





# Tsunamis in Puerto Rico: A Real Threat

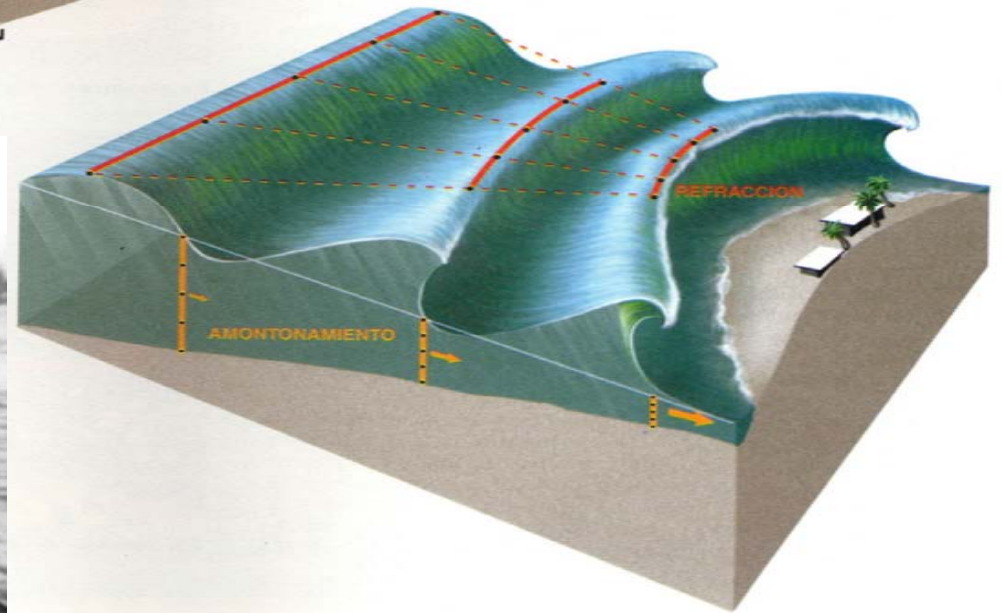
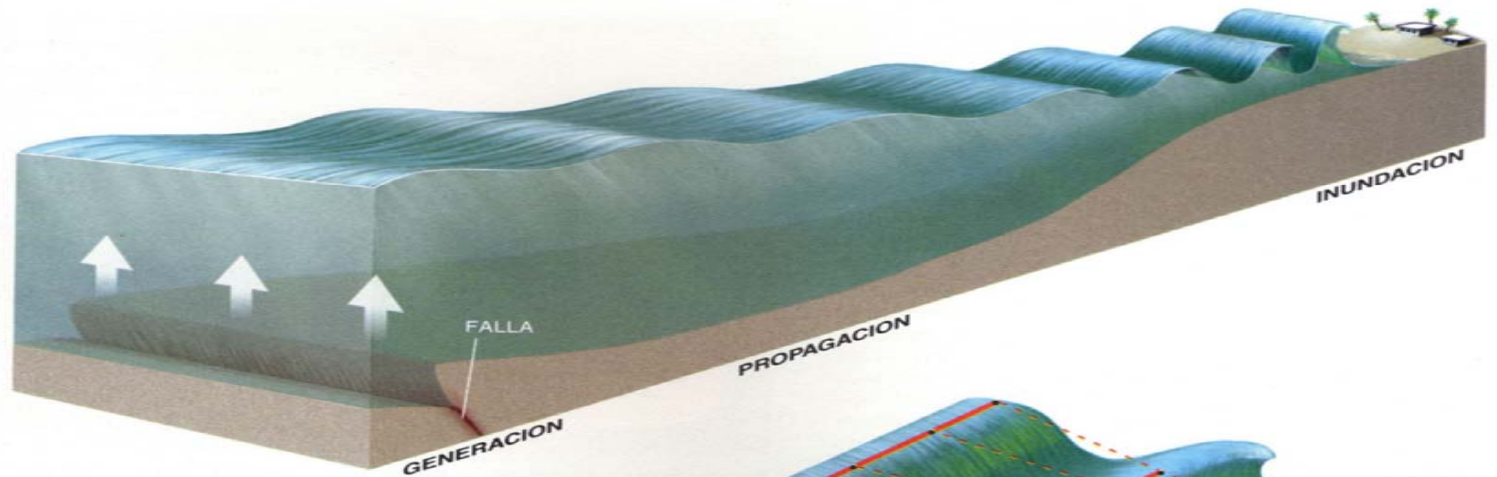
Rotary Club of San Juan

Geologist Christa G. von Hillebrandt-Andrade, MSc  
Manager

NOAA Caribbean Tsunami Warning Program  
c/o Puerto Rico Seismic Network  
Dept. of Geology, UPR-Mayagüez

