

# Southern California Tsunami Awareness and Preparedness

Cynthia Pridmore  
California Geological Survey

## State of California Tsunami Preparedness & Mitigation Program



National  
Tsunami  
Hazard  
Mitigation  
Program

*So Cal ECA February 21, 2018*

Tsunami Basics  
Distant & Local Tsunamis Sources  
Official Tsunami Notifications  
Natural Warnings  
Tsunami Zones  
Tsunami Preparedness

TSUNAMI HAZARD ZONE

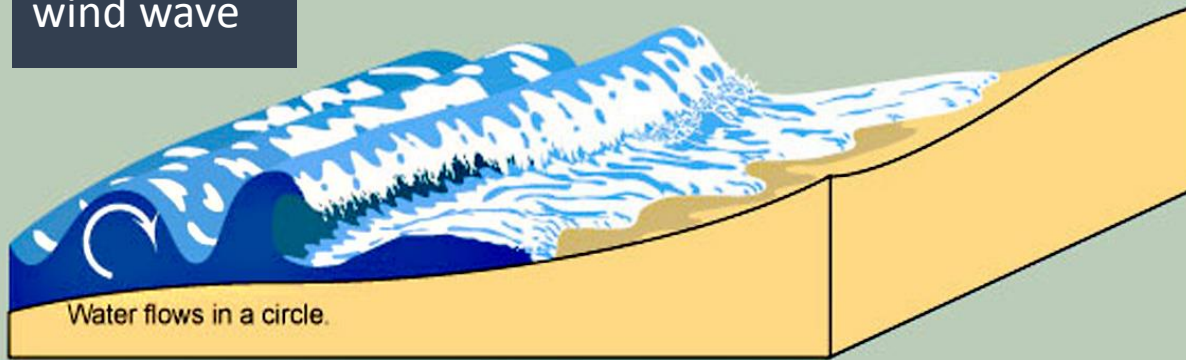


IN CASE OF EARTHQUAKE GO  
TO HIGH GROUND OR INLAND



# What is a tsunami?

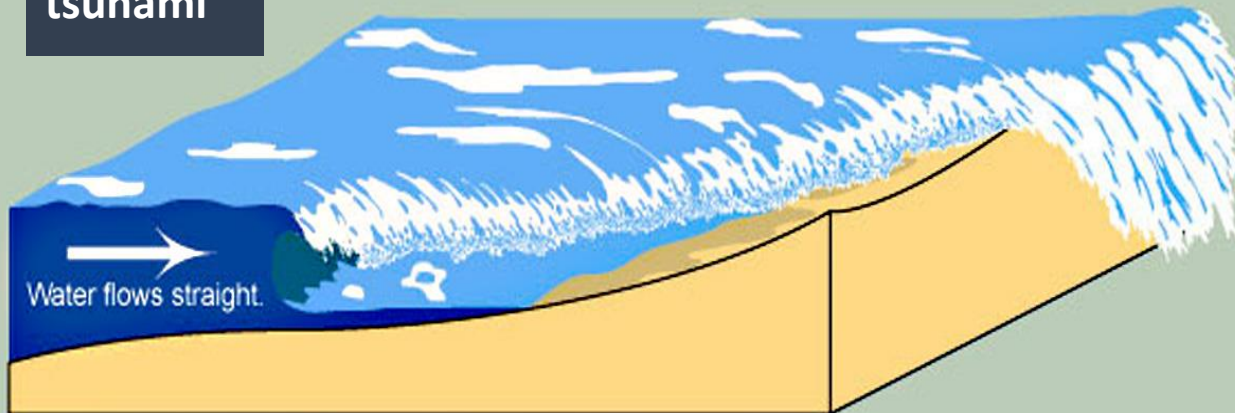
wind wave



Curling, breaking waves

Water flows in for less than a minute

tsunami



Very long surges, water flows in for tens of minutes



# What does a tsunami look like?



# Tsunami Basics

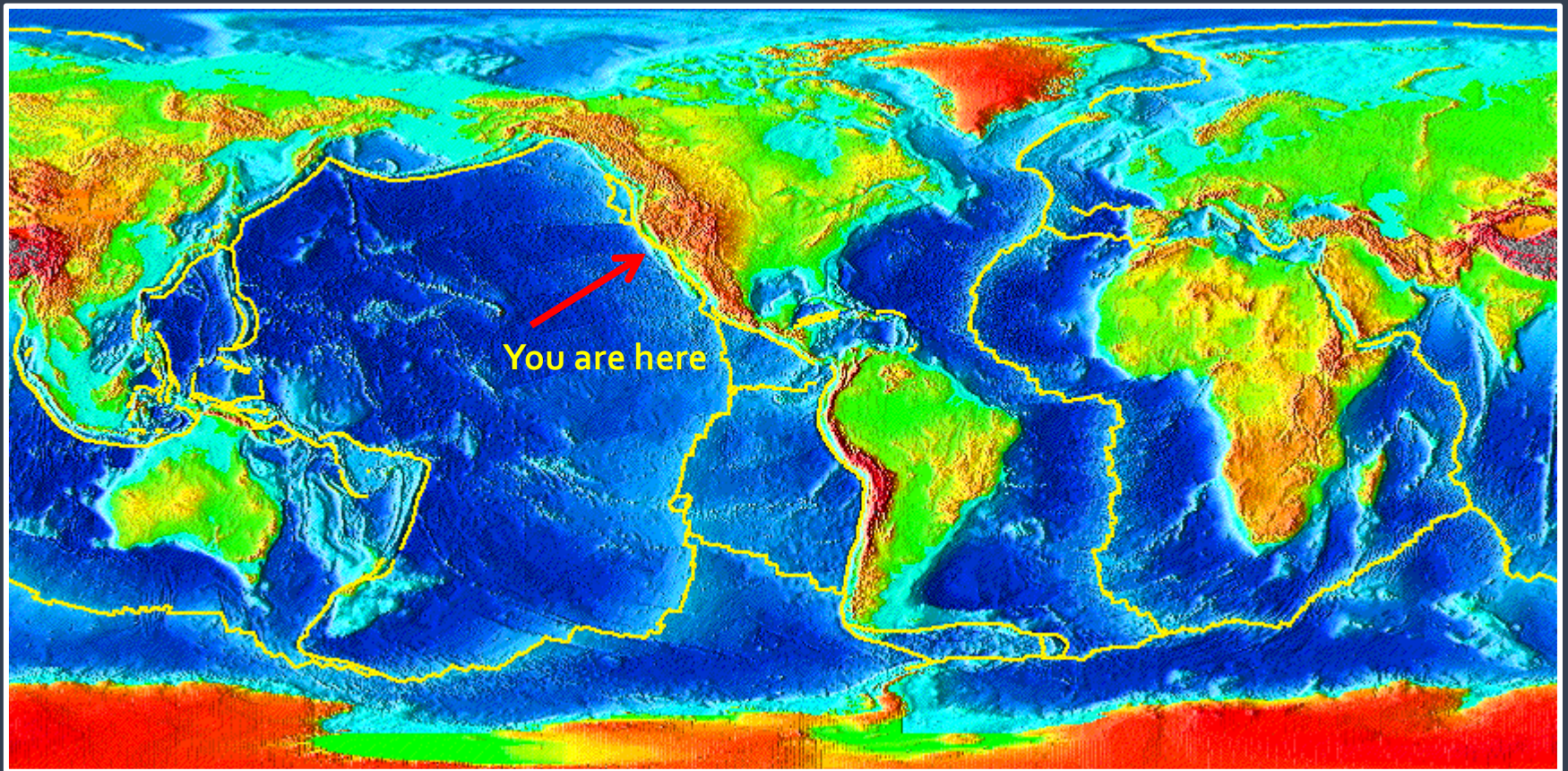
A tsunami can have many surges

This first surge/wave is not always the  
largest

The danger period can last 10 hours or more

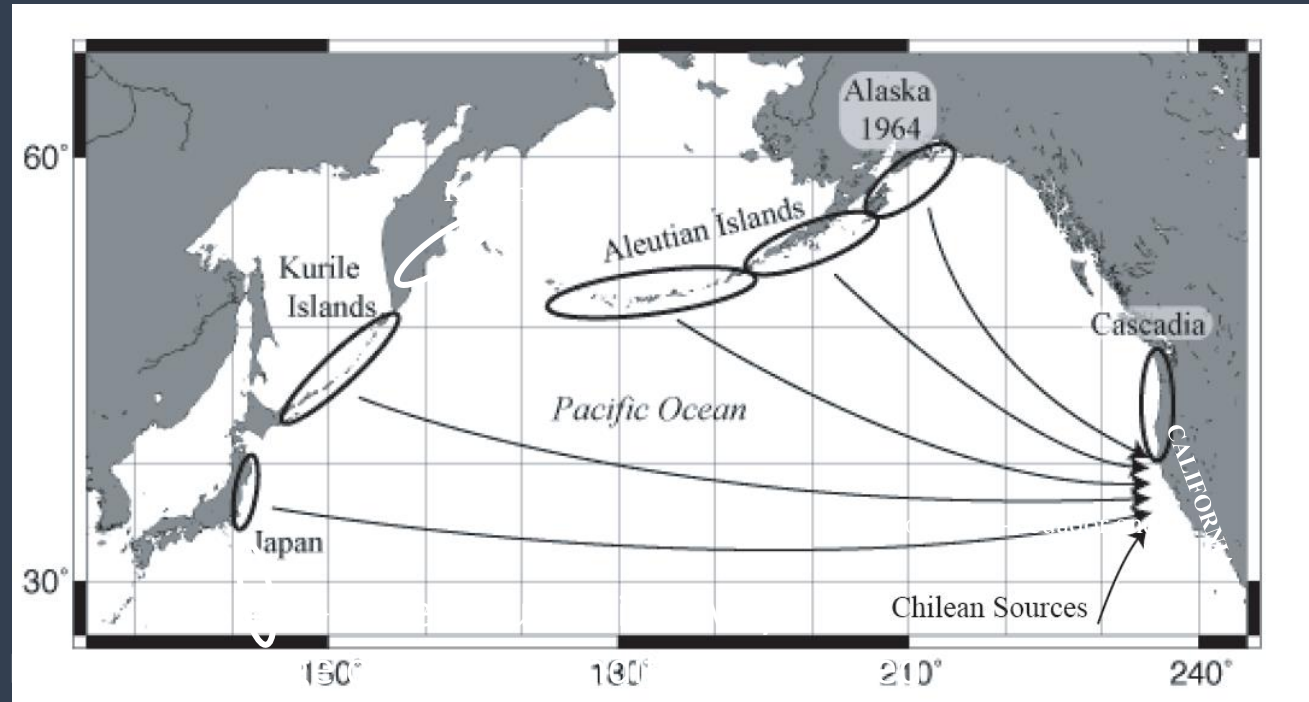


# Where do tsunamis come from?



Distant source tsunamis  
Local source tsunamis

# Distant Source Tsunamis



- Not felt
- Tsunami will arrive in 5+ hours
- Official Warnings – NTHC, NWS, State, County
- Action – partial to full evacuations/keep people away from water



# Notable Historical Tsunamis in Los Angeles County

- Local Source -  
Earthquake and tsunami  
together

- Distant Source -  
Tsunamis without felt  
earthquakes

Date	Magnitude-Source area	Tsunami location	Run-Up/Amp	Remarks
7/10/1855	multiple local Eqs	Santa Monica	?	"...considerable commotion in the water, attended by a strong rushing sound..."
8/13/1868	M8.5 - Chile	LA/San Pedro	2 ft	"...the loading dock was submerged..."
5/10/1877	M8.3 - Chile	LA/San Pedro	6 ft	"...The current was frightfully swift to look at..."
8/10/1879	moderate local EQ	Santa Monica	?	Minor "tidal wave" followed EQ
4/13/1923	M7.2 - Kamchatka	LA/San Pedro	?	"...ships had difficulty holding their lines due to swirling tides..."
8/30/1930	meteotsunami?	Santa Monica	10 ft	One person killed due to high surf; conjecture on tsunami source; possible LS from local M5.2 EQ
4/1/1946	M8.8 – Aleutian Islands	LA/San Pedro	3 ft	Broke ships from moorings
		Long Beach	1 ft	NR
		Catalina	6 ft	Damage to docks
11/4/1952	M9.0 - Kamchatka	Santa Monica	2 ft	NR
		LA/San Pedro	1 ft	Docking ferry problematic
		Long Beach	1 ft	NR
3/9/1957	M8.6 - Aleutian Islands	Santa Monica	2 ft	NR
		LA/San Pedro	1 ft	NR
		Long Beach	1 ft	NR
5/22/1960	M9.5 - Chile	Santa Monica	5 ft	NR
		LA/San Pedro	3 ft	One death (swimmer); \$1M in damages; 800 small craft unmoored, 200 damaged, 40 sunk
		Long Beach	3 ft	Dock damage
		Alamitos Bay	2 ft	NR
		Catalina	2 ft	NR
3/28/1964	M9.2 – Alaska	Santa Monica	3 ft	One boat sunk; \$100k damage at Marina Del Rey
