Introduction to Tsunamis

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PowerPoint Presentations:
1 – Introduction to tsunamis
2 – Great tsunamis
3 – Lessons from recent tsunamis
4 – Tsunami Warning System
5 – Lessons from Indonesia

(note – the presentations in the tutorial may be abbreviated from those posted at the EERI web site)

Notes attached:
Tsunami Table Top Exercise
Surfing Tsunamis on the Internet
Internet Tsunami Resources

Tsunami Table Top Exercise

(Note: tsunami bulletins are attached to this exercise. Please don't look at them until you are instructe3d to do so.)

• Table top exercises are an important tool of emergency managers and planners. An emergency scenario is proposed and participants walk through and discuss what actions they would take to respond.

The Scenario: It is December 5, 1997 and a large earthquake has just occurred offshore of Kamchatka.

• In this exercise you are the emergency manger of one of the following communities:

1) Hilo, Hawaii
2) Crescent City, California
3) Hachinhoe, Hokkaido, Japan
4) Petrapavlovsk, Kamchtka, Russia (it was USSR in 1997)
5) Sitka, Alaska

The earthquake occurs at 11:26 UTC

You will receive bulletins from the tsunami warning centers. Your job is to assess the situation and make decisions as to whether to activate your Emergency Operations Center, order evacuations, assess damages and so forth.

Possibly useful information: Local times compared to UTC

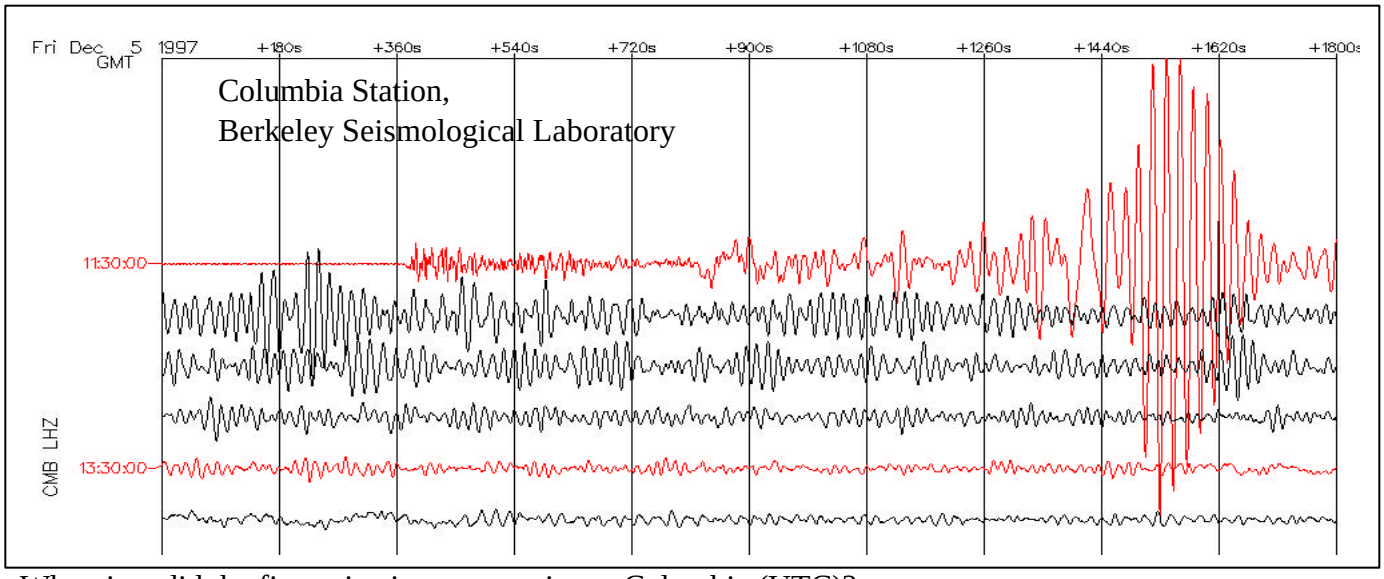
Hawaii Standard Time: UTC - 10 hours
Japan Standard Time: UTC + 9 hours
Alaska Standard Time: UTC - 9 hours
Pacific Standard Time: UTC - 8 hours
Kamchatka Standard Time: UTC + 12 hours

Name of Your community_____

Time of Earthquake 11:26 UTC Local time in your community _____

I. Earthquake travel time.

The trace below was recorded at the Berkeley Seismological Laboratory's Columbia station in the Sierra Foothills on December 5, 1997. The recording begins at 11:30 UTC on December 5. Each vertical line is 3 minutes.