March 2, 2010

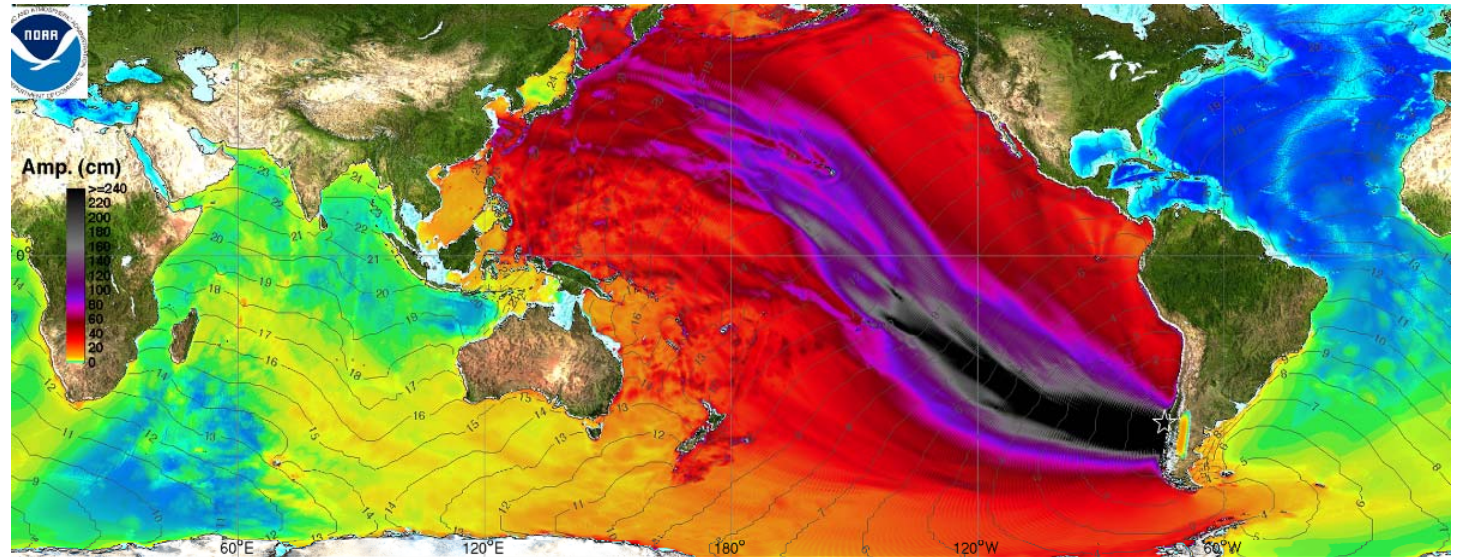
# Tsunamis



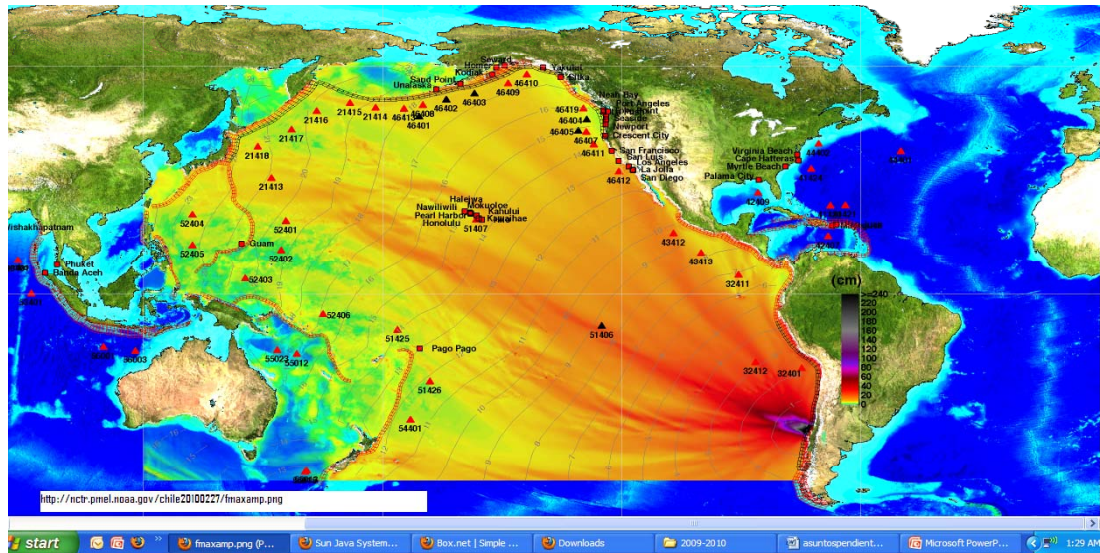
Hawaii  
Terremoto de Alaska, 1964



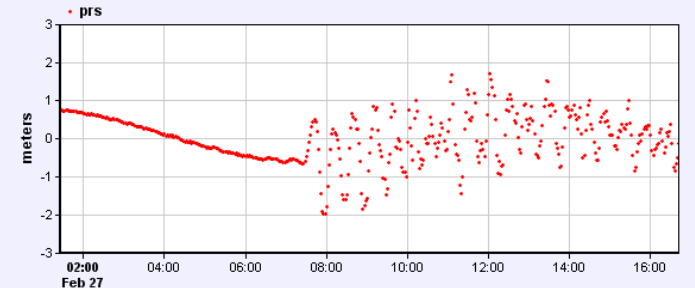
# Chile and its Tsunamis



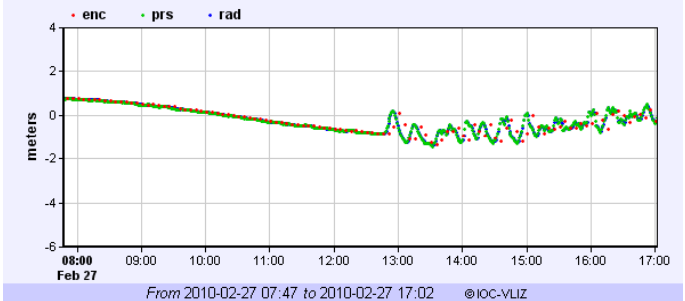
1960 Chile tsunami (earthquake magnitude Mw 9.5) Maximum amplitude plot -- for comparison with Feb 27, 2010 Chile tsunami event



Sealevel at Coquimbo\_CL station - (2.0909 m)



Sealevel at SantaCruz, Galapagos station - (6.6055 m)

