TsuInfo Alert

prepared on behalf of the

National Tsunami Hazard Mitigation Program

by the Washington State Department of Natural Resources

Contents

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In Memorium
Richard Hagemeyer

We were saddened to learn that Richard "Dick" Hagemeyer, 77, former director of the National Weather Service Pacific Region, passed away on Oct. 25, 2001.

Hagemeyer was internationally recognized for his leadership in developing the United States Tsunami Warning Program, modernizing weather services in Hawaii and the Pacific Region, and improving coordination of tropical cyclone response in Pacific Rim countries.

NOAA Acting Administrator Scott Gudes said, "Dick was a dedicated and energetic public servant. His interest in NOAA and improving weather services in the Pacific region made him a valuable member of our management team. Dick possessed that unique combination of technical expertise and an unwavering commitment to his employees and the communities where he lived. He will be sorely missed."

We send our most heartfelt condolences to Dick's family and many friends--but all of us will always have our own "Hagemeyer stories."

(Note: additional information--and fond and funny memories of Dick-- are at http://205.156.54.206/com/hagemeyer.htm.)

TSUNAMI NEWS

Upgrading Oregon State's Multidirectional Wave Basin for Remote Tsunami Research

(NSF NEES Meeting, 22-23 February 2001)
Network for Engineering Earthquake Simulation
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Overview

The O.H. Hinsdale Wave Research Laboratory (WRL) and the Northwest Alliance for Computational Science and Engineering (NACSE) proposed a partnership in support of the national tsunami research community. We will extend and enhance an existing multidirectional wave basin at the WRL to create a Tsunami Basin that will be the only facility of its kind in the world, from three perspectives. First, it will be the largest and most advanced tsunami testing facility of its kind, fulfilling the NEES goal to provide next-generation experimental research equipment. Second, a comprehensive Information Architecture supporting remote users will be developed by experienced usability engineers to ensure a positive impact on researcher effectiveness and productivity. Third, a Tsunami Experiment Databank will be established so the broader research community can study the results of tsunami experiments, reducing the need for experimentation and providing data for validating numerical models.

The Tsunami Basin addresses all the requirements laid out by the tsunami research community. The basin dimensions and wave generation capabilities closely match the community's vision of an ideal basin. The project builds on over two decades of experience operating related experimental facilities at the WRL. The upgraded wave basin will allow repeatable, high resolution, large-scale experiments with very dense instrumentation. It will enable researchers to test and validate advanced analytical and numerical models of tsunami-wave/structure interactions induced by sub-sea earthquakes, for a full range of ocean, coastal, and harbor studies. By controlling changes in bathymetry, surface permeability, roughness, and material erodibility, researchers will be able to measure the effects of tsunami runup and attenuation.

(continued, p. 3)

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electronically (by e-mail), and at http://www.wa.gov/dnr/htdocs/ger/tsuinfo/index.html

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Participants in the TsuInfo program can request copies of reports listed in this issue from:

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

(continued from p. 1)

Recent advances in computing and networking technology will be leveraged in order to broaden the community that can benefit from large-scale tsunami experimentation. Our comprehensive Information Architecture uniquely supports the NEES vision of geographically distributed use of experimental facilities. Sensor-based, visual, and audio data will be harvested in real-time during tsunami tests and converted to formats suitable for transmission to remote sites and for long-term archival storage. Synchronized, multimedia data streams will provide remote users with real-time observation and experiment steering capabilities. Web-based training materials will be interactive, allowing users to try out different settings and observe the effects on simulated experiments. Proven usability engineering methods applied throughout the development process will ensure that the environment meets user needs and is easy to learn and use.

The Tsunami Experiment Databank will extend the lifespan of tsunami tests. Using special search interfaces, researchers will be able to determine if the experiments they are planning replicate or overlap past tests conducted by other investigators. Replay capabilities will allow researchers to re-visit experiments even years after they occurred. Extensive machine- and human-generated metadata will make it possible to search, scan, and fast-forward through data streams to find the portions of greatest research interest. Computational modelers will be able to employ the databank exploration interfaces to identify and extract experimental results to validate the results of their simulations.

Motivation

The coastal margins of the world are exposed to inundation from solitary wave events caused by earthquakes, landslides, meteor impact, and dam-break flooding. In all cases the dynamic water surface behaves like an earthquake-generated tsunami wave and the devastation that results is a function of the velocity, acceleration, and elevation of the water as it interacts with natural and human constructed features of the coastal environment. The decision to strengthen, shelter or evacuate these areas requires a rational and accurate evaluation of the magnitude and probability of a tsunami event. This project is directed at an evaluation of the magnitude of tsunami waves that shoal, refract, diffract, and reflect from coastal boundaries that can vary from smooth, rigid, and planar surfaces to rough, irregular, and movable surfaces.

The goal of this project is to construct and operate a large-scale tsunami wave modeling facility that can be used to validate contemporary and future predictive models. The facility will also be available to model site-specific situations that require tsunami runup information prior to the development of suitable predictive models. To broaden the community that can participate in large-scale tsunami experiments, advances in computing and networking technology will be leveraged to provide a comprehensive teleobservation and teleoperation environment for remote as well as local users. To extend the useful lifespan of their tests, a Tsunami Experiment Databank will preserve electronic records of the procedures, data, and results and provide quick, easy-to-use interfaces for searching and exploring past experiments.

Tsunami Basin Equipment

The Tsunami Basin and generator will expand existing facilities at the WRL to provide the Nation with its first large-scale, shape-controlled, 3-D tsunami testing facility. This will provide the analytical and numerical modeling community with a high-resolution tool for validating predictive models. The facility will enhance the capabilities of an existing directional wave maker to facilitate studies of long wave/short wave interaction and to permit the full range of deep-to-shallow water wave testing for ocean, coastal and harbor studies.

Wave Basin. The Tsunami Basin will be located inside the 0.46-hectare (4560 m^2) building of the WRL of the Oregon State University (OSU) campus in Corvallis, Oregon. The wave basin, which is an integral part of the research equipment, serves as the containment vessel for the water medium, establishes control for depth, and provides definable boundaries for the physical and numerical models. The Tsunami Basin will be an expansion of our existing directional wave basin to meet the dimensions recommended by the NSF Tsunami Working Group. The existing basin is 26.5m long, 18.3m wide and 1.5m deep. The 18.3m dimension will be lengthened to 48.8m. The 1.5m depth will be increased to 2.0m by adding 0.5m of freeboard to the perimeter of the basin. The freeboard extension will serve as the base for a safety rail to prevent accidental intrusion into the basin. The 26.5m dimension will be preserved as the basin width, constrained by the building width. The wave basin is constructed as a reinforced concrete reservoir, with a 15cm wall and floor thickness. Unistrut inserts are placed in rows at 2.1m spacing to affix models, instrumentation and the wave generator throughout the basin. Two vehicle access ramps, 3m wide, allow equipment and materials to be transported conveniently into and out of the basin. A bridge crane with a capacity of 4,500kg will span the length and width of the Tsunami Basin in order to position the tsunami generator, models, and instrumentation.

Tsunami Generator. The major equipment item to be procured is a long-stroke, high velocity, directional, solitary wave generator. The tsunami wave generator will be added to a directional wave generator in an existing 3-D wave basin. The total complement represents the largest, most sophisticated and complete wave modeling laboratory at any university worldwide. The tsunami research community has summarized its request for a large scale Tsunami Basin in an addendum to an NSF Workshop report. Our expansion project satisfies their specifications for a 2m deep basin, generating a 0.8m high tsunami in a 1 m water depth, over a basin length of 50m. We have designed an electrically powered generator with ball-screw and piston motion, having a 2m stroke and velocity capability of 1.87m/sec — consistent with the request.

The selected design utilizes a principle of operation that is similar to the existing directional wave generator at the WRL, designed and constructed by MTS Systems Corporation (MTS) of Minneapolis. MTS constructs the only commercial, edge-driven, piston motion wave generators worldwide. Sandwiched stainless steel plates are driven at the vertical edges through a hinge mechanism that allows adjacent plates to be powered by the same ball screw drive. Ultra-high-molecular-weight plastic seal sheets that slide in the space between the sandwiched plates provide continuity along the face of the wave generator. As adjacent plates are driven out of phase to provide directional control, the plates separate to preserve the diagonal distance between the edges and the seals fill the gap while serving as continuous wave generating surfaces. This technology has worked very satisfactorily at the WRL for a decade. Control of the wave board is achieved through displacement and velocity feedbacks. Displacement control is achieved by comparing the measured position of the wave board to a position algorithm that creates tsunamis. Velocity control utilizes a wave profile measurement at the front of the wave board and compares it to the desired tsunami profile. The board velocity is adjusted via an algorithm that relates wave profile and board velocity. This velocity control cancels reflected waves in the basin and optimizes the wave shape beyond that available by means of the displacement constraint. The 30 wave generator segments will be 0.88m wide and 2m high. To achieve a 0.8m high wave in a water depth of 1m each wave board must be capable of a 2m displacement and a maximum velocity of 1.87m/sec. Each wave board will be powered by an AC electric motor with a peak power rating of approximately 20kW. The tsunami generator will be digitally controlled.

