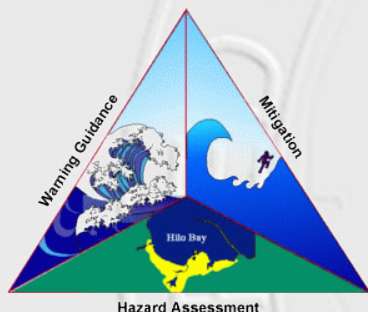


# **NATIONAL TSUNAMI HAZARD AND MITIGATION PROGRAM - NTHMP**

## **PUERTO RICO REPORT**



**Four Year Grant:  
NA09NWS4670024**

**Victor Huérfano, PhD**

**PUERTO RICO SEISMIC NETWORK,  
UNIVERSITY OF PUERTO RICO, MAYAGUEZ  
GEOLOGY DEPARTMENT**

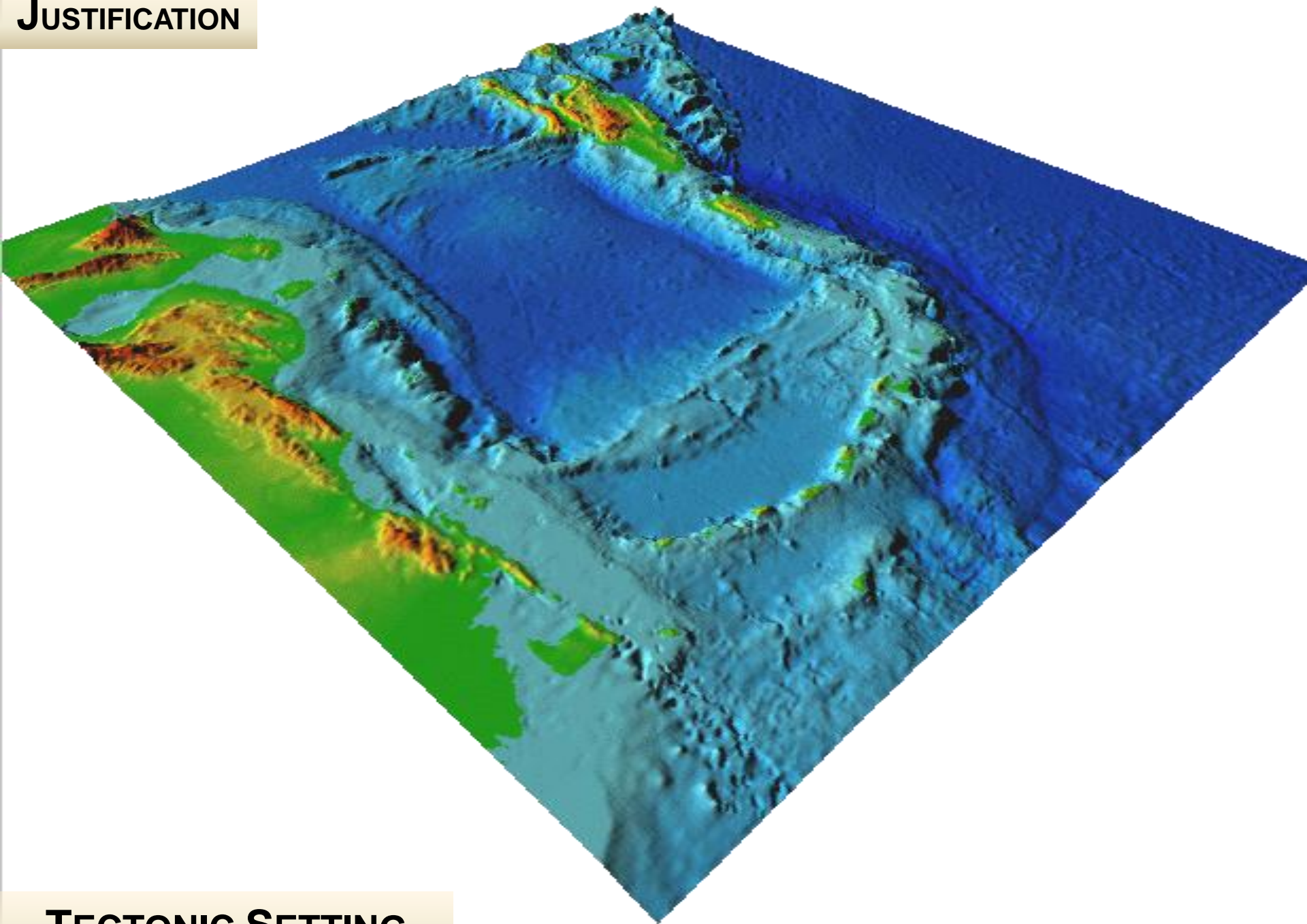
**SAN DIEGO, February / 2012**



# GOALS

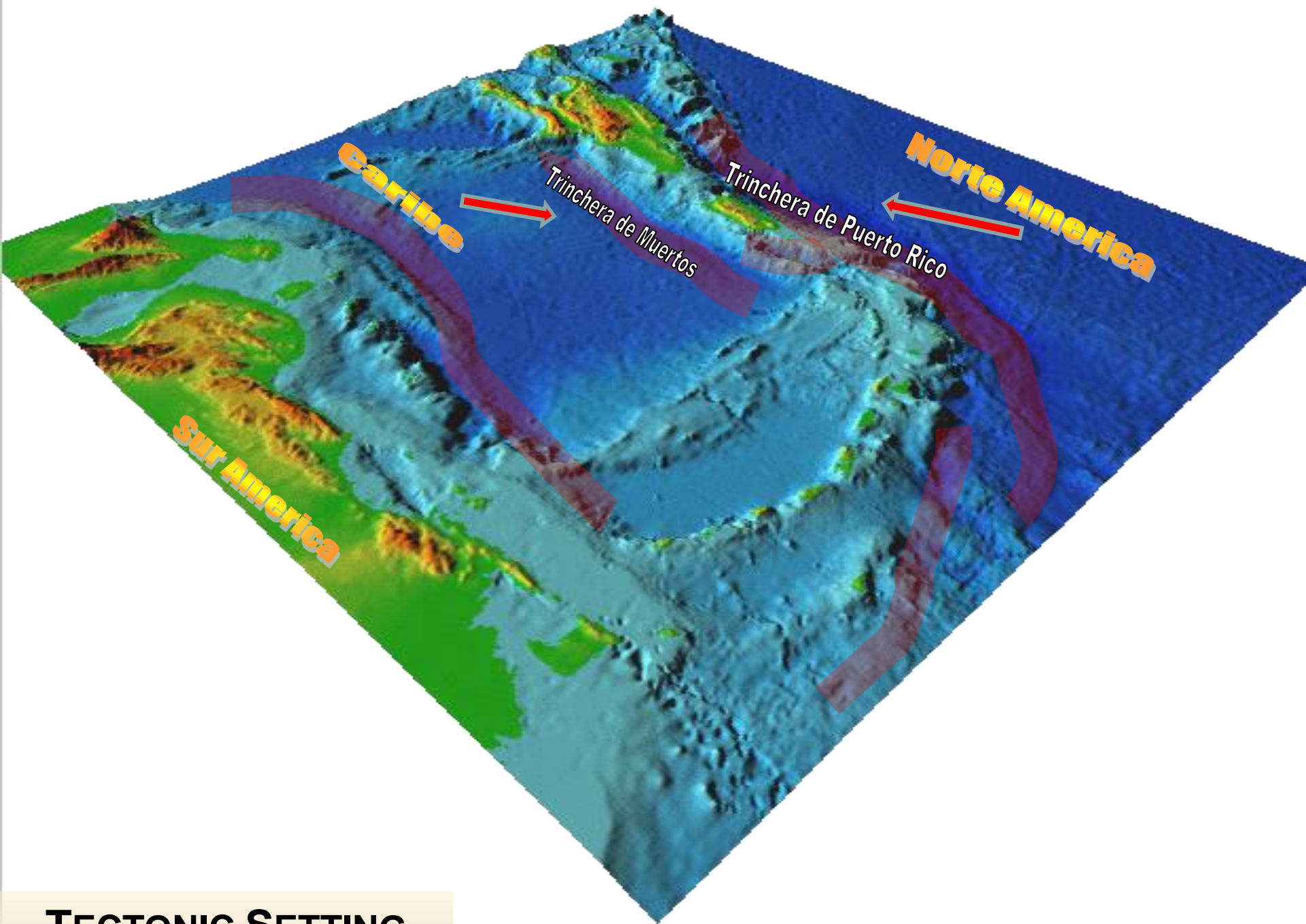
- **Support the National Tsunami Hazard Mitigation Program as members of the Coordinating Committee and Sub Committees.**
- **Facilitate effective coordination of tsunami education, mitigation, warning coordination, preparedness and readiness activities in Puerto Rico among the federal, state, university and local partners.**
- **Successfully execute mapping, modeling, mitigation and education efforts.**
- **Prepare state-of-the-art tsunami inundation maps for Puerto Rico which include all credible sources and new available data.**
- **Improve the understanding of exposed communities in Puerto Rico about tsunami hazards, their associated risks and preparedness and empower them to mitigate the potential effects of a tsunami and thus reduce the loss of life and property from tsunamis.**
- **Establish more tsunami resilient communities and that Puerto Rico with its 44 tsunami threatened communities be recognized as TsunamiReady.**
- **Improve local warning reception and dissemination capabilities in coordination with Federal and Local Authorities.**

