Base Maps
Adak	T		1-2	7	T				T	
Akutan			1	408				T	T	
Cold Bay			2	103	T			T	T	
Cordova (9)		T	3	2571	T	T	T	T	T	T
Craig			3	2145	T	T		T	T	T
Elfin Cove			2	50		T			T	
Haines			3	1463	T	T	T	T	T	T
Homer (2)	T	T	1	4155	T	T	T	T	T	T
Juneau/ Douglas			3	30684	T	T	T	T	T	T
Ketchikan		T	2	8460	T	T	T	T	T	T
King Cove	T		2	1947	T			T	T	
Kodiak (1)	T	T	1	8864	T	T	T	T	T	T
Nikolski	T		?	35						
Ouzinkie	T		2	252	T	T		T	T	
Perryville	T		2	107				T	T	
Petersburg			3	3398	T	T		T	T	
Port Lions			2	242	T	T		T	T	
Sand Point (5)	T	T	2	830	T			T	T	
Seldovia (2)	T	T	1	281	T	T	T	T	T	T
Seward (3)	T	T	3*	3090	T	T	T	T	T	T
Shemya	T		1	0						
Sitka (4)	T	T	2*	8779	T	T	T	T	T	T
Skagway			3	814	T	T	T	T		T
Unalaska (6)	T	T	1	4285	T	T	T	T	T	
Valdez			2	4155	T	T	T	T	T	T
Whittier (8)		T	1	306	T	T	T	T	T	T
Wrangell			2	2589		T	T		T	
Yakutat (7)	T		1	810	T	T		T	T	T

Table 1. Prioritization of Alaska coastal communities for tsunami-inundation mapping. Population is based on 1990 census. **Bold** indicates communities scheduled for mapping, and current order. Bathymetry codes: 1=good, 2=fair, 3=poor (*new bathymetric data are currently being acquired for Sitka and Seward). Homer and Seldovia will be mapped simultaneously.

Tsunami-inundation Maps for the Kodiak Area

The results of our model calculations for the Kodiak vicinity appear on the published maps as inundation-limit lines for each of the seven tsunami scenarios. Separate map sheets show a single line representing the maximum inundation from all scenarios for use by emergency managers. With the exception of part of Womens Bay, the worst-case tsunami scenario for the three Kodiak communities is the inundation caused by the modeled 1964 event with 17 subfaults. The Narrow Cape fault source produced the second largest inundation zone after the inundation caused by the 17-fault model of the 1964 earthquake in almost all locations, and exceeded the modeled 1964 inundation in part of Womens Bay. This result implies that a local offshore earthquake of smaller magnitude can generate a wave comparable to that produced by a great megathrust earthquake.

In addition to the published 1964 inundation limits in downtown Kodiak and USCGR (Kachadoorian and Plafker, 1967), we obtained local observations to help estimate the actual inundation at other locations in our project area. These included observations by local residents who were present at the time of the 1964 event and the inland extent of driftwood and tsunami-deposited sand in the vicinity of Womens Bay. These observations identified a few areas where the actual inundation in 1964 extended farther inland than the inundation from any of our modeled scenarios, most notably in the vicinity of Womens Bay. The maximum inundation lines shown on the published maps include these areas of locally documented effects of the 1964 tsunami. We also made some manual adjustments to the final maximum inundation lines on the basis of detailed local topography in the area of downtown Kodiak where the topography is not accurately resolved by the available digital elevation model.

Inundation Mapping for Other Coastal Communities

We are in the process of acquiring available bathymetric and topographic data for the Homer and Seldovia areas and have begun wave-model calculations there using the 17-subfault model for the 1964 earthquake. A new bathymetric

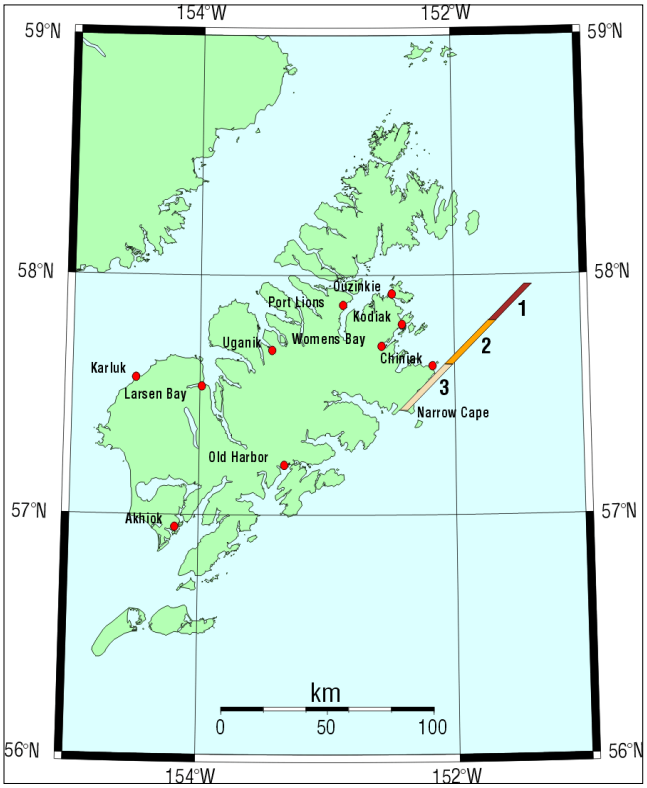

Figure 4. Map of Kodiak Island showing hypothetical rupture zone of Narrow Cape fault divided into three subfaults. Displacement is upward on the northwest side, 3 m on section 1, 4.9 m on section 2, and 9.6 m on section 3.

survey has recently been completed in the Seward area, and another is currently underway in the Sitka area. Our goal is to complete tsunami-inundation maps for Homer Seldovia and the next three priority areas, Seward, Sitka, and Sand Point, over the next two years. Thereafter, we will develop inundation maps for the four remaining communities in order of the priorities indicated in table 1. Other communities will be considered for future mapping pending program funding.

Tsunami-inundation maps are useful for state and local emergency managers to identify areas that should be evacuated in the event of a major tsunamigenic earthquake, and to delineate evacuation routes. Because of the uncertainties inherent in this type of modeling, these results are not intended for land-use regulation.

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Wilson, B. W.; Torum, A., 1968, The tsunami of the Alaskan Earthquake, 1964: Engineering evaluation: U.S. Army Corps of Engineers, Technical memorandum No. 25, 401 p.

Glossary

asperity - an area of a fault where more strain accumulates than in other areas; consequently, during earthquakes, the largest displacements tend to occur on asperities

coseismic - occurring simultaneously with an earthquake

moment magnitude - a measure of the size of an earthquake, calculated on the basis of seismic moment and reported as a value on the Richter scale

numerical modeling - mathematical simulation of a natural process, often with the use of a powerful computer

seismic moment - the rigidity of the rock times the area of faulting times the amount of slip

tectonically generated tsunami - a tsunami generated by vertical motion of the seafloor rather than by a landslide, volcanic eruption, or meteorite impact

tsunami - A sea wave produced by a disturbance of the ocean floor, usually by a shallow submarine earthquake, but also by submarine earth movement, subsidence, or volcanic eruption. These seismic sea waves can travel up to 950 km/hr, and can pile up to heights of 30 m or more when they enter shallow water along an exposed coast

tsunamigenic - capable of generating a tsunami

WEST COAST/ALASKA TSUNAMI WARNING CENTER EARTHVU GEOGRAPHIC DISPLAY

from http://wcatwc.arh.noaa.gov/earthvu/earthvu.htm; reprinted with permission

EarthVu is geographic display software developed at the WC/ATWC. The main functions of EarthVu are:

- display epicenters on large, small, and regional scale maps,
- overlay pertinent information such as historic tsunamis and earthquakes, volcanoes, elevation contours, roads, pipelines, tsunami watch/warning areas, etc.,
- provide a graphical platform for computing tsunami models,
- display results of previously computed models for calibration during tsunami warnings,
- compute and display tsunami travel times from any location in the Pacific basin,
- call earthquake and tsunami data bases, and
- create information maps in the background to post on web site with tsunami messages.

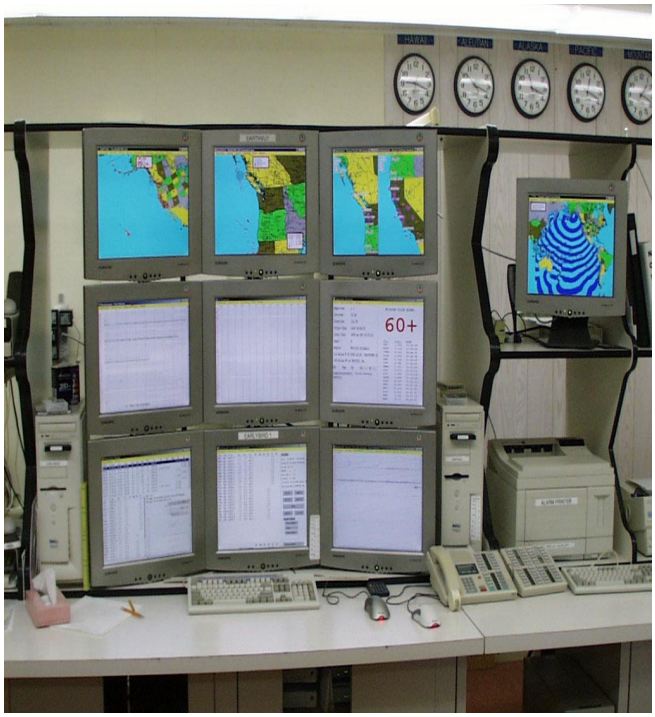


Figure 1. The Ops console. The EarthVu computer drives the top 4 screens--which show the homebrewed GIS (program written by Paul Whitmore). Displays the current earthquake location as well as selected overlays of earthquake history, tsunami history, lat/lon gird, seismic and tide instrument locations, topo contours, roads, cities, etc. The bottom 6 screens are driven by the EarlyBird computer which is used to monitor and display the realtime seismic data, analyze seismic traces and make P-time picks, compute magnitude, send messages, and basically perform the guts of the operation.

EarthVu is most useful when run on a PC with a four-monitor graphics adapter. Each monitor displays a different program of the EarthVu system. The PC running EarthVu can be networked with a system running EarlyBird/Earthworm. As EarlyBird/Earthworm produces epicenter locations, EarthVu displays these locations. EarthVu will also display locations imported from other seismological centers such as USGS-Menlo Park.

EarthVu is composed of five main programs:

- EARTHVU - display large-scale maps,
- CLOSEVU - display small-scale maps,
- REGIONVU - display regional maps and show last seven days epicenters,
- TTVU - create and display tsunami travel time maps triggered by tsunami message generation,
- WEBVU - create maps in background and write to disk for transfer to web site.

EARTHVU

Program EARTHVU is the main program of the EarthVu system and spawns all other programs. Twenty-five precomputed bitmaps are available for display. One shows the entire world, one the Pacific basin, and the others show different sectors of the globe. The bitmap displayed can be specified in a list box, but is normally indicated by a location performed in EarlyBird. An epicenter location can also be specified directly in EARTHVU, which forces display of the nearest bitmap.

Several overlays are available in EARTHVU:

- Major Cities
- Tsunamis - all known Pacific basin tsunamis, from NOAA/National Geophysical Data Center
- Earthquakes - all known quakes with magnitude > 5, 1900-1998, from USGS/National Earthquake Information Center
- Volcanoes - from Global Volcanism Program
- Seismometers - seismometer data processed at WC/ATWC
- Tide Gages - tide gage sites recorded at WC/ATWC
- Watch/Warning Areas - present tsunami watch/warning status
- Lat/Lon Grids - meridians and parallels at specifiable intervals

Other options available in EARTHVU are: display detailed data on a tsunami, volcano, tide gage, or seismometer with a mouse click, re-draw map with color coded elevations/bathymetries, turn on/off voice option (says location as displayed), call historic data bases, and specify an area of the map to expand in CLOSEVU.

Two other options are available in EARTHVU: tsunami travel time and tsunami model computations. Tsunami travel times can be computed on a fine (15'x10'), medium (30' x

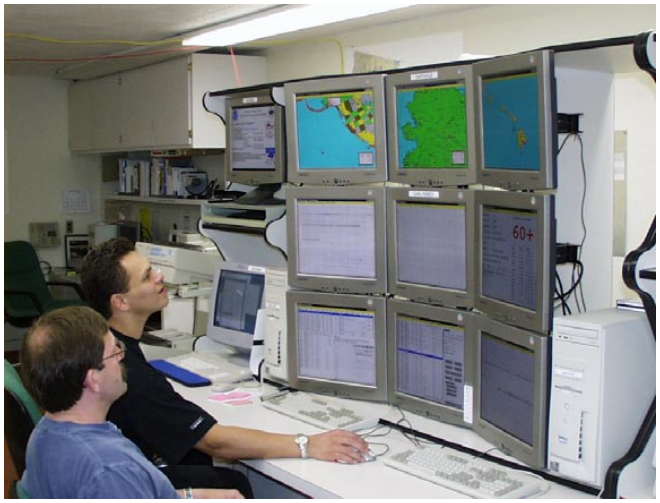


Figure 2. Alec Medbery (gray shirt) and Michael Burgy (black shirt) are pictured at the Ops console. They comprise the Electronic Technician staff--the guys that keep WCATWC operating flawlessly. Alec has worked at WCATWC since December 1975; Michael is the new guy, arriving in March 2002.