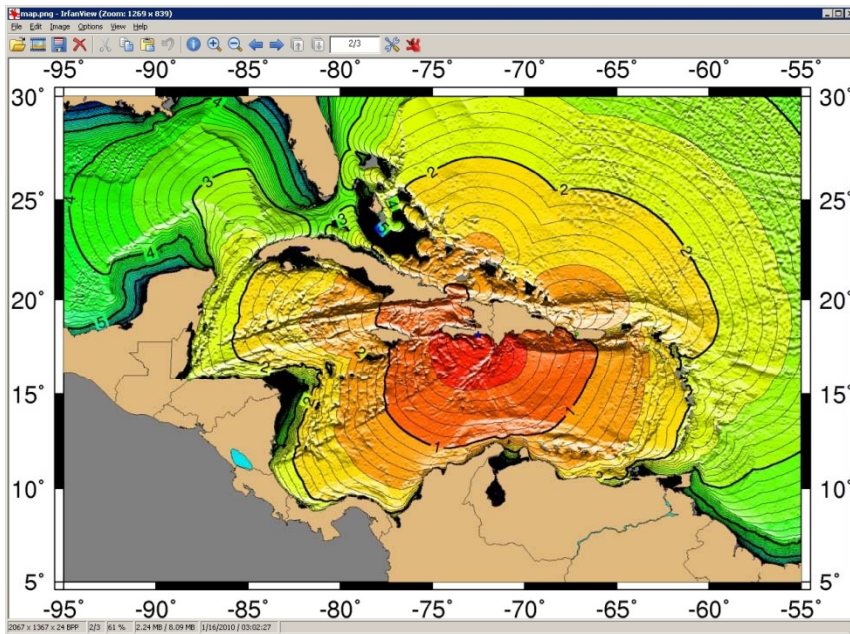


From 2010-02-27 07:47 to 2010-02-27 17:02 © IOC-VLIZ



# Haiti Earthquake and Tsunami

Jan. 12, 2010, Mw 7.0, > 200,000 dead (EQ)



The tsunami took the lives of at least seven villagers in the town of Petit Paradis, on Haiti's western coast.

# Samoa Islands Tsunami

September 29, 2009

Mw 8.0, Max. Runup: 16.3 m



192 dead in American Samoa and Samoa

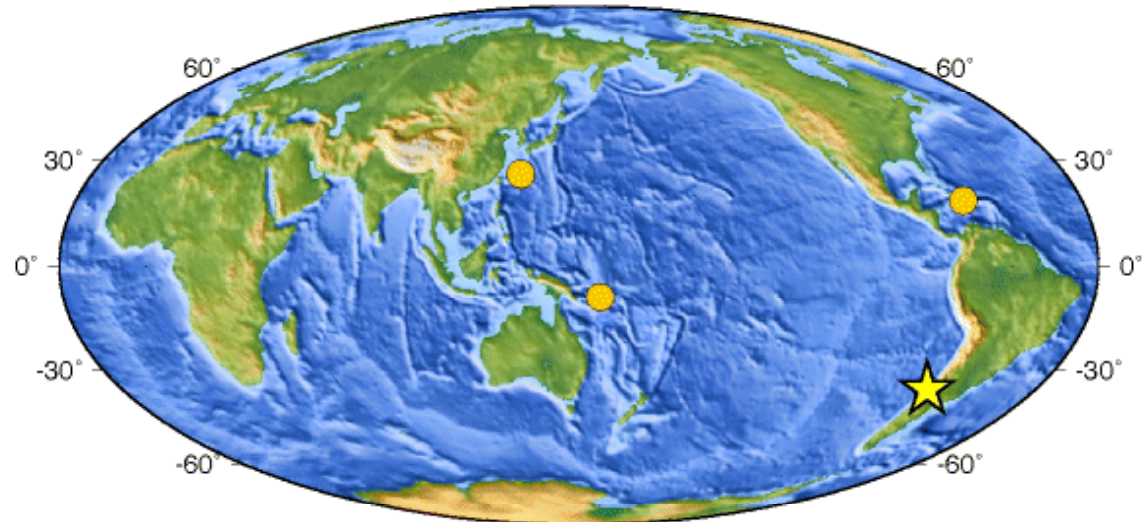
Fotos por Gordon Yamasaki , NOAA



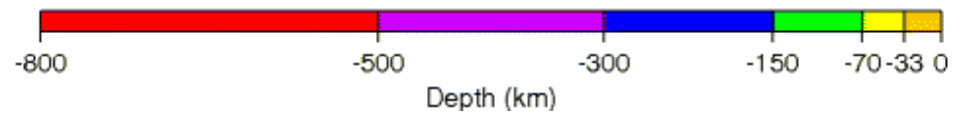
# So are we Next?