**JUSTIFICATION**

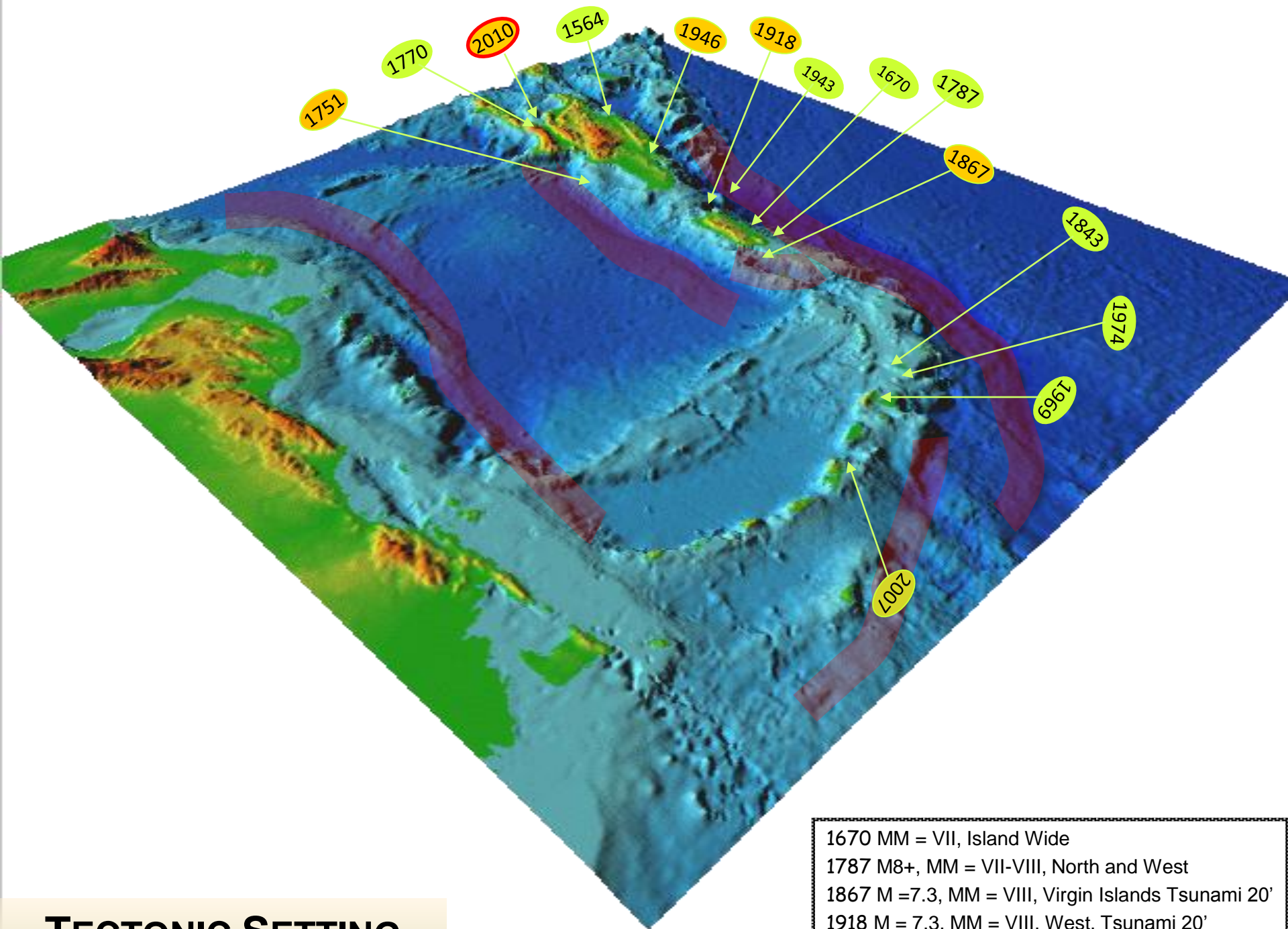


**TECTONIC SETTING**





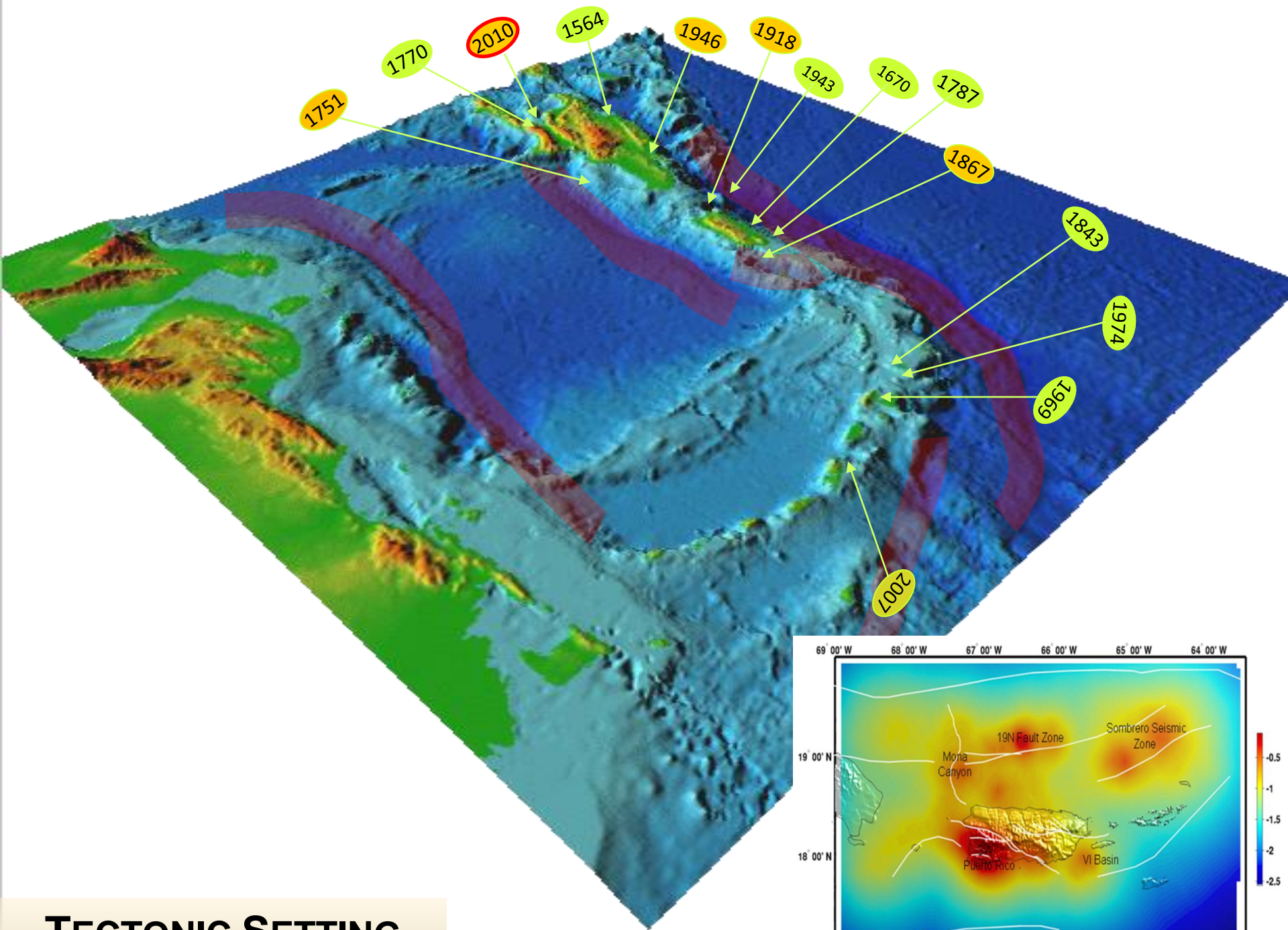
**TECTONIC SETTING**



## TECTONIC SETTING

1670 MM = VII, Island Wide  
1787 M8+, MM = VII-VIII, North and West  