		LA/San Pedro	2 ft	One death to longshoreman by falling object; \$250k in damages; 100 boats unmoored, 6 sunk
		Long Beach	?	\$100k in damages
		Alamitos Bay	2 ft	NR
		Catalina	2 ft	NR
11/29/1975	M7.1 - Hawaii	Catalina	4 ft	Damage to dock and boats
9/29/2009	M8.0 – Samoa	LA/San Pedro	1 ft	NR
2/27/2010	M8.8 – Chile	Santa Monica	2 ft	Minor damage in Marina Del Rey
		LA/San Pedro	1 ft	Minor damage to docks and boats
		Long Beach	?	NR
		Catalina	3 ft	Minor damage to several docks
3/11/2011	M9.0 - Japan	Santa Monica	3 ft	Minor damage in Marina Del Rey
		Redondo B.	2 ft	One dock, five boats damaged; \$15K in damage
		LA/San Pedro	2 ft	Minor damage to boats and docks
		Long Beach	?	Damage to dock and boats
		Catalina	?	Damage to several docks and boats

## *Historical accounts of Distant Source Tsunami from M9.5 EQ off the coast of Chile, 1960*

Chile – 25 ft run up, 1000 deaths

Los Angeles – 3 to 5 ft surges

Oceanside Daily Blade – Tribune, May 23, 1960:

*Currents up to 8 knots raced through West Basin (Los Angeles), water rose 6 feet in few minutes. Skin diver diving off coast of Point Fermin never found.*

*Docks with clusters of as many as 80 boats were tied were torn loose and dumped into other docks, bridges, and the channel walls.*



Crescent City, California

*...Oceanside Daily Blade – Tribune, May 23, 1960:*

*Cabrillo Beach Lifeguard Captain told of a swimmer signaling for help when the current swept him away from the shore.*

*“We didn’t bother sending aid because the next wave brought him back again.”*



# Japan 2011 Distant Source Tsunami

- Large tidal fluctuations, Crescent City 16 feet (largest surges at low tide)
- Los Angeles coast had 2 to 3 foot surges
- Strong currents/debris in harbors
- Potential dangerous tsunami conditions lasted for more than 24 hours
- Statewide impacts: one fatality; two dozen harbors damaged; damages ~\$100M

# Japan 2011 Distant Source Tsunami



*Santa Cruz Harbor, March 11, 2011 - video at 11AM (about 3 hours after first arrival of tsunami) within Santa Cruz Harbor*

# **2011 North Coast California**

- *March 11, 2011 – Small group of friends went down to the coast near the mouth of the Klamath Rive. It was later in the day, hours after the first tsunami wave had arrived.*
- *They thought that the waves would be smaller and they went to take pictures.*
- *A large wave came in knocked them down and took one person out to sea. They were not able to rescue him.*
- *One month later his body was recovered 330 miles to the north in Oregon.*



# Distant Source Tsunami Notifications



You will not feel the earthquake  
Hours to respond

There will be **Official Notifications** with instructions

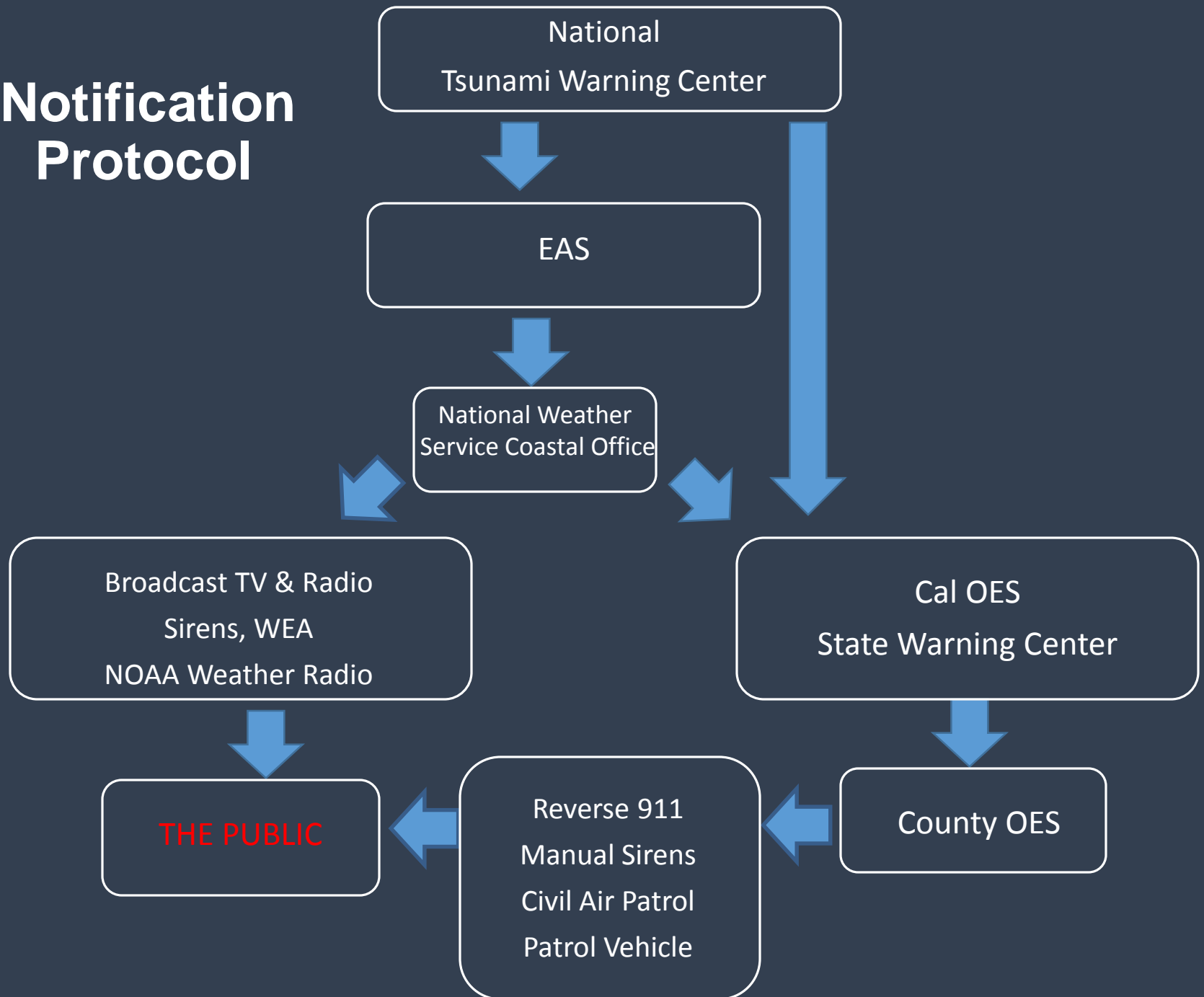
- TV or radio alerts
- Reverse 911
- NOAA weather radios
- Door to door contact by emergency officials
- Outdoor sirens
- Outdoor broadcasting