Earthquakes Magnitude 7.0 and Greater in 2010

Earthquakes Magnitude 7.0 and Greater in 2010



USGS National Earthquake Information Center



# 1918 Tsunami in Puerto Rico

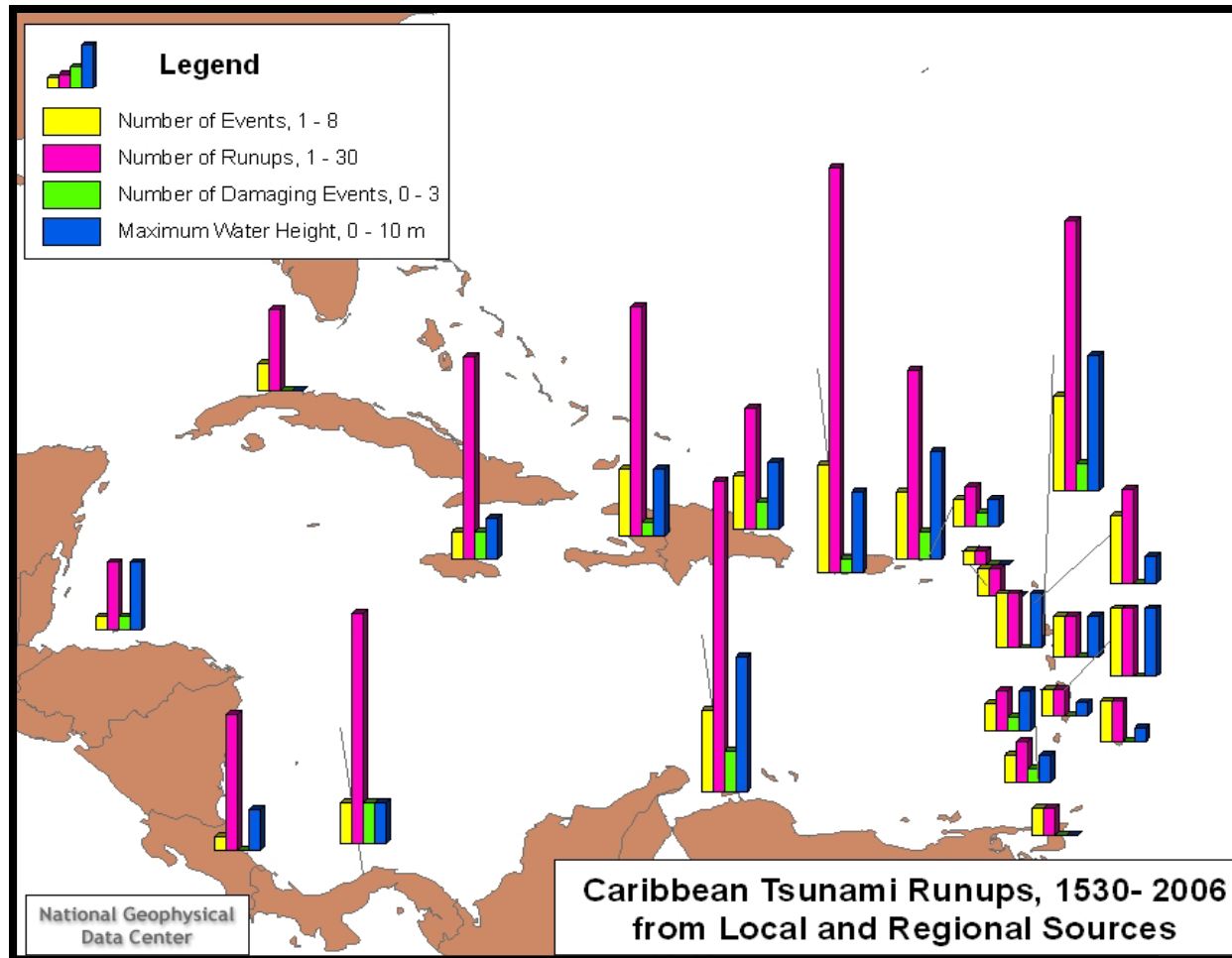
M 7.3 EQ, 20 ft. Max. Wave Height,  
First Arrival 1 minute