1867 M = 7.3, MM = VIII, Virgin Islands Tsunami 20'  
1918 M = 7.3, MM = VIII, West, Tsunami 20'  
1943 M = 7.5, MM = V, North of Puerto Rico



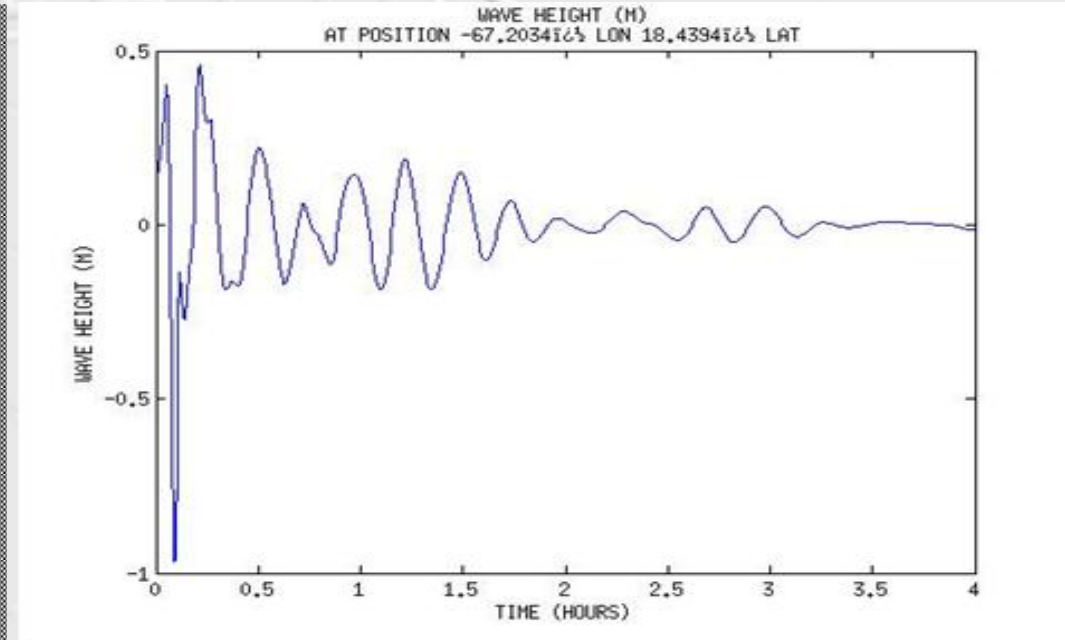
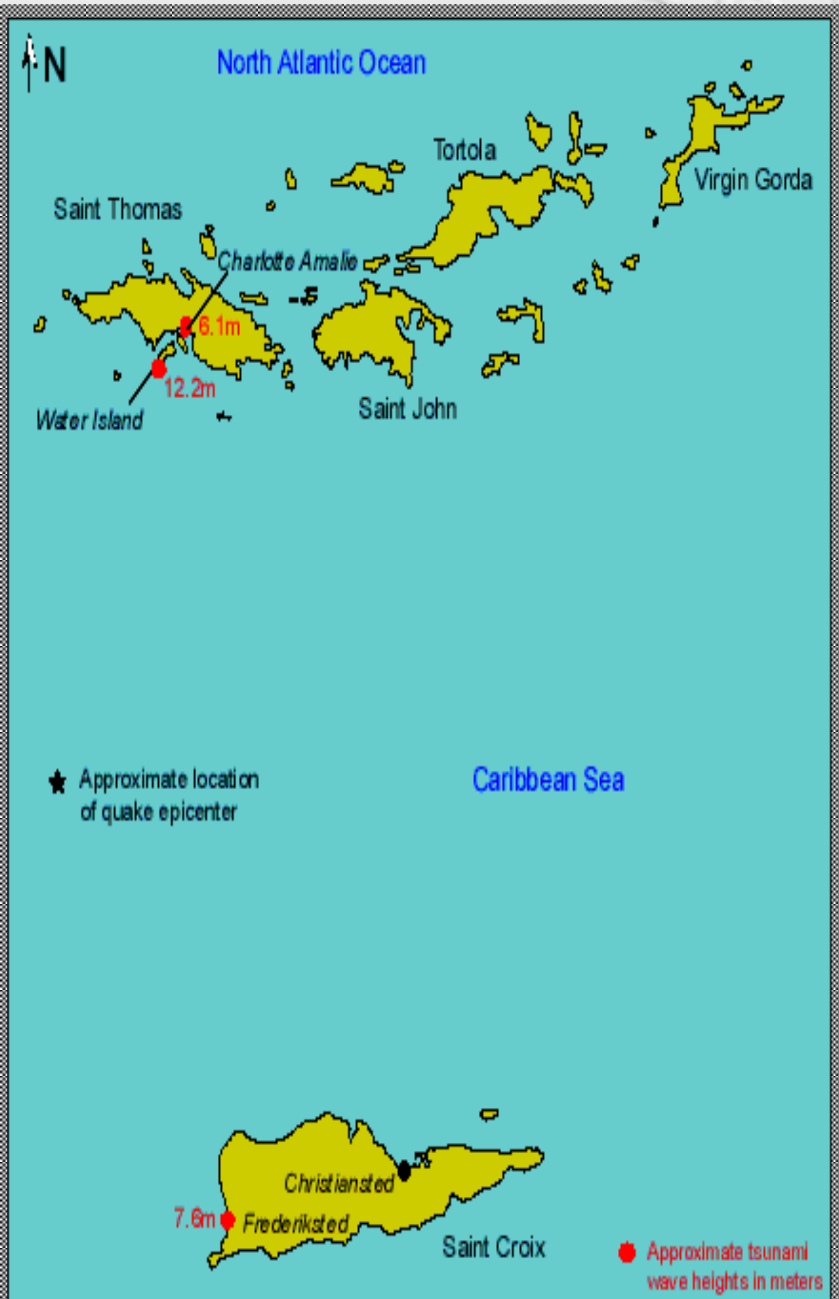