Instrumentation. Real-time water surface profile measurements are essential for characterizing wave shape and magnitude for all wave experiments. Electro-resistive wave gauges, utilizing a design developed at the WRL, will be fabricated and added to our present inventory to provide accurate, local wave measurements. The gauges are differentially driven, alternating current devices that are very stable and very linear. The local measurements they provide will be used to acquire accurate data to validate other imaging techniques (video, laser, radar, and acoustic) that may be employed to determine spacings for aerial coverage of wave diffraction and refraction patterns. Similar devices will be placed along sloping surfaces to measure runup. Wave direction will be resolved with three-axis, ultrasonic current meters measuring mutually orthogonal components of wave induced water particle velocities; these absolute measurements, too, will be used to validate directions resolved from surface imaging techniques.

Digital cameras will enhance the physical model experience by providing multiple, simultaneous frames of reference and fields of view for both local and remote investigators. Full-motion cameras responsive to remote control will be mounted both above and below the water surface. Immediate playback capabilities will permit the experiment to be reviewed and used to determine follow-up test conditions. A new data acquisition system will be developed that will assure reliable and usable sensed data. A comprehensive Information Architecture will allow local and remote users to rapidly examine selected data channels at various levels of analysis.

The instrumentation described here is simply the initial configuration, since we recognize that instrumentation will evolve significantly over the 14-year period of the project. Flexibility and attention to changes in instrumentation technology will be essential in maintaining a first-rate experimen-tal facility. The data acquisition system is designed to accommodate signal acquisition from any instrument that utilizes AC or DC electronic signal conditioning, or any documented digital input format. We have purposely left some of the instrumentation decisions open, and will reassess the technology prior to purchasing the full complement of instruments. One of the planned research uses of the facility, in fact, is to test the deployment and use of a variety of sensors to determine the impact of information transmission and storage requirements as well as suitability for tsumi and coastal processes experimentation. The instrumentation will also be reassessed and updated periodically during the 10-year operational period.

Envisioned Large-Scale Experiments

Large 3-D numerical models are being developed to define regions along coastlines where tsunamis can cause damage due to runup and overland flow. These models are computationally complex and are now incorporating movable and deformable submerged boundaries associated with earthquake induced underwater landslides. To validate these models, one cannot rely on post-event field observations of runup because of the inability to prescribe the causal waves. Furthermore, field measurements of tsunamis would require spatial and temporal predictions of events that are beyond the scope of contemporary probability models. Laboratory modeling of tsunamis becomes the expedient alternative to field observation. However, laboratory modeling must be undertaken at a scale that reproduces prototype behavior. In small-scale free-surface flow experiments, forces due to the fluid properties of elasticity, viscosity, and surface tension can become appreciable compared to inertial forces. For ocean wave phenomena it is generally assumed that gravitational forces are of primary importance compared to inertial forces. The latter condition will occur only in moderate- to large-scale physical models. This has been demonstrated for viscous effects related to wave induced structural instability problems. The scaling dilemma between prototype behavior and small physical models has led the earthquake community to conclude that large-scale experiments are required to validate numerical models. Examples of typical research that will be enabled by the Tsunami Basin are:

--*Scale Effects in Tsunami Runup and Velocity Measurements.* The scale of the Tsunami Basin and generator has been selected by the tsunami research community to minimize viscous scale effects. The scaling hypothesis will be tested to determine if predictive model friction coefficients, validated in the laboratory, will apply at prototype scale.

--*Macro-roughness Effects on Tsunami Behavior.* A potential sheltering scheme from the extreme effects of tsunami inundation is to interfere with the runup process with large elements of surface roughness. These elements may be natural (i.e., trees, geologic outcrops, or submerged features such as reefs and berms) as well as human constructed features. Each of these elements significantly increases the apparent roughness of the seabed, beach, or land margin and enhances the real fluid or viscous effects. It is envisioned that a benchmark test be created in the laboratory to examine the response of numerical models to simulate a highly roughened yet uniform sloping surface.

--*Tsunami Forces on Structures.* It will be desirable to strengthen some nearshore structures, such as fuel tanks and evacuation centers, from the ravages of tsunami inundation. In order to design a structure to survive the severe environmental loads associated with tsunamis, it will be necessary to be able to predict those loads. Quantifying tsunami loads is rendered more difficult by the prospects of partial inundation and breaking waves. The ability of predictive models to quantify local kinematics and forces can be determined by comparison to actual wave velocities and loads measured in the laboratory for idealized, yet representative, structures.

The Challenge of Remote Experimentation

The success of NEES will depend to a large extent on how effective and productive researchers can be when accessing the facilities from a remote site. In recognition of this, our project team includes not just persons experienced in the design and operation of experimental facilities, but also experts in data management, Web technology, and usability engineering.

Barriers to Be Addressed. *Communications bandwidth* is the most obvious barrier to effective use of remote facilities. NEES has addressed this issue at the equipment sites, by insisting on high-speed communications. Those speeds may not be available at the home institution of distant users — and almost certainly will not be available across the last mile between on-campus switches and the user s desktop. Our teleobservation software will provide multiple levels of transmission, adjusting the flow of video streams to match remote capacity. Second, physical experiments, at the scales to be employed in this project, involve a large *number of data channels* involving *multiple data media*. The full complement of instrumentation at the Tsunami Basin will include 20 wave gauges, 4 velocity transducers, 10 underwater cameras, 6 surface cameras, and 3 microphones. We have found that investigators who are physically present switch frequently from one data source to another. At the WRL, the human can move or turn from one source to another, but the space limitations of a desktop screen mean that we will have to provide thumbnail snapshots that can help the user choose where to focus attention next. Third, Each data medium operates at a *different sampling frequency* and a *different rate of data generation.* If they are simply transmitted as-is, the user might see hours of sensor data before even a few minutes of video arrive. In order to simulate the physical environment of the Tsunami Basin, we will have to align the streams and transmit them at controlled rates so as to appear natural when they reach the user s desktop. Finally, *The entire physical process must be observable* — not just the results. Unlike the facilities supported by other existing collaboratories in wave basin research the moments leading up to model failure may yield the most useful information. Our design actually improves upon the physical experience in this case, making it possible to re-play sequences of events to observe them more closely, and providing indices that allow the user to fast-forward through video sequences to the moment when major changes occurred.

Access to Experimental Data. Large-scale tsunami experiments, utilizing sophisticated equipment and large arrays of instrumentation, are time-consuming and costly. One way to reduce dependence on experimentation is to make the results of previous tests available to the general research community. The key is to provide flexible mechanisms for locating information on experiments and presenting it in ways that are easy to understand. This is the objective of the Tsunami Experiment Database that will be developed as part of the project.

Leveraging our experiences in Web-to-database interfaces that improve the productivity of scientific researchers, we will design and implement a database capable of accommodating at least 15 years of Tsunami Basin experimental data. A wide variety of data formats will be supported (e.g., video, audio, sensor data, visualizations, textual summaries of data) and be uniformly accessible through self-explanatory Web-based interfaces. Further, we will add the higher-level information necessary to support exploration of the Databank in order to identify experiments that share particular characteristics or led to particular types of results. This will allow users to draw comparisons or analyses that span entire series of experiments, conducted by different researchers and perhaps over widely separated periods of time. By preserving this record, we hope to reduce the amount of replicated work and increase awareness of the complexity and importance of well-designed tsunami experiments.

Teleobservation and Teleoperation. A significant portion of the overall effort will be devoted to ensuring that the remote user experience captures most, if not all, of the qualities that would be available through physical presence at the Tsunami Basin. Researchers will be able to use the infrastructure to be developed in this project in three role categories:

1. Remote observation and steering of experiments occur during the course of the actual experiment. A *lead researcher* will assume this role to direct the experiment. He or she may choose to be joined by an arbitrary number of colleagues from the same or other institutions. The key concern in supporting this user role is the ability of the Web-based environment to blur the distinctions between on-site investigators and remote ones. For example, an experiment could involve a grad student who actually travels to the Tsunami Basin but works collaboratively with a professor and perhaps other students from the home institution; they need to be able to observe, and perhaps modify, the experiment from the remote site. Another experiment might be conducted entirely from a remote institution.

2. After-the-fact experiment replay occurs at some time after the experiment has completed. Any number of researchers, singly or in collaborative groups, may choose to replay the progress of the experiment, observing it in simulated time. For this role, the challenge is to store and maintain sufficient data and present it in such a fashion that users can derive real benefit after experiments have completed. Our effort will focus on software to help researchers understand experiments that they did not conduct themselves. We consider this to be critical for the NEES vision, since it offers a mechanism for reducing the need for new experimentation by exposing the results of previous tests to a broader community.

3. Exploration of the Tsunami Experiment Databank also occurs after the experiment has been completed. This role can also be assumed by an arbitrary number of researchers. Rather than replaying the experiment, they access the data acquired during experimentation in order to compare them against other experiments, validate the results from a computational model, etc. Data from previous experiments can also be a valuable resource for researchers who wish to test the predictive power of computational models, or as an aid in planning subsequent experiments. Again, we anticipate that most users in this role will be exploring data relating to other people s experiments. The key challenges in supporting them are the ability to store key data in appropriate ways and provide flexible enough search mechanisms that users can quickly and accurately local the experimental results most germane to their needs.

The report by S.C. Yim, C. M. Pancake, and C. K. Sollitt is available in pdf files at http://nees.orst.edu/pres.yim.feb01.PDF , http://www.nees.org/ , and at http://www.eng.nsf.gov/nees/Workshops/Feb01GranteesMeeting/yim.pdf —

Presenting EarthScope

EarthScope is an integrated, multiorganizational program to apply modern observational, analytical, and telecommunications technologies to investigate the structure and evolution of the North American continent and the physical processes controlling earthquakes and volcanic eruptions. EarthScope will provide a foundation for fundamental and applied research that will contribute to the mitigation of risk from geological hazards, development of natural resources, and understanding of earth dynamics. The program will address such fundamental questions as "Why do earthquakes and volcanic eruptions occur?" and "How do continents form and evolve?"