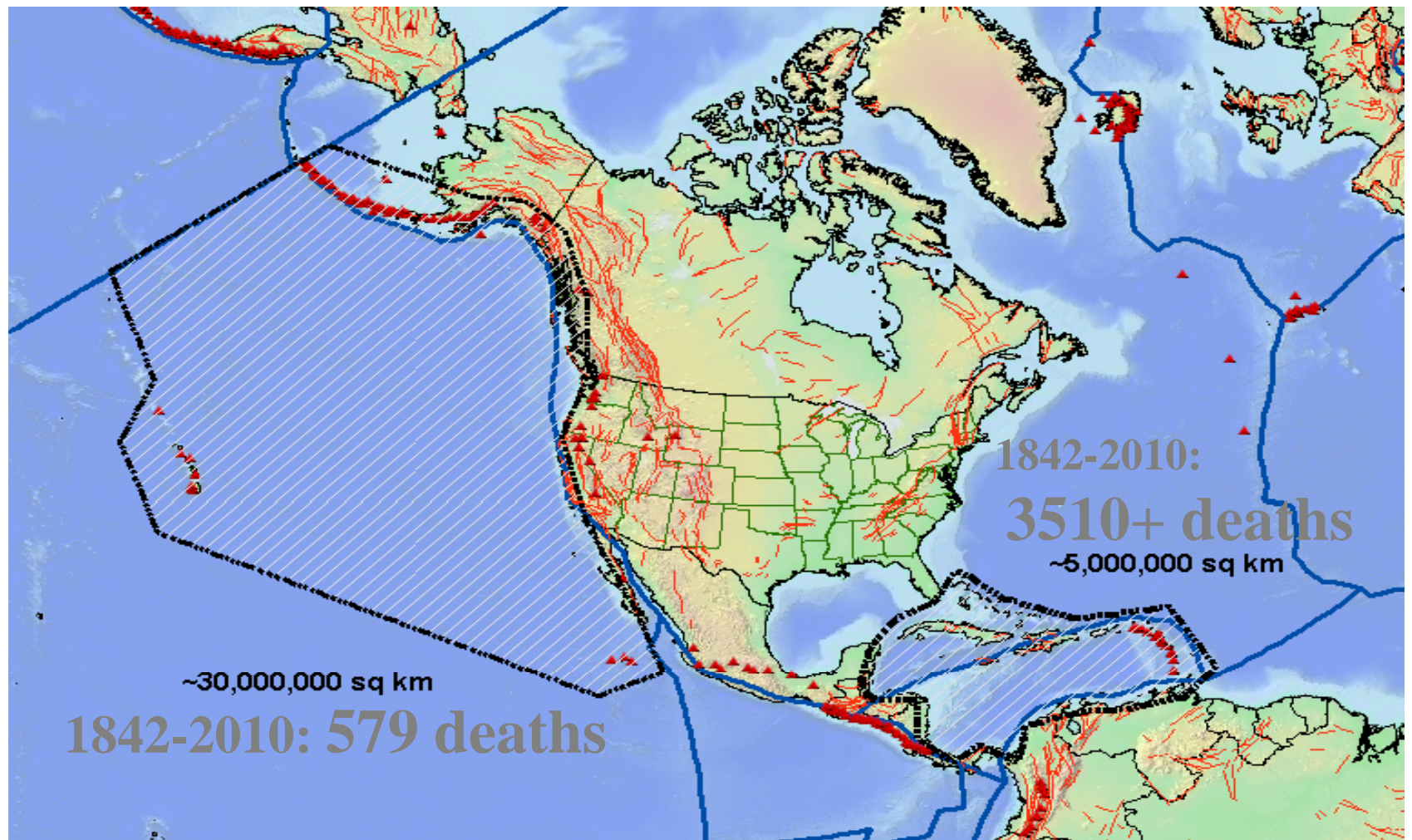
Damage in Mayagüez, Puerto Rico



# Tsunamis in the Caribbean



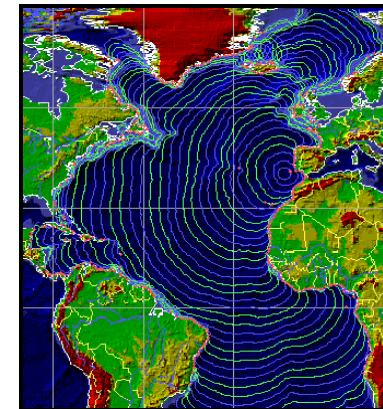
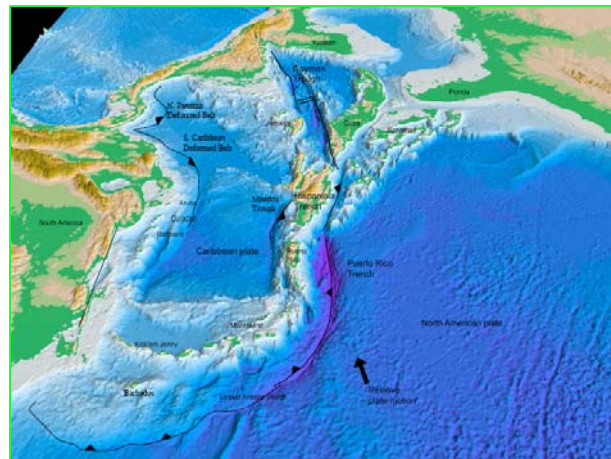
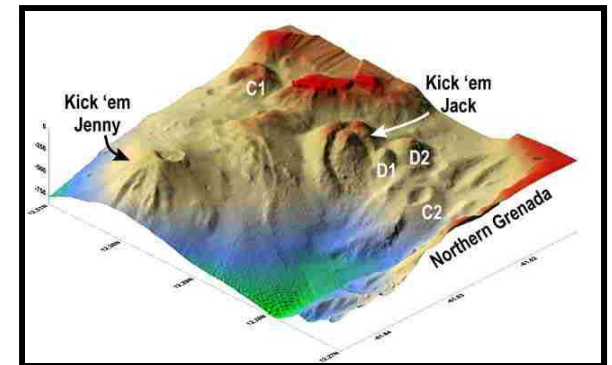
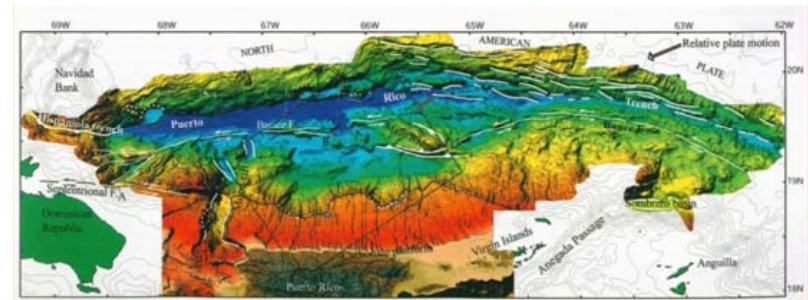
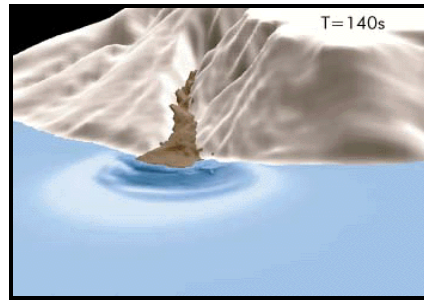
Tsunami deaths since 1842 in two key areas, the northeastern Pacific (Alaska, Hawaii, West Coast States) & the Caribbean Basin (includes Puerto Rico & US Virgin Islands). **The Caribbean basin with only 1/5 the area has 6x more deaths !**





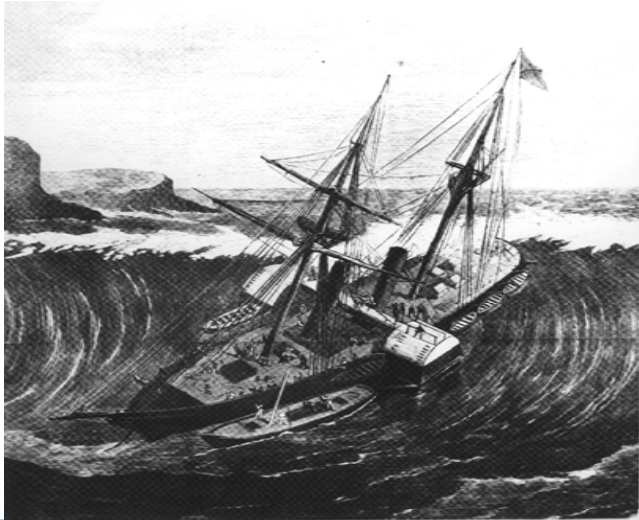
# Caribbean Tsunamigenic Sources, *Mostly short-fused*

- Local and Regional Earthquakes
- Subaerial and Submarine Landslides
- Subaerial Volcanoes- Soufriere Hills, Montserrat
- Submarine Volcanoes-Kick 'em Jenny
- Tele-tsunami (e.g. "Lisbon" Nov. 1, 1755)





The risk from tsunamis has increased dramatically due to population growth, coastal infrastructure development and tourism