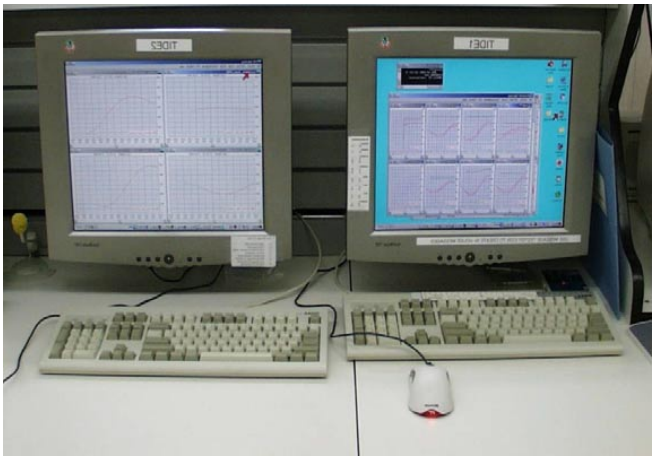


Figure 3. Tide1 and Tide2 are the two systems used to record and display the water level data from about 100 instruments around the Pacific. Tide1 specifically displays the data from 8 realtime tide stations in Alaska only, whereas Tide2 displays about 90+ tide stations located all around the Pacific. These displays allow WCATWC to confirm and measure wave height at the selected locations.

30'), or coarse grid (60'x60'). Results are displayed on the present EARTHVU map. The tsunami model computation technique is described in Kowalik and Whitmore (1990). EARTHVU acts as a graphic interface where model areas are specified and results are displayed. EARTHVU also displays pre-computed model results and provides a method to scale the results based on recorded tsunamis during a warning.

Historic tsunami and earthquake data bases are maintained at the WC/ATWC. These are accessed with program HISTORY which is called from EARTHVU. HISTORY retrieves information from the data bases by date, location, and magnitude. The output can be in summary form or in great detail, and is written to the screen and/or printer. The earthquake database is from the USGS/National Earthquake Information Center. It contains all earthquakes between 1900 and 1998 over magnitude 5 (more than 69,000 quakes). The tsunami data base is taken mostly from NOAA /National Geophysical Data Center studies (e.g. Lander and others, 1993; Lander, 1996). It contains over 1000 Pacific basin tsunamis dating back to 47BC. The same information accessed by program HISTORY is also used by EARTHVU and the other programs when displaying tsunamis and earthquake data on maps.

CLOSEVU

Program CLOSEVU's main function is to display small-scale maps around an epicenter. When EarlyBird produces an epicenter, CLOSEVU either creates a map showing the epicentral region or displays a pre-computed regional bit-map (if one exists). The region displayed in CLOSEVU can also be specified in EARTHVU.

In addition to overlays described in the EARTHVU section, the following are available.

- Cities - from DOD Digital Chart of the World
- Contours - from DOD Digital Chart of the World
- Geographic Names - from DOD Digital Chart of the World
- Airports, roads, pipelines, power lines, trails, railroads - from DOD Digital Chart of the World

Other options available in CLOSEVU are the same as in EARTHVU (except for tsunami travel times and model computations) plus a zoom in/out feature and an option to measure distances on the screen.

Figure 4. The pager photo shows what the on-duty person sees when an earthquake is automatically located and sized by EarlyBird and sent out to the pagers.

REGIONVU

Two REGIONVU programs are started in EarthVu. Each displays a map on one-half a monitor. One displays a map of the Pacific Northwest (southern British Columbia, Washington, and Oregon) while the other displays a map of California. These maps display the latest epicenters computed at WC/ATWC, USGS-Menlo Park, and the University of Washington. In addition to the last computed epicenter, which is shown with concentric rings, all the epicenters produced over the last week are shown as a purple ring. The size of the ring relates to the quake's magnitude. Full hypocenter information from any previous quake can be displayed by right-clicking on the ring.

The same overlays and options available in CLOSEVU are available here, except for the zoom in/out feature. The displayed map in REGIONVU can not be changed.

TTVU

Program TTVU is a separate program to compute and display tsunami travel time maps. Map creation is triggered by monitoring tsunami messages created in EarlyBird. When a message is created, a tsunami travel time map is computed and displayed for the epicenter used in the message. This tsunami travel time map is updated every three minutes with a red line showing the present location of the wavefront. This map is also sent to the web site without the red line. TTVU supports most of the overlays discussed in EARTHVU.

WEBVU

Program WEBVU runs in the background and does not create its own window. It monitors tsunami messages created in EarlyBird. Whenever a message is created, WEBVU makes maps for display along with the message in the WC/ATWC web site. Maps created and sent to the web site are: large-scale epicentral area map, small-scale epicentral region map, historic tsunami and earthquake maps, and a watch/warning area map.

References

Lander, J. F., 1996, Tsunamis affecting Alaska, 1737-1996: U.S. National Geophysical Data Center Key to Geophysical Research Documentation 31, 195 p.

Lander, J. F.; Lockridge, P. A.; Kozuch, M. J., 1993, Tsunamis affecting the west coast of the United States, 1806-1992: U.S. National Geophysical Data Center Key to Geophysical Records Documentation 29, 243 p.

Kowalik, Zygmunt.; Whitmore, P. M., 1991, An investigation of two tsunamis recorded at Adak, Alaska: Science of Tsunami Hazards, v. 9, p. 67-84.

Thanks to Bruce Turner for the photos and the captions.

g g g g g

HISTORIC TSUNAMI EVENTS

August 17, 1999 Izmit, Turkey earthquake
7.6 M
http://neic.usgs.gov/neis/bulletin/99_EVENTS/990817000138/990817000138.HTML
http://quake.wr.usgs.gov/research/geology/turkey/
http://quake.wr.usgs.gov/research/geology/turkey/historical.html (eyewitness historical account)

August 31, 1886 Charleston, SC earthquake

This was the most damaging earthquake to occur in the Southeast United States and one of the largest historic shocks in Eastern North America (7.3 M; Intensity X)

http://www.eas.slu.edu/Earthquake_Center/1886EQ/ (photos!)
http://neic.usgs.gov/neis/eqlists/USA/1886_09_01.html
http://www.sfmuseum.org/1906.2/charleston.html

Sept. 10, 1899 Yakutat Bay, AK earthquake
Foreshock of 7.4 M; main shock of 8.2 M
http://neic.usgs.gov/neis/eqlists/USA/1899_09_10.html
http://www.wcatwc.gov/web_tsus/18990910/narrative1.htm

Sept. 19, 1985 Mexico City, Mexico earthquake
8.1 M, with aftershock of 7.5 M
http://www.gcn.ou.edu/~jahern/v&e/subduct/subduct_quakes/mexico_city.html
http://wwwijh.lkwash.wednet.edu/teacher/emily.html
http://www.johnmartin.com/earthquakes/eqshow/647003_00.htm

Oct. 8, 1865 San Francisco, California earthquake
http://www.sfmuseum.org/hist1/1865eq.html

See page 22 for Mark Twain's eyewitness account of the 1865 San Francisco earthquake, from his book *Roughing It.* This earthquake was called the "great earthquake" long before the 1906 event gained fame.

Partnership to Revamp U.S. Alert System

The Partnership for Public Warning (PPW), a private/public group meeting since December 2001 to improve the nationwide Emergency Alert System, began in June a two-pronged effort to evaluate the effectiveness of current emergency notification systems and to help develop a national Strategic Plan for Public Warning.

"PPW's current 24-member board of trustees has been meeting monthly to lay a foundation for the outlines of a new nationwide alert system," said George Q. Nichols, group vice president at Dialogic Communications Corp. and a member of PPW's board of trustees. "We want to fill in that outline with data from veterans in the emergency notification field and creators of innovative technology."

PPW's Web site contains questions that those in the emergency notification field can answer regarding their own systems, and they can add recommendations for a nationwide system. PPW will collect information on benefits and problems with current emergency notification systems, catalog the types of systems available, and suggest individuals who should help write the strategic plan.

Last month [June 2002] PPW held a workshop that included physical and social scientists experienced in issuing warnings and evaluating their effectiveness, and specialists in terrorism and weapons of mass destruction. The group recommended ways to improve the Homeland Security Advisory Systems announced by Tom Ridge, OHS director and former governor of Pennsylvania.

Once a draft of the plan has been completed, PPW will seek nationwide reviews and additional input. "By the time this plan is released next year, we hope to have a practical, timely solution that will have garnered widespread support," said Nichols.

Visit www.partnershipforpublicwarning.org for more information.

from: Contingency Planning & Management, v. 7, no. 5, July/August 2002, p. 10.

Federal Rules Require New Hazard Mitigation Plans

State agencies and local governments must prepare hazard mitigation plans using recently published federal guidelines if they wish to remain eligible for hazard mitigation funding for new disasters after Nov. 1, 2003.

Required by the Disaster Mitigation Act of 2000, the plans will seek to reduce the nation's disaster losses as well as help decision makers reduce their jurisdiction's susceptibility to disasters.

Key elements of the new planning requirements are:

* A risk assessment that identifies the type and location of hazards, describes the jurisdiction's vulnerability, identifies critical facilities and infrastructure in hazard areas, and provides an estimate of potential dollar losses to vulnerable structures.
* A hazard mitigation strategy that describes the jurisdiction's hazard mitigation goals, identifies and prioritizes mitigation actions, and identifies its capability to mitigate hazards.
* A linkage between state and local mitigation programs. Local plans will provide the basis for the state plan's risk assessment and hazard mitigation strategy.

All plans must be formally adopted. Local plans must be sent by July 1, 2003 to the State Hazard Mitigation Office for review; the state will forward the plan to the Federal Emergency Management Agency for approval. Local jurisdictions are encouraged to build upon their work in flood plain management, growth management, and critical area ordinances in developing their hazard mitigation plans.

Without an approved plan, the state will lose its ability to obtain federal funding to repair damaged public facilities, and to pay for hazard mitigation projects, fire management and other response and recovery activities provided under the Stafford Act. Emergency response assistance will be unaffected.

Washington's EMD Mitigation Section is providing technical assistance and preparing planning materials to help local government planning efforts.

The local hazard mitigation planning guide [note: for Washington State] has been revised and is posted on the EMD web site at www.wa.gov/wsem.

EMD will award, this summer, planning grants on a competitive basis to local governments that previously submitted a planning letter of intent and followed up with a planning grant application.

Additionally, EMD is working on the state's plan and is re-establishing the State Hazard Mitigation Advisory Committee to assist with the state's planning initiative.

For more information on local hazard mitigation planning, contact Marty Best, State hazard Mitigation Officer, at (253) 512-7073, or Joan Sterling, Hazard Mitigation Project Supervisor, at (253) 512-7079.

Contact Mark Stewart, State Hazard Mitigation Strategist, at (253) 512-7072, for more information on the state planning effort.

from: Emergency Responder (Washington State Emergency Management Division), May-June 2002, p. 3, 4.

The Emergency Email Network Changes

To simplify access The Emergency Email Network can now be accessed at the following web addresses:

1. Citizen sign up page can be accessed at http://www.emergencyemail.ORG/ and via a link on the U.S. Federal Government Website at http://www.firstgov.gov/America Responds to Terrorism Link Page.
2. If you are a government agency wanting to become a network member to be able to send messages to citizens within your community please visit....

http://www.emergencyemailnetwork.com/EMEPublicServices.htm.

from: June 26, 2002 email from the Emergency Email & Wireless Network - A Service of The Emergency Email Network, Inc.

FEMA Creates One-stop Shopping for Disaster Relief

The September 11 terrorist attacks underscored the need for the federal government to provide fast and easy disaster-related information to citizens. To better aid victims of disaster, the Federal Emergency Management Agency (FEMA) recently established *Disasterhelp.gov*, a web site designed to be a one-stop portal for citizens looking for disaster-relief information and assistance. The site will consolidate federal and other disaster-relief programs on a single site as well as provide links to state and local emergency management groups.

Eventually the site will provide a secure link for an automated transaction-processing system for disaster assistance. In the meantime, FEMA's Eligibility Assistance Online, the site that provided aid for citizen disaster benefits, will be moved to the Labor Department. *Disasterhelp.gov* began in April.

For more information about *Disasterhelp.gov*, go to the web site or contact FEMA, 500 Street S.W., Washington, DC 20472; e-mail: eipa@fema.gov; http://www.fema.gov

from: Natural Hazards Observer, v. XXVI, no. 5, May 2002, p. 7

Response to Suggestions on Mitigation of Disasters: An On-Line Survey

Please take a few minutes to answer a few questions and help further the science of decision-making regarding hazards. The purpose of this on-line study is to gain an understanding regarding responses to suggestions for mitigation of disasters. Such an understanding could be helpful in developing mitigation strategies for many different disaster scenarios. From data collected in interviews with disaster-relevant professionals, a short survey was designed to elicit from a wider range of respondents information about reactions to suggestions that they have encountered. Many questions about disasters that disaster professionals have are included in the survey.