## TECTONIC SETTING





# TSUNAMI HISTORY OF PUERTO RICO





# Vulnerability: Top 10 Tsunami Exposed Municipalities

	Tsunami Exposure			
Municipality	Population	%Pop	Houses	% Houses
Mayagüez	18,950	19.25%	7,500	19.05%
San Juan	6,308	1.45%	3,896	2.14%
Arecibo	5,551	5.54%	2,273	5.83%
Aguada	4,798	11.41%	1,954	12.53%
Carolina	4,576	2.46%	4,513	6.33%
Ponce	3,617	1.94%	1,416	2.13%
Loíza	3,344	10.28%	1,212	11.09%
Aguadilla	2,801	4.33%	1,191	4.79%
Cabo Rojo	2,400	5.12%	2,358	10.17%
Hatillo	2,389	8.43%	904	8.43%

**Total top 10:**

**Population: 54734**  
**Homes: 27217**

# **NTHMP PUERTO RICO GRANT ITEMS**

- 1. Full Participation of Puerto Rico in NTHMP activities.**
- 2. Regenerate tsunami inundation maps for Puerto Rico including local faults, landslides, regional and teleseismic sources. NGDC new DEM's must be used.**
- 3. Improve the understanding of communities, emergency managers and operators of critical facilities in Puerto Rico to tsunami hazards, their associated risks and level of preparedness.**
- 4. Improve planning, zoning, permitting and engineering practices to support tsunami resilient practices.**
- 5. Prepare and distribute tsunami evacuation maps for all tsunami threatened communities.**
- 6. Increase and improve awareness of the tsunami hazard and appropriate response by people at risk in Puerto Rico.**
- 7. Improve the capability of Puerto Rico to have reliable TWC product reception and the capability to distribute the message to those at risk.**
- 8. The TsunamiReady Component: Maintain and strengthen the TR program in Puerto Rico**



# ITEM 1

**Task 1.1 Participate in and support regional and national NTHMP meetings, sub committees and activities.**

- MMS
- MES
- WCS
- CC
- Regional Working Groups
- Spanish Support

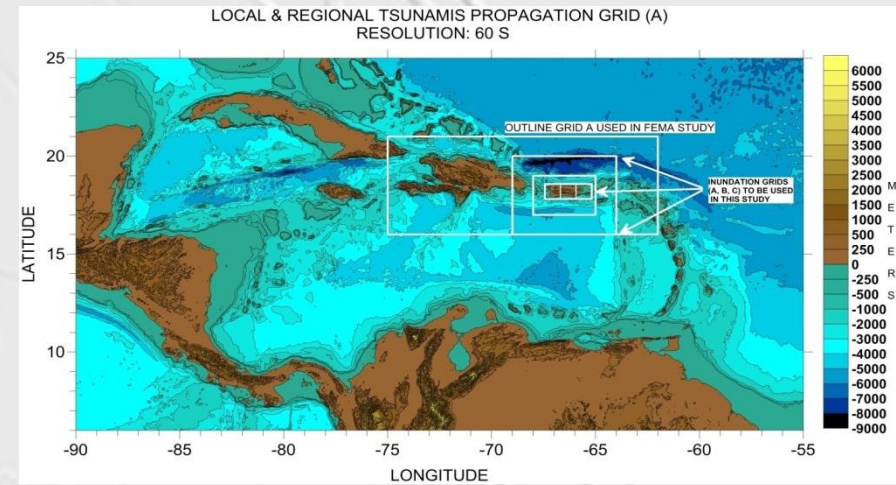
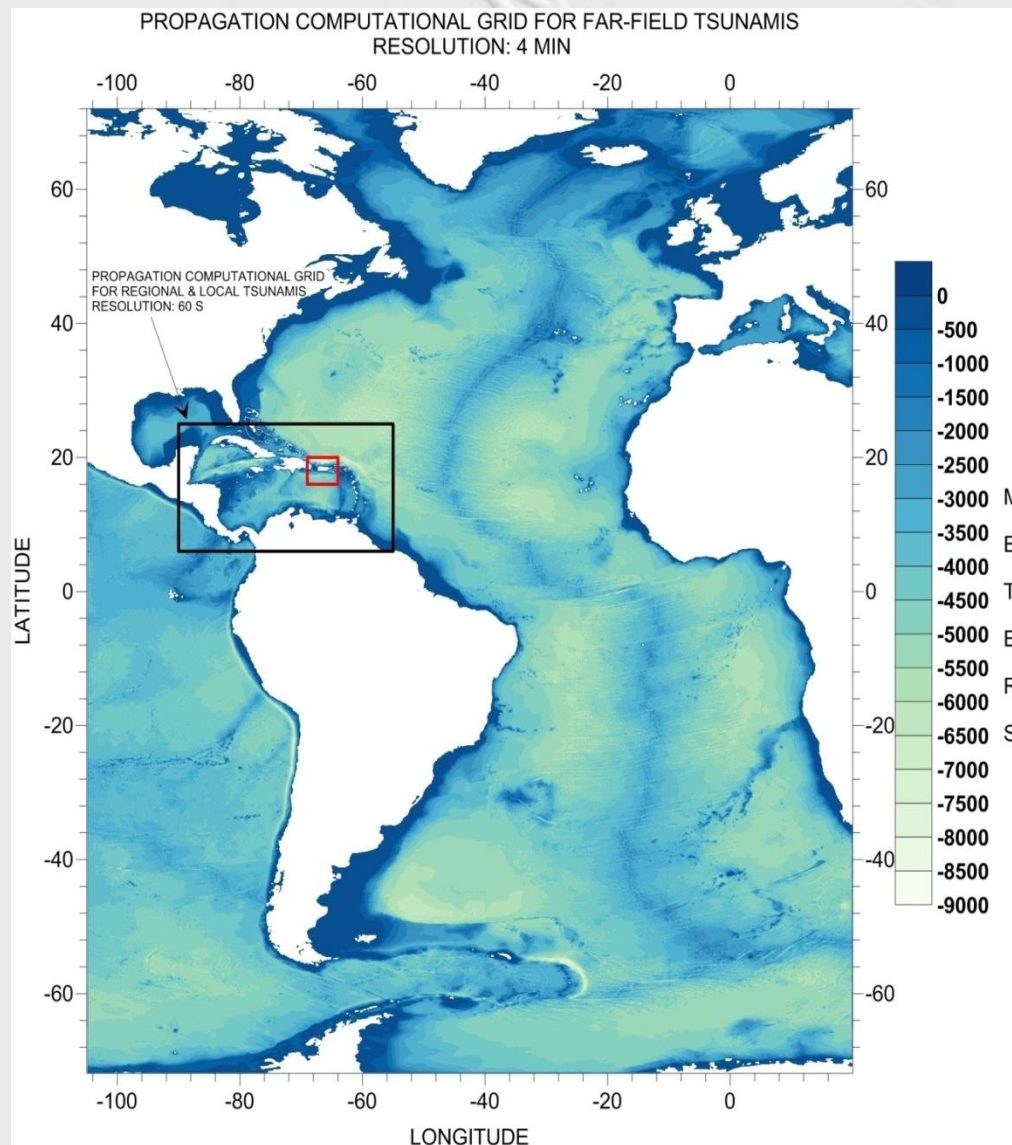
**Task 1.2. Place all NTHMP related products on the website <http://redsismica.uprm.edu>. Compile data and products for the NOAA Tsunami Information Clearinghouse.**