What time did the first seismic waves arrive at Columbia (UTC)? _____

How long did it take the seismic waves to travel from Kamchatka to Columbia? _____

The Tsunami Warning Centers use seismic information as the first alert to warn communities of a possible tsunamigenic earthquake. Seismic waves travel much faster than tsunami waves. The Warning Centers can locate the earthquake and estimate a magnitude usually in less than 15 minutes.
In this exercise I have combined the actual bulletins issued by the Pacific Tsunami Warning Center in Hawaii and the West coast Alaska Tsunami Warning Center in Alaska. If you were an actual emergency manager, you would receive only WCATWC Bulletins in Alaska and the West Coast of North America and only PTWC Bulletins elsewhere.

II. First bulletin: (look only at the attached Bulletin #1)

Time Bulletin issued (UTC):_____ Time Bulletin issued (local):_____AM/PM

How much time elapsed between the earthquake and the first bulletin?_____

Alert Status for your community: Warning Watch Advisory

Estimated Tsunami Arrival time (UTC) _____ Estimated Local Arrival Time _____

What do you do?

What additional information do you wish you had?

III. Second bulletin: (now look at the attached Bulletin #2)

Time Bulletin issued (UTC):_____ Time Bulletin issued (local):_____AM/PM

How much time elapsed between the earthquake and the second bulletin?_____

Alert Status for your community: Warning Watch Advisory

Estimated Tsunami Arrival time (UTC) _____ Estimated Local Arrival Time _____

What new information have you received since the first bulletin?

What do you do?

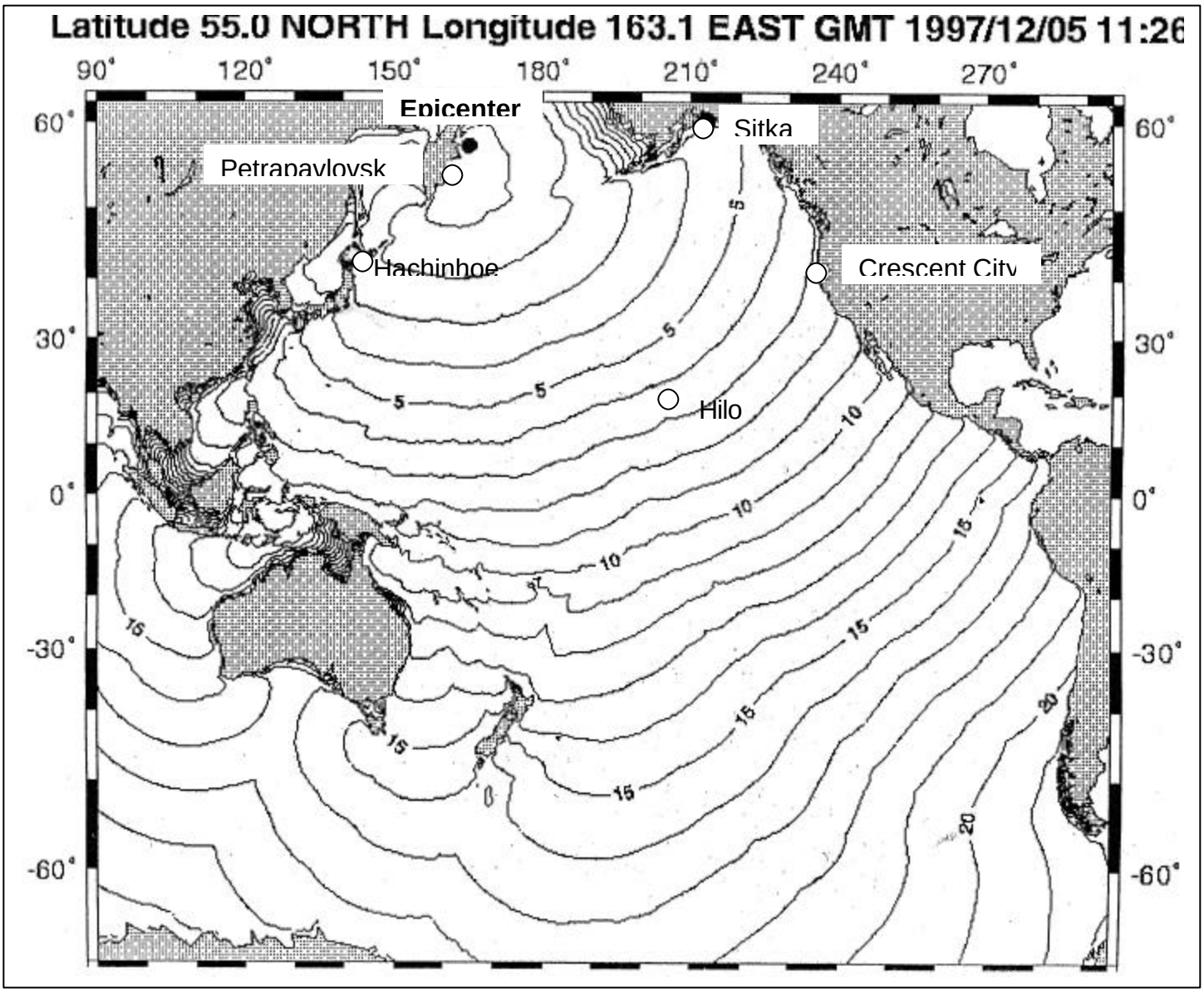
What additional information do you wish you had?