The survey should take approximately 10 minutes to complete. The entire study should be completed by the fall of 2002. The survey is part of a masters degree project in Earth and Environmental Sciences Journalism at Columbia University and can be found on the web page of Columbia University's Center for Hazard and Risk Research: http://www.ldeo.columbia.edu/CHRR.

Please visit the site and complete the survey.

from: Disaster Research 368, June 10, 2002

Announcing CIRI and TISP

In all disasters, natural or human-caused, maintaining the integrity of the built environment is critical if damage and loss of life are to be held to a minimum. Recently, the American Society of Civil Engineers (ASCE) launched the Critical Infrastructure Response Initiative (CIRI) to address infrastructure vulnerability and develop strategies for mitigating the effects of natural and human-caused disasters on critical elements of the nation's transportation, water, power, communication, and other important systems. As part of that effort, CIRI assembled two building performance study teams that are gathering data on the effects of the September 11 terrorist attacks in New York and Washington, D.C. and joined with construction industry groups and federal agencies to form the Infrastructure Security Partnership (TISP).

ASCE will hold a series of "summits" wherein participants will share information and expertise needed to make the various components of the nation's infrastructure more secure. Summit topics include "The Critical Water Infrastructure Dialog," building systems security, and security for transportation systems. Goals of TISP will be to assess infrastructure vulnerability; prioritize needed infrastructure renovation based on the results of vulnerability assessment; and determine research and development that will help protect critical elements, develop retrofit designs to mitigate disaster damage, formulate new design procedures, and improve disaster preparedness and response.

Spearheaded by the U.S. Army Corps of Engineers, TISP was established so that the collective technical expertise of professionals within both the design and construction industries and the government sector could collectively improve security. Other founding members include the American Institute of Architects, the Society of American Military Engineers, the American Council of Engineering Companies, the Federal Emergency Management Agency, the National Institute for Standards and Technology, and others.

Other objectives of TISP include promoting efforts to improve antiterrorism and asset protection, disseminating infrastructure knowledge, transferring knowledge of effective security measures, and encouraging protocols related to the sensitivity of information generated by the new partnerships.

To obtain more information about CIRI, contact Marla Dalton, Critical Infrastructure Response Initiative, American Society of Civil Engineers, 1801 Alexander Bell Drive, Reston, VA 20191; (800) 548-2723. To learn more about TISP, contact Larry Delaney, U.S. Army Corps of Engineers, Engineering and Construction Division, (202) 761-4945. Interested persons can also view the TISP web site: http://www.tisp.org.

from: Disaster Research 369, June 19, 2002

Transportation Research Board Creates Committee on Evacuation

The Transportation Research Board (TRB), Technical Committee on Transportation Safety Management, part of the National Academies of Science, has created a new Subcommittee on Emergency Evacuations. The subcommittee

will explore:
- Operational and safety guidelines for interstates and other major roadways during evacuations;
- Applications of technology and remote sensing for evacuations;
- Evacuation travel demand forecasting and operation planning;
- Human behavior and related issues in evacuations; and
- Traffic enforcement issues.

The subcommittee comprises a diverse cross-section of professionals with a range of transportation-related expertise. The first formal meeting of the subcommittee was held in January in Washington, D.C. Interested persons should contact Brian Wolshon, LSU Hurricane Center, 3513 CEBA Building, Louisiana State University, Baton Rouge, LA 70803; (225)578-5247; fax: (225)578-5263.

from: Disaster Research 369, June 19, 2002

USGS Creates Earthquake Research Committee

The U.S. Geological Survey (USGS) recently announced the establishment of a Scientific Earthquake Studies Advisory Committee to advise the director of the Survey on matters relating to that agency's participation in the National Earthquake Hazards Reduction Program (NEHRP). At the committee's first meeting in May, the group reviewed the program's current status and USGS's five-year NEHRP plan. Created through an act of Congress, the committee is required to issue an annual report to the director before September 30 of each year regarding performance goals and policy issues related to the NEHRP. To obtain more information about the committee, contact John Filson, USGS, 12201 Sunrise Valley Drive, Reston, VA 20192; (703) 648-6785.

from: Disaster Research 369, June 19, 2002

Send Us Your Reprints!

The Natural Hazards Center would like all hazards authors to send them copies of their recently published articles. NHC promises to give them a good home among their extensive collection of documents on human adaptation to natural hazards and related events. As an added incentive, works will be accessible via the NHC's on-line bibliographic database, HazLit (see website listing below), to other researchers, practitioners, and individuals with an interest in natural hazards and disasters.

Please send or fax your article reprints to Wanda Headley, Library Manager, Natural Hazards Research and Applications Information Center, University of Colorado, 482 UCB, Boulder, CO 80309-0482; fax: (303) 492-2151.

from: Disaster Research 369, June 19, 2002

SPURS-EM Project Development Underway

Development work has started under the new SPURS-EM Project under the contract between the National Aeronautics and Space Administration (NASA) and the Emergency Management Division (EMD).

NASA last fall announced the award of a $703,500 grant, spread over a three-year period, to Washington EMD to study the use of satellite information in emergency management activities.

The Strategic and Practical Use of Remotely Sensed data in Emergency Management (SPURS-EM) application will capture and interpret space imagery data about the earth's ground surface.

University of Washington-Seattle scientists will interpret the remotely sensed data to develop a product that will be most useful to emergency managers. The goal places remotely sensed data in a central role for all phases of emergency management--preparedness, response, recovery and mitigation.

The SPURS-EM application will complement two other FEMA-created programs, HAZUS and FEMIS, for use in emergency management.

Allen Jakobitz, EMD senior hazard analyst, began assembling a geographic information system (GIS) as a foundation upon which to overlay data from the NASA satellite to assist with risk assessment, hazard vulnerability and mitigation.

Jakobitz is gathering data from free sources to create a base layer map depicting counties, cities, roads, ferry routes, rivers, lakes, etc. He will then layer the remotely sensed product provided by the UW into a usable format.

The ArcView platform, the same platform used by the FEMIS and HAZUS GIS software programs, will also be used to access the SPURS-EM product.

"I foresee that GIS will become the new PowerPoint for office workers. Ten years ago, the average office worker did not use any presentation software, and now most do. Two years ago, nobody even knew what GIS was, and now they are using it to create roadmaps over the Internet," said Jakobitz. "I predict it will be commonplace in the next 10 years."

from: Emergency Responder (Washington Emergency Management Division), May-June 2002, p. 2, 4.

PERI to Host Internet Symposium on Evaluating Community Emergency Services

How adequate are the fire suppression and emergency services in your community? Can your services handle today's risks and hazards effectively? What guidelines or benchmarks do you follow for evaluating these services? These questions, along with many others, will be discussed during an upcoming Internet symposium sponsored by the Public Entity Risk Institute September 23-27, 2002. The program is free and all-electronic. To enroll, see: http://www.riskinstitute.org/symposium_signup.asp.

from: Disaster Research 370, July 5, 2002

PERI Opens New Library: No Library Card Needed!

The Public Entity Risk Institute (PERI) has created an on-line library to offer both timely and timeless material on

risk management concerns of interest to local governments, nonprofits, and small businesses. The library, housing a growing collection of in-depth articles, is actively seeking contributions for its virtual shelves. Articles that address the following areas are being sought: disaster response and recovery, risk management, risk financing and insurance, human resources, and workers' compensation. Visit the library at: http://www.riskinstitute.org/lib.asp.

To propose or submit an article, contact PERI's Claire Reiss: (703) 352-1846; e-mail: creiss@riskinstitute.org.

from: Disaster Research 370, July 5, 2002

Hazard Geographers, Take Note!

The Association of American Geographers (AAG) has agreed to host an"orphan" session on hazards-related issues during its upcoming Annual Meeting March 4-8, 2003, in New Orleans, Louisiana (official conference notification to come later). Jayajit Chakraborty of the Department of Geography at the University of South Florida has agreed to organize the session and collect all hazards-related papers for submission to the AAG conference prior to the official conference deadline. The deadline for anyone wishing to submit a paper for inclusion in a hazards session organized by Jay is September 25, 2002. For more information e-mail: jchakrab@chuma1.cas.usf.edu; or contact: Jayajit Chakraborty, Department of Geography, University of South Florida, 4202 East Fowler Avene, SOC 107, Tampa, FL 33620.

from: Disaster Research 370, July 5, 2002

FEMA's Higher Education Project Seeking Contributions for "Practitioner's Corner"

The Federal Emergency Management Agency's Higher Education Project is interested in establishing a "Practitioner's Corner" on its web site (http://www.training.fema.gov/EMIWeb/edu). The purpose of this section is to create another means for emergency management professionals to communicate their thoughts and ideas concerning college-level hazard, disaster, and emergency management classes and programs to the educators responsible for those programs. The organizers envision short papers on subjects like:

* types of competencies that should be emphasized in such courses,
* perspectives on different ways to examine or approach emergency management,
* case studies of disasters,
* lessons learned in bureacratic politics,
* success stories/failures, and
* public policy issues.

Submissions and questions should be sent to the Higher Education Project Manager, Wayne Blanchard, e-mail: wayne.blanchard@fema.gov. Selected papers will be posted on the Higher Education web site; the project reserves the right to edit content.

(Adapted from the IAEM Bulletin--the newsletter of the International Association of Emergency Managers)

from: Natural Hazards Observer, v. 26, no. 6, July 2002

Update Your Calendars and Address Books

The Institute for Business and Home Safety (IBHS) is moving its headquarters to a new disaster-resistant building on the campus of MOSI, Tampa's Museum of Science and Industry. Effective July 22nd, their new address is 4775 East Fowler Avenue, Tampa, FL 33617; (866)657-4247 or (813) 286-3400; fax (813) 286-9960. Read more about the design and see the building on this link: http://www.ibhs.org/newsroom/view.asp?id=194.

from: Disaster Research 371, July 31, 2002

Announcing Natural Hazards Center's New Referral Service

As an addition to its already considerable store of information, the Natural Hazards Center is now poised to refer inquiries to those researchers and/or practitioners who have expertise and/or practical experience in different facets of sustainable recovery from disaster. As part of the project it recently completed for the Public Entity Risk Institute, the Center has compiled an in-house database of "experts" in local disaster recovery, economic vitality, environmental quality, social equity, livability, disaster resilience, and the art of combining those attributes in a local context. Persons listed on the database have indicated a willingness to respond to queries of this nature.

Individuals, groups, or local governments who need information about sustainable recovery, advice, on-site assistance, or simply moral support can query the Hazards Center with a phone call: (303) 492-5787; or an e-mail message: wanda.headley@colorado.edu. A staff person will search the database to see who might have the expertise needed and provide their contact information. The Hazards Centers' website, http://www.colorado.edu/hazards, will also have a link for submitting queries in the near future.

from: Natural Hazards Observer, v. XXVI, no. 5, May 2002, p. 5

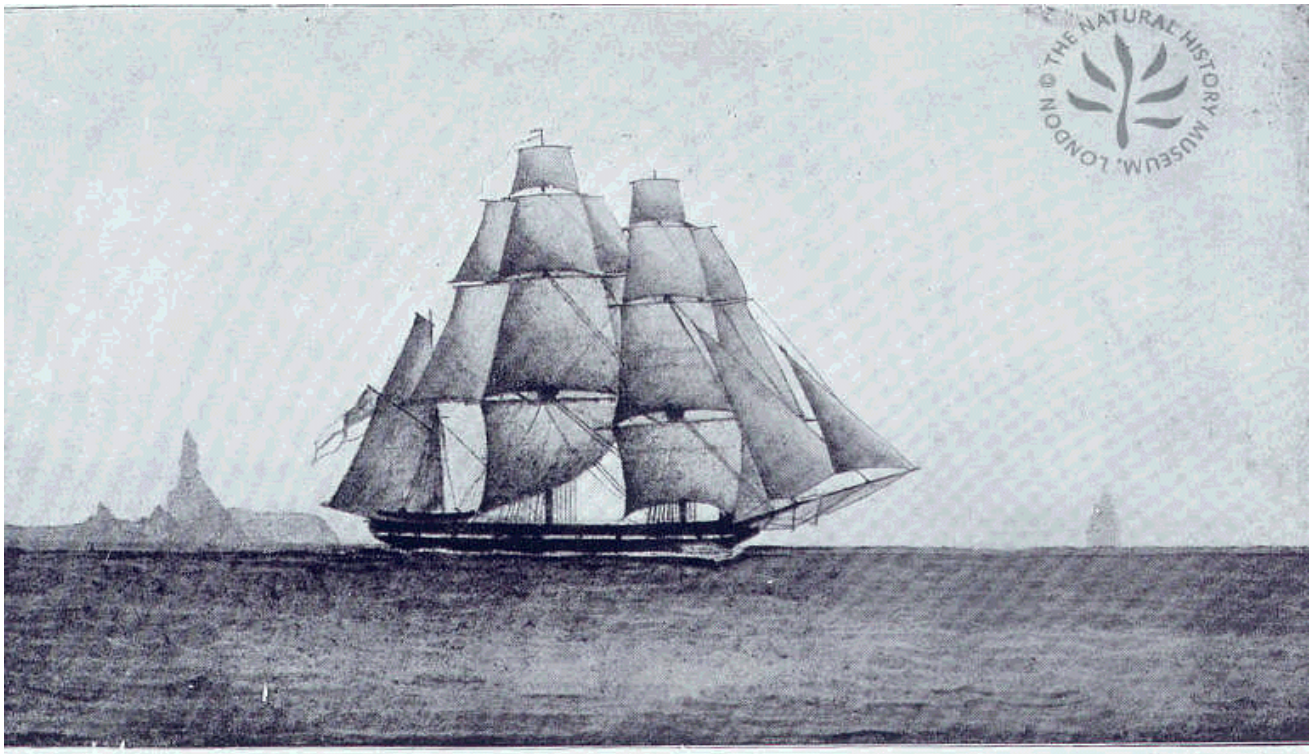
DARWIN'S EARTHQUAKE/TSUNAMI
from: The Voyage of the BEAGLE, by Charles Darwin
abridged and edited by Millicent E. Selsam
Harper & Brothers, 1959