**Task 1.3. Attend and give oral or poster presentations at technical and scientific workshops and conferences to share best practices of the NTHMP and improve the capacity of Puerto Rico in NTHMP priority areas.**

- AGU
- IOC (Intergovernmental Oceanographic Commission)
- WMO
- UNESCO/SOP
- The Tsunami Society
- Caribbean Vulnerability Meeting
- CDEMA (Caribbean Disaster Emergency Management Agency)

# ITEM 2

## Task 2.1 Re-determine maximum of maximum tsunami inundation limits for all of Puerto Rico from local sources.





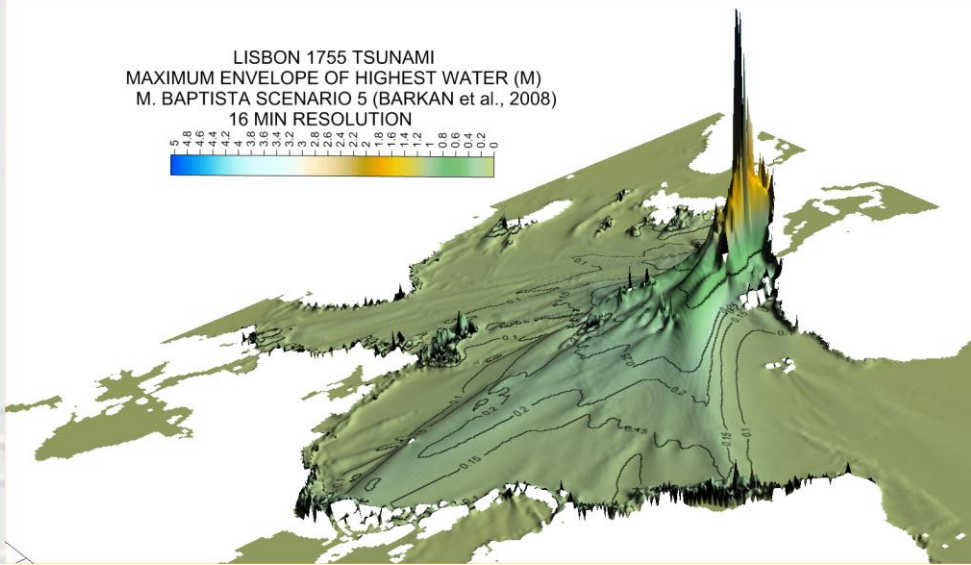
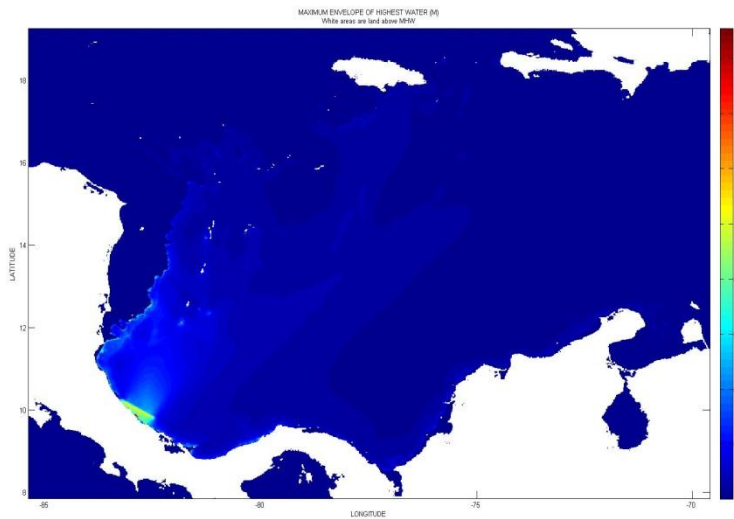
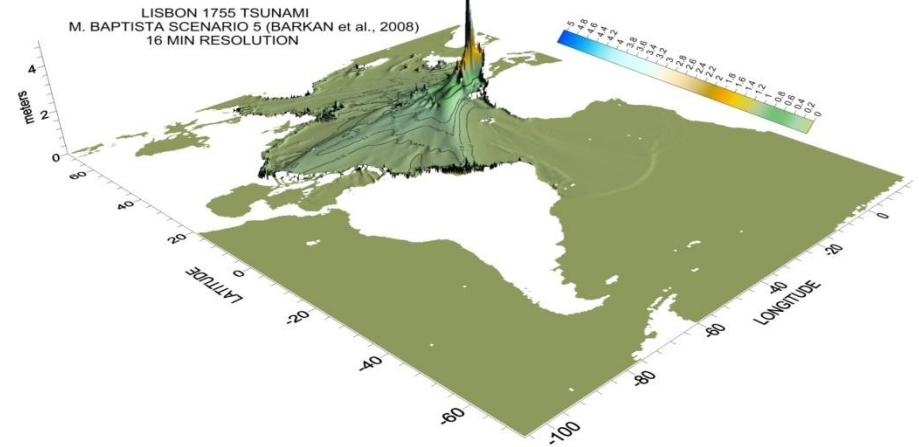
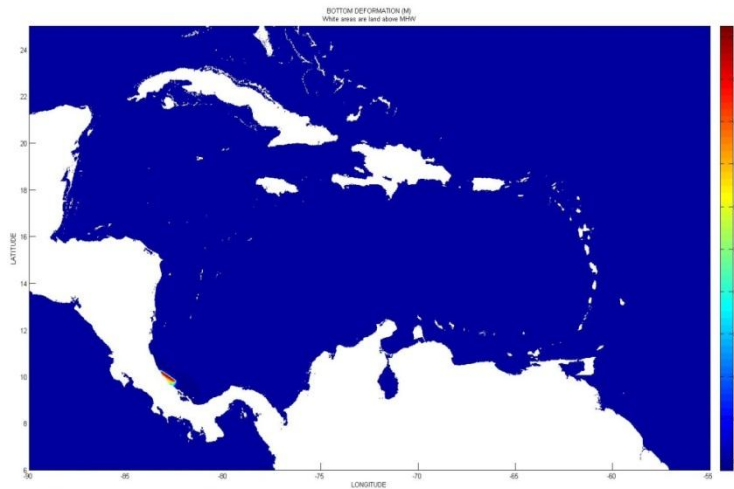
## ITEM 2

**Task 2.2 Run tsunami inundation models for local landslide sources affecting Puerto Rico, especially along the Puerto Rico Trench.**