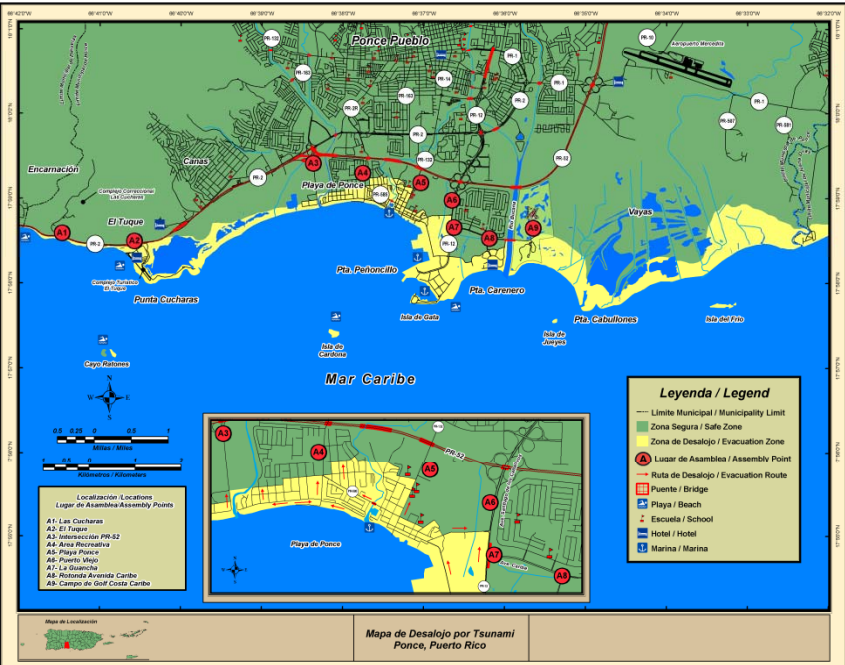
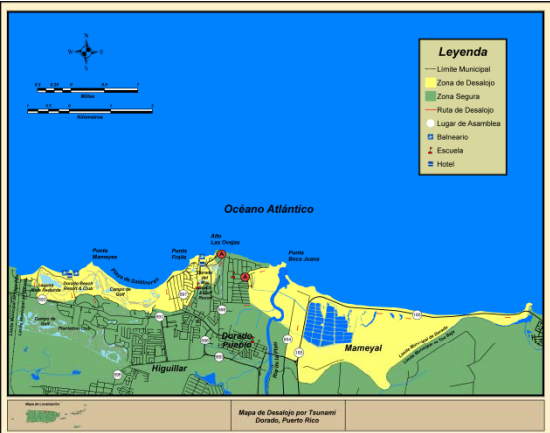
US Virgin Islands, 1867

US Virgin Islands, today



During high season, there can be as many as 25,000 people arriving on cruise ships during a day. During low season, as much as 15,000 people/day.

# Tsunami Evacuation Maps



# Current Tsunami Warning Service Providers

- Pacific Tsunami Warning Center
  - Provides Interim Tsunami Warning Guidance Service to the non US Caribbean and adjacent regions
- West Coast and Alaska Tsunami Warning Center
  - Provides Interim Warning Service to Puerto Rico and the USVI (US Government)
  - Backup to the PTWC
- Puerto Rico Seismic Network
  - Provides 24 x 7 tsunami warning service to Puerto Rico and the USVI and BVI (local governments protocol)
- Caribbean Tsunami Warning Center (in development phase)





- Danger!
- Run for High Ground!
- Follow Emergency Instructions.

**W A R N I N G**

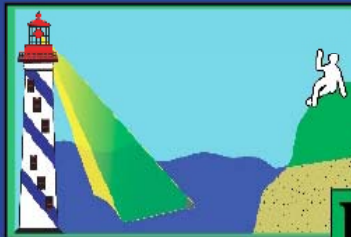
**A D V I S O R Y**

- Possible Strong and Dangerous local Currents.
- Stay tuned for local Emergency guidance.



- Potential Danger.
- Stayed tuned for more information.

**W A T C H**



- Relax.
- No Danger.
- A distant ocean basin may be in danger.

**I N F O R M A T I O N  
S T A T E M E N T**

WEST COAST & ALASKA TSUNAMI WARNING CENTER



**Red Sísmica de Puerto Rico**  
<http://redsismica.uarm.edu> Teléfono: 787-833-8433  
**Centro de Alerta de Tsunami de la Costa Oeste & Alaska**  
<http://westwacrh.noaa.gov>



**4 Niveles de Mensajería de Tsunami**



- ¡Peligro!
- ¡Corra a tierras altas!
- Siga las instrucciones de emergencia.

**Aviso**

**Advertencia**

- Posibles corrientes locales fuertes y peligrosas.
- Manténgase escuchando las instrucciones locales de emergencia.



- Peligro potencial.
- Permanezca alerta para mas información.

**Vigilancia**

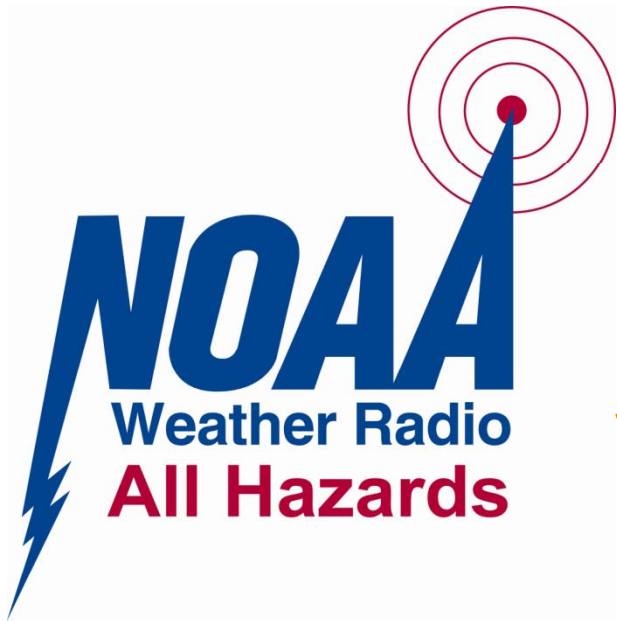


- Permanezca tranquilo.
- No hay peligro.
- Una cuenca oceánica distante puede estar en riesgo.