from Chapter 14, pages 196-206

On January the 15th [ed. note: 1835] we sailed from Low's Harbor, and three days afterward anchored a second time in the bay of San Carlos in Chiloe. On the night of the 19th the volcano of Osorno was in action. At midnight the sentry observed something like a star, which gradually increased in size till about three o'clock, when it presented a very magnificent spectacle. By the aid of a glass, dark objects, in constant succession, were seen, in the midst of a great glare of red light, to be thrown up and to fall down. The light was sufficient to cast on the water a long bright reflection. Large masses of molten matter seem very commonly to be cast out of the craters in this part of the Cordillera. I was assured that when the Corcovado is in eruption, great masses are projected upward and are seen to burst in the air, assuming many fantastical forms, such as trees; their size must be immense, for they can be distinguished from the high land behind San Carlos, which is no less than ninety-three miles from the Corcovado. In the morning the volcano became tranquil.

I was surprised at hearing afterwards that Aconcagua in Chile, 480 miles northward, was in action on this same night; and still more surprised to hear that the great eruption of Coseguina (2,700 miles north of Aconcagua), accompanied by an earthquake felt over 1,000 miles, also occurred within six hours of this same time. This coincidence is the more remarkable as Coseguina had been dormant for twenty-six years, and Aconcagua most rarely shows any signs of action. It is difficult even to conjecture whether this coincidence was accidental or shows some subterranean connection. If Vesuvius, Etna, or Hecla in Iceland (all three relatively nearer each other than the corresponding points in South America) suddenly burst forth in eruption on the same night, the coincidence would be thought remarkable; but it is far more remarkable in this case, where the three vents fall on the same great mountain chain, and where the vast plains along the entire eastern coast, and the upraised recent shells along more than 2,000 miles on the western coast, show in how equable and connected a manner the elevatory forces have acted.

February 4. Sailed from Chiloe….We steered northward along shore, but, owing to thick weather, did not reach Valdivia till the night of the 8th. The next morning the boat proceeded to the town, which is distant about ten miles. We



H.M.S. "BEAGLE." [Frontispiece

followed the course of the river, occasionally passing a few hovels and patches of ground cleared out of the otherwise unbroken forest, and sometimes meeting a canoe with an Indian family. The town is situated on the low banks of the stream, and is so completely buried in a wood of apple trees that the streets are merely paths in an orchard….

Great Earthquakes

February 20. This day has been memorable in the annals of Valdivia, for the most severe earthquake experienced by the oldest inhabitant. I happened to be on shore, and was lying down in the wood to rest myself. It came on suddenly, and lasted two minutes, but the time appeared much longer. The rocking of the ground was very sensible. The undulations appeared to my companion and myself to come from due east, while others thought they proceeded from southwest: this shows how difficult it sometimes is to perceive the direction of the vibrations. There was no difficulty in standing upright, but the motion made me almost giddy: it was something like the movement of a vessel in a little cross-ripple, or still more like that felt by a person skating over thin ice which bends under the weight of his body.

A bad earthquake at once destroys our oldest association: the earth, the very emblem of solidity, has moved beneath our feet like a thin crust over a fluid; one second of time has created in the mind a strange idea of insecurity which hours of reflection would not have produced. In the forest, as a breeze moved the trees, I felt only the earth tremble, but saw no other effect. Captain Fitzroy [of the *Beagle*] and some officers were at the town during the shock, and there the scene was more striking; for although the houses, from being built of wood, did not fall, they were violently shaken, and the boards creaked and rattled together. The people rushed out of doors in the greatest alarm. It is these accompaniments that create that perfect horror of earthquakes experienced by all who have thus seen, as well as felt, their effects. Within the forest it was a deeply interesting, but by no means an awe-exciting, phenomenon. The tides were very curiously affected. The great shock took place at the time of low water; and an old woman who was on the beach told me that the water flowed very quickly, but not in great waves, to high-water mark, and then as quickly returned to its proper level; this was also evident by the line of wet sand. This same kind of quick but quiet movement in the tide happened a few years since at Chiloe, during a slight earthquake, and created much causeless alarm. In the course of the evening there were many weaker shocks, which seemed to produce in the harbor the most complicated currents, and some of great strength.

Ruins of Concepción

March 4. We entered the harbor of Concepción. While the ship was beating up to the anchorage, I landed on the island of Quiriquina. The major-domo of the estate quickly rode down to tell me the terrible news of the great earthquake of the 20th: "That not a house in Concepción or Talcahuano [the port] was standing; that seventy villages were destroyed; and that a great wave had almost washed away the ruins of Talcahuano." Of this latter statement I soon saw abundant proofs---the whole coast being strewed over with timber and furniture as if a thousand ships had been wrecked. Besides chairs, tables, bookshelves, etc., in great numbers, there were several roofs of cottages which had been transported almost whole. The storehouses at Talcahuano had been burst open, and great bags of cotton, yerba, and other valuable merchandise were scattered on the shore. During my walk round the island, I observed that numerous fragments of rock, which, from the marine productions adhering to them, must recently have been lying in deep water, had been cast up high on the beach; one of these was six feet long, three broad, and two thick.

The next day I landed at Talcahuano, and afterwards rode to Concepción. Both towns presented the most awful yet interesting spectacle I ever beheld. To a person who had formerly known them, it possibly might have been still more impressive, for the ruins were so mingled together, and the whole scene possessed so little the air of a habitable place, that it was scarcely possible to imagine its former condition. The earthquake commenced at half past eleven o'clock in the forenoon. If it had happened in the middle of the night, the greater number of the inhabitants (which in this one province amount to many thousands) must have perished, instead of less than a hundred: as it was, the invariable practice of running out of doors at the first trembling of the ground alone saved them. In Concepción each house, or row of houses, stood by itself, a heap or line of ruins; but in Talcahuano, owing to the great wave, little more than one layer of bricks, tiles, and timber, with here and there part of a wall left standing, could be distinguished. From this circumstance Concepción , although not so completely desolated, was a more terrible and, if I may so call it, picturesque sight. The first shock was very sudden. The major-domo at Quiriquina told me that the first notice he received of it was finding both the horse he rode and himself rolling together on the ground. Rising up, he was again thrown down. He also told me that some cows which were standing on the steep side of the island were rolled into the sea. The great wave caused the destruction of many cattle; on one low island, near the head of the bay, seventy animals were washed off and drowned. It is generally thought that this has been the worst earthquake ever recorded in Chile; but as the very severe ones occur only after long intervals, this cannot easily be known; nor indeed would a much worse shock have made any great difference, for the ruin was now complete. Innumerable small tremblings followed the great earthquake, and within the first twelve days no less than three hundred were counted.

After viewing Concepción , I cannot understand how the greater number of inhabitants escaped unhurt. The houses in many parts fells outwards, thus forming in the middle of the streets little hillocks of brickwork and rubbish. Mr. Rouse, the English consul, told us that he was at breakfast when the first movement warned him to run out. He had scarcely reached the middle of the courtyard when one side of his house came thundering down. He retained presence of mind to remember that if he once got on top of that part which had already fallen, he would be safe. Not being able from the motion of the ground to stand, he crawled up on his hands and knees; and no sooner had he ascended this little eminence than the other side of the house fell in, the great beams sweeping close in front of his head. With his eyes blinded and his mouth choked with the cloud of dust which darkened the sky, at last he gained the street. As shock succeeded shock at the interval of a few minutes, no one dared approach the shattered ruins; and no one knew whether his dearest friends and relations were not perishing from the want of help. Those who had saved any property were obliged to keep a constant watch, for thieves prowled about and, at each little trembling of the ground, with one hand they beat their breasts and cried "misericordia!" and then with the other filched what they could from the ruins. The thatched roofs fell over the fires, and flames burst forth in all parts. Hundreds knew themselves ruined, and few had the means of providing food for that day.

Earthquakes alone are sufficient to destroy the prosperity of any country. If beneath England the now inert subterranean forces should exert those powers which most assuredly in former geological ages they have exerted, how completely would the entire condition of the country be changed! What would become of the lofty houses, thickly packed cities, great manufactories, the beautiful public and private edifices? If the new period of disturbance were first to commence by some great earthquake in the dead of night, how terrific would be the carnage! England would at once be bankrupt; all papers, records, and accounts would from that moment be lost. Governing being unable to collect the taxes and failing to maintain its authority, the hand of violence and rapine would remain uncontrolled. In every large town famine would go forth, pestilence and death following in its train.

Tidal Waves

Shortly after the shock, a great wave was seen, from the distance of three or four miles, approaching in the middle of the bay with a smooth outline; but along the shore it tore up cottages and trees as it swept onward with irresistible force. At the head of the bay it broke in a fearful line of white breakers which rushed up to a height of 23 vertical feet above the highest spring tides. Their force must have been prodigious, for at the fort a cannon with its carriage, estimated at four tons in weight, was moved 15 feet inward. A schooner was left in the midst of the ruins, 200 yards from the beach. The first wave was followed by two others, which in their retreat carried away a vast wreck of floating objects.

In one part of the bay a ship was pitched high and dry on shore, was carried off, again driven on shore, and again carried off. In another part, two large vessels anchored near together were whirled about, and their cables were thrice wound round each other; though anchored at a depth of 36 feet, they were for some minutes aground. The great wave must have traveled slowly, for the inhabitants of Talcahuano had time to run up the hills behind the town; and some sailors pulled out seaward, trusting successfully to their boat riding securely over the swell if they could reach it before it broke. One old woman with a little boy four or five years old ran into a boat, but there was nobody to row it out: the boat was consequently dashed against an anchor and cut in twain; the old woman was drowned, but the child was picked up some hours afterward clinging to the wreck. Pools of salt water were still standing amid the ruins of the houses, and children, making boats with old tables and chairs, appeared as happy as their parents were miserable. It was, however, exceedingly interesting to observe how much more active and cheerful all appeared than could have been expected. It was remarked with much truth that, from the destruction being universal, no one individual was humbled more than another, or could suspect his friends of coldness--that most grievous result of the loss of wealth. Mr. Rouse and a large party whom he kindly took under his protection lived for the first week in a garden beneath some apple trees. At first they were merry as if it had been a picnic, but soon afterward heavy rain caused much discomfort, for they were absolutely without shelter.

In Captain Fitzroy's excellent account of the earthquake it is said that two explosions, one like a column of smoke and another like the blowing of a great whale, were seen in the bay. The water also appeared everywhere to be boiling, and it "became black, and exhaled a most disagreeable sulphureous smell." These latter circumstances were observed in the Bay of Valparaiso during the earthquake of 1822; they may, I think, be accounted for by the disturbance of the mud at the bottom of the sea containing organic matter in decay. In the Bay of Callao, during a calm day, I noticed that as the ship dragged her cable over the bottom, its course was marked by a line of bubbles. The lower orders in Talcahuano thought that the earthquake was caused by some old Indian women who two years ago, being offended, stopped the volcano of Antuco. This silly belief is curious because it shows that experience has taught them to observe that there exists a relation between the suppressed action of the volcanoes and the trembling of the ground. It was necessary to apply the witchcraft to the point where their perception of cause and effect failed; and this was the closing of the volcanic vent. This belief is the more singular in this particular instance because, according to Captain Fitzroy, there is reason to believe that Antuco was noways affected.

I have not attempted to give any detailed description of the appearance of Concepción , for I feel that it is quite impossible to convey the mingled feelings which I experienced. Several of the officers visited it before me, but their strongest language failed to give a just idea of the scene of desolation. It is a bitter and humiliating thing to see works which have cost man so much time and labor overthrown in one minute; yet compassion for the inhabitants was almost instantly banished by the surprise in seeing a state of things produced in a moment of time which one was accustomed to attribute to a succession of ages. In my opinion, we have scarcely beheld, since leaving England, any sight so deeply interesting.