Follow Official's instructions

Follow directions of emergency personnel

Do not return until Officials state that it is ok to do so

# Notification Protocol



# Official NOAA Alert Bulletins



## Tsunami WARNING (>3 feet)

Widespread inundation is imminent or occurring  
Full Evacuation Suggested, Move to Higher Ground



## Tsunami ADVISORY (1 foot to 3 feet)

Strong currents are imminent or occurring  
Move Away From Shore, Harbors, Marinas



## Tsunami WATCH

There is a potential tsunami which may later impact the area  
Stay Alert For More Info, May be upgraded to  
Warning/Advisory



# Official NOAA Alert Bulletins



## Tsunami INFORMATION STATEMENT

Minor Waves at Most

No Action Suggested



## Tsunami THREAT

**International only – Not for domestic U.S. coastlines.**

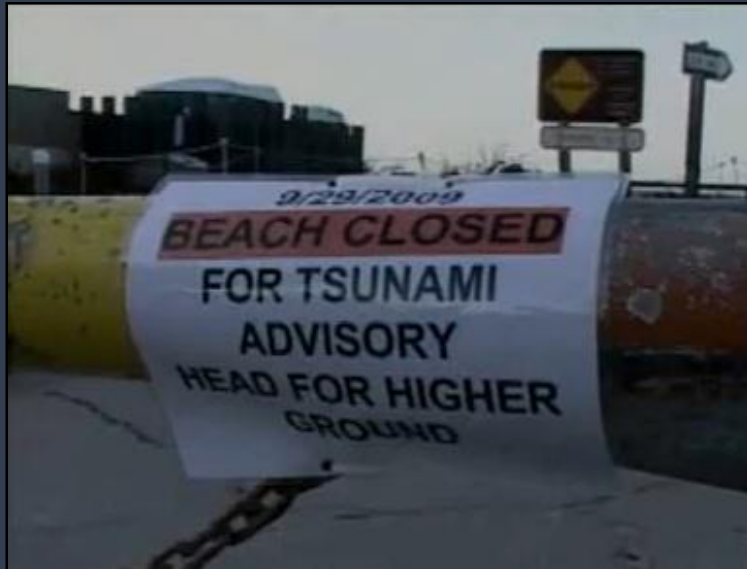
Dangerous coastal flooding and/or powerful currents

Get more information, follow instructions from national and local authorities

# Distant Source Tsunami

Level of Response depends on event size

Partial to full evacuation



Keep people away from water

# Local Source Tsunamis

## Large Local Earthquake

### No Official Warning

Strong and/or Long Shaking is the  
Warning

Evacuate out of Inundation Zone

Get to higher ground

Go inland

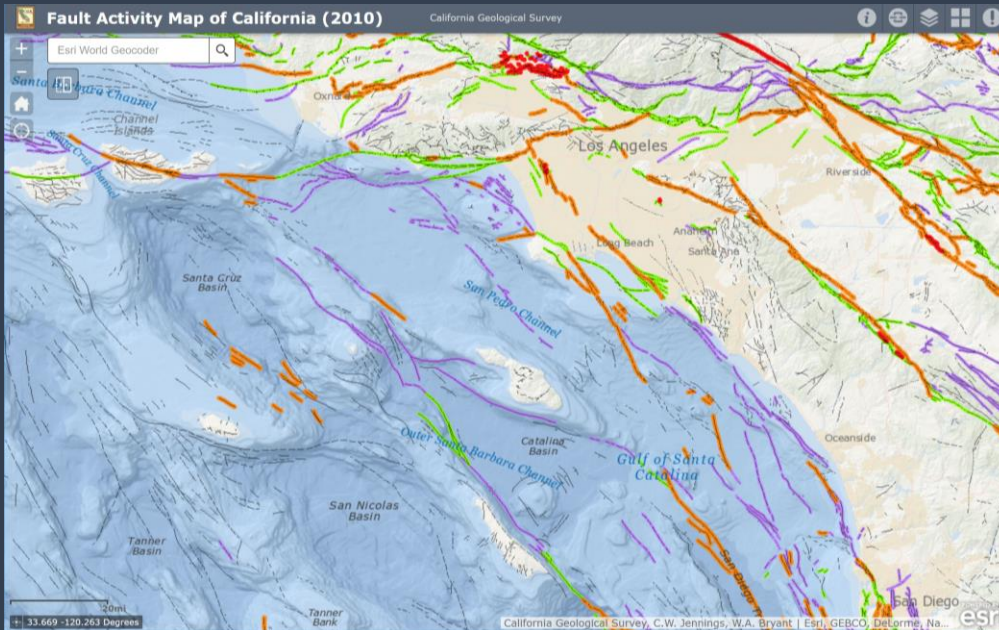
Do not return until you hear from  
officials



# Local Sources for LA-OC Tsunamis

Offshore  
Fault Movement

Submarine  
Landslide



	TSUNAMI SOURCES	Approximate Travel Time	Leo Corrillo State Beach	Malibu Beach/Lagoon	Santa Monica Pier	Marina Del Rey	Manhattan Beach	Redondo Beach	Palos Verdes Hills	San Pedro-POLA	Long Beach Middle Harbor-POLB	Long Beach	Naples-Alamitos Bay	Catalina - Avalon	Catalina - Two Harbors
Local Sources	M7 Newport-Inglewood Fault	10-15min								2	3	3	3		
	M7.5 Channel Isl. Thrust Fault	10-15min	4		3	2	3	3	3						
	M7.2 Anacapa Dume Thrust Fault	10-15min		8	6	3	6	6	5						
	Palos Verdes Landslide 1	10-15min			7	4	6	10	20	4	4	4	5		
	Palos Verdes Landslide 2	10-15min								6	5	5	5	12	16
	M7.1 Santa Monica Thrust Fault	10-15min		4	5	3	3	4	3						
	M7.7 Catalina Fault	15-20min	4	6	6	5	6	6	6	5	7	7	7	27	10
	Maximum Runup - Local Source		4	9	8	5	7	11	24	7	8	8	8	30	18



# Local Source Tsunami

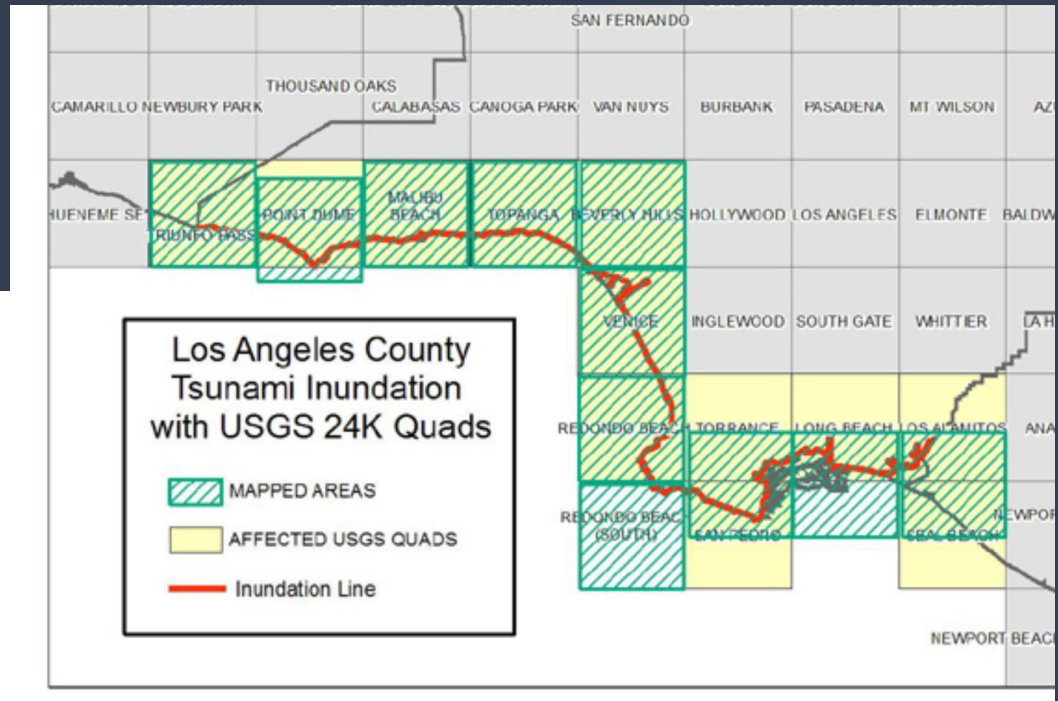


- You will feel the earthquake
- Strong or long shaking
- There will be no “Official Warning”
- Tsunami may arrive within 10-20 min
- Signs
- Education and training of local population
- Know Your Zone
- [www.tsunamizone.org](http://www.tsunamizone.org)