IV. Third bulletin:

Time Bulletin issued (UTC):_____ Time Bulletin issued (local):_____ AM/PM

How much time elapsed between the earthquake and the third bulletin?_____

What do you do?


Latitude 55.0 NORTH Longitude 163.1 EAST GMT 1997/12/05 11:26
90°
120°
150°
180°
210°
240°
270°
60°
30°
0°
-30°
-60°
Epicenter
Sitka
Petropavlovsk
Hachinhoe
Crescent City
Hilo
5
10
15
20

TSUNAMI BULLETIN NUMBER 1
ISSUED 12/05/1997 AT 1139 UTC

.A TSUNAMI WARNING IS IN EFFECT. THIS IS A TSUNAMI WARNING FOR THE COASTAL AREAS FROM DUTCH HARBOR,AK TO ATTU, AK., INCLUSIVE. FOR THE COASTAL AREAS AND FOR RUSSIA AND JAPAN.

.A TSUNAMI WATCH IS IN EFFECT FOR THE COASTAL AREAS FROM THE NORTH TIP OF VANCOUVER I. BC. TO DUTCH HARBOR, AK, AND FOR MARCUS IS., MIDWAY IS., WAKE IS., HAWAII, MARSHALL ISL, GUAM, JOHNSTONE ISL., TAIWAN, CHUUK.

AT THIS TIME, THIS BULLETIN IS FOR INFORMATION ONLY FOR OTHER AREAS OF THE PACIFIC.

EARTHQUAKE DATA
PRELIMINARY MAGNITUDE – 7.6
LOCATION - 54.7N 163.6E - VICINITY: KAMCHATKA
TIME - 0227 AST 12/05/1997
0327 PST 12/05/1997
1127 UTC 12/05/1997

EVALUATION
IT IS NOT KNOWN - REPEAT NOT KNOWN - IF A TSUNAMI EXISTS BUT A TSUNAMI MAY HAVE BEEN GENERATED. THEREFORE PERSONS IN LOW LYING COASTAL AREAS SHOULD BE ALERT TO INSTRUCTIONS FROM THEIR LOCAL EMERGENCY OFFICIALS. PERSONS ON THE BEACH SHOULD MOVE TO HIGHER GROUND IF IN A WARNED AREA. TSUNAMI WAVE HEIGHTS CANNOT BEPREDICTED. TSUNAMIS MAY BE A SERIES OF WAVES WHICH COULD BE DANGEROUS FOR SEVERAL HOURS AFTER THE INITIAL WAVE ARRIVAL.

ESTIMATED TIMES OF INITIAL WAVE ARRIVAL FOR WATCH/WARNING AREAS:

	UNIVERSAL TIME	LOCAL TIME
PETRAPAVLOVSK, RUSSIA	**1151 UTC 05 DEC**	**2351 RST 05 DEC**
SHEMYA, AK	1234 UTC 05 DEC	0334 AST 05 DEC
HACHINOHE, JAPAN	**1418 UTC 05 DEC**	**2318 JST 05 DEC**
MARCUS	1532 UTC 05 DEC	
MIDWAY	1533 UTC 05 DEC	
SHIMIZU, JAPAN	1611 UTC 05 DEC	
NAWILIWILI, HI	1712 UTC 05 DEC	
GUAM, USA	1722 UTC 05 DEC	
HONOLULU, HI	1736 UTC 05 DEC	0736 HST 05 DEC
YAKUTAT, AK	1657 UTC 05 DEC	
SITKA, AK	**1658 UTC 05 DEC**	**0758 AST 05 DEC**
HOMER, AK	1740 UTC 05 DEC	
HILO, HI	**1744 UTC 05 DEC**	**0744 HST 05 DEC**
JUNEAU, AK	1820 UTC 05 DEC	