Elevation of the Land

The most remarkable effect of this earthquake was the permanent elevation of the land; it would probably be far more correct to speak of it as the cause. There can be no doubt that the land round the Bay of Concepción was upraised two or three feet; but it deserves notice that, owing to the wave having obliterated the old lines of tidal action on the sloping sandy shores, I could discover no evidence of this fact, except in the united testimony of the inhabitants that one little rocky shoal, now exposed, was formerly covered with water. At the island of Santa Maria (about thirty miles distant) the elevation was greater; on one part Captain Fitzroy found beds of putrid mussel shells *still adhering to the rocks* ten feet above high-water mark: the inhabitants had formerly dived at low-water spring tides for these shells. The elevation of this province is particularly interesting from its having been the theater of several other violent earthquakes, and from the vast numbers of seashells scattered over the land, up to a height of certainly 600, and I believe of 1,000 feet. At Valparaiso, as I have remarked, similar shells are found at the height of 1,300 feet: it is hardly possible to doubt that this great elevation has been effected by successive small uprisings, such as that which accompanied or caused the earthquake of this year, and likewise by an insensibly slow rise, which is certainly in progress on some parts of this coast. g

OTHER 1835 DARWINIA

Darwin's Letter to His Sister about the Concepción Earthquake

After nearly five years of journeying aboard the H.M.S. Beagle, Charles Darwin found himself in March of 1835 becalmed in the seas off Valparaiso, Chile. He took the opportunity to write letters to friends and relatives, including this letter to his sister Caroline.

My dear Caroline,

We now are becalmed some leagues off Valparaiso and instead of growling any longer at our ill fortune, I begin this letter to you. ... The voyage has been grieviously too long; we shall hardly know each other again; independent of these consequences, I continue to suffer so much from sea-sickness, that nothing, not even geology itself can make up for the misery and vexation of spirit. ...

We are now on our road from Concepción . The papers will have told you about the great Earthquake of the 20th of February. I suppose it certainly is the worst ever experienced in Chili (sic). It is no use attempting to describe the ruins--it is the most awful spectacle I ever beheld. The town of Concepción is now nothing more than piles and lines of bricks, tiles and timbers-- it is absolutely true there is not one house left habitable; some little hovels builts of sticks and reeds in the outskirts of the town have not been shaken down and these now are hired by the richest people. The force of the shock must have been immense, the ground is traversed by rents, the solid rocks are shivered, solid buttresses 6-10 feet thick are broken into fragments like so much biscuit. How fortunate it happened at the time of day when many are out of their houses and all active: if the town had been over thrown in the night, very few would have escaped to tell the tale. We were at Valdivia at the time. The shock there was considered very violent, but did no damage owing to the houses being built of wood. I am very glad we happened to call at Concepción so shortly afterwards: it is one of the three most interesting spectacles I have beheld since leaving England--A Fuegian Savage--Tropical Vegetation--and the ruins of Concepción . It is indeed most wonderful to witness such desolation produced in three minutes of time.

from: http://www.crustal.ucsb.edu/ics/understanding/accounts/darwin.html

Charles Darwin's Problem

Charles Darwin once remarked (1845) that "the connec-

tion between earthquakes and the weather has often been disputed." Here is the quotation from "The Voyage of the *Beagle*" by Charles Darwin, chapter 16: "In Northern Chile, the inhabitants are here most firmly convinced of some connection between the state of the atmosphere and of the tremblings of the ground. To their minds an earthquake foretold rain as surely as rain foretold abundant pasture."

Mikhail Nosov, Boris Levin, and Lev Rykunov respond, in Journal of Conference Abstracts, v. 3, no. 1 (Conference on Mathematical Geophysics 1998), "In our opinion this connection is realised using the ocean as a mediator. During systematic and purposeful analysis of near-real time earthquake bulletin (NEIS) and Sea Surface Temperature (SST) Anomaly maps (FNMOC) the appearance of large-scale (~500 km) cool SST anomalies were discovered in the epicenter region of strong underwater earthquakes near islands Bougenville and Samar in May and June, 1996. Considering the analysis of energy from the theory of similarity point of view, the conclusion can be made that the only mechanism that could lead to the cool SST anomaly origin was certainly connected with an export of cold lower water layers to the ocean surface as the result of turbulent mixing or vertical non-linear currents generated by seismic bottom motions.

The generation of such seismogenic SST anomalies may lead to some obvious and at the same time important consequences and accompanying phenomena should be studied. Among all the phenomena we single out the following: 1) export of the nutrients toward upper water layers where there is an usual shortage of the substances causing an increase of the productivity (like in an upwelling zone), 2) generation of large amplitude internal ocean waves (much larger than internal tsunami waves) as a result of evolution of the anomaly stratification zone; 3) the appearance of the cool SST anomaly should cause a response of the atmosphere, it can change the direction of the heat flux at the surface "water-air" and even can promote the cyclone origin. The last point gives us grounds to state that the Charles Darwin Problem will be solved in near future.

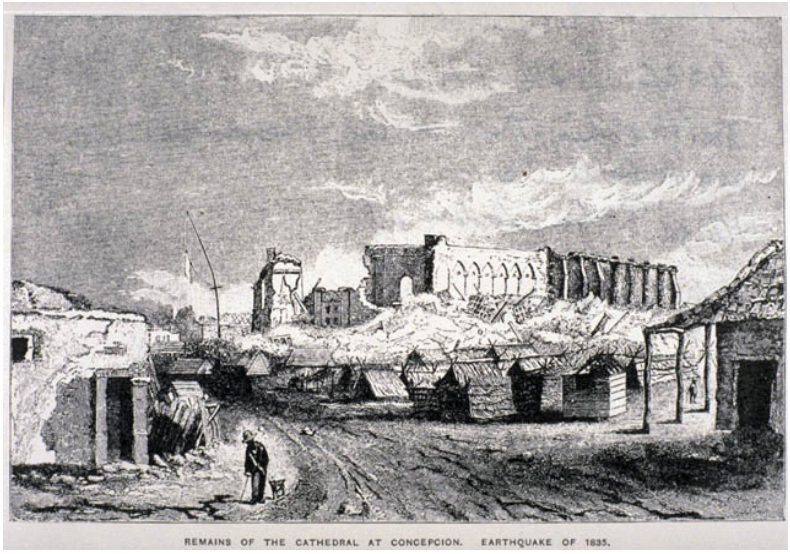
from: www.compublic.co.uk/science/publications/JconfAbs/3/94.html

Note about Darwin's Tsunami Observations

Darwin also detected two kinds of movements in the water of the near sea: during the stroke the water rises and moves back, also without major disturbance. But then waves follow destroying the port and the beaches. The first movement seems to be a direct consequence of the earthquake that has different effects on liquid and on solid masses, thus creating an imbalance between them. But the second phenomenon of high waves, primarily in rather shallow coast water seems to originate on the open sea; according to Darwin's surmise exactly where the less disturbed water of the deep ocean meets the coastal water completely disturbed by the earthquake. This is the area where the big waves develop that reach the coast, sometimes half an hour after the earthquake.

The strangest phenomenon of this earthquake was the permanent elevation of the main land around the gulf of Concepción by two or three feet. Darwin thought that in this case the earthquake was not the cause but the effect of this elevation. In addition during the earth shock on 20 February, 1835, the island Juan Fernandez, 360 miles northwest of Concepción was heavily rocked, and close to the coast a submarine volcano erupted. At the same time three volcanoes far from each other in the Cordilleras erupted: the volcano Osorno near the island Chiloe; the volcano Aconcagua near Valparaiso, 480 miles north of Osorno; the volcano Cosiguina 2,700 miles north of Aconcagua in Central America.

from: http://www.univie.ac.at/Wissenschaftstheorie/heat/heat-2/heat281.htm



Remains of the Cathedral at Concepcíon (Steel engraving, London, 1888).

from the Kozak Collection, KZ260: "Courtesy National Information Service for Earthquake Engineering, University of California, Berkeley"

CONCEPCÍON, CHILE EARTHQUAKE AND TSUNAMI-- OTHER EYEWITNESS ACCOUNTS:

Syms Covington:
The Journal of Syms Covington
Assistant to Charles Darwin Esq.
on the Second Voyage of the *HMS Beagle*
December 1831 - September 1836

Portrait of Syms Covington, reproduced courtesy of the Merimbula-Imlay Historical Society Inc.
from the publication *Syms Covington of Pambula*, by B. Ferguson

February 20th we felt a very severe shock of an earthquake; this happened when we were lying on the ground, resting ourselves. The sensation was something like a ship in a gentle seaway, the trees could be perceived to wave a lot too and fro in a north easterly direction; the sea came up of a sudden six feet, and as suddenly retired, but there was done here no damage. Sailed from Valdivia THE 22nd OF February and arrived at Talcunano March 3rd. Went to the Island of Quiriquina previous to ship coming to an anchor. This island is in the mouth of the harbour. In our going on shore we found the Island dreadfully cracked. The Island was also surrounded with the timbers and furniture of houses which had floated from Talcahuano. Left the island for the ship after dark. IT WAS about four miles, and in consequence of its blowing heavy, and both wind and tide against us, we were four or five hours before reaching ship, both cold and wet, the waves constantly breaking over the boat, and of course, drenched to the skin. A treat, but nothing new.

Went to Talcahuano the the following morning. We found the town in a most deplorable state, viz. not a single house habitable, the earth cracked in all directions, roads blocked up with fallen rocks, cliffs shattered to pieces on the sea coast, fish etc. left on the dry land; indeed, the whole country round spoke the devastation it had made.

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at http://www.asap.unimelb.edu.au/bsparcs/covingto/

Captain Paul Delano:

On November 14, 1824, Captain Delano was appointed Commander of the Department of the Navy in Valparaiso. In 1831, to fend off the dangerous Northerners, he was commissioned by the Supreme Government to build the first jetty of this foremost Chilean port. Another major earthquake on February 20, 1835, hit Concepcíon and destroyed the city, including the house of Captain Paul Delano. In writing to his cousin, Captain Jabez Delano of Fairhaven, he narrated the event in which he was forced to climb a neighboring mountain just as the return wave swept away his house. The closing lines are truly characteristic: "I have lost everything I possess on earth, and now I am ready for the first fashion, Paul Delano"."

from: http://www.delanoye.org/primary/CaptPaulDelano.html
quoting: Delano, J. A., 1899, The genealogy history and alliances of the American house of Delano 1621 to 1899: [N.E. Historic Genealogical Society?], p. 473.

THE 1835 CHILEAN EARTHQUAKE/TSUNAMI

20 February of 1835, "The Ruin"
Preparado por Jorge Quezada Flory
http://www.udec.cl/gema/Ter_hist/20_2_1835.html (Spanish)
translated by the Internet; edited by Lee Walkling

Of the Chilean earthquakes, this one appears to be more widely documented and studied thanks to the contribution of English naturalist Charles Darwin who was in Valdivia and experienced the tremors there.

The descriptions of the phenomenon in diverse locales indicate that there were at least two main shocks in a space of two minutes. The first tremor was felt in Concepcíon at 11:40 a.m., but was not strong enough to produce panic. The main earthquake (second tremor) destroyed most of the buildings in a few seconds. On Quiriquina Island, the local administrator told Darwin that his first memory of the earthquake was being thrown to the ground along with the horse he had been riding. While riding he had not felt the first, weaker tremor, and that the epicenter of the second tremor was closer to Quiriquina Island.

Next it is described by Captain Fitz-Roy, captain of the *Beagle* on which Darwin was a passenger, who was in the vicinity of Concepcíon during the earthquake. "Conceptíon, 20 of February. Ten in the morning, great flocks of marine birds were observed on the roofs of houses, flying from the coast to the interior. Old-timers and experts on the climate of Concepcíon were astonished by the unusual behavior of the birds (mostly gulls) and did not see any signs of approaching storms, which is very rare in this area. About eleven in the morning,the south breeze refreshed as usual, the sky was clear and almost without clouds. At 11:40 a movement was felt that began weakly and without any preceding underground noise; the intensity increased quickly. During the first minutes, many people remained inside, but the movements became so violent that soon the terrified

people rushed outside. No one could remain on their feet and the buildings seemed to swing like waves; suddenly a tremendous shock demolished and destroyed everything. In less than 6 seconds the city became a pile of ruins. The noise of the houses that collapsed; the horrible screaming of the Earth when it opened and closed, repeated in numerous sites; the heart-rending shouts of the people; the suffocating heat; the dust clouds that blinded and choked the unfortunate inhabitants; the desperation and confusion, the extreme horror and the alarm cannot be described nor imagined."

The main convulsion lasted about two minutes, during which time it was impossible to remain standing without leaning on trees or other firm objects. Some were thrown to the ground but the movement was so violent that others had to stretch their arms to each side to avoid being thrown to the ground. The birds fled in all directions. The horses were very scared, they shook nervously, with raised legs and low heads. The vigorous shaking continued at short intervals and the Earth was not at rest in the following three days. By March 4 there had been more than 400 aftershocks. The coastline raised between one and two meters, nevertheless this deformation disappeared with time.