# Tsunami Inundation Maps



[Tsunami.ca.gov](http://Tsunami.ca.gov)

# Tsunami Source Scenario Model Results for Los Angeles County

Near shore tsunami heights (flow depths) for both local and distant source scenarios, in FEET above Mean Sea Level. NOTE: The projections do not include any adjustments for ambient conditions, such as storm surge and tidal fluctuations, and model error (it is very important to note this difference, as those numbers can increase the projected water height during an event).

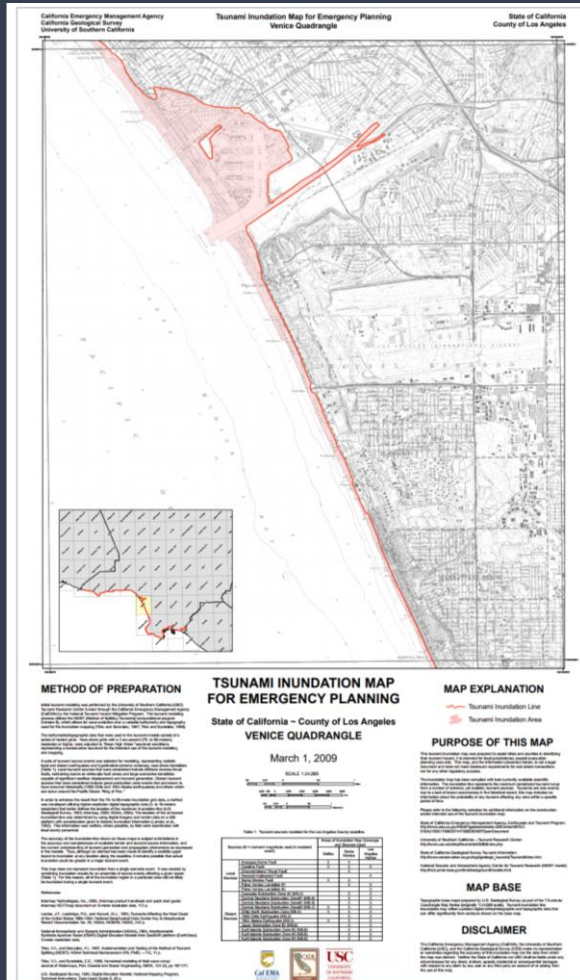
	TSUNAMI SOURCES	Approximate Travel Time	Leo Corrillo State Beach	Malibu Beach/Lagoon	Santa Monica Pier	Marina Del Rey	Manhattan Beach	Redondo Beach	Palos Verdes Hills	San Pedro-POLA	Long Beach Middle Harbor-POLB	Long Beach	Naples-Alamitos Bay	Catalina - Avalon	Catalina - Two Harbors
Local Sources	M7 Newport-Inglewood Fault	10-15min								2	3	3	3		
	M7.5 Channel Isl. Thrust Fault	10-15min	4		3	2	3	3	3						
	M7.2 Anacapa Dume Thrust Fault	10-15min		8	6	3	6	6	5						
	Palos Verdes Landslide 1	10-15min			7	4	6	10	20	4	4	4	5		
	Palos Verdes Landslide 2	10-15min								6	5	5	5	12	16
	M7.1 Santa Monica Thrust Fault	10-15min		4	5	3	3	4	3						
	M7.7 Catalina Fault	15-20min	4	6	6	5	6	6	6	5	7	7	7	27	10
Distant Sources	M9 Cascadia-full rupture	2hr			4	4	4	4	3	3	4	4	4	3	3
	M9.2 Alaska 1964 EQ	6hr	5	5	7	6	5	4	4	8	7	9	8	4	4
	M8.9 Central Aleutians I	6hr	3		5	5	4	4	4	4	5	5	4		
	M8.9 Central Aleutians II	6hr			3	4	3	4	3	3	3	4	4		
	M9.2 Central Aleutians III	6hr	6	7	10	10	7	6	5	13	10	11	13	5	5
	M9 Kamchatka 1952 EQ	9hr	3												
	M8.8 Kuril Islands II	10hr			3	2	3	2	2	2	3	3	3		
	M8.8 Kuril Islands III	10hr			3	3	3	3	2	2	3	3	3		
	M8.8 Kuril Islands IV	10hr			3	3	3	3	2	2	3	3	3		
	M8.8 Japan II	11hr			3	3	3	3	2	2	3	3	3		
	M9.5 Chile 1960 EQ	13hr			5	5	4	4	4	4	7	9	10	3	3
	M9.4 Chile North	13hr	5	5	5	6	5	5	5	4	10	9	11	4	5
Maximum Runup - Local Source			4	9	8	5	7	11	24	7	8	8	8	30	18
Maximum Runup - Distant Source			7	9	11	11	8	7	5	15	12	13	15	7	7



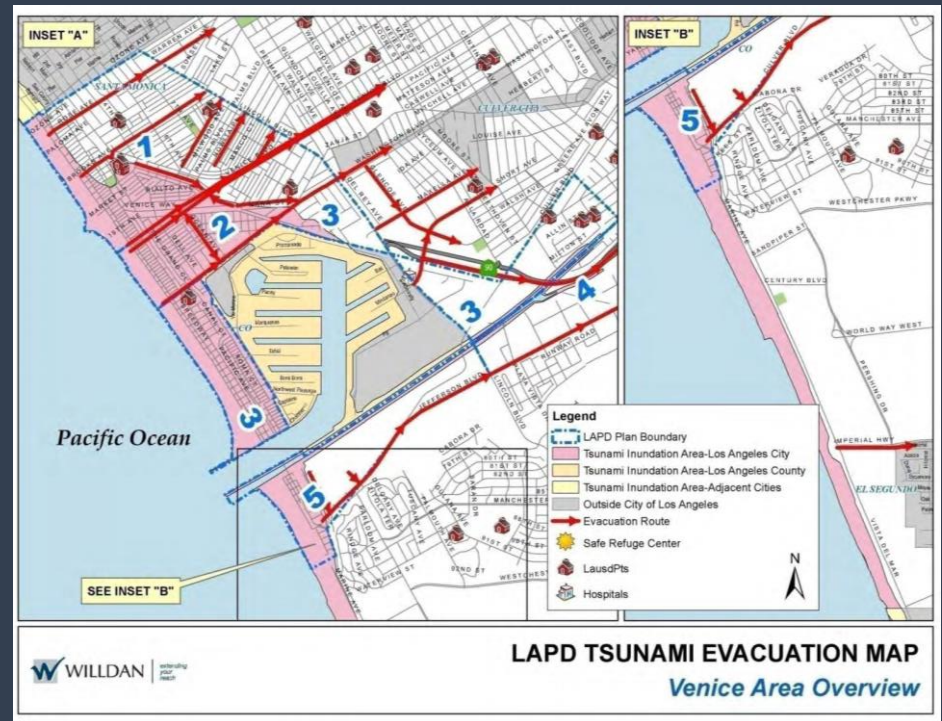
Whether you live, work, and or visit the coast:

# Know Your Zone

## Official Inundation Maps



## Local evacuation maps

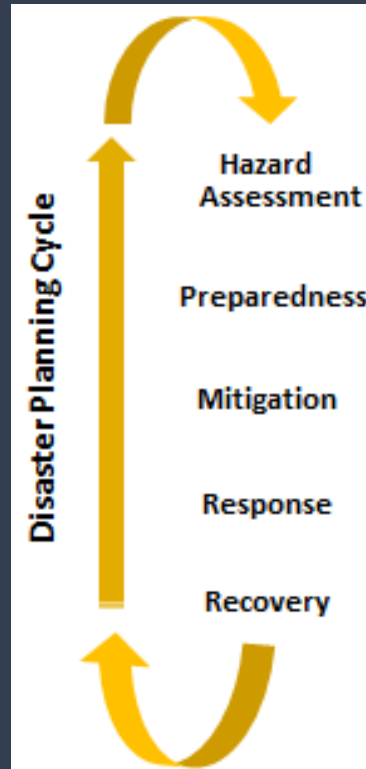


Counties/cities/tribal areas create their own evacuation maps

[tsunami.ca.gov](http://tsunami.ca.gov)  
[myhazards.caloes.ca.gov](http://myhazards.caloes.ca.gov)  
[TsunamiZone.org](http://TsunamiZone.org)