**Declaración de Información**

WEST COAST & ALASKA TSUNAMI WARNING CENTER





# Communications and Dissemination



# Natural Warning Signs of a Tsunami

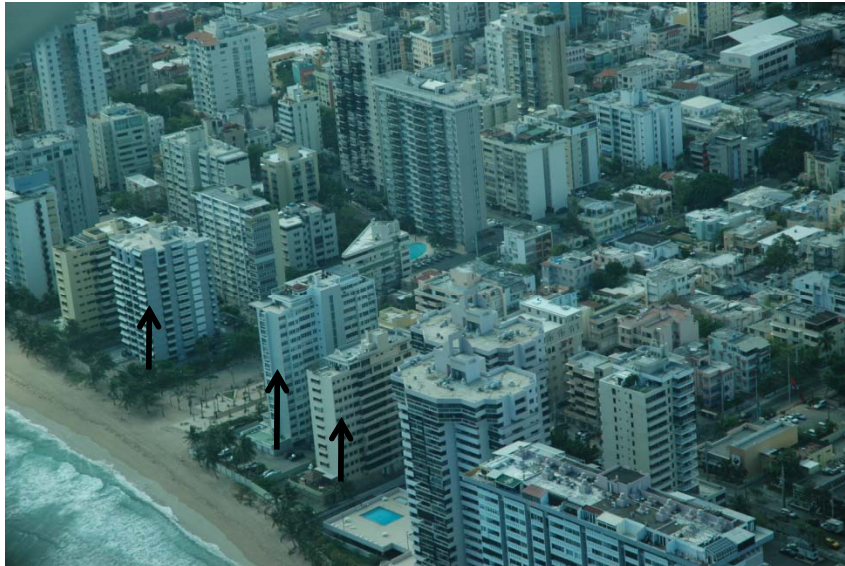
- Very strong earth shaking, objects falling off shelves, walls cracking
- Very long (> 1 minute) ground shaking
- Water suddenly recedes or rises (over the course of minutes, not hours)
- Strange noises from the sea



At any of these signs, run  
for high ground  
**INMEDIATELY**



# Evacuate to Safety



# NOAA TsunamiReady Designations

## Puerto Rico and U.S. Virgin Islands

13 StormReady Sites

5 StormReady/TsunamiReady Communities

4 StormReady Communities

4 TsunamiReady Only Communities



### StormReady/TsunamiReady Blue and Cyan Dots

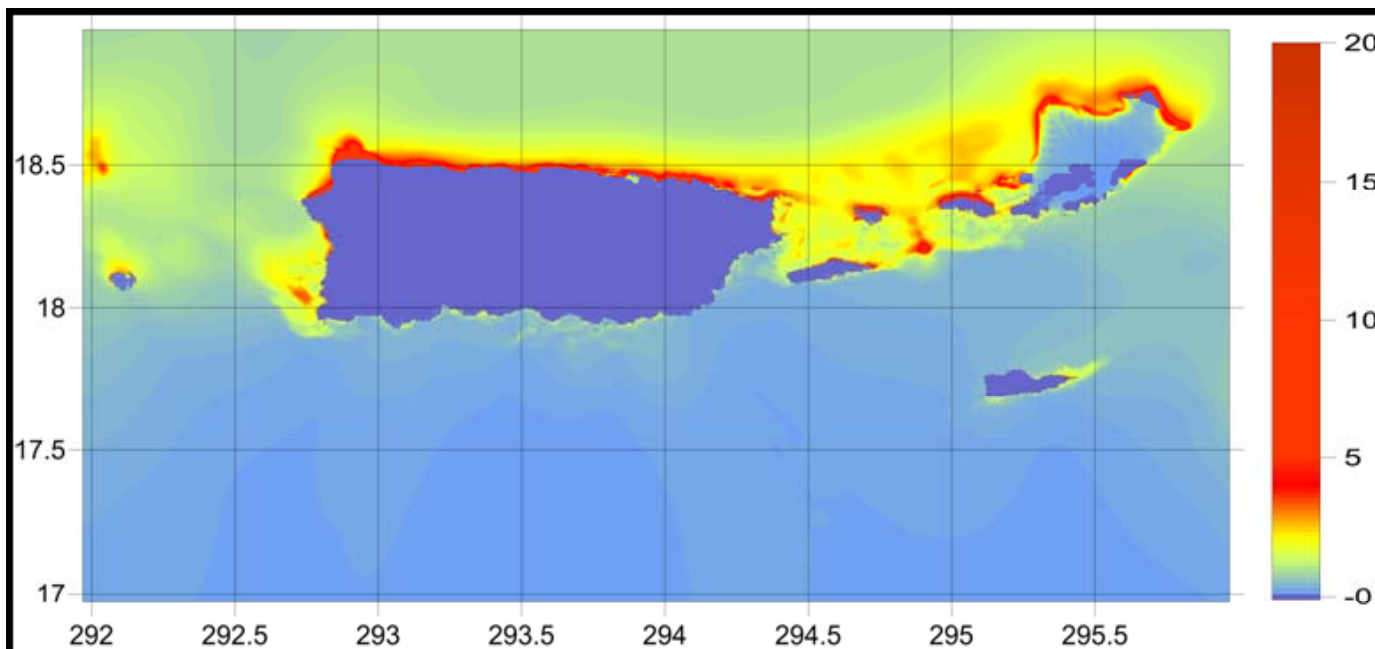
StormReady Communities: Blue Dot  
TsunamiReady: Cyan Dot

- |  |  |
|--|--|
| <ul style="list-style-type: none"><li>• Aguadilla</li><li>• Anasco</li><li>• Caguas</li><li>• Carolina</li><li>• Coamo</li><li>• Juncos</li><li>• Dorado</li></ul> | <ul style="list-style-type: none"><li>• Lajas</li><li>• Manati</li><li>• Mayaguez</li><li>• Ponce</li><li>• Rincon</li><li>• San Lorenzo</li></ul> |
|--|--|

- 24 hour tsunami warning reception and dissemination point
- Local emergency response plan
- Signage
- Evacuation Map
- Education and outreach activities, including drills

# LANTEX 2010

- Tsunami generated by a magnitude 7.5 earthquake with epicenter at  $40^{\circ}\text{N}$ ,  $70^{\circ}\text{W}$  (off coast of Massachusetts) occurring on March 24, 2010 at 1300UTC.