FOR INFORMATION ONLY

TOFINO, BC	1832 UTC 05 DEC	
NEAH BAY, WA	1842 UTC 05 DEC	
ASTORIA, OREGON	1918 UTC 05 DEC	
SEASIDE, OREGON	1855 UTC 05 DEC	
CRESCENT CITY, CA	**1853 UTC 05 DEC**	**1053 PST 05 DEC**
SAN FRANCISCO, CA	1938 UTC 05 DEC	
SAN PEDRO, CA	2000 UTC 05 DEC	
LA JOLLA, CA	2011 UTC 05 DEC	

BULLETINS WILL BE ISSUED HOURLY OR SOONER IF CONDITIONS WARRANT. THE TSUNAMI WATCH/WARNING WILL REMAIN IN EFFECT UNTIL FURTHER NOTICE.

TSUNAMI BULLETIN NUMBER 2
ISSUED 12/05/1997 AT 1240 UTC

.A TSUNAMI WARNING IS IN EFFECT. THIS IS A TSUNAMI WARNING FOR THE COASTAL AREAS FROM DUTCH HARBOR,AK TO ATTU, AK., INCLUSIVE. FOR THE COASTAL AREAS AND FOR RUSSIA AND JAPAN.

.A TSUNAMI WATCH IS IN EFFECT FOR THE COASTAL AREAS FROM THE NORTH TIP OF VANCOUVER I. BC. TO SAND POINT, AK, AND FOR MARCUS IS., MIDWAY IS., WAKE IS., HAWAII, MARSHALL ISL, GUAM, JOHNSTONE ISL., TAIWAN, CHUUK, YAP, BELAU, PHILIPPINES.

AT THIS TIME, THIS BULLETIN IS FOR INFORMATION ONLY FOR OTHER AREAS OF THE PACIFIC.

EARTHQUAKE DATA
PRELIMINARY MAGNITUDE – 7.7
LOCATION - 54.7N 163.6E - VICINITY: KAMCHATKA
TIME - 0227 AST 12/05/1997
0327 PST 12/05/1997
1127 UTC 12/05/1997

EVALUATION
IT IS NOT KNOWN - REPEAT NOT KNOWN - IF A TSUNAMI EXISTS BUT A TSUNAMI MAY HAVE BEEN GENERATED. THEREFORE PERSONS IN LOW LYING COASTAL AREAS SHOULD BE ALERT TO INSTRUCTIONS FROM THEIR LOCAL EMERGENCY OFFICIALS. PERSONS ON THE BEACH SHOULD MOVE TO HIGHER GROUND IF IN A WARNED AREA. TSUNAMI WAVE HEIGHTS CANNOT BEPREDICTED. TSUNAMIS MAY BE A SERIES OF WAVES WHICH COULD BE DANGEROUS FOR SEVERAL HOURS AFTER THE INITIAL WAVE ARRIVAL.

ESTIMATED TIMES OF INITIAL WAVE ARRIVAL FOR WATCH/WARNING AREAS:

	UNIVERSAL TIME	LOCAL TIME
PETRAPAVLOVSK, RUSSIA	**1151 UTC 05 DEC**	**2351 RST 05 DEC**
SHEMYA, AK	1234 UTC 05 DEC	0334 AST 05 DEC
HACHINOHE, JAPAN	**1418 UTC 05 DEC**	**2318 JST 05 DEC**
MARCUS	1532 UTC 05 DEC	
MIDWAY	1533 UTC 05 DEC	
SHIMIZU, JAPAN	1611 UTC 05 DEC	
NAWILIWILI, HI	1712 UTC 05 DEC	
GUAM, USA	1722 UTC 05 DEC	
HONOLULU, HI	1736 UTC 05 DEC	0736 HST 05 DEC
YAKUTAT, AK	1657 UTC 05 DEC	
SITKA, AK	**1658 UTC 05 DEC**	**0758 AST 05 DEC**
HOMER, AK	1740 UTC 05 DEC	
HILO, HI	**1744 UTC 05 DEC**	**0744 HST 05 DEC**
JUNEAU, AK	1820 UTC 05 DEC	

FOR INFORMATION ONLY

TOFINO, BC	1832 UTC 05 DEC	
NEAH BAY, WA	1842 UTC 05 DEC	
ASTORIA, OREGON	1918 UTC 05 DEC	
SEASIDE, OREGON	1855 UTC 05 DEC	
CRESCENT CITY, CA	**1853 UTC 05 DEC**	**1053 PST 05 DEC**
SAN FRANCISCO, CA	1938 UTC 05 DEC	
SAN PEDRO, CA	2000 UTC 05 DEC	
LA JOLLA, CA	2011 UTC 05 DEC	

BULLETINS WILL BE ISSUED HOURLY OR SOONER IF CONDITIONS WARRANT. THE TSUNAMI WATCH/WARNING WILL REMAIN IN EFFECT UNTIL FURTHER NOTICE.