EarthScope will combine several sophisticated geophysical monitoring and measurement systems with data and observations from other disciplines. The project is a partnership involving more than 100 universities, the National Science Foundation, U.S. Geological Survey, National Aeronautics and Space Administration, U.S. Department of Energy, regional seismic networks, and state geological surveys.

Detailed information about EarthScope is available on the World Wide Web from www.earthscope.org. In particular, program brochures can be downloaded from www. earthscope.org/EarthScope1.pdf, and www.earthscope.org/ EarthScope2.pdf

from: Natural Hazards Observer, Sept. 2001, p. 7

Networking to Beat the Shakes

Engineers who design earthquake-resistant buildings and bridges will soon be able to reach into cyberspace to, say, run a shake table or a tsunami-generating tank. The Network for Earthquake Engineering Simulation will not only give earthquake engineers access to data and software, it will also allow them to operate experiments at some 20 engineering centers over a speedy broadband Internet 2 link. That means these experts will join other scientific communities---such as astronomers and microscopists---already operating instruments remotely on the Web. The National Center for Supercomputing Applications (NCSA) at the University of Illinois, Urbana-Champaign, just received a $10 million grant from the National Science Foundation to lead the design of the network.

Applications scientist Tom Prudhomme of NCSA says that the project aims to promote cooperation between groups that normally work apart: the structural engineers who design buildings and bridges, the geotechnical engineers who understand earth movements, and the tsunami experts who are worried about big waves. The network begins operating in the fall of 2004.

from: Science, v. 293, 7 Sept. 2001, p. 1735, reprinted with permission

Hazard Preparedness in Spanish

Surviving a tsunami--Lessons from Chile, Hawaii, and Japan, by Brian Atwater, Marco Cisternas, and others, has long been available as U.S. Geological Survey Circular 1187. Well! The Spanish edition of that, *Sobreviviendo a un tsunami--Lecciones de Chile, Hawai y Japon*, is now available for **FREE**! as U.S. Geological Survey Circular 1218.

Plan de preparacion familiar para emergencias, a 25 page brochure. is also available.

Order from *TsuInfo Alert* (see ordering instructions, p. 2).

EMI Announces 2001-2002 Resident Courses

The schedule for this year's Emergency Management Institute's (EMI) resident courses is now available. The Institute offers a wide variety of training programs in six broad categories: simulation and exercize, professional development, master trainer program, mitigation, preparedness and technological, and response and recovery. The courses, only for emergency management professionals who are U.S. residents, are held at the EMI campus, Emmitsburg, Maryland, or at the Mount Weather Emergency Assistance Center. EMI, the training branch of the Federal Emergency Management Agency, provides resident and non-resident courses as part of its nationwide training program to enhance U.S emergency management practices.

Course dates, admission applications, and other information are available on EMI's website at http://www.fema.gov/emi/.

from: Disaster Research 357, November 9, 2001

BGHRC Launches Rapid Environmental Impact Assessment Methodology Development Project

Benfield Greig Hazard Research Centre (BGHRC) and CARE International have initiated a project to develop a Rapid Environmental Impact Assessment (REA) methodology for use by field personnel and disaster victims during disasters. Initial funding for the project is being provided by the United Nation's UNEP/OCHA offices.

Accurate assessments are key to effective disaster response. Identifying, evaluating, and responding to the environmental impacts of disasters is required for effective disaster relief and recovery operations. However, standard environmental impact assessment procedures are unsuited for relief operations. This project will use applied research and development to establish and field test a practical REA methodology and develop a training syllabus to allow the adoption of REA as a best practice for relief operations. The project is currently developing the actual REA methodology, and this task will be completed by the end of 2001. Additional information on the project can be found at http://www.bghrc.com under disaster management.

Charles Kelly, Affiliate, Benfield Greig Hazard Research Centre. E-mail: 72734.2412@compuserve.com

from: Disaster Research 355, Oct. 3, 2001

GAO Says Disaster Declaration Criteria Need Improvement

In recent years, members of Congress have expressed a desire that more "clear and meaningful" criteria be established for issuing presidential disaster declarations under the Robert T. Stafford Disaster Relief and Emergency Assistance Act. As a result, the General Accounting Office (GAO) has taken an in-depth look at the issues surrounding disaster assistance to states and recently presented their findings in the report, "Disaster Assistance: Improvement Needed in Disaster Declaration Criteria and Eligibility Assurance Procedures" - Report to the Subcommittee on VA, HUD, and Independent Agencies, Committee on Appropriations, U.S. Senate (GAO Report GAO-01-837).

The Stafford Act requires that conditions exceed state and local capability to respond before disaster assistance from the federal government is granted. The law, however, specifically denies FEMA from denying federal assistance "solely by virtue of an arithmetic formula or sliding scale based on income or population." Factors FEMA uses to recommend a presidential disaster declaration include damge that exceed $1.04 per capita statewide and $1 million in total, the heavy impact of a disaster on a particular area, or recent multiple disasters in the same area. However, the GAO believes that problems with the criteria remain, paricularly because staff assigned to disaster field offices are temporary and may not have the skills and training needed to make appropriate decisions.

The GAO notes that FEMA has made improvements in this area, but maintains that problems persist. Therefore, the office provides several recommendations to improve FEMA's disaster declaration process.

Copies of the report are available free and can be requested from the GAO, P.O. Box 37050, Washington, DC 20013; (202) 512-6000; fax: (202) 512-6061; TDD (202) 512-2537; e-mail: info@www.gao.gov. The complete text of the report is also available on-line at:http://www.gao.gov.

from: Disaster Research 356, October 23, 2001

Coastal Construction Manual (FEMA 55)

In July 2000, the Federal Emergency Management Agency (FEMA) released the latest revision to its popular Coastal Construction Manual (CCM). The new manual, *Coastal Construction Manual: Principles and Practices of Planning, Siting, Designing, Constructing, and Maintaining Residential Buildings in Coastal Areas*, provides technical guidance on the best practices for design professionals, state and local officials, and builders to prevent/mitigate natural hazards to one- to four-family residential buildings in coastal areas. The focus is on new residential buildings--principally detached single family, attached single family (townhouses), and low-rise (three story or less) multifamily buildings. This new edition of FEMA 55 is a 3-volume manual that includes discussions about all the coastlines of the United States (including the Great Lakes and islands) and considers other hazards that may exist in coastal areas. The Building Science Branch of the FEMA Mitigation Directorate recently announced that the CD version of the Third Edition of FEMA's Coastal Construction Manual is now available and may be ordered from FEMA Publications, (800) 480-2520. This is the first time a FEMA manual has been offered entirely in a CD format that has many additional features such as online calculations, indexes, and navigational tools. Those wishing to have these features should order FEMA 55 CD.

from: http://www.ncafpm.org/flashflood/winter2001/page7.htm

Conferences and Training

Winter 2002

"Building Resilient Communities Through Hazards Mitigation (URBDP 598)." Winter 2002 *distance learning* offered by: University of Washington, Distance Learning. For details, contact: Bob Freitag, Director, Institute for Hazards Mitigation, Department of Urban Design and Planning, Box 355740, University of Washington, Seattle, WA 98195-5740; (206) 616-2395; email: bfreitag@u.washington.edu; http://www.outreach.washington.edu.

January 28-29, 2002

Disaster Management 2002. "Preparation, Response, Recovery & Mitigation" Host: NIGI, the National Institute for Government Innovation and George Washington University. Las Vegas, Nevada. Contact: (888) 670-8200; fax: (941) 365-2507; e-mail: register@iirusa.com; http://www.nigi.org.

February 24-27, 2002

Solutions to Coastal Disasters 2002, San Diego, California. Organizers: Coasts, Oceans, Ports, and Rivers Institute of the American Society of Civil Engineers; Coastal Zone Foundation; and others. The four main conference tracks are Coastal Storms, Seismic Effects, Impacts on Climate Change, and Shoreline Change. A call for papers has been issued.

Contact: Lesley Ewing, California Coastal Commission, 45 Fremont Street, Suite 2000, San Francisco, CA 94105; (415) 904-5291; fax: (415) 904-5400; e-mail: lewing@coastal.ca.gov or Louise Wallendorf, Hydromechanics Laboratory, U.S. Naval Academy, 590 Holloway Road, Annapolis, MD 21402-5042; (410) 293-5108; fax; (410) 293-5848; e-mail: lou@usna.edu; Internet: http://www.asce.org/conferences/cd2002/index.html.