# State of California

## Tsunami Preparedness & Mitigation Program



### Hazard Assessment & Understanding

- Inundation modeling
- Evacuation maps
- Probabilistic modeling

### Preparedness

- Evacuation/Maritime Planning and “Playbooks”
- Training and Exercise Support
- System and Comms Testing
- TsunamiReady® Program Support
- Tsunami Preparedness Week
- Public Education

### Response

- 24/7 Duty Officer Program
- Real-Time / Post-Tsunami Field Teams

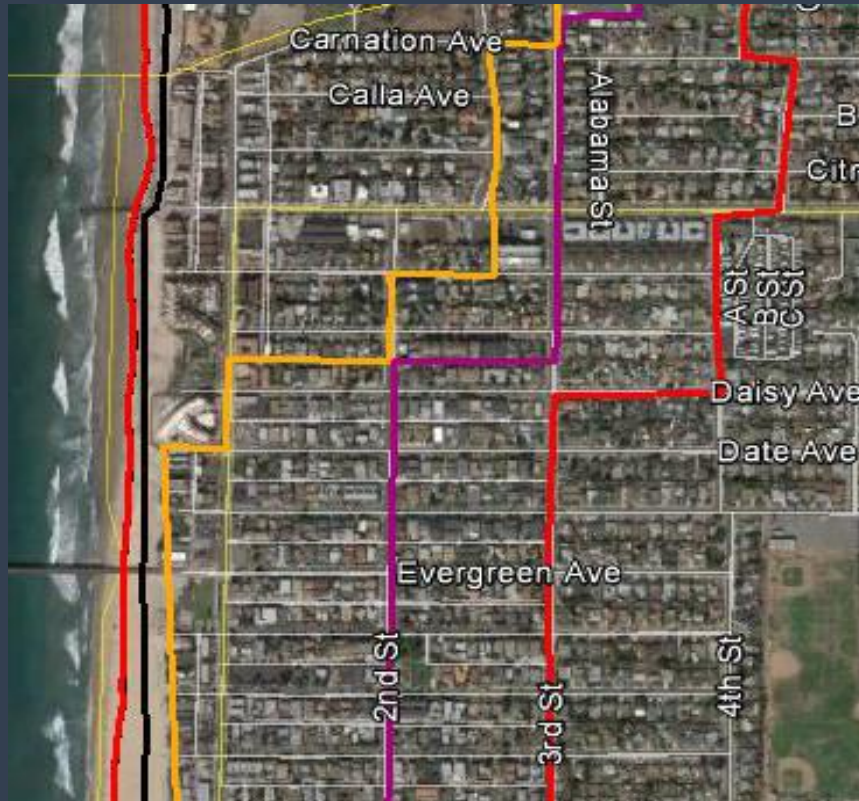
### Mitigation & Recovery

- Policy Analysis and Development
- Resiliency and Improvement Reports



# Evacuation Playbooks for Tsunami Events

(less than “worst case” scenario)



*Draft tsunami evacuation “playbook” lines based on elevation, San Diego*

Storm surge, tide level, and run up potential

Elevation-Based Playbooks

Provides different levels of evacuation corresponding to different size tsunami events

Areas to be evacuated broadcasted by officials



# Tsunami Preparedness Week 2018 Activities

- Local preparedness efforts
- Community Outreach
- Local Brochures
- Progress toward TsunamiReady criteria (e.g. Signs, Warning Point, Planning, Outreach)
- Exercises / Drills / Street Fair
- Media Events / Website / Social Media
- Workshops / Training / Courses (planned/needed)
- FEMA Tsunami Awareness Course



# TsunamiZone.org

## www.tsunamizone.org

Official Participant

# Join Us for Tsunami Preparedness Week.

March 26 - 30, 2018



Register at **TsunamiZone.org**

The screenshot shows the homepage of TsunamiZone.org. The header includes navigation links: Home, TsunamiZone Regions, Other Languages, Contact Us, Search, and Login. The main banner features a city skyline and a person running, with the text 'The TsunamiZone' and 'California Tsunami Preparedness Week March 26-30, 2018'. Below the banner is a navigation bar with links: Register Here!, Know Your Zone, Who is Participating?, How to Participate, Resources, News & Events, and Partners & Sponsors. The main content area is divided into two columns. The left column is titled 'WELCOME TO THE TSUNAMIZONE IN CALIFORNIA!' and contains text about the 2018 Tsunami Preparedness Week, a list of activities, and a map of California. The right column is titled 'CALIFORNIA EVENTS' and contains a list of events. The bottom of the page features a blue bar with the text 'Over 160,000 participants registered' and social media icons for Facebook and Twitter. Below this are two sections: 'KNOW YOUR ZONE' and 'CALIFORNIA RESOURCES'.

Home \* TsunamiZone Regions \* Other Languages \* Contact Us Search Login

The TsunamiZone California Tsunami Preparedness Week March 26-30, 2018

Register Here! Know Your Zone Who is Participating? How to Participate Resources News & Events Partners & Sponsors

**WELCOME TO THE TSUNAMIZONE IN CALIFORNIA!**

California's 2018 Tsunami Preparedness Week is March 26-30. Join us by [registering](#) your tsunami preparedness activities!

What will you do in your home, organization, or community this year? Participating is a great way for your family or organization to "know your zone" if you live, work, or visit near the ocean (or may visit), and to learn what to do to be safe.

Event organizers: If your activity is open to the public or a potential news venue, please complete our [Event Form](#).

Media Contact:

Brad Alexander, Public Information and Media Relations  
California Governor's Office of Emergency Services  
Phone: (916) 845-8455

**73,056**  
California participants and counting!

Click the map for details about each area

**CALIFORNIA EVENTS**

A list of TsunamiZone events will appear below.

Coming Soon

[Add an event to the California calendar.](#)

Over 160,000 participants registered

**KNOW YOUR ZONE**

**TSUNAMI HAZARD ZONE**

Millions of people enjoy California's wonderful coastline! Whether you live, work, or visit, it is important to be aware that the coastal region is vulnerable to tsunamis. California's large offshore faults and steep underwater slopes can cause a local tsunami to arrive in minutes. Tsunamis

**CALIFORNIA RESOURCES**

A collection of tsunami preparedness materials specific to California is listed below. You may want to also access our global [resources](#) page for more information.

[California Geological Survey Tsunami Program](#)

[Cal OES Earthquake and Tsunami Program](#)

# Outreach Materials

## The March 11, 2011 Tohoku Tsunami In Japan and California

**TSUNAMI IN JAPAN:** A magnitude 9.1 earthquake off the northeast coast of Japan caused a massive tsunami that struck Japan's coast within 10 minutes after the earthquake. The tsunami's power along the Sanriku coast was estimated to be an equivalent of 100 Mt of atomic bombs.

**IMPACTS IN JAPAN:** Roughly 10,000 people were killed, over 10,000 people were injured, and over 10,000 people were missing in Japan. The tsunami caused significant damage to infrastructure, including the Fukushima Daiichi Nuclear Power Plant, which led to a major disaster.

**RECOVERY IN JAPAN:** After several weeks, construction began to rebuild using various methods, including the use of prefabricated buildings and other emergency construction measures. Significant progress has been made in rebuilding the damaged areas.

**TSUNAMI IN CALIFORNIA:** The tsunami caused a total of 100 deaths in California. The tsunami's power along the California coast was estimated to be an equivalent of 100 Mt of atomic bombs.

**IMPACTS IN CALIFORNIA:** The tsunami caused significant damage to infrastructure, including the San Francisco-Oakland Bay Bridge, which led to a major disaster.

**RECOVERY IN CALIFORNIA:** After several weeks, construction began to rebuild using various methods, including the use of prefabricated buildings and other emergency construction measures. Significant progress has been made in rebuilding the damaged areas.

**Forecasted maximum tsunami amplitudes from the National Oceanic and Atmospheric Administration for the March 11, 2011 event.**

**Wave Height (m)**

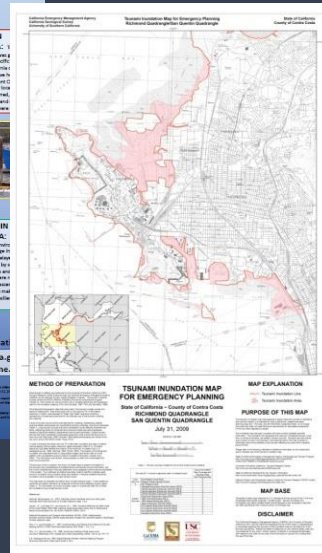
**What is a Tsunami?**

- Tsunamis are long wave series which are caused by a displacement of the ocean surface, commonly initiated by large underwater earthquakes.
- Tsunamis travel in the open ocean at speeds of up to 500 miles per hour.
- Tsunamis have a period of about 10 minutes, but they can last for hours.
- Tsunamis can be caused by earthquakes, volcanic eruptions, and landslides.

**Preparing for a Tsunami**

- Stay calm and follow the instructions of local emergency managers.
- Evacuate to a safe area as soon as possible.
- Do not return to the area until it is safe.