TSUNAMI BULLETIN NUMBER 3
ISSUED 12/05/1997 AT 1352 UTC

TSUNAMI WARNING AND WATCH ARE CANCELLED FOR ALL COASTAL AREAS AND ISLANDS IN THE PACIFIC.

AN EARTHQUAKE, PRELIMINARY MAGNITUDE – 7.7 OCCURRED 05 DEC 1126 UTC.
LOCATION - 54.7N 163.6E - VICINITY: KAMCHATKA

EVALUATION:
NO DESTRUCTIVE PACIFIC-WIDE TSUNAMI THREAT EXISTS. HOWEVER, SOME AREAS MAY EXPERIENCE SMALL SEA LEVEL CHANGES. THIS WILL BE THE FINAL BULLETIN UNLESS ADDITIONAL INFORMATION BECOMES AVAILABLE. FOR ALL AREAS THE TSUNAMI WARNING AND TSUNAMI WATCH ARE CANCELLED.

Geology 700 Surfing Tsunamis on the web

Begin by taking your web browser to the Humboldt State University home page http://www.humboldt.edu and select webmail from the Quick Links pulldown menu.
Log in to the geophs email account at:
Name: geophs password: Equake (note capital E, lowercase quake)
Select the 700 folder from the list on the left. The first message should be titled: tsunami surfing the web. It contains this document. You can use it to quickly link to the web sites listed.
The activities below are a guide for your web surfing only. These links were active as of April 10, 2006. Some may have changed!

1) Viewing tsunamis:

The National Geophysical Data Center (NGDC) which is under the auspices of NOAA and the Department of Commerce, archives a variety of geologic, geophysical and hazards data and slides. Start by viewing a quick slide show by looking at the thumbnails at:
http://www.ngdc.noaa.gov/seg/hazard/slideset/25/25_slides.shtml

Click on Download Full Resolution Tiff to see a full screen image. Look carefully at slides 8 - 10 (starting with Hawaiian Beach before the arrival of the 1957 tsunami) taken at Laie Point on the Island of Oahu, Hawaii. Read the captions and look carefully at the photos to answer the following:

Question 1: What was the SOURCE of this tsunami and where was it located?

Question 2: Is this a DISTANT, LOCAL or REGIONAL tsunami (from the perspective of the people living on Oahu?)

Question 3: Describe the appearance and the phenomenon associated with this tsunami BASED ONLY ON THESE THREE SLIDES.

Look through the remainder of the slides at this site. Which ones represent Local or near-source effects and which ones are distant tsunami events?

Tsunami videos:
The December 26 Indian Ocean tsunami provided more video coverage than all previous tsunamis combined. You can view a number of these videos at: http://www.asiantsunamivideos.com/
http://homepage.mac.com/jlgolson/candc/
Note – most of these videos are wmv (Windows Media) and require a Windows Media Player to view. If you don't have it, it can be downloaded for free at: http://www.microsoft.com/windows/windowsmedia/default.aspx (Windows version)
http://www.microsoft.com/windows/windowsmedia/software/Macintosh/osx/default.aspx (Mac)

2) Tsunami Warning Centers

View the most recent bulletins issued by the tsunami warning centers at:
http://wcatwc.arh.noaa.gov/
Select Most Recent from the menu on the left. Look at the supplementary material - maps and historic tsunami activity. You can pull up other Warning Center information by selecting Other Centers from the same menu.

Question 4: What is the most recent message?

Question 5: What is the difference between the PTWC and the WC/ATWC most recent message? Why are they different?

This web site also has links to tsunami travel time maps for communities within its jurisdiction. Select the About tsunamis from the menu on the left on the WCATWC main page. No. 6 on the list gives links to travel time maps. Scroll down and select Crescent City. Each colored band on the map is an hour of travel time.

Question 6: If a great earthquake were to occur near the east coast of Hokkaido, Japan, how long would it take for the first tsunami waves to reach Crescent City?

Click the "About Tsunamis" link to get information about historic tsunamis, tsunami generation and other tsunami information. Select #2 for a summary of West Coast and Alaska tsunamis.