April 28-May 1, 2002

Third National Seismic Conference and Workshop on Bridges and Highways. Location: Portland, Oregon. Contact Info: Third National Seismic Conference and Workshop on Bridges and Highways, c/o MCEER, State University of New York at Buffalo, Red Jacket Quadrangle, Buffalo, NY 14261-0052. Telephone: 716-645-3391; Fax: 716-645-3399, or Michael Higgins, P.E., Regional Manager Eastern Region, Pure Technologies, US Inc., 10015 Old Columbia Rd.,Suite B-215, Columbia, MD 21046. Phone: 410-309-7050; Fax: 410-309-7051; Email: mceer@ascu.buffalo.edu or mike.higgins@soundprint.com Web Site: http://mceer.buffalo.edu/ meetings/3nsc/default.asp

April 29, 2002

Fires, Floods and Faults III. Location: San Jose, California. Contact Info: Collaborative for Disaster Mitigation . Phone: 408-924-3596; Fax: 886-2-2363-1558; Email: sjsu_cdm@email.sjsu.edu Web Site: http://www.caece.net/~icccbe

August 26 - 30, 2002

World Congress on Disaster Reduction Location: Washington, DC, Contact: Walter Hays, ASCE, 1801 Alexander Bell Drive, Reston, VA 20191. Phone: 703-295-6054; Fax: 703-295-6141 or MichaelCassaro at macass@aye.net or walter_hays@msn.com Web Site: http://www.asce.org/conferences/disaster2002

The Inappropriate Tsunami Icon

by
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Joint Institute for Marine and Atmospheric Research, University of Hawaii, Honolulu, Hawaii 96822
originally published in Science of Tsunami Hazards, v. 19, no. 2, p. 87-92.
available at http://www.geocities.com/sthjournal/ts192c.pdf
reprinted with permission

Abstract

The supposition that the Japanese printmaker Hokusai intended to represent a tsunami in his print of the "Great Wave at Kanagawa " is unfounded, and the use of his "Great Wave" as a tsunami icon gives a false impression of the nature of tsunami waves.

Hokusai and His Print of the "Great Wave off Kanagawa"

The artist most widely known as Hokusai was born in Edo (now Tokyo) in 1760 and died in 1849. When adopted as an infant by Nakajima Ise, he was given the name Nakajima Tamekazu, but he took many different names later including Katsuhika from the district of Tokyo in which he was born, and Hokusai, which he used as a surname beginning about 1797.

At least outside of Japan, Hokusai has been considered the greatest of the artists of the Popular School (Ukiyo-e) of that nation, although Japanese have tended not to rank him so high. He is best known for his illustrations of books, particularly the *Mangwa*, a 15 volume pictorial encyclopedia of Japanese life, for his color prints, many of which were published in sets, and for his 'Hundred Views of Mount Fuji", monochrome prints published in three volumes. The print commonly referred to as the "Great Wave off Kanagawa" (Figure 1. Hokusai's "Great Wave off Kanagawa". For graphic, go to http://www.geocities.com/sthjournal/ts192c.pdf) was one of the colored prints in the set of the "Thirty-six Views of Mount Fuji" that Hokusai made between 1823 and 1829. (The wording within the cartouche on the print is essentially a combination of the title of the individual print and the title of the set of which it was a part. It might be translated more or less literally as: 'Mount Fuji, Thirty-Six Views--from Within the Waves of the Open Sea off Kanagawa).

The dominant feature of the print is a breaking peak on the crest of a steep wave that is moving from the left toward the center; the back of a similar wave is shown at the extreme right; and a subsidiary wave peaks in the left foreground. There is a fishing boat with eight crewmen in the trough between the subsidiary wave and the wave at the right; what appears in a reduced-sized version of the print to be a part of the same boat to the left of the subsidiary wave may be distinguished in an unreduced version as a separate boat; and in the background, sliding down the back of the wave to the right, there is a third boat, again with eight crewmen. Mount Fuji is shown in the distance behind this third boat. In this print, as in the case of most of his prints, Hokusai exercised considerable artistic license. The title he used for this print suggests, however, that he intended to represent in it a typical scene. Combined with the title, the position of Fuji in the print and the direction in which the waves are moving in it suggest that the scene was that of a viewer looking west-northwest from a point in the Sagami Wan (Sagami Bay) off the coast of the Kanagawa Prefecture in the vicinity of Kamakura (Figure 2. South coast of central Honshu, Japan, showing Kanagawa, Fuji, Sagami Wan, and surroundings. For graphic, go to http://www.geocities.com/sthjournal/ts192c.pdf). Neither the Kanagawa shore nor the hills and lower mountains southeast of Fuji are shown in the print, but that they are beyond the horizon cannot be certain because the viewpoint is clearly in the trough of the waves.

Erroneous Identification of the "Great Wave" as a Tsunami Wave and Its Inappropriate Use as a Tsunami Icon

Some have supposed that Hokusai intended the "Great Wave" to represent a tsunami wave and during the last few decades it has been used by individuals and organizations involved with research on tsunamis and the mitigation of tsunami hazards as an icon symbolizing such endeavors.

I am not certain when the "Great Wave" was first associated with tsunamis. I was given a copy of Hokusai's print by Ryutaro Takahasi, the Director of the Earthquake Research Institute of Tokyo University in 1961, when I first went to Japan as the geophysicist in charge of the newly established Tsunami Research Program at the Institute of Geophysics of the University of Hawaii. It was my impression, however, that Takahasi selected the gift in recognition of our mutual oceanographic interests in general and perhaps because I had expressed an admiration for Japanese prints, and not because he attached any special tsunami significance to the print. I can neither recall nor find evidence for any reference to the Hokusai print at the tsunami meetings sponsored by various organizations associated with the Pacific Science Congress in 1961.

The association had, however, been made by 1964, the year of publication of the Japanese version of *Studies on Oceanography*, a collection of papers dedicated to Koji Hidaka, the then retiring Director of the Ocean Research Institute of the University of Tokyo. In one of those papers Hokusai's print was described as portraying "The crest of a great tsunami wave off Kanagawa" (Wilson, 1964,1965). I

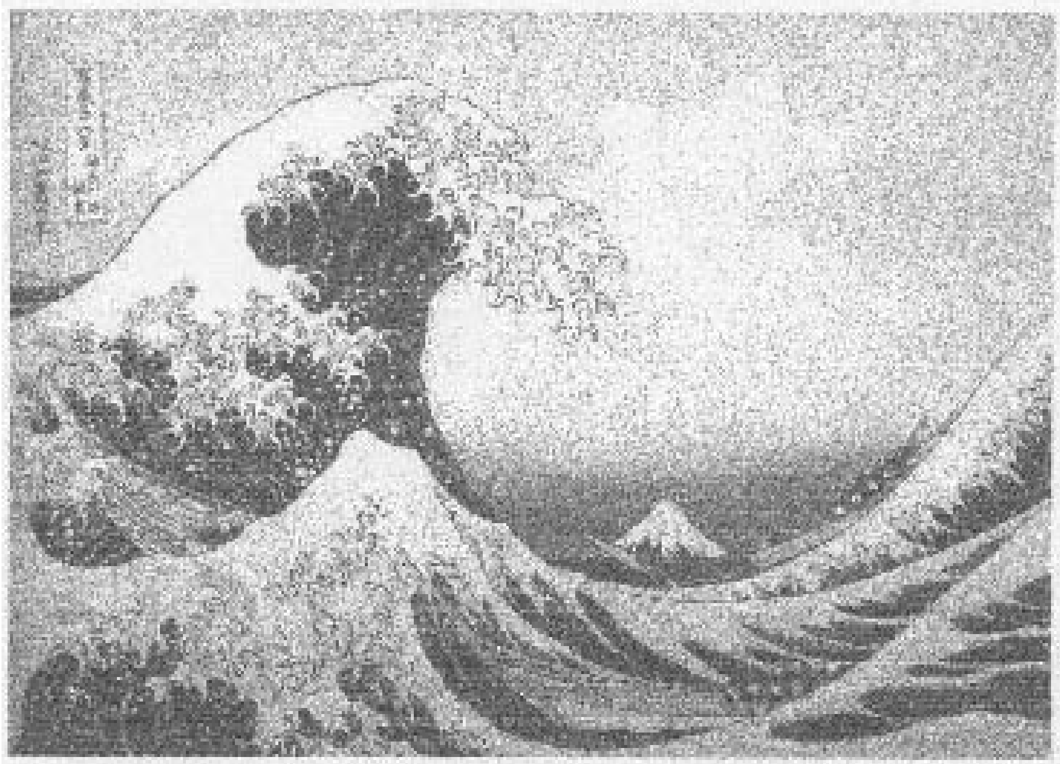

Figure 1. Hokusai's "Great Wave Off Kanagawa"