**For More Information:** [www.tsunami.ca](http://www.tsunami.ca)



## TSUNAMIS

**What is a tsunami?**

**Tsunami Warning Signs**

**Tsunami Hero**

**Thank the 911!**

**Stay Calm!**

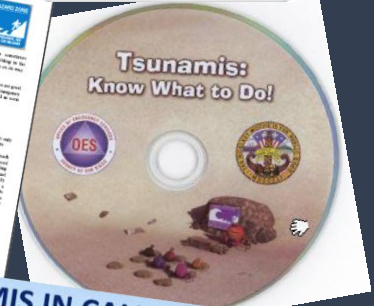
**Evacuate!**

**Stay Calm!**

**Evacuate!**

**Stay Calm!**

**Evacuate!**



## TSUNAMIS IN CALIFORNIA

**TSUNAMI BASICS**

**WHAT? WHERE? HOW? FEEL? SEE AND HEAR? KNOW WHAT TO DO?**

**NOTABLE CALIFORNIA TSUNAMIS**

**1700**

**1812**

**1946**

**1964**

**2008**



## Vertical Evacuation from Tsunamis: A Guide for Community Officials

FEMA P646A / June 2009

FEMA





*Thank you!*  
Cindy Pridmore  
[cpridmore@consrv.ca.gov](mailto:cpridmore@consrv.ca.gov)



California Geological Survey  
[www.tsunami.ca.gov](http://www.tsunami.ca.gov)



Cal OES  
[myhazards.caloes.ca.gov](http://myhazards.caloes.ca.gov)



NOAA  
[www.tsunami.gov](http://www.tsunami.gov)



[TsunamiZone.org](http://TsunamiZone.org)







# Extra Slides

# Tsunami Preparedness Week - EXERCISES

## March 26-30, 2018

### Tsunami Warning Communications Test (3 County OA's)

- Weds, 3/28/18 (**betw 11:00 and Noon** PDT)
- NOAA Press Release (via Western Region HQ)

### Required Monthly Test (RMT) (17 County OA's)

- Weds. 3/28/18(**10:15** PDT)
- NOAA Press Release (via Western Region HQ)

### Air Ops On-Board Audio Testing


### Playbook Communications Drill (20 County OA's)

- Weds. 3/28/18 (**14:00** PDT)
- State to County Conference Call



www.tsunami.gov

AK/BC/US West Coast



U.S. Tsunami Warning System

Home

News

Organization

Search for:

☒ NWS

☐ All NOAA

Search

Products/Messages

Tsunami Data

Education/Outreach

Exercises

NOAA Tsunami Program

TsunamiReady

International Tsunami Information Center

Caribbean Tsunami Warning Program

Tsunami Research

National Tsunami Hazard Mitigation Program

IOC/UNESCO Tsunami Program

Tsunami Warning Centers

Follow Us!

No Tsunami Warning, Advisory, Watch, or Threat

Earthquake:

Magnitude: 7.5

Depth: 6 mi.

Location: OAXACA MEXICO

Origin Time: 2/16/2018, 3:39:37 PM

Lat: 16.4° N Lon: 97.9° W

Note: Times are local to your browser, unless otherwise indicated

See the map or table below for more information

☒ Alerts/Threats

☒ Earthquakes

☐ Previous 40 Messages

☐ Observations

☐ Forecasts

☐ Water-Level Stations

☐ DART Systems

☐ Travel Time

☒ Auto Update

1 min

Default View

Topographic

+

-

3000km

2000mi

Earthstar Geographics

esri

POWERED BY

Warning

Advisory

Watch

Threat

Earthquake

U.S / Canada

International

Map FAQ

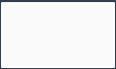
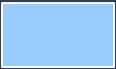
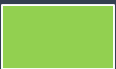
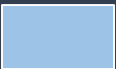
More earthquake information

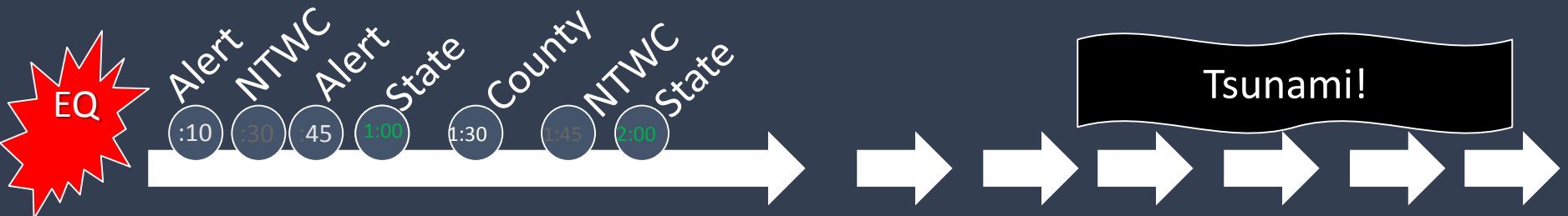
Previous 40 Tsunami Messages

Issued *	Origin Time *	Mag †	Depth †	Lat †	Lon †	Location	Messages	Additional Resources **
02-16-2018 23:46:53	02-16-2018 23:39:37	7.5	6 Mi.	16.4° N	97.9° W	OAXACA MEXICO	Guam/CNMI Informational #1	Select Resource ▼
02-16-2018 23:46:42	02-16-2018 23:39:37	7.5	27 Mi.	16.4° N	97.9° W	IN OAXACA, MEXICO	AK/BC/US West Coast Informational #1	Select Resource ▼
02-16-2018 23:46:36	02-16-2018 23:39:37	7.5	6 Mi.	16.4° N	97.9° W	OAXACA MEXICO	American Samoa Informational #1	Select Resource ▼
02-16-2018 23:46:08	02-16-2018 23:39:37	7.5	6 Mi.	16.4° N	97.9° W	OAXACA MEXICO	Hawaii Informational #1	Select Resource ▼
02-16-2018 23:45:01	02-16-2018 23:39:37	7.5	6 Mi.	16.4° N	97.9° W	OAXACA MEXICO	Non-US/Canada Pacific Informational #1	Select Resource ▼
02-16-2018 00:03:39	02-16-2018 00:00:15	5	13 Mi.	51.5° N	176.8° W	120 MILES SW OF ATKA VILLAGE, ALASKA	AK/BC/US West Coast Informational #1	Select Resource ▼
02-13-2018 02:47:17	02-13-2018 02:31:08	5.8	10 Mi.	13.7° N	146.6° E	ABOUT 93 MILES EAST OF ROTA	Guam/CNMI Informational #1	Select Resource ▼
02-13-2018 02:12:13	02-13-2018 02:03:03	5.9	6 Mi.	13.8° N	146.7° E	ABOUT 95 MILES EAST OF ROTA	Guam/CNMI Informational #1	Select Resource ▼
02-13-2018 01:21:01	02-13-2018 01:11:46	5.9	15 Mi.	13.8° N	146.3° E	ABOUT 74 MILES EAST OF ROTA	Guam/CNMI Informational #1	Select Resource ▼
02-11-2018 23:22:26	02-11-2018 23:14:18	6.2	26 Mi.	13.8° N	146.5° E	ABOUT 86 MILES EAST OF ROTA	Guam/CNMI Informational #1	Select Resource ▼
02-09-2018 20:02:45	02-09-2018 19:55:08	5.4	19 Mi.	51.1° N	176.6° E	85 MILES SE OF BULDIR I., ALASKA	AK/BC/US West Coast Informational #1	Select Resource ▼
02-09-2018 17:48:06	02-09-2018 17:43:34	5.5	6 Mi.	19° N	61.7° W	ABOUT 165 MILES EAST OF ANE-GADA	PR/Virgin Isl. Informational #1	Select Resource ▼
02-09-2018 16:53:32	02-09-2018 16:50:20	4.3	14 Mi.	18.7° N	65.6° W	ABOUT 20 MILES NORTH OF PUERTO RICO	PR/Virgin Isl. Informational #1	Select Resource ▼
02-09-2018 08:58:55	02-09-2018 08:22:25	4.6	16 Mi.	56.5° N	148.6° W	170 MILES SE OF KODIAK CITY, ALASKA	AK/BC/US West Coast Informational #1	Select Resource ▼

# Sample timeline for info exchanged during tsunami:

Time after EQ (hrs:min)	Tsunami statements and conference calls
00:00	Earthquake occurs
00:10	First tsunami alert: INFORMATION STATEMENT from NTWC
00:30	First conference call between NTWC and states/WFOs
00:45	Second tsunami alert: INFORMATION STATEMENT from NTWC (WATCH possible)
01:00	First conference call between state and county OA's
01:20	First conference call between county OA and cities
01:30	Third tsunami alert from NTWC with ADVISORY or WARNING status created
01:45	Second conference call between NTWC and states/WFOs
02:00	Second conference call between state and county OA's
02:20	Second conference call between county OA and cities
02:30	Fourth tsunami alert from NTWC – confirmation on forecasts
04:00-13:00	Tsunami arrival in California