Question7a. What is the largest runup (meters) in the catalong?

Click on this earthquake, select damage summary, Lituya Bay to read a fascinating eye-witness account.

Now go back to the list of events and select 1992 4/25. This is the Cape Mendocino earthquake. Click on the Marigrams link. Select any of the stations listed to see the tide-gage recording for this event.

Question 7b. Which marigram shows the largest amplitude tsunami wave from the 1992 earthquake?

If you wish to look at other tsunami events, go back to the table and click.

Would you like to receive email notification of tsunami bulletins and messages? If so, click the "get it by email" link on the left hand menu.

3) Most Recent Significant Event

On December 26, 2004 a great earthquake occurred off the northwest coast of Sumatra, Indonesia. Many scientific teams are studying this earthquake. A compilation of preliminary results is at:
http://www.pmel.noaa.gov/tsunami/indo_1204.html
Click on Global tsunami propagation to view the model.
Select the Computed Tsunami Arrival Time from the global tsunami propagation model link. Read the legend bar on the right to answer the following:

Question 8a: How long did it take the first waves to reach Sri Lanka? Somalia? Crescent City? If there had been a tsunami warning system in the Indian Ocean on December 26, and it worked the same way as the Pacific Tsunami Warning System, what type of alert bulletin would each of the above cities have received (Warning, Watch, Advisory)?

Warnings are issued for areas within 3 hours travel time, Watches for areas 3 – 6 hours travel time and Advisories for areas greater than 6 hours away. You can find out more about alert messages at:
http://wcatwc.arh.noaa.gov/definition.htm
Now go back to the December 26 page and click the link to Maximum Computed Tsunami Heights around the Globe.
Question 8b: Where are the wave heights the greatest?

Can you think of a reason why the wave heights along central and southern Sumatra are so much less than Sri Lanka or Somalia?

4) Tsunami models.

You looked at modeling results for the 2004 Indian Ocean tsunami above. In the past few years, the science of mathematically modeling tsunamis has made great advances and there are many models on the web. Take a look at the following:

First Model: Chile 1960
http://www.geophys.washington.edu/tsunami/general/historic/models_60.html
Click on "animation" to run the video.

Question 9: How much of the Pacific basin was affected by the tsunami caused by the 1960 Chilean earthquake?

Second Model: Papua New Guinea 1998
http://walrus.wr.usgs.gov/tsunami/PNGhome.html
This page has quite a bit of information on the 1998 Papua New Guinea tsunami. Go about halfway down the page to the diagram of the coastline and click on "computer simulation of the Papua New Guinea tsunami. Choose the "Medium Resolution" Movie (the high resolution will take too long to load and isn't a great improvement).

Question 10: The Papua New Guinea tsunami killed more people than the Chilean tsunami. Comparing this animation with the previous one, what are the differences and similarities between these two tsunamis?

Third Model: Okushiri Island, Japan, 1993
http://www.pmel.noaa.gov/tsunami/research.html - go to the bottom of the page. There are several inundation models. First select the Tsunami propagation animation – Andreanov Islands. Then look at the models of the 1993 tsunami at Aonae near the bottom of the page. I like the "Inundation of Aonae during Hokkaido-Nansei-Oki Tsunami".

Question 11: Which part of the town of Aonae appears to have been hit the hardest by the tsunami? How many times does the tsunami flood the tip of the peninsula?

If you have time, take a look at some of the other models on this page.

5) US National Tsunami Hazard Mitigation Program

GO TO: http://www.pmel.noaa.gov/tsunami-hazard/ NOTE - this page is best viewed with Internet Explorer.

This page has links to a number of different projects currently funded by the Federal Government. Start by looking at NOAA's new tsunami main page. You will find great background information on tsunami genesis and hazard mitigation. Return to the National Tsunami Hazard Mitigation Program page.