## ITEM 2

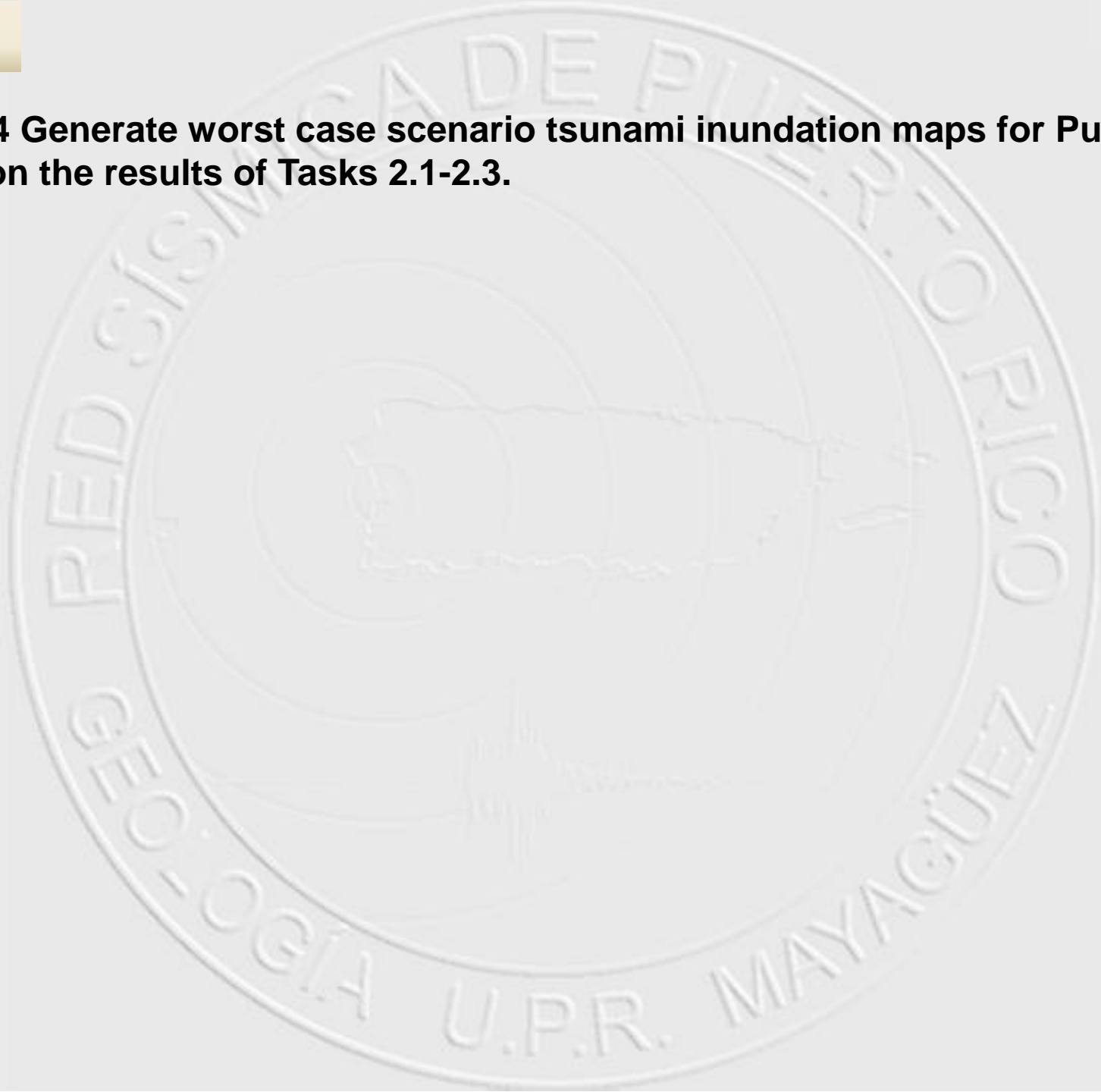
### Task 2.3 Run tsunami inundation models for regional and teleseismic sources affecting Puerto Rico.





## ITEM 2

**Task 2.4 Generate worst case scenario tsunami inundation maps for Puerto Rico based on the results of Tasks 2.1-2.3.**



# ITEM 3

## Task 3.1 Empower communities and their emergency managers to prepare and strengthen their tsunami and emergency response plans

- 20 (44) municipalities have already approved tsunami response plans,
- 10 municipalities to be approved
- State laws to require mandatory plans.
- Tsunami Technical Review Committee (2 meetings)
- State Tsunami Preparedness week proclamation

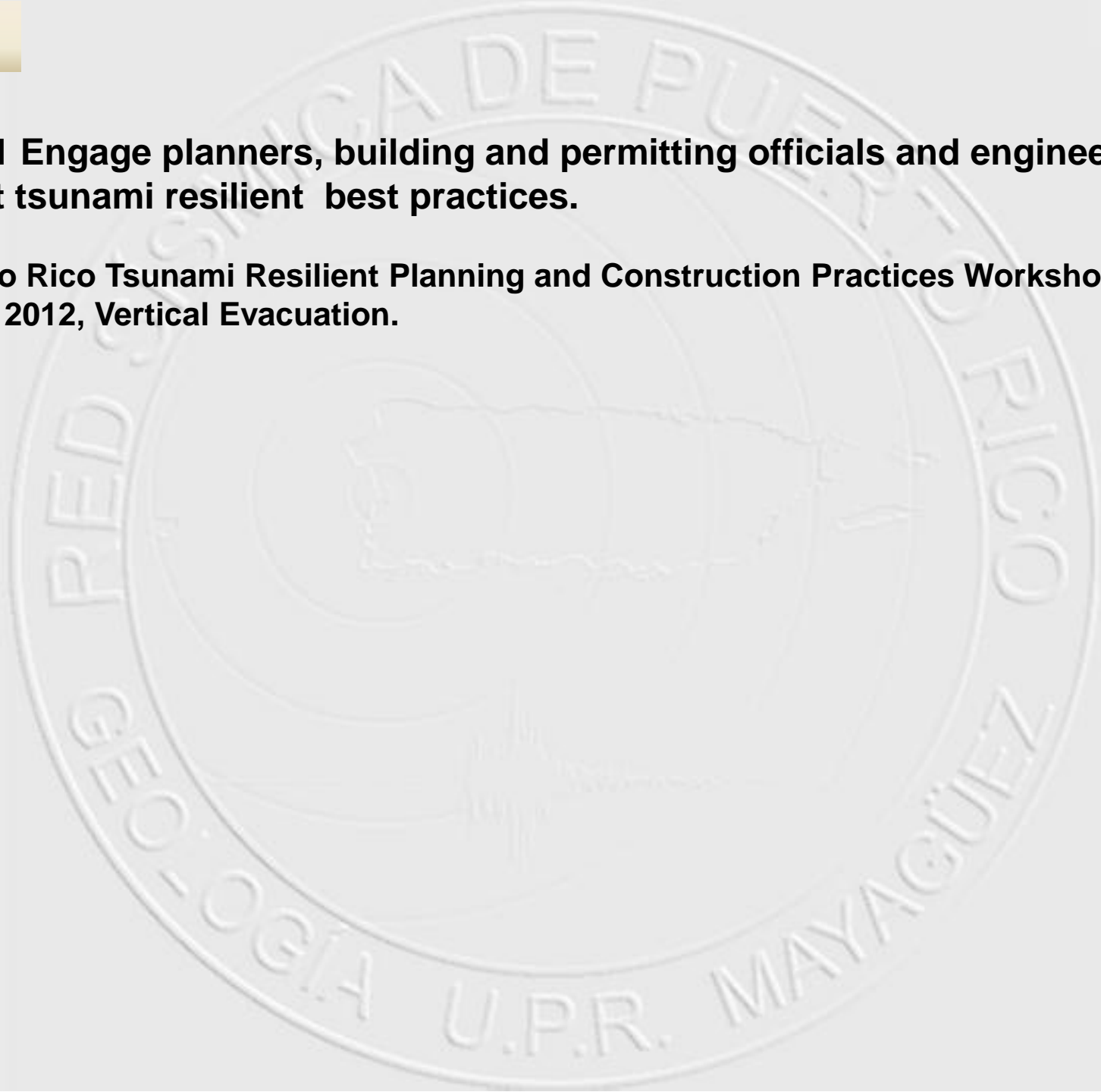
## Task 3.2. Facilitate the inclusion of tsunamis in critical facilities' emergency response plans (EPA).