-  NOAA Alert
-  Fed-State Call
-  State-County Call
-  County-City Call



State Response to: WARNING and/or ADVISORY

## ACTIONS:

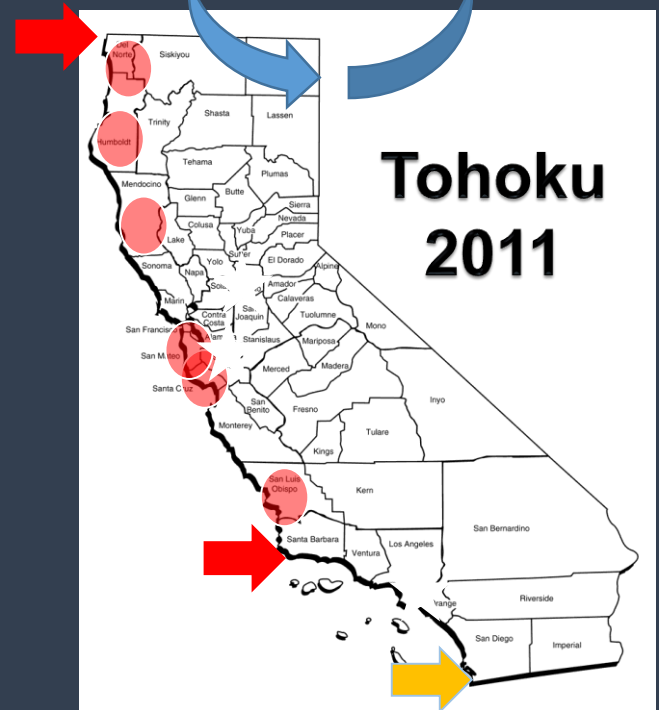
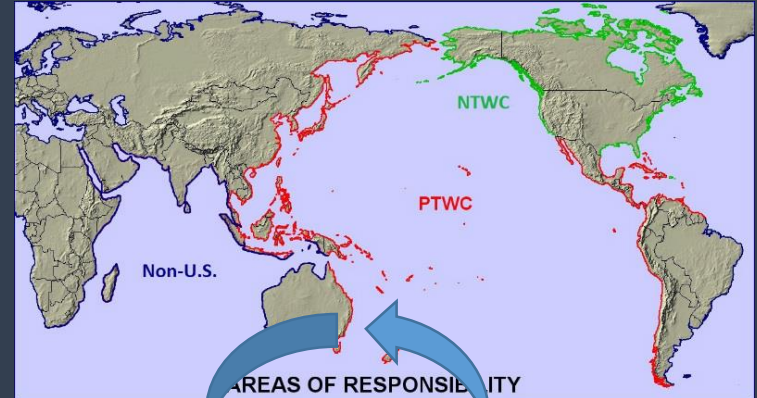
- PARTICIPATE in CALLS WITH NOAA TSUNAMI WARNING CENTER
- ACTIVATE STATE EOC's (SOC/REOC's)
- CONDUCT CALLS WITH EMERGENCY MANAGERS IN 20 COASTAL COUNTIES

Focus on specific areas or locations of heightened concern based on:

## Start of Tsunami

# Wave Heights

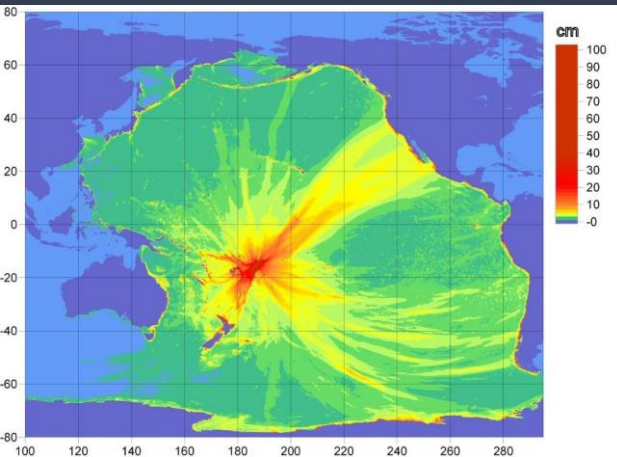
## Tide Conditions



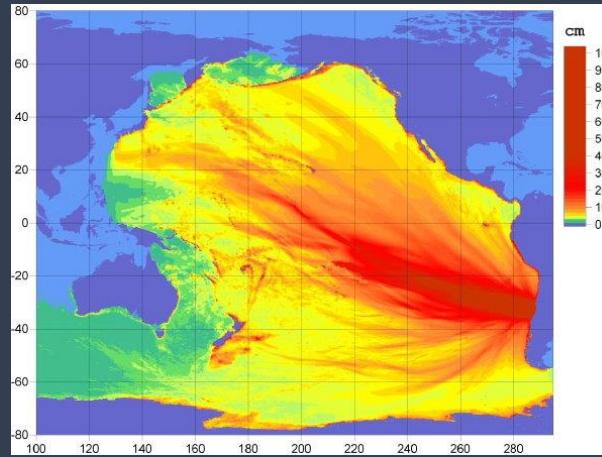


# Recent Tsunamis Activating California Emergency Response

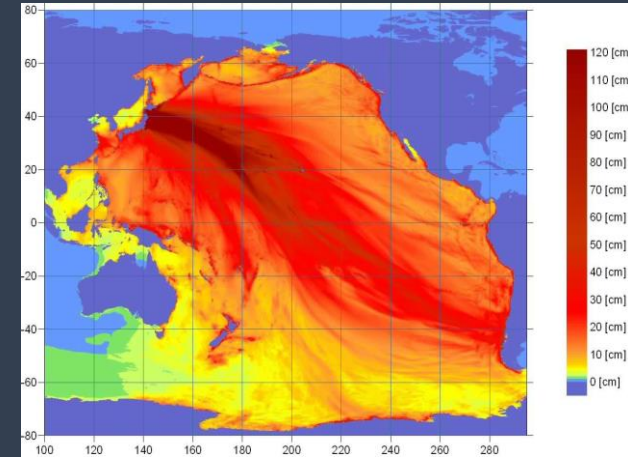
Samoa Sept 2009



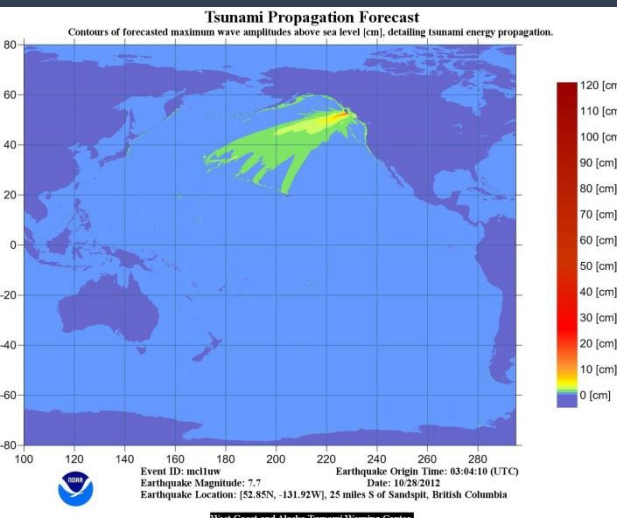
Chile Feb 2010



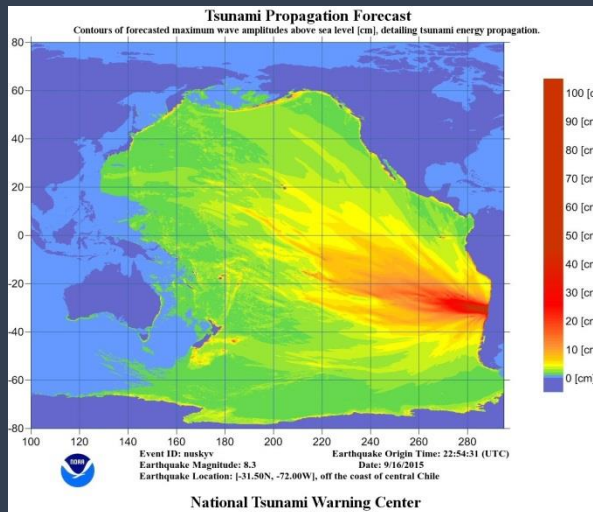
Japan March 2011



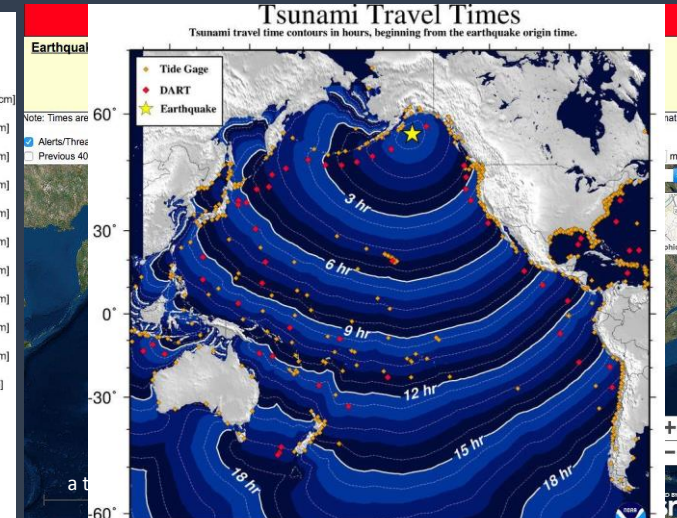
Haida Gwaii Oct 2012



Chile Sept 2015



Alaska April 2014



# 2011 Japan Tsunami in Marin County

**Open coastline  
strong currents in Bolinas  
~ 3 feet**

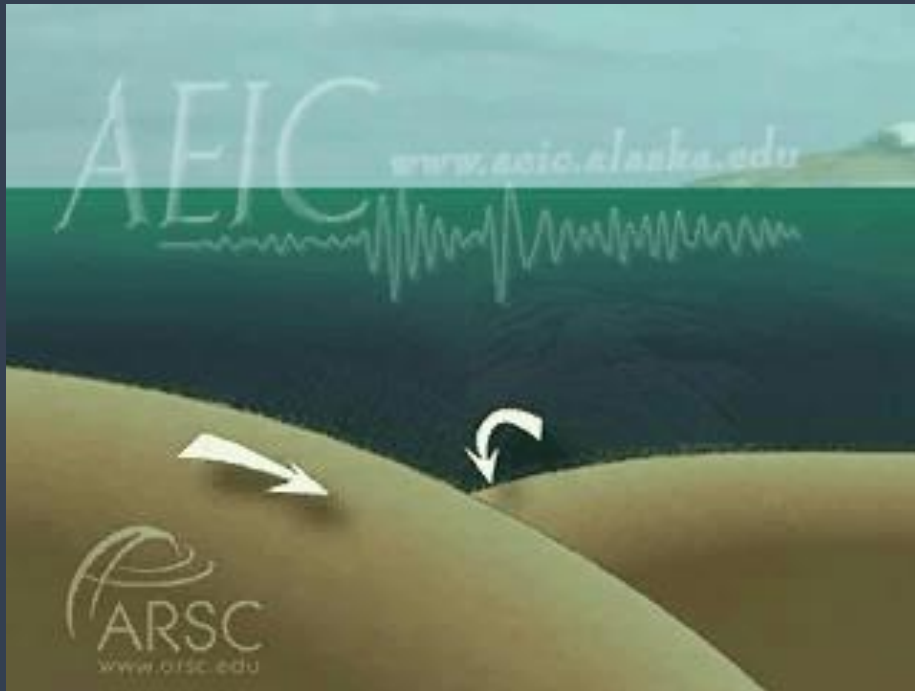


**Inside north SF Bay  
tsunami drawdown and bores  
~ 1-4 feet**



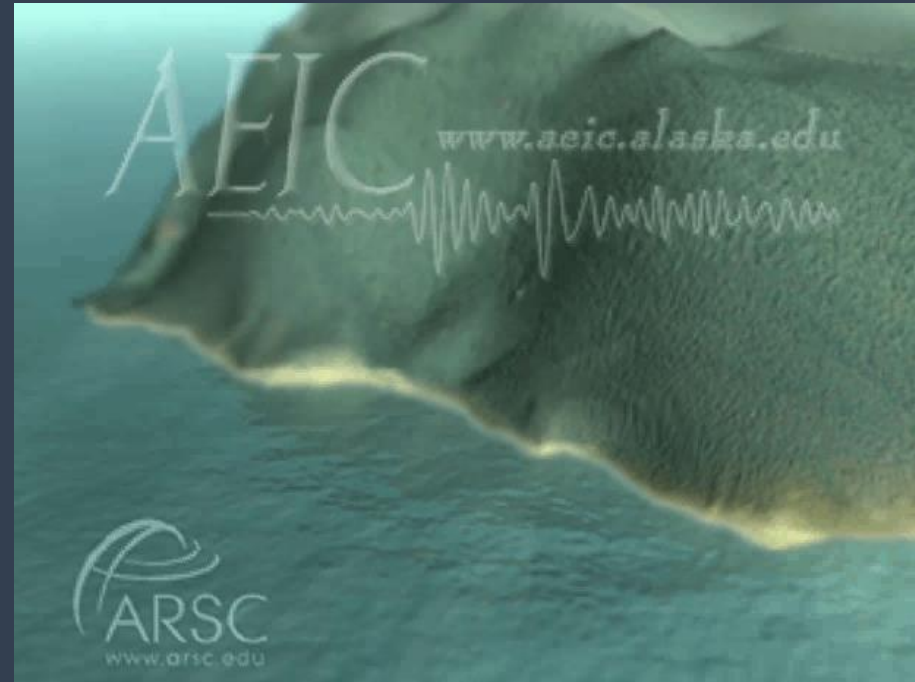
# How tsunamis form

## Submarine faults



Tsunami generated by the sudden movement of the ocean floor

## Submarine landslides



Tsunami generated by landslide due to earthquake shaking



# Tsunami Sources and Warnings

## Distant Earthquake

### Natural Warnings

- The tide might rise or recede very quickly
- Bubbling sounds, unusual frothy foam
- An unusual load roar

### Official Notifications

- Tsunami **Advisory** - Keep people away from water
- Tsunami **Warning** - Partial or Full evacuation
- Tsunami **Watch** – An event has happened and it is being evaluated
- Tsunami **Information Statement** – An event has happened and there is no threat

# 2011

## National Tsunami Warning Center

**Warning**

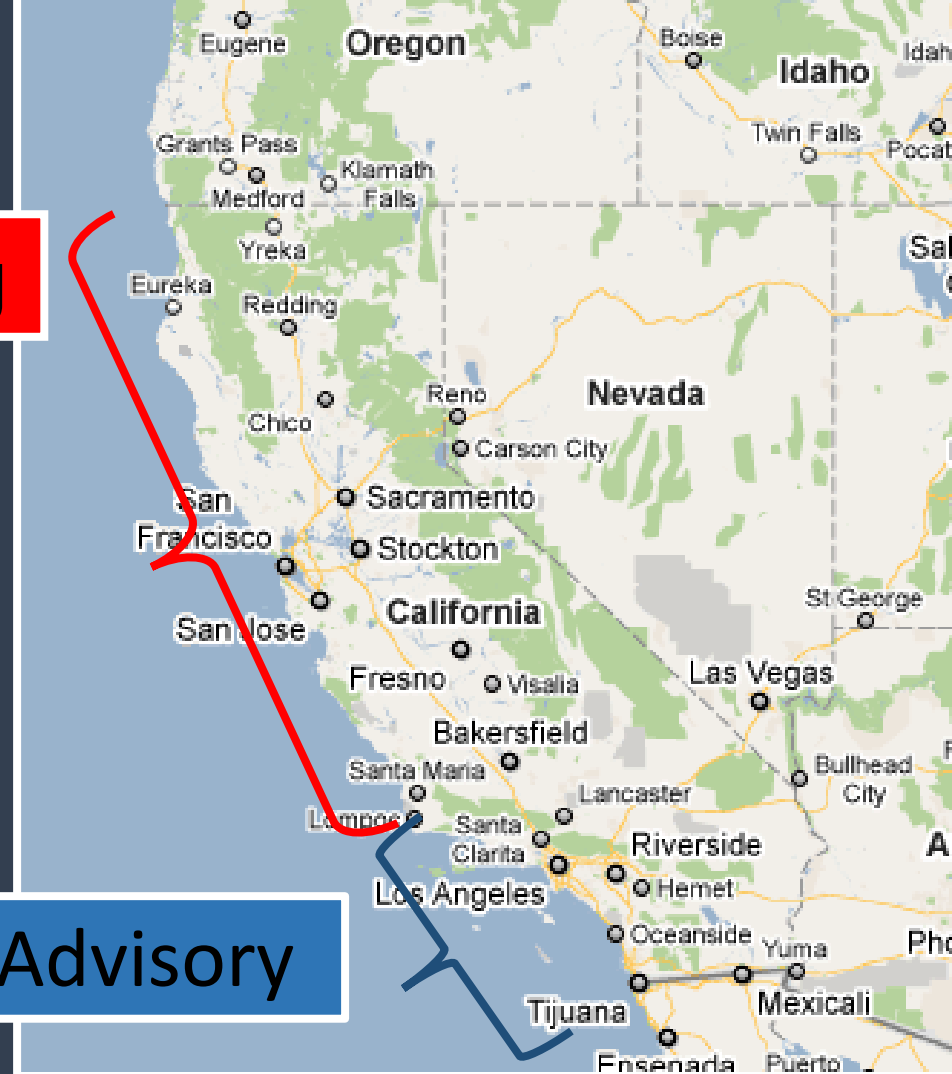
### Tsunami Warning

- potential tsunami with significant widespread inundation is imminent or expected
- typically tsunami forecast amplitudes over 1 m.

### Tsunami Advisory

- potential tsunami which may produce strong currents or waves dangerous to those in or near the water
- typically tsunami forecast amplitudes 30 cm to 1 m. (~1 to 3 feet)

**Advisory**





# Lessons Learned/Needs:

- 1) Consistent response statewide
- 2) Response plans for minor to moderate event  
(not just “worst case”)
- 3) Harbor specific planning tools; and
- 4) Recommended minimum actions ahead of  
event

# National Tsunami Warning Center



# National Tsunami Warning Center

Located in Palmer, Alaska

This center monitors earthquakes world-wide and determines if a tsunami has been generated which may effect the U.S. west coast, Canada, Alaska.

All west coast tsunami warnings, advisories, watches, and informational statements are issued by this office.



[www.tsunami.gov](http://www.tsunami.gov)

AK/BC/US West Coast