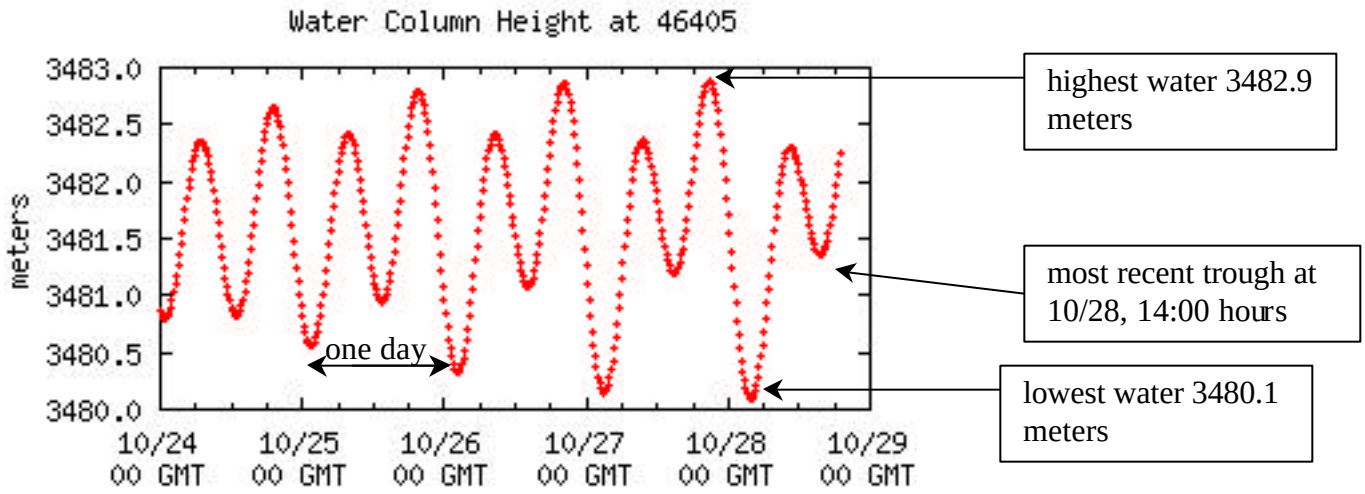
Go to the bottom of the page and click on Real Time Data and select Dart Buoy Data. This takes you to the US Deep-ocean Assessment and Reporting of Tsunamis (DART) program.

The DART Program: Prior to the December 2004 tsunami, 6 "Deep-ocean Assessment and Real time reporting of Tsunami" instrument packages were in operation – three off of Alaska and the Aleutians, two off of the Pacific Northwest and one near the equator off of South America. The Indian Ocean tsunami provided a big boost to the DART program and ten US Dart buoys are currently deployed and an additional buoy is maintained by Chile. Legislation authorizing eventual deployment of 35 DART buoys is working its way through Congress. A pressure sensor sits on the ocean floor in very deep water (over 2000 meters). The sensor is very sensitive to the weight of the water above it and can be calibrated to show the height of the water surface. The sensor sends information to a surface buoy that is tethered to the sea floor nearby. The buoy beams the information to a GOES satellite that transmits information to the tsunami warning centers. In the absence of a tsunami, they are in a "sleep" mode - sending back tidal heights every hour. If a tsunami were to occur, they would wake up. A computer program compares the actual water height to the expected tidal height. If they are different, the sensors are triggered into an "awake" mode and start sending data back much more frequently. The tsunami warning centers can then view the deep water tsunami wave heights soon after the they were generated and adjust the warning and information bulletins sent to the Pacific States.

You can look at the most recent data from each of the buoys by passing the mouse over the buoy location on the map. The buoy number and the last week of data are displayed. If the graph says no data, the buoy is not currently operating.

The graph shows water height (or depth depending on your point of view) as a function of day and time. The vertical axis is water height in meters. The horizontal axis is the day/hour given in Universal Time. You should notice an oscillating pattern of peaks and troughs. This is the typical background sleep pattern of hourly water surface heights.

The graph below shows a record for buoy 4605 off the Oregon coast:



Question 1 Pass your mouse over each of the buoy locations shown on the map. These buoys are located in remote areas and extremely rough weather and ocean conditions. Periodically one or more instruments breakdown and unfortunately can't be repaired for many months. Are any of the buoys off-line at the moment? If so, write down their numbers. Otherwise, write NONE._____

SELECT THE BUOY LOCATED OFF CAPE MENDOCINO (46411)
Put your cursor over buoy number 46406, the newest buoy and the one closest to us.
Question 13 a) What is the largest water depth (greatest height) recorded? _____

b) What is the smallest water depth (smallest height) recorded? _____

Now select the buoy off of the equator: #46406.
Question 14 How does this record differ from 46411? Why do you think they appear different?

Look at the records from the other buoys. Do you notice any pattern in the records?

Go back to the National Tsunami Program Home Page at: http://www.pmel.noaa.gov/tsunami-hazard/ and explore some of the other links. (I like the media and links link at the bottom of the page)

6) International tsunami field surveys

http://www.usc.edu/dept/tsunamis/

This is the home page of the USC tsunami group. They have participated in nearly every tsunami field study since 1992. Click and drag the blue rectangle over the world map. The red dots are areas that have been part of past field surveys. Select Video/animation link at the bottom of the page to see model results and video clips. Select the non-tsunami clip from China. It shows a true tidal-wave that is similar to a small tsunami.