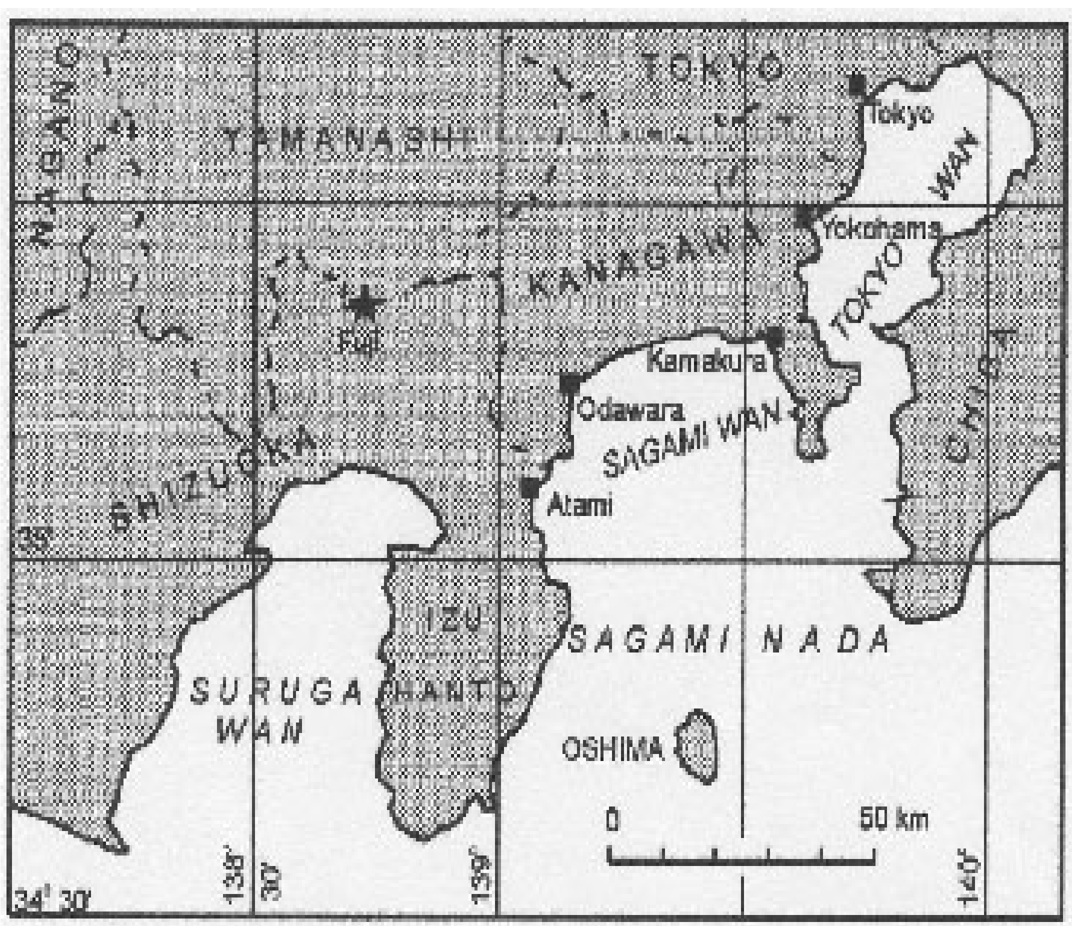

Figure 2. South coast of central Honshu, Japan, showing Kanagawa, Fuji, Sagami Wan, and surroundings.

have since heard Hokusai's print described many times as intended to represent a tsunami and, recently, as intended to represent specifically the Sanriku tsunami of 1896. This last rumor may have been based on similarities between Hokusai's "Great Wave" and representations of waves of the 1896 tsunami in a number of contemporary drawings by other artists that were reproduced in a pamphlet published for the l00th anniversary of the event (Nanashita, 1995).

Since the 1970's at least, various monochrome versions of Hokusai's print or the "Wave" from it have been used as symbols for tsunamis. For example, small, much simplified versions of the "Wave" without Fuji in the background and with the initials ITIC superimposed have been used since 1972 as an icon by the International Tsunami Information Center appearing somewhere on the cover of each issue of the Center's *Tsunami Newsletter*. In addition, large but slightly cropped copies of the print, generally including Fuji, have appeared on the cover of each *Newsletter* issued from 1993 through 1999. Other uses noted before 1996 when I prepared a first version of this paper, include small, simplified versions appearing on the fronts of brochures describing the International Tsunami Warning System and on the front of a brochure of the Hilo (now Pacific) Tsunami Museum. A very small version, greatly simplified and with a palm tree replacing Fuji in the background, appeared on a handsome pin of which copies were distributed to participants in a conference on tsunamis held so long ago that I cannot now remember its date or sponsors. What seems to be a highly stylized version of the wave was the base of a symbol used at an international tsunami symposium held in Novosibirsk in 1989 and again on the cover of a Tsunami Hazard Mitigation Plan prepared by a USA Federal/State Civil Defense working group.

It would, of course, have been impossible for Hokusai to have included in any of his prints a wave of the Sanriku tsunami that occurred 55 years after his death. In any case the "Great Wave" he portrayed was off the coast of the Kanagawa Prefecture, not the coasts of the Sanriku prefectures of northeastern Honshu. The record of tsunamis known to have affected the Kanagawa coast in the 18th and 19th centuries (Table 1, below), includes none occurring during the period when Hokusai was portraying various aspects of Fuji in his set of "Thirty-Six" prints (there were actually 46).

Indeed the last major tsunami significantly affecting the Kanagawa coast had accompanied a major earthquake occurring nearly 50 years before Hokusai's birth on 31 December 1703. That tsunami is reported to have caused 600 deaths at Kamakura where it had a runup height estimated at 8 m, and 230 deaths at Odawara, where it had a runup height estimated at 4 m. Another earthquake that was felt strongly in Kanagawa and Tokyo Prefectures and that caused considerable damage at Odawara in 1782 was accompanied by a tsunami. However, little is known about the effects of that tsunami, which occurred when Hokusai was 22, 21 years before he began preparing the "Thirty-Six Views". What is known as the Great Ansei Tokaido Tsunami did not occur until December 1854, five years after Hokusai's death.

The characteristics of the "Great Wave" are shared with waves in other Hokusai prints, for example a wave traveling in the opposite direction in another of the "Thirty-Six Views of Mount Fuji" that is titled simply "A Wave". There is no evidence that Hokusai intended to represent non-wind generated waves in any of his Fuji prints, and if he had wished to commemorate the occurrence of one of the tsunamis that affected Kanagawa by incorporating one of its waves in the foreground of one of the prints, it seems very doubtful that he would have done so without identifying the wave as that of a tsunami (or kaisho).

Regardless of Hokusai's intent, the use of his "Great Wave" as a tsunami icon gives a false impression of the nature of tsunami waves. Even as a representation of a wind generated wave. Hokusai's "Great Wave" has a steepness that is exaggerated. As such, the exaggeration is not only within the bounds of artistic license but in accord with how ordinary waves are often perceived. However, the steepness of tsunami waves in the ocean and even as they approach

Date		Earthquake Epicenter				Tsunami	
Gregorian	Japanese	Time(local)	N Lat	E Lon.	Mag.*	Source	Mag#
1703 Dec 31	Genroku 16 XI 23	~02:00	34.7	139.8	8.2	Sagami Nada	4
1782 Aug 22	Tenmei 2 VII 15	~02:00	34.5	138.8	7.3	Sagami Nada	1
1854 Dec 23	Ansei I XI 4	09:00-09:15	33.2	135.6	8.4	S. of Wakayama Hanto	4

* Earthquake magnitude, authority: Tokyo Astronomic Observatory
#Tsunami magnitude: m = 1, maximum runup ~1 m
m = 2, maximum runup ~2 m
m = 3, maximum runup ~4 m
m = 4, maximum runup ~8 m

Sources of information: Iida *et al* ., 1967; Solov'ev and Go, 1974, 1984.

Table 1. Tsunamis affecting the coast of Kamagata Prefecture, Japan, 1700- 1900.

many coasts is so small that they cannot be perceived as waves. If not accompanied on such coasts by wind-waves, they may best be described on these coasts as gradual rises and falls of water level whose most dramatic effects are the high water velocities that result from their inundation of and recession from the shore. Their tide-like behavior under these circumstances is undoubtedly the reason that they have been referred to as "tidal waves" in non-technical language. Where a tsunami wave approaches the shore in shallow water it may convert to a bore with one or more steep, step-like fronts; and the steepness of the fronts of waves inundating the Sanriku coast in some of the drawings of the 1896 tsunami to which reference was made earlier (Nanashita, 1995) cannot be considered inappropriately exaggerated. However, for a considerable distance behind the steep wave front of a bore, the water level is characteristically nearly flat whereas the backslope of Hokusai's "Great Wave" is apparently as steep as its foreslope. There is, in any case, no evidence that his "Great Wave" is approaching shore in shallow water and the general impression given by the print is that the scene portrayed is well offshore.

Failure to realize that tsunami waves often have such small steepness that they cannot be recognized as waves has undoubtedly contributed to the loss of life associated with tsunamis. The adoption of representations of steep waves as symbolic of tsunamis therefore seems unfortunate. I must admit, however, that I can think of no substitute whose artistic attractiveness would approach that of representations of Hokusai's "Great Wave". Hence it seems unlikely that these representations will be replaced as tsunami icons. In my opinion, however, each use of such an icon should at least be accompanied by explicit recognition that real tsunami waves do not resemble the icon.

Acknowledgements

I acknowledge with gratitude the help I have received from several people in the preparation of this note. George Curtis, Augustine Furumoto, and Charles McCreery provided information on uses of Hokusai's "Great Wave" as an icon, drew to my attention the drawings of waves of the 1896 tsunami, or both. Phillip Roach of the Honolulu Academy of Arts provided information on Hokusai and the provenance of his 'Great Wave off Kanagawa". Diane Henderson, Editor, School of Ocean and Earth Science and Technology, University of Hawaii, provided valuable editorial services.

The preparation of this paper was supported in part by National Science Grant BCS 9208173.

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Storing Emergency Drinking Water

Guidelines for Storing Water
-- Store water in clean "food grade" plastic containers such as 2-liter soda bottles, with tight fitting screw-cap lids.
-- Store in a cool dark place like a closet.
-- Empty and refill at least every 6 months.

Additional guidelines when storing water from a Commercial Utility
-- Fill appropriate containers with water.
-- Do not add any bleach or other agents to the water.
-- Remember, empty and refill every 6 months.

Additional guidelines when storing water from a well or spring
-- Store in appropriate containers.
-- Add two drops of liquid household bleach per gallon of water. (Use bleach with the only active ingredient of 5.25% hypochorite & fragrance free.)
-- Remember, empty and refill every 6 months.

from: Alaska Division of Emergency Services

Editors' note: This is a splendid example of "how science works": First, an observation; then, some preliminary data gathering; then, a hypothesis. The next steps include rigorous field work, historical and literature research, and lab work to test that hypothesis. Are any grad students listening?