Five died and 30 disappeared in Concepcíon, but there were also victims in Talcahuano, Chillan, Constitucíon, Cauquenes, Talca and other towns. All the cities to the south of Rancagua suffered damage. There was no damage in the buildings of Santiago, but periodic inundations of water in numerous irrigation ditches were observed. In the alluvial lands surrounding Concepcíon the central valley, earth craters and cracks appeared. A series of great cracks (some a foot wide) appeared in alluvial lands at the skirt of the hills in Concepcíon, parallel to mountainous spurs. The city of Chillan was totally destroyed. It was decided to more safely reconstruct the town in a place about 3 kilometers from the previous site. All the inhabitants did not move to the new place, causing the city to be divided into Chillan Viejo and Chillan Nuevo.

A magnitude of 8 is estimated for this earthquake whose epicenter would have been less than 30 kilometers from the city of Concepcíon. It also generated a tsunami of such proportions more destruction was caused. In the history of Chile, the earthquake of February 20, 1835 is known as "The Ruin."

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DREAMS DISSIPATED
excerpted from *Roughing It*
by
Mark Twain
from: http://www.sfmuseum.org/hist6/65twain.html
Reprinted with permission from Richard Hansen, Museum of the City of San Francisco

A month afterward I enjoyed my first earthquake. It was one which was long called the "great" earthquake [Note: October 8, 1865], and is doubtless so distinguished till this day. It was just after noon, on a bright October day. I was coming down Third street. The only objects in motion anywhere in sight in that thickly built and populous quarter, were a man in a buggy behind me, and a street car wending slowly up the cross street. Otherwise, all was solitude and a Sabbath stillness. As I turned the corner, around a frame house, there was a great rattle and jar, and it occurred to me that here was an item!–no doubt a fight in that house. Before I could turn and seek the door, there came a really terrific shock; the ground seemed to roll under me in waves, interrupted by a violent joggling up and down, and there was a heavy grinding noise as of brick houses rubbing together. I fell up against the frame house and hurt my elbow. I knew what it was, now, and from mere reportorial instinct, nothing else, took out my watch and noted the time of day; at that moment a third and still severer shock came, and as I reeled about on the pavement trying to keep my footing, I saw a sight! The entire front of a tall four-story brick building in Third street sprung outward like a door and fell sprawling across the street, raising a dust like a great volume of smoke! And here came the buggy, overboard went the man, and in less time than I can tell it the vehicle was distributed in small fragments along three hundred yards of street.

One could have fancied that somebody had fired a charge of chair-rounds and rags down the thoroughfare. The street car had stopped, the horses were rearing and plunging, the passengers were pouring out at both ends, and one fat man had crashed half way through a glass window on one side of the car, got wedged fast and was squirming and screaming like an impaled madman.

Every door, of every house, as far as the eye could reach, was vomiting a stream of human beings; and almost before one could execute a wink and begin another, there was a massed multitude of people stretching in endless pro-

cession down every street my position commanded. Never was solemn solitude turned into teeming life quicker.

Of the wonders wrought by "the great earthquake," these were all that came under my eye; but the tricks it did, elsewhere, and far and wide over the town, made toothsome gossip for nine days.

The destruction of property was trifling–the injury to it was wide-spread and somewhat serious.

The "curiosities" of the earthquake were simply endless. Gentlemen and ladies who were sick, or were taking a siesta, or had dissipated till a late hour and were making up lost sleep, thronged into the public streets in all sorts of queer apparel, and some without any at all. One woman who had been washing a naked child, ran down the street holding it by the ankles as if it were a dressed turkey. Prominent citizens who were supposed to keep the Sabbath strictly, rushed out of saloons in their shirt-sleeves, with billiard cues in their hands. Dozens of men with necks swathed in napkins, rushed from barbershops, lathered to the eyes or with one cheek clean shaved and the other still bearing a hairy stubble. Horses broke from stables, and a frightened dog rushed up a short attic ladder and out on to a roof, and when his scare was over had not the nerve to go down again the same way he had gone up.

A prominent editor flew down stairs, in the principal hotel, with nothing on but one brief undergarment–met a chambermaid, and exclaimed:

"Oh, what shall I do! Where shall I go!"

She responded with naive serenity:

"If you have no choice, you might try a clothing-store!"

A certain foreign consul's lady was the acknowledged leader of fashion, and every time she appeared in anything new or extraordinary, the ladies in the vicinity made a raid on their husbands' purses and arrayed themselves similarly. One man who had suffered considerably and growled accordingly, was standing at the window when the shocks came, and the next instant the consul's wife, just out of the bath, fled by with no other apology for clothing than–a bath-towel! The sufferer rose superior to the terrors of the earthquake, and said to his wife:

"Now that is something like! Get out your towel my dear!"

The plastering that fell from ceilings in San Francisco that day, would have covered several acres of ground. For some days afterward, groups of eyeing and pointing men stood about many a building, looking at long zig-zag cracks that extended from the eaves to the ground. Four feet of the tops of three chimneys on one house were broken square off and turned around in such a way as to completely stop the draft.

A crack a hundred feet long gaped open six inches wide in the middle of one street and then shut together again with such force, as to ridge up the meeting earth like a slender grave. A lady sitting in her rocking and quaking parlor, saw the wall part at the ceiling, open and shut twice, like a mouth, and then drop the end of a brick on the floor like a tooth. She was a woman easily disgusted with foolishness, and she arose and went out of there. One lady who was coming down stairs was astonished to see a bronze Hercules lean forward on its pedestal as if to strike her with its club. They both reached the bottom of the flight at the same time, the woman insensible from the fright. Her child, born some little time afterward, was club-footed. However–on second thought–if the reader sees any coincidence in this, he must do it at his own risk.

The first shock brought down two or three huge organ-pipes in one of the churches. The minister, with uplifted hands, was just closing the services. He glanced up, hesitated, and said:

"However, we will omit the benediction!"–and the next instant there was a vacancy in the atmosphere where he had stood.

After the first shock, an Oakland minister said:

"Keep your seats! There is no better place to die than this"–

And added, after the third:

"But outside is good enough!" He then skipped out at the back door.

Such another destruction of mantel ornaments and toilet bottles as the earthquake created, San Francisco never saw before. There was hardly a girl or a matron in the city but suffered losses of this kind. Suspended pictures were thrown down, but oftener still, by a curious freak of the earthquake's humor, they were whirled completely around with their faces to the wall! There was great difference of opinion, at first, as to the course or direction the earthquake traveled, but water that splashed out of various tanks and buckets settled that. Thousands of people were made so seasick by the rolling and pitching of floors and streets that they were weak and bed-ridden for hours, and some few for even days afterward.–Hardly an individual escaped nausea entirely.

The queer earthquake–episodes that formed the staple San Francisco gossip for the next week would fill a much larger book than this, and so I will diverge from the subject.

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Infrequently Asked Questions

compiled by Lee Walkling

Which of the following geologic events did Charles Darwin experience during his voyage on the *Beagle* in 1835?

a. volcanic eruption
b. earthquake
c. tsunami

A and B. Darwin saw the volcano Osorno in action on January 19, 1835, and was ashore on February 20, 1835 for the big earthquake. Although he did not see the resulting tsunami, he did see the devastating effects it had on the town of Concepcíon. His detailed observations and his questioning the local people resulted in the tsunami account he gives in his journal, an excerpt of which is printed on page 16.

from: http://www.odci.gov/cia/publications/factbook/

From 1975–1995 which four states did not experience *any* earthquakes?

From 1975-1995 there were only four states that did not have any earthquakes. They were: Florida, Iowa, North Dakota, and Wisconsin.

from: http://earthquake.usgs.gov/4kids/facts.html

TsuInfo Alert reported on tsunami and earthquake myths in a previous issue. What famous myths were omitted?

Urban myths, currently believed by the uneducated, continue to be passed along by word-of-mouth. For example:

"Big earthquakes always happen in the early morning." This myth may be so common because we want it to be true. Several recent damaging earthquakes have been in the early morning, so many people believe that all big earthquakes happen then. In fact, earthquakes occur at all times of day. The 1933 Long Beach earthquake was at 5:54 p.m. and the 1940 Imperial Valley event was at 9:36 p.m. Even recently, the 1990 Upland earthquake was at 3:43 p.m. and the 1989 Loma Prieta event was at 5:02 p.m. It is easy to notice the earthquakes that fit the pattern and forget the ones that don't."

from: http://www.scecdc.scec.org/eqmyth.html

What is the date of the earliest recorded earthquake?

The earliest earthquake for which we have descriptive information occurred in China in 1177 B.C. The Chinese earthquake catalog describes several dozen large earthquakes in China during the next few thousand years. Earthquakes in Europe are mentioned as early as 580 B.C., but the earliest for which we have some descriptive information occured in the mid-16th century.

from: http://www.germantown.k12.il.us/html/earthquakes.html

The USGS provides this answer: The earliest recorded evidence of an earthquake has been traced back to 1831 BC in the Shandong province of China, but there is a fairly complete record starting in 780 BC during the Zhou Dynasty in China.

from: http://earthquake.usgs.gov/4kids/facts.html

What is the date of the earliest recorded tsunami?

The earliest recorded [in written records] tsunami was in 326 B.C. near the Indus delta/Kutch region. Alexander the Great was returning to Greece after his conquest and wanted to go back by a sea route. But an earthquake of large magnitude destroyed the mighty Macedonian fleet as reported by Lietzin (1974).

from: http://www.punjabilok.com/india_disaster_rep/earth_quake/tsunami.htm

Another answer [recorded in geologic records]: "Now the earliest tsunami we know of is the one associated with

the giant rock that wiped out the dinosaurs some 60 million years ago. It looks as though when it hit the water near the Yucatan Peninsula in Mexico, it sent a sandy tsunami surging over the Texas plains. It left behind a very unusual 70-cm thick bed of sandstone, packed with fragments of shells and fish teeth, wood debris and clumps of mudstone.

Another tsunami happened around 1500 BC, when the volcanic Greek island of Santorini exploded, blowing some 50 cubic kilometres of rock into the air. An island about 18 kilometres in diameter, with a 1.5 kilometre-high volcano in the middle, suddenly turned into a lagoon! Some historians think that the volcanic debris combined with a gigantic tsunami destroyed the Minoan civilisation which was on the nearby island of Crete. The Minoans were instantly wiped out. Even today, along parts of the Mediterranean coast, you can still find an ancient flood contour, about 100 metres above sea level."

from: http://www.abc.net.au/science/k2/trek/4wd/tsunami.htm

SEPTEMBER IS WEATHER RADIO AWARENESS MONTH IN WASHINGTON

by
Ted Buehner
Warning Coordination Meteorologist
National Weather Service - Seattle/Tacoma
206-526-6095 x223

It is 2 AM in the morning and you are sound asleep in your Ocean Shores residence, motel room, or campground tent. A major earthquake occurs near Kodiak Island, generating a tsunami. Minutes later, the West Coast and Alaska Tsunami Warning Center issues a tsunami watch for the Washington coast. Upon receipt of the watch, the National Weather Service in Seattle activates the Emergency Alert System (EAS) via NOAA Weather Radio. The Forks/Mt. Octopus NOAA Weather Radio transmitter sends the tsunami watch message. But you are sound asleep. How are you going to get this potentially life-saving message ?

In another scenario, you live in the Puget Sound region. It is 3 AM and again you are asleep. A train derails nearby, spilling dangerous chemicals into the air. Local emergency management officials activate EAS, sending a message for everyone in the path of the lethal airborne chemicals to evacuate immediately. The National Weather Service in Seattle, receives and retransmits this EAS message over NOAA Weather Radio within just a few minutes. But you are asleep. How do you get this critical life-saving message in a timely fashion?

NOAA Weather Radio can save lives and property via its warning alarm feature, and site specific and event select capabilities. However, many people do not know about this cost effective life saving service. Hence, Washington State Governor Gary Locke has proclaimed the month of September as Weather Radio Awareness Month. The goal of the awareness campaign is to have weather radios become as common as smoke detectors in homes, businesses, school, health care facilities and other places where people gather.

This year's awareness campaign slogan is *Weather Radio is Washington's "All-Hazards" Warning System*. NOAA Weather Radio not only airs immediate flood and weather warning information from 16 transmitters broadcasting in the state, but now also airs national EAS warning messages from sources like the White House or FEMA, state or regional EAS warning messages from sources such as the Governor or other state emergency officials, and warning messages from county and municipal emergency officials. These warning messages include tsunami events, volcanic hazards, hazardous material releases, nuclear accidents, radiological hazards, and secondary hazards from earthquakes and terrorism events.

The campaign is a partnership with Washington State Emergency Management and the National Weather Service. The key campaign offer is consumer incentives offered by a number of weather radio manufacturers and retailers. The incentives and all information about weather radio are available through the campaign's host web site from Washington State Emergency Management at http:// www.wa.gov/wsem.

On the web site's "Where To Get Weather Radios?" link, each manufacturer or retailer displays their weather radio models, with specific features and prices via their web site, permitting you to shop for the radio that's right for you. Emphasis is on the EAS programable weather radios, that permit you to select which county and what warning events you want to be immediately notified of.

Other campaign activities include distribution of campaign materials in schools and the emergency management community, media segments, etc. The campaign is held in September, the traditional start to the school year, the month before the state's fall and winter storm season begins, and just ahead of the coming holiday season.