# Our Mission: Avoid this...



Thank you very much

# More information...

- PRSN
  - <http://redsismica.uprm.edu>
- NOAA Tsunami Site
  - <http://tsunami.gov>
- PRTWMP website with tsunami inundation maps
  - <http://poseidon.uprm.edu>
- UNESCO IOC Caribe EWS

**SISMOS SIGNIFICATIVOS MAS RECIENTES**

Magnitud	Agencia	Hora Local (GMT-4)	Latitud	Longitud	Prof.	Región
3.7MI	PRSN	2010-02-21 10:55:02	18.858	-88.983	128	ZONA ORIENTAL DE LA REPUBLICA DOMINICANA
2.52MI	PRSN	2010-02-13 14:39:40	18.190	-88.899	15	REGION CENTRAL DE PUERTO RICO
2.59MI	PRSN	2010-02-04 00:08:38	18.056	-88.759	17	REGION SUR DE PUERTO RICO
3.61MI	PRSN	2010-02-01 21:01:09	19.373	-88.218	87	ZONA SIMICA DEL SOMBRERO
3.1MI	PRSN	2010-01-31 00:23:15	18.919	-88.128	8.8	ZONA SIMICA DEL SOMBRERO
3.56MI	PRSN	2010-01-30 23:45:30	18.878	-88.699	185.9	ZONA ORIENTAL DE LA REPUBLICA DOMINICANA
3.61MI	PRSN	2010-01-28 20:22:17	18.245	-88.594	74.9	ZONA ORIENTAL DE LA REPUBLICA DOMINICANA
2.6MI	PRSN	2010-01-26 13:08:26	18.202	-88.955	13.5	REGION CENTRAL DE PUERTO RICO
2.78MI	PRSN	2010-01-24 04:50:26	19.116	-88.428	15	ZONA DE FALLA DE LOS 19° N
6.1Mwp	PRSN	2010-01-20 07:03:44	18.428	-72.875	9.9	HAITI

**CARIBBEAN TSUNAMI HAZARD**  
 Proceedings of the NSF Caribbean Tsunami Workshop  
 San Juan, Beach Hotel, Puerto Rico 30 - 31 March 2004

edited by Aurelio Mercado-Irizarry (University of Puerto Rico, USA) & Philip Liu (Cornell University, USA)

This book aims to present the overall existing tsunami hazard in the Caribbean Sea region, a region which is typically only associated with hurricanes. It initially presents an overview of all of the existing tsunami-causing factors found in the region: earthquakes, sub-aerial and submarine landslides, and submarine explosions. This is followed by field evidence of recent and pre-historic tsunami events, which gives credibility to all of this effort. The next section is a description of the tsunami hazard mitigation efforts being carried out locally and in collaboration with national and international programs. The final part is dedicated to the presentation of related recent research results.

August 28, 2008

**TSUNAMI THE FORGOTTEN DANGER**  
**VIDEO DOCUMENTARY**  
**NEW DVD VERSION AVAILABLE FOR DOWNLOAD!**

The tsunami documentary produced in Puerto Rico. This video includes the history, hazards, and protective measures concerning tsunamis. The video was prepared by JAM Media (San Juan, P.R.) and it has been freely distributed to many schools, governmental and private agencies. To obtain copies of the documentary (VHS or DVD) contact the Puerto Rico Seismic Network. Teléfonos: 787-833-8433, 787-265-5452.

Three DVD quality versions available for download. On IE right button click on image and select "Save Target As...". Warning: This are very large files! Broadband (DSL or Cable Internet) recommended. If you're on dial-up use a download manager.

**West Coast and Alaska Tsunami Warning Center**

**Latest Event**

2010/02/23 12:57:45 (UTC)  
 Swathless Magnitude 4.7  
 Location: 25 miles W of Alaska, Alaska  
 20104

Please click here to see the area-of-responsibility (AoR) for the WC/ATWC and the PTWC.

**The NWS operates two Tsunami Warning Centers and the International Tsunami Information Center**

**West Coast/ Alaska Tsunami Warning Center (WC/ATWC)**

The WC/ATWC provides tsunami warning guidance for all U.S. coastal states (except Hawaii), the Canadian coastal provinces, Puerto Rico, and the Virgin Islands.

**Richard H. Hagemeyer Pacific Tsunami Warning Center (PTWC)**

The PTWC provides tsunami warning guidance for Hawaii and countries in the Pacific Ocean, Indian Ocean, and Caribbean Sea.

**International Tsunami Information Center (ITIC)**

Operated by the NWS on behalf of the Intergovernmental Oceanographic Commission of UNESCO, the ITIC supports the IOC's Tsunami Program which focuses on the coordination of tsunami warning and mitigation systems globally. The ITIC provides direct support to Member States in the Pacific by monitoring and recommending operational improvements to the Tsunami Warning System in the Pacific, and by working with countries to increase tsunami awareness and preparedness, and promote education and research.

**Is your community prepared for the next destructive tsunami?**

**TsunamiReady Program**

A program designed for recognition for Communities that have met certain standards of tsunami preparedness.

Thanks for your support and attention