The Fall of Camano Head: A Snohomish Account of a Large Landslide and Tsunami in Possession Sound During the Early 1800s

by

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Historical accounts among the Snohomish people describe a large landslide at Camano Head that sent a large wave south towards Hat Island. The landslide buried a small village and the resulting tsunami drowned many people. The story, summarized in Tweddell, 1953, is estimated to be from the 1820s and contains details consistent with geological understanding of such events.

The Snohomish people occupied the northern Possession Sound area, including Everett, southern Whidbey and Camano Islands, Hat Island (also called Gedney Island), and the northern Snohomish County shoreline. Camano Head (*Xweshud*), at the south end of Camano Island, and the northern shore of Hat Island (*Tssi'li*) were among their best clam beds and would likely have been busy during summer months.

Accounts of the landslide are based on observations from Hat Island, two miles away:

> *The bluff slid in. People at Hat Island in the early summer morning saw Camano Island bluff smoking; they couldn't see it for the smoke; and there was something black coming toward them, and then they saw it was a wave. They fled to high land. Some of the men and women, and some of the children were drowned (Tweddell, 1953, p. 67).*

People on Hat Island "heard a noise like thunder" and their view of Camano Head was obscured by dust. The tsunami washed away houses or camps and people were either drowned or caught in the drifts [logs and debris].

Details of the landslide itself are limited: "When the point slid, trees and everything went in." A tribal member reported that "when I came, some of the old trees on that point were still at the bottom of the salt water--there is a clam bed there now." Prior to the slide, there may have been a permanent village at Camano Head (one, possibly exaggerated, report suggested that hundreds of people were killed at Camano Head).

The accounts also mention that some flooding may have occurred at Hibolb (a larger village on the northern Everett shoreline near the mouth of the Snohomish), but if damage occurred at all, it was limited. No mention is made of the wave at other low-lying sites in the vicinity, such as Sandy Point on Whidbey Island - the closest barrier beach and marsh to Camano Head.

Discussion

Although the accounts leave many questions unanswered, the following seems fairly clear. Early on a summer morning in the early 1800s, a large landslide occurred at Camano Head, carrying standing trees to the beach, and burying many people living at the toe of the bluff. The landslide sounded like thunder and created large volumes of dust. The landslide also resulted in a tsunami that traveled south toward Hat Island, washing over the barrier beach, destroying houses or encampments and drowning many people.

Camano Head, which comprises the southernmost tip of Camano Island, is a steep headland that rises over 300 feet from the beach. It is subject to landslides of various scales - the Washington Coastal Zone Atlas (1979) indicates a large "recent" landslide and aerial photographs confirm numerous smaller slides in the years since the atlas was published. As a result, the occurrence of large landslides at Camano Head is neither surprising nor unprecedented. What makes the 1820's slide notable is its apparent scale, its capacity to generate a tsunami, and the large accompanying loss of life.

Hat Island lies directly south of Camano Head, along the southern extension of the same topographic ridge that forms Camano Island. Both the northwest and northeast points of Hat Island are marked by small spits of land (barrier beaches), backed by low marshes or lagoons. The historical account appears to refer to the northwestern point of the island (now developed residentially). The elevation of the beach berm on spits typically lies within a few feet of mean high water and these sites are therefore particularly vulnerable to tsunami overtopping. The lack of reports of significant flooding or casualties at other low-lying sites in the area (except for Hibolb) may indicate that the north end of Hat Island was more vulnerable due to its proximity, its alignment with the slide, or the character of the local bathymetry, or it may simply reflect the lack of observations or accounts from other sites.

The accounts make no mention of ground shaking, suggesting that the landslide was not associated with a major earthquake. The description of the sound and the dark cloud of dust is consistent with other reports of large landslides. A nighttime landslide at Lilly Point on Point Roberts on Memorial Day weekend of 1999 was heard by residents in the vicinity and left dust coating the forest in the area (as far as we know, the Point Roberts landslide did not result in a tsunami).

Most landsliding on Puget Sound shorelines occurs as shallow, rapid failures or as periodic reactivation of deep-seated prehistoric landslide complexes. The former are too small to generate waves whereas the latter typically move too slowly. In addition, few slides extend far enough from the toe of the bluff to displace a significant volume of water. Very large and rapid landslides do occasionally occur, however, and such slides, particularly if coincident with a particularly high tide, may be capable of generating a tsunami. The 1949 Tacoma Narrows slide (Chleborad, 1994) generated a tsunami and a 1983 landslide north of Brownsville is reported to have generated a small wave (Arndt, 1999, p.89). The risk of tsunami from subaerial landslides is increased by higher tidal stages, not only because the slide is more likely to generate a wave, but because the risk to low-lying areas is greatly increased.

Conclusion

The Camano Head landslide is the only known example of a landslide on Puget Sound generating a tsunami large enough to cause significant loss of life. It underscores the vulnerability of low-lying areas around the Sound to tsunamis generated by large landslides. We have many low-lying communities in this region built on spits or on filled tidelands that occur in close proximity to high unstable bluffs capable of generating significant landslides. Although the impacts may be relatively localized, they may also be severe and will occur with little, if any, advance warning.

The report also highlights the value (and untapped potential) of native records in understanding historical geologic events. The detail and the relatively recent nature of this event make the account particularly useful, particularly given the potential for corroborating the story through geological investigations of marsh stratigraphy behind barriers.

Acknowledgements.

Karen Prasse (Stanwood Area Historical Society) pointed me to Dr. David Cameron's article. Dr. Cameron kindly supplied me with background notes and information about his sources.

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The June 23, 2001 Event--Time Line of a Tsunami Advisory

The June 23, 2001 Peruvian earthquake provided a clear example of how a tsunami warning system works--in this case the Stormweb System in Washington State (www.stormweb.com), managed by John Dominoski.

1) On Saturday, June 23, at 5:00 PM (1700 hrs) this message was given:

Read this bulletin slowly and carefully. This advisory is being issued in conjunction with local emergency management in Pacific and Grays Harbor Counties (Washington).

At this time a tsunami advisory applies to California and Oregon coasts only. An investigation is currently underway. No, repeat no action has been ordered at this time. This is an informational bulletin only. Monitor local media for the most current information. Do not call 911 for information.

It might be a good idea to check and update your 72 hour emergency kit at this time.

BULLETIN (extract): Tsunami Advisory Bulletin-Supplement bulletin number 3, West Coast and Alaska Tsunami Warning Center/NOAA/NWS. Issued 06/23/2001 at 2317 UTC.

…This Tsunami Advisory Bulletin is for Alaska, British Columbia, Washington, Oregon, and California only…

No, repeat no watch or warning is in effect. The watch issued in the previous message has been downgraded to an advisory. No watch is in effect.

Earthquake data: Preliminary magnitude 8.2; location 16.0S 72.7W - near coast of Peru; time 1333 PDT 06/23/2001.

Evaluation: A tsunami may have been generated that could be potentially dangerous to the coasts of Alaska, British Columbia, Washington, Oregon, and California. The Tsunami Warning Centers have begun an investigation to determine the level of danger. More information will be issued as it becomes available.

2) Two minutes later (5:02 PM) this message was posted:

For immediate release - Press release, Grays Harbor County, Department of Emergency Management, PO Box 630, Montesano, WA 98563. June 23, 2001

This afternoon at 1:33 PM PDT there was an earthquake off the coast of Peru. The preliminary magnitude of the quake is 8.2.

There have been observed wave heights of 81 cm in Arica, Chile, 67 cm at Iquique, Chile and 63 cm at Antofagasta, Chile.

At this time the Washington Coast is under an advisory as are California and Oregon. An advisory indicates that the wave is traveling through the Pacific Basin and the Alaska West Coast Tsunami Warning Center is monitoring the wave arrival in South America.

At this time there are no evacuations being issued. The Department of Emergency Management and Local Officials will continue to monitor the situation throughout the afternoon and evening.

Please monitor your local radio station for more information.

3) At 8:30 PM, this status report was issued:

To all Tsunami Warning System participants

Subject: Tsunami watch bulletin - supplement bulletin number 7

West Coast and Alaska Tsunami Warning Center/ NOAA/NWS

Issued 06/23/2001 at 2012 PDT

Extract: A tsunami watch is in effect for the coastal areas from the California-Mexico border to Cape Mendocino, CA, inclusive…

At this time, this bulletin is for information only for other areas of California, Oregon, Washington, British Columbia, and Alaska…

…Evaluation: A tsunami has been generated which could cause damage to the Pacific Coast. Therefore persons in low lying coastal areas should be alert to instructions from their local emergency officials. Tsunami wave heights cannot be predicted. Tsunamis may be a series of waves which could be dangerous for several hours after the initial wave arrival.

Observed tsunami heights [*list abridged by TsuInfo*]:

Arica, Chile 0200cm/6.55 ft p-t
Iquique, Chile 0110cm/3.6 ft p-t
Antofagasta, Chile 0060cm/1.9 ft. p-t

4) Bulletin number 8 was issued at 2108 PM PDT on 23 June 2001

Extract: A tsunami watch is in effect for the coastal areas from the California-Mexico border to Cascade Head, OR, inclusive…

At this time, this bulletin is for information only for other areas of Oregon, Washington, British Columbia, and Alaska…

Estimated times of initial wave arrival

La Jolla, CA	0052 PDT June 24
Crescent City, CA	0246 PDT June 24
San Pedro, CA	0109 PDT June 24
Charleston, OR	0303 PDT June 24
San Francisco, CA	0224 PDT June 24

No, repeat no tsunami watch or warning is in effect for the coastal areas from Cascade Head, OR. to Attu, AK.