NOAA Weather Radio is a life-saver for the cost of a pair of shoes. For more information about the September Weather Radio Awareness Month, visit http://www.wa.gov/wsem, or contact Barb Thurman of Washington State Emergency Management at 253-512-7047, or the National Weather Service offices in Seattle, Spokane, Pendleton, or Portland.

current

SHMO 101 Training Course Available: State Hazard Mitigation Officer Training Course materials are now available through the National Emergency Management Association (NEMA). The course is designed for new SHMOs and is field deliverable. Materials include a student guide, independent study guide and desk reference. An instructor manual and powerpoint slides are also available. NEMA produced the training course through a grant from the Public Entity Risk Institute (PERI). The individual training publications are available from the NEMA web site library, key word "SHMO 101". For more information about PERI, visit http://www.riskinstitute.org .

current

Emergency Planning and Management Self-Study Course. This self-study course is available from Government Institutes/ABS Consulting. See: http://govinst.com; or contact ABS Consulting, Government Institutes Division, 4 Research Place, Rockville, MD 20850; (301) 921-2300; fax: (301) 921-0373.

from: Disaster Research 368, June 10, 2002

current

Postgraduate Training Program in Emergency Management and Public Health. George Washington University announces a new postgraduate training program in emergency management and public health for beginning and mid-career professionals interested in combining emergency services, disaster relief, and the rapid assessment of public health concerns and services. For more information: http://www.homelandsecurity.org/hls/gwu071202.htm.

from: Disaster Research 371, July 31, 2002

July 24-25: Seattle, WA

"Connecting Communities: Emergency Preparedness and Security Regional Forums." Sponsor: Federal Transit Administration (FTA). "These two-day forums are intended to help metropolitan areas and their surrounding communities become better prepared to respond to emergency situations in the coordination, communication, planning and practice of safety and security measures."

This forum will also be given August 12-13 : San Jose, CA; August 14-15: San Francisco, CA Other forum cities with dates to be determined are: Los Angeles, CA; San Diego, CA. Additional cities may be added at a later date. See: http://www.transit-safety.volpe.dot.gov; or e-mail: Tami von Isakovics at Isakovics.Tami.Von@fta.dot.gov.

from: Disaster Research 369, June 19, 2002

September 1-5, 2002

National Emergency Management Association (NEMA) Annual Conference, Asheville, NC. NEMA is the professional association of state, Pacific, and Caribbean state emergency management directors. The association's annual meeting not only offers opportunities to learn about the latest issues and innovations in emergency management, but also a chance to meet with federal elected and non-elected officials who determine and manage national programs dealing with hazards and disasters. For more information and registration materials, contact NEMA, c/o Council of State Governments, PO Box 11910, Lexington, KY 40578; (859) 244-8162; e-mail: nema_admin@csg.org; http://www.nemaweb.org/index.cfm.

from: Natural Hazards Observer, v. 26, no. 6, July 2002

September 8-11, 2002

Fall World 2002: 14th International Disaster Recovery Symposium and Exhibition. Sponsor: Disaster Recovery Journal (DRJ). Orlando, Florida. Details about this expansive biannual exposition are available from DRJ, PO Box 510110, St. Louis, MO 63151; (314) 894-0276; fax (314) 894-7474; http://www. drj.com/conferences/orl2002/8pg/.

September 23-27, 2002

PERI to Host Internet Symposium on Evaluating Community Emergency Services. This Internet symposium is sponsored by the Public Entity Risk Institute September 23-27, 2002. The program is free and all-electronic. To enroll, see: http://www.riskinstitute.org/symposium_signup.asp.

from: Disaster Research 370, July 5, 2002

September23-27, 2002 and March 12-21, 2003

Disaster Management Workshops will be offered by the University of Wisconsin-Madison, Department of Engineering Professional Development in Madison, Wisconsin. This program is intended for emergency managers in business, industry, government service, and community organizations, and covers emergency information management; disaster communications; response planning; damage, needs, and resources assessment; monitoring; evaluation; and reporting. For details, contact Don Schramm, e-mail: schramm@epd.engr.wisc.edu; or see http://epdweb.engr.wisc.edu/courses (click on "Disaster Management").

from: Natural Hazards Observer, v. 26, p. 6, July 2002

September 25, 2002 and October 2, 2002

The American Planning Association (APA) is developing a day-long training course in hazard mitigation planning under a cooperative agreement with FEMA. The course includes an overview of the provisions and planning requirements of the Disaster Mitigation Act of 2000. Pilot versions of the course will be given at the APA conference in Florida and at the upcoming Michigan Society of Planning (MSP) meeting.

The Florida APA Conference is scheduled for Septem-

ber 25, 2002 in Key West. The MSP Conference will be held on October 2, 2002 in Kalamazoo. More information about this course can be obtained from: http://www.planning.org/conferences/disaster.htm.

from: Disaster Research 371, July 31, 2002

October 7-10, 2002

California Emergency Services, Southern California Chapter 2002 Conference. Palm Springs, California: October 7-10, 2002. See: http://www.scesa.org.

from: Disaster Research 369, June 19,2002

February 5-8, 2003

Earthquake Engineering Research Institute (EERI) Annual Meeting. Portland, Oregon. For their 2003 annual meeting, EERI members will repair up the coast to view the beautiful Cascade Mountains, feast on fresh salmon, and discuss current problems and the cutting edge information and technology available to alleviate seismic hazards. For details, contact EERI, 499 14th Street, Suite 320, Oakland, CA. 94612-1934; (510) 451-0905; fax (510) 451-5411; e-mail: eeri@eeri.org; http://www.eeri.org.

from: Natural Hazards Observer, v. 26, no. 6, July 2002

February 6-9, 2003

2003 International Disaster Management Conference: "Disaster 2003." Sponsor: Florida Emergency Medicine Foundation. Orlando, Florida: The organizers have issued a call for presentations; for details, contact John Todaro, Director of Education, Florida Emergency Medicine Foundation, Florida College of Emergency Physicians, 3717 South Conway Road, Orlando, FL 32812-7607; (407) 281-7396, ext. 17; fax: (407) 281-4407; e-mail: jtodaro@femf.org.

from: Disaster Research 367, May 23, 2002

February 22-26, 2003

National Emergency Management Association (NEMA) 2003 Mid-year Conference. Washington, D.C. More information and registration materials will be available in December 2002. Contact: NEMA; (859) 244-8162; e-mail: nema_admin@csg.org; WWW: http://www.nemaweb.org/index.cfm.

from: Disaster Research 365, April 30, 2002

March 12-21, 2003

Disaster Management Workshops will be offered by the University of Wisconsin-Madison, Department of Engineering Professional Development in Madison, Wisconsin. This program is intended for emergency managers in business, industry, government service, and community organizations, and covers emergency information management; disaster communications; response planning; damage, needs, and resources assessment; monitoring; evaluation; and reporting.

For details, contact Don Schramm, e-mail: schramm@epd.engr.wisc.edu; or see http://epdweb.engr.wisc.edu/courses (click on "Disaster Management").

from: Natural Hazards Observer, v. 26, o. 6, July 2002

April 21-23, 2003

Disaster Resistant California Conference. Host: Governor's Office of Emergency Services and the Collaborative for Disaster Mitigation. San Jose, California. This statewide conference will promote partnerships among public and private sectors to reduce state vulnerability to natural disasters. For more information: Disaster Resistant California (916) 845-8263; http://www.oes.ca.gov.

from: Disaster Research 371, July 31, 2002

PUBLICATIONS

Results of the August-September 2001 Washington State Tsunami Survey, by D. Johnston, D. Paton, B. Houghton, J. Becker and G. Crumbie,is now available online at http://www.wadnr.gov:81/htdocs/ger/pdf/gns_sr2002-17.pdf.

RI 2002-2. *Tsunami hazard maps of the Kodiak area, Alaska*, by E. N. Suleimani, R. A. Hansen, R. A. Combellick, G. A. Carver, R. A. Kamphaus, J. C. Newman, and A. J. Venturato, 2002. 16 p. 4 sheets, scale 1:12,500. $54. Text and maps may be sold separately. Maps are $13 each; text is $2.

from: Alaska GeoSurvey News, v. 6, no. 2.

Disaster Reduction: Living in Harmony with Nature, by Julio Kuroiwa, 2002 (Spanish only).

This comprehensive publication looks at disaster prevention from an overall multidisciplinary point of view. In a departure from a more traditional focus on this issue, this book looks at aspects of social science and economics and how they can be applied to reduce vulnerability to these natural phenomena. The publication is the product of field studies carried out at the site of the most important disasters in the Americas in the last 30 years. Its ten chapters range from geological phenomena to climatological disasters to reducing social vulnerability.

For an overview of the content of each chapter, visit the publication's web site at: www.reducciondedesastresjk.com/. For information on ordering, write to: jkuroiwah@infonegocio.com.pe.

from: Disasters Preparedness and Mitigation in the Americas, issue no. 87, April 2002, p. 6

The *MCEER Information Service News* is a monthly, online newsletter that reviews current events and literature in earthquake hazards mitigation, and related fields. This web

version of the newsletter features *E-News*. *E-News* allows you to customize your newsletter. You can focus on just those topics of particular interest to you. You can also set up email notification of new issues. http://mceer.buffalo.edu/infoService/enews/default.asp?dview=Isnews

ITIC Tsunami Newsletter June 2002, volume 34, no. 3 and other back issues are available online. The June issue contains a report on the Second Tsunami Symposium held in Honolulu May 28-31, 2002 (page 5). http://www.shoa.cl/oceano/itic/newsletter.html

Household and Personal Property Inventory Book can be downloaded as a 61-page (653 kilobytes) Acrobat file (http://www.ag.uiuc.edu/~vista/abstracts/ahouseinv.html).

How many of your possessions could you name and describe accurately if an insurance adjuster asked for a list? No one likes to think about experiencing a household disaster, but taking stock of the items you own is wise protection. A complete and accurate accounting of your household furnishings and personal possessions can help you settle insurance claims and documenting losses for tax purposes, create an inventory to indicate the monetary value of your belongings for a net worth statement, provide proof of ownership in the case of separation or divorce, and decide how much insurance to carry on household goods.

This publication contains over 40 pages of forms to help you record your possessions. You are encouraged to print them out for your own use.

from: http://www.ag.uiuc.edu/~vista/abstracts/ahouseinv.html

The Socioeconomic Benefits of Earth Science and Applications Research: Reducing the Risks and Costs of Natural Disasters in the United States, by Ray A. Williamson, Henry R. Hertzfeld, Joseph Cordes, and John M. Logsdon. 2001. 24 p. Free. The report can be found on the web site of the Space Policy Institute of the Elliott School of International Affairs, The George Washington University; http://www.gwu.edu/~spi.

Within the United States and its territories between 1980 and 2001, major weather and climate disasters resulted in more than $248 billion in losses and killed 690 people. In that same period, earthquakes and volcanoes cost the U.S. an additional $541 billion and 193 lives. The federal investment in earth science research from space, funded primarily through the National Aeronautics and Space Administration (NASA) and the National Oceanic and Atmospheric Administration (NOAA), has led to an improved understanding of weather, climate, earth movement, and other terrestrial phenomena. The authors of this report examine losses caused by Hurricane Floyd in 1999, the western wildfires in 2000, flooding in the nornern plains in 1997, and the Northridge earthquake in 1994. They also discuss the economic value of better information and issues related to obtaining it. Tables present data that compare the losses for various types of disasters.

from: Natural Hazards Observer, v. 26, no. 6, July 2002

The Ten Most Wanted: A Search for Solutions to Reduce Recurring Losses from Natural Hazards.2002. 29 p. Free. The full report can be downloaded as a pdf file from the IBHS web site: http://www.ibhs.org/research_library/downloads/292.pdf.

The Ten Most Wanted, published by the Institute for Business and Home Safety (IBHS), outlines 10 of the most important solutions to decrease recurring losses from natural disasters. The 29-page report is the result of a June 2000 workshop convened by the American Society of Civil Engineers and IBHS. It addresses why losses from natural disasters are increasing and offers recommendations and priorities for future research and development of cost-effective solutions to reduce these losses. Participants identified research needed regarding both residential and commercial buildings and prioritized mitigation methods that would offer the biggest loss reductions in the shortest time for damage from hurricanes/windstorms, earthquakes, floods, hail, wildfire, and winter storms. They concurred on incorporating holistic measures that integrate research, development, and education with professional practices and public policies.

from: Natural Hazards Observer, v. 26, no. 6, July 2002

Mitigation Success Stories in the United States; 4th edition. 2002, 102 p. Free. Copies can be downloaded from the Association of State Floodplain Managers (ASFPM) web site (http://www.floods.org).