Question 15 How high a wave is capable of knocking someone down?

7) Tsunami Hazard in Humboldt County

http://www.humboldt.edu/~geodept/earthquakes/eqk_info.html

This is the Humboldt Earthquake Education Center home page. It includes information about historic earthquakes and tsunamis on the north coast. Select the Tsunami hazard map link at the top of the page. This connects you to our recently completed tsunami maps of the Humboldt Bay region. Select map #2 Mckinleyville – Arcata

Question 16 What do the diagonal purple lines mean?

Question 17 What is the tsunami hazard at Tyee City? Mad River Hospital? Valley West?

Tsunami Web Links – April 2006

WestCoast/Alaska Tsunami Warning Center http://wcatwc.arh.noaa.gov/
Pacific Tsunami Warning Center http://www.prh.noaa.gov/ptwc/
NOAA Tsunami Research Program http://www.pmel.noaa.gov/tsunami/
National Tsunami Hazard Program http://www.pmel.noaa.gov/tsunami-hazard/
Tsunami! http://www.geophys.washington.edu/tsunami/welcome.html
USGS Tsunami site http://walrus.wr.usgs.gov/tsunami/
Deep Ocean Buoy Data http://www.ndbc.noaa.gov/dart.shtml
USC Tsunami Field Survey Site http://www.usc.edu/dept/tsunamis/
Recent Tsunamis in the Pacifc http://omzg.sscc.ru/tsulab/recent.html
Tsunami! The Great Wave http://www.nws.noaa.gov/om/brochures/tsunami.htm
http://www.prh.noaa.gov/pr/itic/library/pubs/great_waves/tsunami_great_waves.html
Surviving a Tsunami http://geopubs.wr.usgs.gov/circular/c1187/
The Orphan Tsunami of 1700 http://pubs.usgs.gov/pp/pp1707/
California Seismic Safety Commission Tsunami Page http://www.seismic.ca.gov/Tsunami.htm
Redwood Coast Tsunami Work Group http://www.humboldt.edu/~geodept/earthquakes/rctwg/
The Tsunami Risks Project http://www.nerc-bas.ac.uk/tsunami-risks/
The Pacific Tsunami Museum http://www.tsunami.org/
NGDC Hazard Slide Sets http://www.ngdc.noaa.gov/seg/fliers/se-0801.shtml
NOVA The Wave the Shook the World http://www.pbs.org/wgbh/nova/tsunami/
Tsunamis from Asteroid Impact http://www1.tpgi.com.au/users/tps-seti/spacegd7.html
International Tsunami Info Center http://www.tsunamiwave.info/
TsuInfo Alert http://www.dnr.wa.gov/geology/tsuinfo/
Science of Tsunami Hazards http://www.sthjournal.org/
OSU Tsunami Wave Tank Project http://nees.orst.edu/
Savage Earth:Waves of Destruction http://www.pbs.org/wnet/savageearth/tsunami/
Peru 2001 Tsunami Links http://www.pmel.noaa.gov/tsunami/peru_pmel.html
Indonesia 2004 Tsunami links http://www.pmel.noaa.gov/tsunami/indo_1204.html
ABAG's Tsunami Page http://www.abag.ca.gov/bayarea/eqmaps/tsunami/tsunami.html
Reducing tsunami Hazards in US http://pubs.usgs.gov/fs/fs150-00/
Pacific NW Tsunami Hazards http://walrus.wr.usgs.gov/tsunami/cascadia.html
The giant Lituya Bay tsunami of 1958 http://www.extremescience.com/BiggestWave.htm
Hawaii Tsunami Safety Information http://www.co.honolulu.hi.us/ocda/
Chile Tsunami Information http://www.shoa.cl/
Tsunami data from the National Geophysical Data Center
http://www.ngdc.noaa.gov/seg/hazard/tsu.shtml
FEMA for kids - disaster activities http://www.fema.gov/kids/dizarea.htm
British Columbia Tsunami Preparedness
http://www.pep.bc.ca/hazard_preparedness/tsunami_preparedness.html
North Coast Earthquake and tsunami information
http://www.humboldt.edu/~geodept/earthquakes/eqk_info.html
1883 Eruption of Krakatau http://www.drgeorgepc.com/Tsunami1883Krakatoa.html
Tsunami from the eruption of Santorini http://www.drgeorgepc.com/TsunamiSantorin.html
Mega-tsunamis http://www.bbc.co.uk/science/horizon/2000/mega_tsunami.shtml