For information only - estimated times of initial wave arrival

Seaside, OR	0345 PDT June 24
Seward, AK	0541 ADT June 24
Neah Bay, WA	0407 PDT June 24
Juneau, AK	0541 ADT June 24
Astoria, OR	0413 PDT June 24

5) Bulletin number 9 cancelled the tsunami watch.

Issued 06/23/2001 at 10:03 PM PDT

Extract: The tsunami watch status is cancelled for California and Oregon…

Evaluation: No tsunami danger exists for Alaska, British Columbia, Washington, Oregon, or California. However, some areas may experience small sea level fluctuations. As local conditions can cause a wide variation in tsunami wave action, the all clear determinations must be made by local authorities.

STORMWEB

"Since 1996, the Stormweb Emergency Information System has provided realtime disaster reports and emergency information to the residents of Coastal Washington and the Olympic Peninsula.

Under normal circumstances, Stormweb provides links to surface and marine weather, PNW satellite and Doppler radars, road conditions, tides, rivers, and more. Stormweb also offers a broad database of disaster preparedness information and a comprehensive library for the researcher.

When potential emergency conditions begin to develop, Stormweb operates at a heightened level behind the scenes. Conditions are monitored around the clock and sent out to Stormweb subscribers via email when warranted. Watches are posted online when they are issued.

Lastly, Stormweb offers a unique advisory system called STORMWEB_ALERT. This system provides emergency bulletins, preparedness education information and periodic newsletters via electronic mail, 24 hours a day - at no cost. If you use your email on a frequent basis, if you commute, if you are interested in training opportunities and emergency road closures, etc., this system is for you."

(*from* www.stormweb.com on 6/21/2001)

Information for Stormweb is gathered from local emergency management, fire and rescue services, public safety agencies, HAZMAT and emergency medical services, combined with Washington State Department of Transportation, NWS, NEIC, USGS, WCATWC, USACE, TAMU, and the University of Washington.

INFREQUENTLY ASKED QUESTIONS

compiled by
LEE WALKLING

Ok, so you all know about the 1755 Lisbon earthquake and tsunami. Where was the other big 1755 earthquake and how soon after the Lisbon quake did it happen?

Boston, Massachusetts, USA (1755, November 18) This earthquake occurred merely seventeen days after the devastating Lisbon quake, leading many researchers to believe a relationship existed between the two. This earthquake was the most violent shock ever felt in the area. The epicenter, north of Boston, produced an earthquake at 4:11 a.m. Many witnesses reported a roaring sound like distant thunder. The tremor produced a long, rolling shock wave that forced people to grab stable objects to prevent being thrown to the ground. Treetops swung in large arcs, and the quake shook buildings and cracked house beams. Walls and chimneys in Boston fell, stone fences collapsed, and cisterns cracked. Amazingly, there were no reported deaths.

from: http://library.thinkquest.org/C003603/english/earthquakes/casestudies.shtml#6

The quake's magnitude is estimated to have been 6 to 6.5. *from:* http://geology.about.com/library/bl/blboston1755eq.htm

This earthquake caused the heaviest damage in the region around Cape Ann and Boston. At Boston, much of the damage was confined to an area of infilled land near the wharfs. There, about 100 chimneys were leveled with the roofs of houses, and many others (1,200 to 1,500) were shattered and partly thrown down. Some chimneys, which were broken off below their tops, tilted dangerously 3 or 4 centimeters; others were twisted or partly turned. The gable ends of several brick buildings (12 to 15) were thrown down, and the roofs of some houses were damaged by the fall of chimneys. Stone fences were thrown down throughout the countryside, particularly on a line extending from Boston to Montreal. New springs formed, and old springs dried up. At Scituate (on the coast southeast of Boston), Pembroke (about 15 kilometers southwest of Scituate), and Lancaster (about 40 kilometers west of Boston), cracks opened in the earth. Water and fine sand issued from some of the ground cracks at Pembroke.

The earthquake generated a tsunami that left vessels aground and fish on the banks after the water withdrew from St. Martin's Harbor in the West Indies. When the water flowed back into the harbor, it rose about 2 meters higher than normal and inundated the low-lying lands.

This earthquake was reported from Halifax, Nova Scotia, south to the Chesapeake Bay in Maryland and from Lake George, New York, east to a ship 320 kilometers east of Cape Ann. The location of the ship is thought to be near the epicenter, because the shock was felt so strongly that those onboard believed the ship had run aground. Several aftershocks occurred.

Abridged from: Stover, C. W.; Coffman, J. L., 1993, Seismicity of the United States, 1568-1989 (revised): USGS Professional Paper 1527, at: http://wwwneic.cr.usgs.gov/neis/eqlists/USA/1755_11_18.html

"Last Tuesday Morning about half an Hour past Four o'Clock, the Weather being serene, the Air clear, the Moon shining very bright, we were surpriz'd with a most terrible Shock of an Earthquake: The conditions were so extreme as to wreck the Houses in this Town to such a degree that the Tops of many Chimnies, and some of them quite down to the Roofs, were thrown down."

from: The Boston Weekly News-Letter, November 20, 1755

When was the first tsunami recorded and where?

"Since tsunamis are relatively rare, instrumentation dedicated to collecting tsunami data has been slow to be developed. Tide gauges were developed in the 1850s and a large tsunami from Japan was recorded on the U.S. West Coast in 1854---the first tsunami to be recorded."

from: Report of the International Tsunami Measurements Workshop, Estes Park, CO., June 28-29, 1995, p. 9.

Why is Benjamin Franklin's great-grandson known to tsunami researchers?

"As far as anyone knows, the first general estimate of ocean depths by scientific methods was made in 1856 by Alexander Dallas Bache, a great-grandson of Benjamin Franklin and for more than twenty years superintendent of the United States Coast and Geodetic Survey. It was an indirect but ingenious measure, in the best tradition of Eratosthenes.

From a Russian naval officer's account of the destruction of his ship in the Japanese earthquake of 1854, Bache established the time of the earthquake's first shock wave. By means of tidal-gauge records [*Editor's note*: see previous question!], he determined how long it took the earthquake's first seismic sea waves, or tsunamis, to cross the Pacific and reach the California coast---an interval of some twelve hours. Bache then made his calculations, using a recently discovered physical law that related the velocity of very long waves such as tsunamis to the depth of the ocean. In this way, Bache concluded that the average depth of the Pacific along the wave path must be about 3,600 meters. It was a reasonably accurate estimate. The average depths of the Pacific, Atlantic, and Indian Oceans are, respectively, 4,280, 3,930, and 3,960 meters."

from: Wilford, N. N., 1981, The mapmakers: Alfred A. Knopf, p. 280

Boston, Massachusetts. Wooden buildings shaken and damaged; church steeples leaning. People outside in panic. Image used to illustrate a religious tract. (Woodcut, American, 18th c.). Originals in Reilly, E. C., 1975, Dictionary of colonial American painters' ornaments and illustrations: Worcester, Mass., American Antiquarian Society, 515 p.

www.ccee.orst.edu/wavelab/index.html
www.ccee.orst.edu/wavelab/directional_basin.html

For more information about Oregon State University's wave basin (The O.H. Hinsdale Wave Research Laboratory), check out these two webpages. There are photographs and a diagram of the facility, giving its dimensions. (See also the article on page 1.)

www.ngdc.noaa.gov/seg/hazard/resource/

The online source of the Natural Hazards Data Resources Directory, a resource for the Disaster and Hazard Management Community of Practitioners and Research Scholars and the general public. The Directory includes two types of information: 1) data resources organized by natural hazard topic; and 2) lists of hazard-related organizations.

The NHRD was originally published jointly by the Natural Hazards Research and Applications Center, University of Colorado, and NOAA's National Geophysical Data Center. Leaura M. Hennig was the compiler and editor.

http://www.redcross.org/services/disaster/keepsafe/unexpected.html

The American Red Cross has developed a brochure that lists many of the things people can do to prepare for a terrorism attack. Entitled "Terrorism - Preparing for the Unexpected," it is available from the URL above. The brochure addresses common questions that the Red Cross has been asked and that the agency feels it can knowledgeably address. It is intended to be informative, non-alarmist, but factual and forthright and covers shelter-in-place and evacuation instructions, as well as other useful information.

from: Disaster Research 355, October 3, 2001

Tsunami Website of the Month

http://omzg.sscc.ru/tsulab/

Tsunami Laboratory
Institute of Computational Mathematics and Mathematical Geophysics (Computing Center)
Siberian Division, Russian Academy of Sciences
Head of the Laboratory: Dr. Viacheslav K.Gusiakov
Tel: (3832) 34-20-70 Fax: (3832) 32-42-59 Email: gvk@omzg.sscc.ru

Current research projects [links]

On-line Pacific Tsunami Catalog, 47B.C.-2000A.D.
On-line Mediterranean Tsunami Catalog, 1628 B.C.-2000A.D.
July 17, 1998 Papua New Guinea Tsunami
Recent Pacific Tsunamis
Tsunamis in the Caribbean
Tsunamis in the Mediterranean
Historical Tsunami Database for the Pacific Region
Historical Tsunami Database for the US Pacific Coast
Tsunami Hazard Assessment for the Mediterranean
Investigation of Geological Traces of Paleotsunamis in Kamchatka
Geological Traces of Giant Tsunamis in Australia

Estimation of Tsunami Risk for the Bering Coast of Kamchatka
Kamchatka Tsunami Workshop, August 21-24, 1996
Kuril-Kamchatka Bathymetry Project
IUGG Tsunami Commission

Last update Tuesday, July 03, 2001

http://www.worldwatch.org
http://secure.worldwatch.org/cgi-bin/wwinst/WWP0158
[From the Worldwatch Institute:]

More people worldwide are now displaced by natural disasters than by conflict. In the 1990s, natural catastrophes, including hurricanes, floods, and fires, affected more than two billion people and caused in excess of $608 billion in economic losses worldwide - a loss greater than during the previous four decades combined. But more and more of the devastation wrought by such "natural" disasters is unnatural in origin - caused by ecologically destructive practices and an increasing number of people living in harm's way.