Since the 1980s, mitigation activities have been implemented throughout the U.S. to save lives and reduce property damage. In many cases, mitigation success has been achieved following devastating disasters, when local officials and the general public have realized the need to effect change in their community. Major recent efforts to reduce flood damage include programs such as the Federal Emergency Management Agency's Hazard Mitigation Grant Program and Flood Mitigation Assistance Program. *Mitigation Success Stories IV*, a joint effort between FEMA and the ASFPM, showcases mitigation activities, demonstrating the benefits of mitigation in 39 communities in 24 states. The examples presented in this document can be used by other communities and can provide decision makers with valuable information about how to achieve natural hazard reduction. Topics include flood control projects, elevation issues, acquisition efforts, floodproofing, and watershed management.

from: Natural Hazards Observer, v. 26, no.6, July 2002

WEBSITES

http://www.seagrantnews.org
USA National Sea Grant College Program

Link to 30 individual US state programs, NOAA and a wealth of topically specific sites. Sea Grant is a network of 30-university-based programs in coastal and Great Lake states involving more than 300 institutions nationwide in research, education and the transfer of technology regarding coastal, marine and Great Lakes issues. Sea Grant is supported by the U.S. Department of Commerce's National Oceanic and Atmospheric Administration (NOAA) in partnerships with the states and private industry. [*Editors' note*: Great educational site. Strongly Recommended]

from: icoast newsletter, version 4.6, June 30 2002

http://wcatwc.arh.noaa.gov/

Just in case you missed the Nisqually, Northridge, Landers, Mammoth, Kobe or Izmit earthquakes, click on "Experience a Virtual Earthquake" and enjoy.

http://www.usc.edu/dept/engineering/costasNYT
http://www.smh.com.au/articles/2002/04/23/1019441246665.html
http://www.smh.com.au/text/articles/2002/04/23/1019441246665.htm
"Experts Find Clues to Cause of Deadly Pacific Tsunami" (Copyright: New York Times), by Kenneth Change

Read the article about an underwater microphone that recorded the roar of a submarine landslide 2,200 miles from Papua New Guinea which may have caused the terrible tsunami that killed more than 2,000 people in 1998.

http://208.184.24.125
http://208.184.24.125/presspass

The Emergency Email Network provides emergency notifications from local, regional, and national governments, the Red Cross, and civil defense and other public service agencies to subscribers via the Internet and e-mail (computer, cell phone, digital pager, and fax). Users sign up to receive the emergency information alerts by filling out an on-line form and choosing one or more U.S. counties of interest. Messages contain alerts about severe weather, evacuations, health emergencies, natural disasters, utility outage information, locating emergency supplies, organ donations, daily weather forecasts, routine blood drives organized by the Red Cross, and other Internet services (third-party solicitation). Government and public agencies can join the network and distribute their alerts and notices to professional and citizen subscribers.

from: Natural Hazards Observer, v. XXVI, no. 5, May 2002, p. 11

http://www.fema.gov/mit/planning_toc3.htm

Understanding Your Risks—Identifying Hazards and Estimating Losses, the first entry in the Federal Emergency Management Agency's new series of mitigation planning publications, is now on-line at this URL. Like its printed precursor, the downloadable PDF format of the document gives step-by-step guidance for estimating the physical damage and economic losses a community could suffer from natural hazards.

from: Natural Hazards Observer, v. XXVI, no. 5, May 2002, p. 11

http://www.redcross.org/services/disaster/eduinfo/colorbk.pdf

American Red Cross *Disaster Preparedness Coloring Book*, 20 pages, PDF File (ARC 2200, English, or Spanish) for children ages 3-10.

http://www.ibhs.org/newsroom/view.asp?id=166
http://www.ibhs.org/research_library/view.asp?id=289

It's a question asked often following a natural disaster: "Why did they let them build *here*?" "Here" could be on the edge of a fire-prone forest, upon a barrier island vulnerable to hurricanes, in a floodplain, or even along an active earthquake fault. All too often decisions on where to build and live do not consider the natural hazards of the surrounding environment.

Still, some communities do make smart decisions regarding how they build, and to answer the questions of who is planning for such events and why, the Institute for Building and Home Safety (IBHS) undertook a major survey of planners across the country. Titled "Community Land Use Evaluation for Natural Hazards," the study explored the extent to which natural hazards are integrated into local comprehensive or general plans. The responses of the more than 500 planners surveyed varied greatly and showed that many communities fail to identify natural hazard issues in their comprehensive or general plans. At the same time, the survey had a positive effect on participating planners; most said they are interested in putting natural hazards information and loss reduction strategies into their local plans.

The survey also showed that state mandates requiring planning or hazard elements in local plans were effective and constituted one of the best means to ensure local planning for hazards safety.

The survey concludes with several recommendations to help local planners address hazards. A brief article and the full report on the results of this national survey of community planners are available from the URLs above.

from: Disaster Research 368, June 10, 2002

http://muweb.millersville.edu/~isarcdue/

"Unscheduled Events," the quarterly newsletter of the International Research Committee on Disasters of the International Sociological Association is now available on-line. Besides news regarding what's going on in disaster sociology, the newsletter contains interesting editorials, articles,

abstracts, and links to other recent sociological studies, books, and papers available on the web.

from: Disaster Research 368, June 10, 2002

http://www.ibhs.org/research_library/view.asp?id=289

The Institute for Business and Home Safety (IBHS) recently completed an extensive study of how land-use planning is used (or *not* used) by local jurisdictions to mitigate natural hazards. The results of that research are presented in "Are We Planning Safer Communities?," which is available from the URL above. In that volume, the author, Michele Steinberg, analyzes when, where, and how land-use planning is used. She found that it is frequently used on a limited basis but seldom used comprehensively, and that it was most likely to be an effective tool in locations where such planning was mandated by the state. Another volume, "The IBHS Showcase State Model for Natural Disaster Resistance and Resilience," which includes ideas for state and local planning, is also available from http://www.ibhs.org/research_library.

from: Disaster Research 369, June 19, 2002

Reminder!
http://www.colorado.edu/hazards/litbase/litindex.htm

HazLit is the on-line library database of the Natural Hazards Research and Applications Information Center at the University of Colorado at Boulder. The library of the Natural Hazards Center houses an extensive collection of social science literature focusing on how society prepares for, responds to, recovers from, and mitigates natural disasters. This nonlending library is an important resource for all persons involved in disaster management. The collection includes approximately 22,000 items. The HazLit Database is an on-line index that provides *bibliographic access only* to that collection. Hazlit is not a full-text database, and the Hazards Center Library does not loan its holdings to the general public. Please contact your local library for document ordering information.

from: Disaster Research 369, June 19, 2002

http://www.gadr.giees.uncc.edu

Although under construction, the web site for the Global Alliance for Disaster Reduction (GADR) is up and running, and the developers are looking for comments and suggestions on their emerging site. GADR is headquartered at the University of North Carolina Charlotte, under the institutional leadership of the Global Institute for Energy and Environmental Systems (GIEES). It has evolved as an "epistemic community" of more than 1000 experts on disaster reduction and related aspects of sustainable development, representing regional, national, and international organizations and institutions. GADR is creating seven global regional "blueprints for change," and preliminary drafts of those blueprints are now available from this site.

from: Disaster Research 370, July 5, 2002

http://www4.nas.edu/cets/ffc.nsf/web/ffc_emergency_preparedness

The National Academies' Federal Facilities Council has created a Web site for "Emergency Preparedness and Business Continuity for Facilities Management," a forum held on June 25, 2002. The site features a description of the forum's objectives, the agenda and speaker presentations. Please contact Jason Driesbach at jdriesba@nas.edu for more information.

from: July 12, 2002 WHAT'S NEW at National-Academies.org e-mail

http://www.hazardmaps.gov/

This is the web site of the Federal Emergency Management Agency's Multi-Hazard Mapping Initiative (MMI), which includes an on-line "Multi-Hazard Atlas." Users can scan a map of the U.S. and zoom in or out to determine the hazards of a particular location. They can also specify a state, zip code, or congressional district, as well as specific hazards.

from: Natural Hazards Observer, v. 26, no. 6, July 2002

http://meted.ucar.edu/emgmt/index.htm

This site provides a valuable overview of information, curricula, scenarios and other resources for emergency management education. The site addresses effective emergency management and practices and decision-making issues in response to natural hazards.

from: Disaster Research 371, July 31, 2002

How many Chilean volcanoes erupted on the day of the big 1835 Chilean earthquake/tsunami?

Three. Minchinmavida, Robinson Crusoe, and Yanteles, Cerro all erupted on February 20, 1835-- the day of the earthquake.

from: http://www.volcano.si.edu/gvp/faq/answer.cfm?faq=07

NEW TSUNAMI MITIGATION MATERIALS

(see page 2 for ordering instructions)

Note: These, and all the other tsunami mitigation materials we've gathered, are included in our on-line index at http://www2.wadnr.gov/dbtw-wpd/washbib.htm

Popular or General Materials

CVTV-23, 2000, Forum--Earthquakes and tsunamis: CVTV-23, 1 video tape, 2 hrs.

Monastersky, Richard, 1998, How a middling quake made a giant tsunami: Science News Online, Aug. 1, 1998, 3 p.

Monastersky, Richard, 1999, Seabed slide blamed for deadly tsunami: Science News Online, Aug. 14, 1999, 2 p.

Monastersky, Richard, 1998, Waves of death: Science News Online, Oct. 3, 1998, 8 p.

Ocean Shores Interpretive Center, 2000?, The wild sea--Enjoy it...safely: Ocean Shores Interpretive Center, 1 video tape, 20 min.

U.S. Federal Emergency Management Agency; American Red Cross, 1992, Adventures of disaster dudes: U.S. Federal Emergency Management Agency, 1 video tape, 14 min.

U.S. National Geophysical Data Center, 1997, Geologic hazards photos: U.S. National Geophysical Data Center, 3 CD-ROM disks.

Includes:

Lockridge, P. A.; Racey, S. D.; McLean, S. J., 1997, Geologic hazards photos user's manual.

U.S. National Oceanic and Atmospheric Administration Pacific Marine Environmental Laboratory, 1998, Tsunami--Killer wave, born of fire: U.S. National Oceanic and Atmospheric Administration Pacific Marine Environmental Laboratory, 1 video tape, 9 min., 25 sec.

Technical Reports

General

de Lange, W. P., 2002, Tsunami earthquakes--Are they all the same? [abstract]: Eos (American Geophysical Union Transactions), v. 83, no. 22, Supplement, p. WP53.

Ettensohn, F. R.; Rast, Nicholas; Brett, C. E., editors, 2002, Ancient seismites: Geological Society of America Special Paper 359, 190 p.

Gelfenbaum, Guy; Jaffe, B. E.; Morton, R. A.; Richmond, Bruce, 2002, Distinguishing tsunami and hurricane overwash deposits [abstract]: Eos (American Geophysical Union Transactions), v. 83, no. 22, Supplement, p. WP54.

Hinton, Anne C.; de Lange, Willem P., 2002, The study of tsunami, storm surge, relative sea-level and coastal change [abstract]: Eos (American Geophysical Union Transactions), v. 83, no. 22, Supplement, p. WP53.

Hoffman, Irina; Synolakis, C. E.; Okal, E. A., 2002, Systematics of the distribution of tsunami run-up along coastlines in the near-field for dislocation sources with variable parameters [abstract]: Eos (American Geophysical Union Transactions), v. 83, no. 22, Supplement, p. WP54.

Intergovernmental Oceanographic Commission, 1985, IOC workshop on the technical aspects of tsunami analyses, prediction and communications, Sidney, B.C., Canada, 29-31 July 1985: UNESCO Intergovernmental Oceanographic Commission Workshop Report 40, 38 p.

Intergovernmental Oceanographic Commission, 1988, Wave reporting procedures for tide observers in the Tsunami Warning System; rev. ed.: UNESCO Intergovernmental Oceanographic Commission Manuals and Guides 6, 30 p.

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Lamarche, Geoffroy, Volume calculations of submarine avalanches--Compaction/decompaction problems. p. 14.
Lewis, Keith, Hikurangi margin landslides. p. 15.
McFadgen, B. G., Tsunami in Maori archaeology. p. 8-9.
Nichol, Scott, Depositional evidence for palaeotsunami on the Aukland-Northland coast. p. 10.
Stirling, M. W., Hazard analysis. p. 22.
Todd, Derek, Tsunami impact assessments. p. 23.
Walters, R. A., Tsunami propagation--A review. p. 18-19.
Webb, Terry, GeoNet and local tsunami warning systems. p. 24.
Webb, Terry, Some seismological aspects of tsunami sources. p. 16.
Williams, A. L., Estimating tsunami run-up for planning purposes. p. 23.
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There are three ways in which you can view the images in this collection. You may browse individual albums, you may browse the catalogs of images, or you may search the collection by keyword.

Editor's note: Searching by keyword, "tsunami," found 14 files of tsunami photos.

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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

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

___**Not Business as Usual: Emergency Planning for Small Businesses,** sponsored by CREW (Cascadia Regional Earthquake Workgroup), 2001. 10 min. Discusses disaster preparedness and business continuity. Although it was made for Utah, the multi-hazard issues remain valid for everyone. Websites are included at the end of the video for further information and for the source of a manual for emergency preparedness for businesses.

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

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

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

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

___**Disaster Mitigation Campaign** (15 min.)
American Red Cross; 2000 TV spots. Hurricanes, high winds, floods, earthquakes

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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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
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E-Mail: rprice@pdc.org http://iao.pdc.org

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595 Cottage Street, NE
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http://www.osp.state.or.us/oem/oem.htm

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