	A	BJ	BK	BL	BM	BN	BO	BP	BQ	BR	BS	BT	BU	BV	BW	BX	BY
1	Facilities	Peñuelas		Ponce		Quebradillas		Rincón		Río Grande		Salinas		San Juan		Santa Isabel	
2		Total	Tsunami	Total	Tsunami	Total	Tsunami	Total	Tsunami	Total	Tsunami	Total	Tsunami	Total	Tsunami	Total	Tsunami
3	Dam					1	0										
4	Regional Emergency Operation Centers (EOC)			1	0									1	0		
5	Policía Police Station	1	0	2	0	1	0	1	0	2	0			5	1	1	0
6	Airports			1	0									1	0		
7	Shelters	4	0	16	0	3	0	1	0	7	0	5	0	21	0	2	0
8	Sub Power Plants			2	0									7	0		
9	Water Sources	4	0	3	0	1	0			6	0						
10	Water Filtration Plants	2	0			1	0	1	0	6	0	1	0	1	0	1	0
11	Hospitals	1	0	20	1	1	0	1	0					61	1	1	0
12	Wastewater Treatment Plants	2	0	8	0	1	0			3	0						
13	Main Power Plants											1	0	1	0		
14	Governmental Complex													3	0		

## **ITEM 4**

**Task 4.1 Engage planners, building and permitting officials and engineers to support tsunami resilient best practices.**

- **“Puerto Rico Tsunami Resilient Planning and Construction Practices Workshop” summer 2012, Vertical Evacuation.**

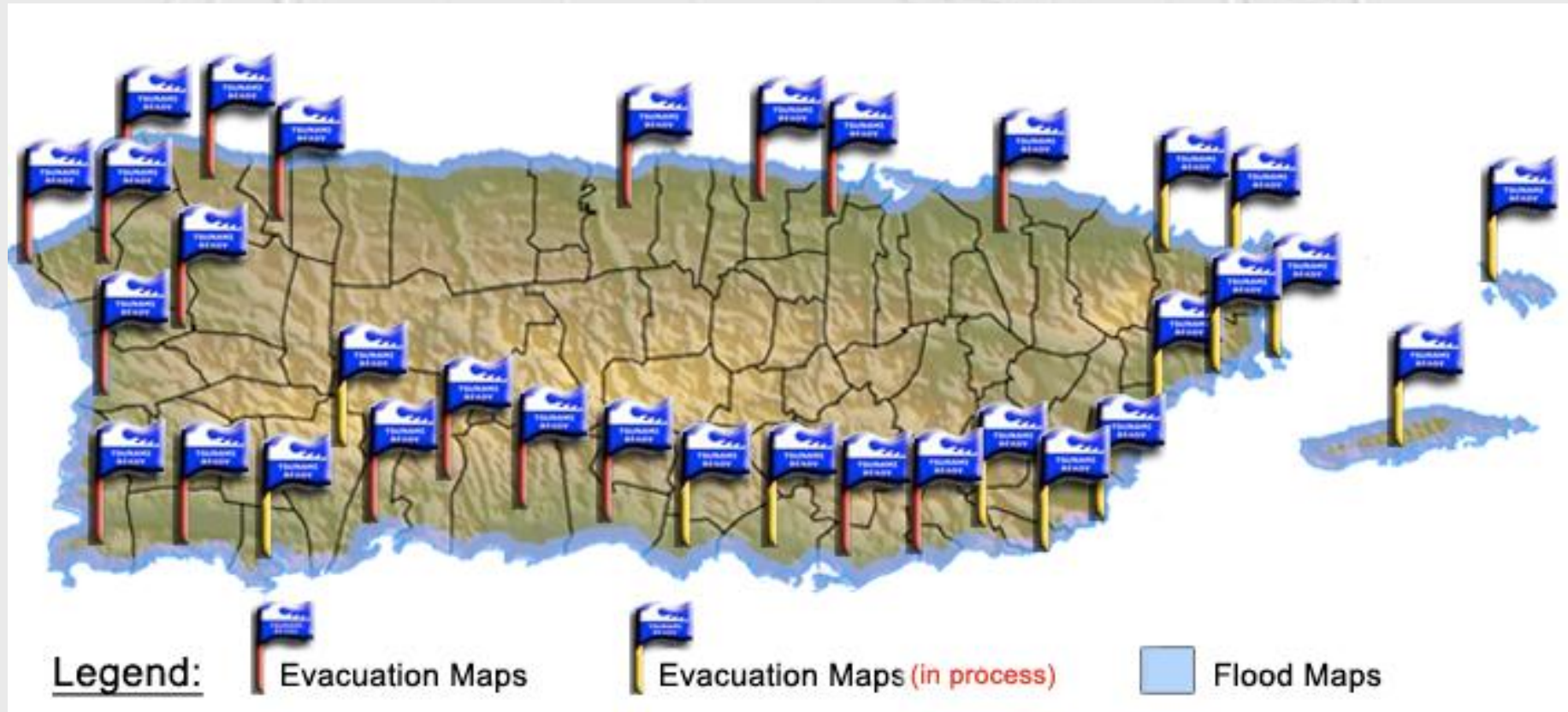




## ITEM 5

### Task 5.1 Development, printing and distribution of GIS based bilingual Spanish/English evacuation maps for all 44 tsunami threatened municipalities.

- 20 approved and 13 in process
- On line
- 2000/Map hard copies
- Google overlays



## ITEM 6

**Task 6.1 Organize and participate in educational events throughout Puerto Rico at schools, local, state and federal government agencies, faith based organizations, industry, among others.**



**Direct people impacted:**  
**36500+**

**Conferences:**  
**500+**

**Interviews:**  
**150+**

**Webinars:**  
**2**

**PR Tsunami Curriculum (?)**

**Flyers, Brochures, DVD's,  
Cartoon Booklets, mugs,  
Coloring booklets, pens,  
Stickers, pencils,  
Back packs, Emergency kits**