These are the basic findings presented in a new study, "Unnatural Disasters" (61 p., ISBN: 1-878071-60-2) by Janet Abramovitz of the Worldwatch Institute, a Washington, D.C.-based environmental research organization. "By degrading forests, engineering rivers, filling in wetlands, and destabilizing the climate, we are unraveling the strands of a complex ecological safety net," said Abramovitz. "We have altered so many natural systems so dramatically, their ability to protect us from disturbances is greatly diminished." Also contributing to the rising toll of disasters is the enormous expansion of the human population and the built environment, which put more people and more economic activities in harm's way.

Although "unnatural disasters" occur everywhere, their impact falls disproportionately on the poor as they are more likely to live in vulnerable areas, and they have fewer resources to deal with disasters. Between 1985 and 1999, 96% of recorded disaster fatalities were in developing countries.

At the same time, economic losses from "unnatural disasters" are greater in the developed world. The earthquake that rocked Kobe, Japan, in 1995, for example, cost more than $100 billion, making it the most expensive natural disaster in history. Still, smaller losses often hit poor countries harder, where they represent a larger share of the national economy. The damage from 1998's Hurricane Mitch in Central America was $8.5 billion - higher than the combined gross domestic product of Honduras and Nicaragua, the two nations hardest hit.

Besides presenting these issues, Abramovitz suggests measures that could lessen disasters' toll--from economic/financial safety nets to ecological measures, promotion of community-based disaster planning, wise land-use planning, and hazard mapping.

Copies of "Unnatural Disasters" can be downloaded for $5.00 in PDF format from the second URL above. They can also be ordered from the Worldwatch Institute, 1776 Massachusetts Ave, N.W., Washington, DC 20036; 1-800-555-2028 (U.S.) or 1-301-567-9522 (outside the U.S.).

from: Disaster Research 356, October 23, 2001

http://www.myflorida.com/doea/healthfamily/learn/elderservices/doeaelderupdate.html

The Florida Department of Elder Affairs has published the 2001 version of its "Disaster Preparedness Guide for Elders" in both print and PDF format (available from the web site above). The guide includes useful information on preparedness for hurricanes, floods, and tornadoes; evacuation; pet safety; safety for motorists in emergencies; as well as an emergency preparedness checklist, suggestions on how to build a disaster-resistant neighborhood, and other information and references to other sources of information.

from: Disaster Research 356, October 23,2001

http://www.trinet.org
http://www.trinet.org/shake/archive/scenario.html

TriNet is a collaborative project among the California Institute of Technology, the California Division of Mines and Geology, and the U.S. Geological Survey. Its aim is to create an effective real-time earthquake information system for Southern California (see DR #306). Now nearing completion, TriNet incorporates new technologies to provide vital information within minutes of an earthquake, thus helping to mitigate the impact of large earthquakes in the region. The system is designed to aid both scientists and emergency managers.

Through continuous monitoring of seismicity in Southern California, TriNet produces rapid estimates of earthquake times, locations, and magnitudes, enabling direct estimates of the strength of ground shaking near earthquakes. Its products include maps known as "ShakeMaps" that demonstrate ground acceleration, velocity, and other measures of intensity. The TriNet ShakeMap Web pages now display not only near-real-time information, but also, at the second URL above, selected earthquake scenarios for southern California. Maps for other regions of the U.S. will be available soon. Indeed, users interested in specific scenarios not currently available can make a request to the ShakeMap Working Group via a comment form on the ShakeMap web site. The maps are already being used in emergency response planning by city, county, state, and federal agencies, by response planners and managers of utilities and other private organizations, and by engineers.

from: Disaster Research 356, October 23, 2001

http://newport.pmel.noaa.gov/time/animations.html

Animations of inundation model results for selected communities (Newport, OR.; Seaside,OR.; Warrenton-Astoria, OR.; Grays Harbor, WA.; and Willapa Bay, WA.). Done by the Center for Tsunami Inundation Mapping Efforts in conjunction with the Oregon Graduate Institute's CCALMR. Animations use either the Cascadia subduction zone earthquakes or the 1964 Alaska earthquake as the tsunami source mechanism.

http://tsunami.pmel.noaa.gov/dartqc/WaveWatcher

National Tsunami Hazard Mitigation Program DART Data Quality Control "Deep-ocean Assessment and Reporting of Tsunamis." This site gives real-time data being received from the tsunami detection buoys, along with data received during the last 4 days. There are links to the DART project, DART buoys, and related sites.

http://www.csc.noaa.gov/library/

This is the homepage of NOAA Coastal Services Center's library. Links are provided to the library holdings, other online NOAA libraries and the Coastal Information Library

"The CSC Library focuses specifically on information pertinent to coastal issues. The collection includes reference and general resources, journals and newsletters, CD-ROMs, posters and videos. These materials are available to library clientele outside the Center through interlibrary loans."

from: http://www.csc.noaa.gov/library/text/aboutlib.html

Editors' Delight!!

The *entire* TsuInfo bibliography-- including **ALL** the tsunami materials we've been gathering for the last 7 years-- is now searchable online! It's all included in our library database at, **http://www2.wadnr.gov/dbtw-wpd/washbib.htm** If you just want to search on the newest materials, you can do that, too!

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

___**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. You will be responsible for return postage.

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For general emergency management information, contact:

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

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

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

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

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

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

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(with thanks to Linda Sjogren, ITIC)

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Activities of the National Tsunami Hazard Mitigation Program for FY2000, by Eddie N. Bernard. v. 3, no. 1, p. 1, 3-4.

Draft summary report of the Tsunami Hazard Mitigation Steering Group meeting, May 16-17, 2001, Portland Oregon, by Eddie N. Bernard. v. 3, no. 4, p. 1, 3-6.

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Features

A brief history of seismology to 1910, adapted from Charles Davison. v. 3, no. 2, p. 9.

The fall of Camano Head--A Snohomish account of a large landslide and tsunami in Possession Sound during the early 1800s, by Hugh Shipman, v. 3, no. 6, p. 13-14.

Geological records of tsunami events, by Simon J. Day. v. 3, no. 3, p. 6-7.

---Comment, by James R. Goff. v. 3, no. 4, p. 24-26.

---Reply, by Simon J. Day. v. 3, no. 4, p. 26-28.

Hazard warning systems--Review of 20 years of progress, by John H. Sorensen. v. 3, no. 1, p. 14-20.

The impact of Project Impact on the Nisqually earthquake--An invited comment, by Robert Freitag. v. 3, no. 4, p. 7-8.

The inappropriate tsunami icon, by Doak C. Cox. v. 3, no. 6, p. 9-12.

Natural Hazards Caucus holds event, releases discussion paper, by David Applegate. v. 3, no. 1, p. 9-10.

Ocean Shores lauded for tsunami readiness, by John Dodge. v. 3, no. 4, p. 9.

Periodicals for disaster mitigation and tsunami information. v. 3, no. 2, p. 13-16.

Pets and emergencies, v. 3, no. 2, p. 9.

Reconstruction of world map according to Strabo (18 A.D.). v. 3, no. 1, p. 31.

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Conference Draws Momentum For National Warning Organization

from: Cal-EPI; e-mail from Art Botterell, Dec. 4, 2001

McLean, Va., November 30 - More than 120 leaders from the emergency warning community met yesterday and unanimously called for the creation of a public-private partnership aimed at improving the delivery of timely and accurate emergency information to people at risk.

The group came together at a special conference arranged by the National Warning Organizing Committee, a group of emergency warning advocates representing the public and private sectors. Conferees included federal, state and local government officials, not-for-profit organizations, and representatives from the private sector.

The mission of the new organization is to improve the delivery of warnings and emergency information to the public through better education, research, standards creation and policy recommendations.

Committee Chair David Liebersbach, Director of the Alaska Division of Emergency Services, appointed Peter Ward, formerly of the U.S. Geological Survey and chair of a White House-appointed working group on natural disaster information systems, to head up a committee to determine the new organization's structure and governance.

Ward, who also serves as the new organization's spokesman, stressed that "The need for a partnership of this kind has been underscored in numerous studies and by many national committees over the past few years."

Liebersbach added: "It is gratifying to sense the momentum for a partnership of this kind. We're moving ahead on a national initiative which will enhance ongoing efforts to save lives by providing integrated solutions for rapid, reliable and precise emergency warning and notification to the public."

The conference was hosted by The MITRE Corporation in McLean, Va. MITRE (www.mitre.org) is a not-for-profit national technology resource that provides systems engineering, research and development, and information technology support to the government.

For further information, contact MITRE Corporate Communications. Alan Shoemaker (781-271-2488); Francis McLoughlin (781-271-2810)

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