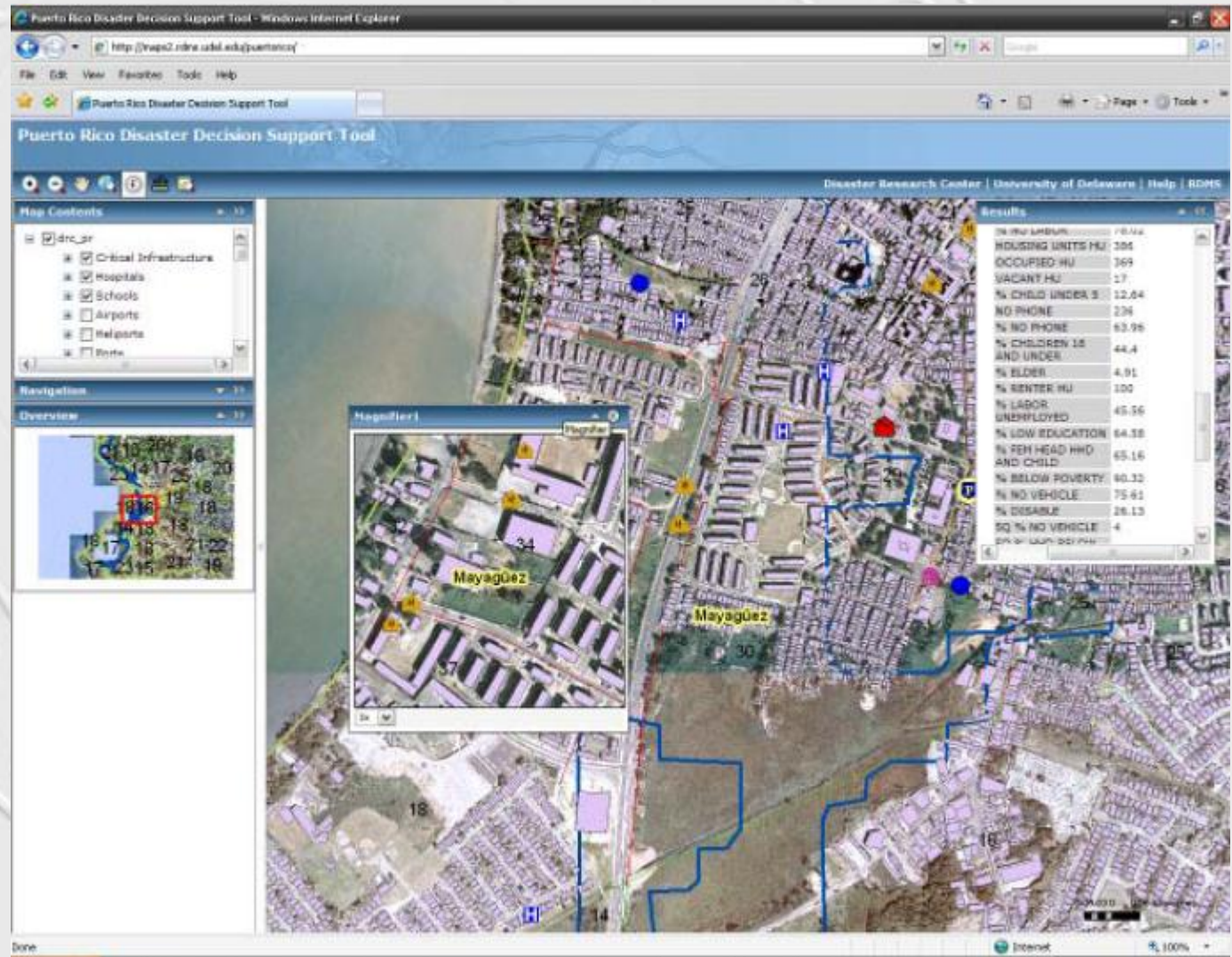
**PRSN + PRSEMA + FEMA**



# ITEM 6

**Task 6.2. Conduct an annual full day workshop for emergency managers on the Disaster Decision Support Tool for PR.**

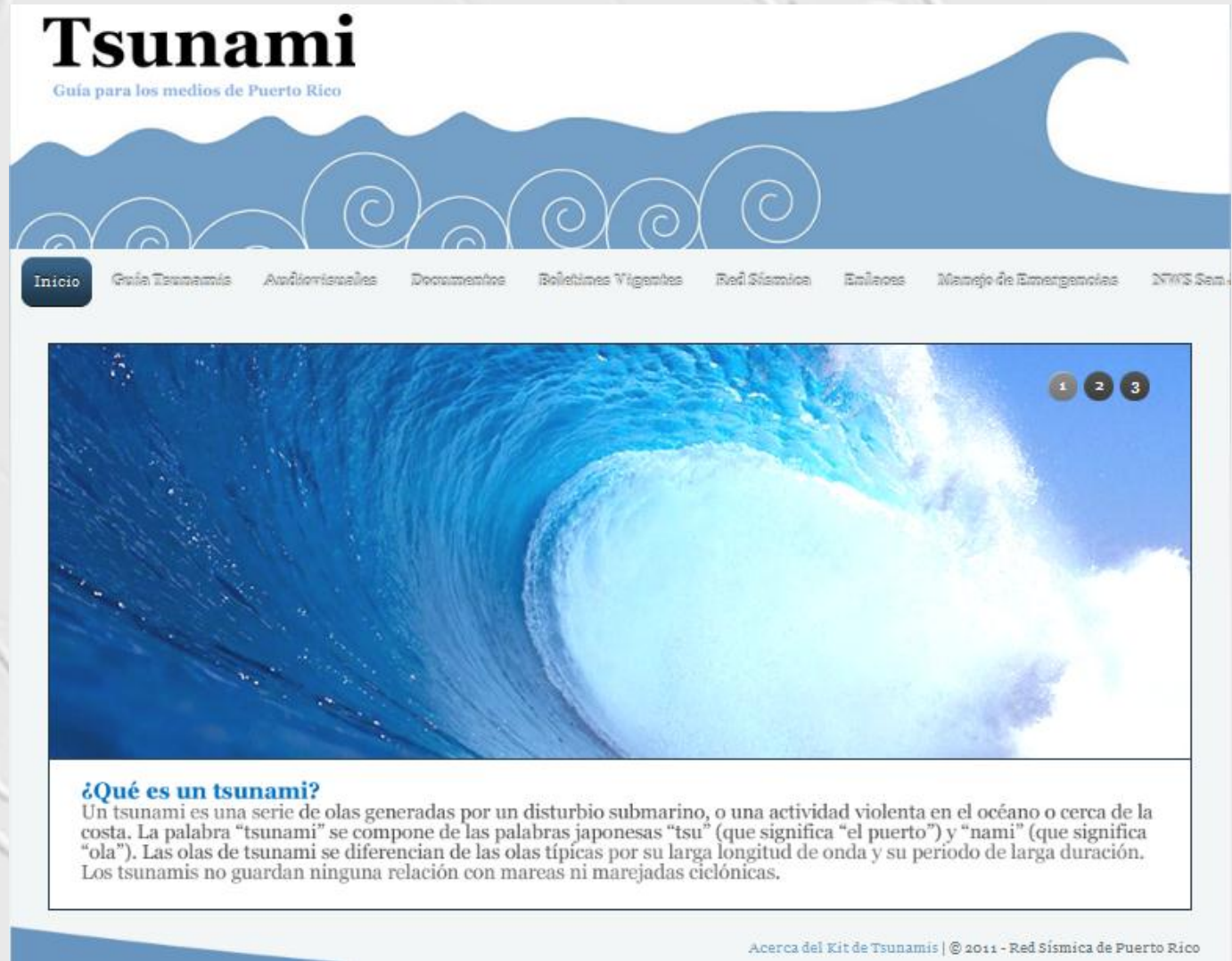
- Spanish manual
- Summer training
- Summer 2012



# ITEM 6

## Task 6.3. Development, reproduction, presentation and distribution of PR tsunami media toolkit in print, electronic and place on line.

- V1.0
- V1.5
- V2.0 in process
- Two workshops
- Previous of LanTex





# ITEM 6

## Task 6.4. Conduct an island wide survey of tsunami preparedness.

- Island wide public survey
- Pre/Post Latex Surveys

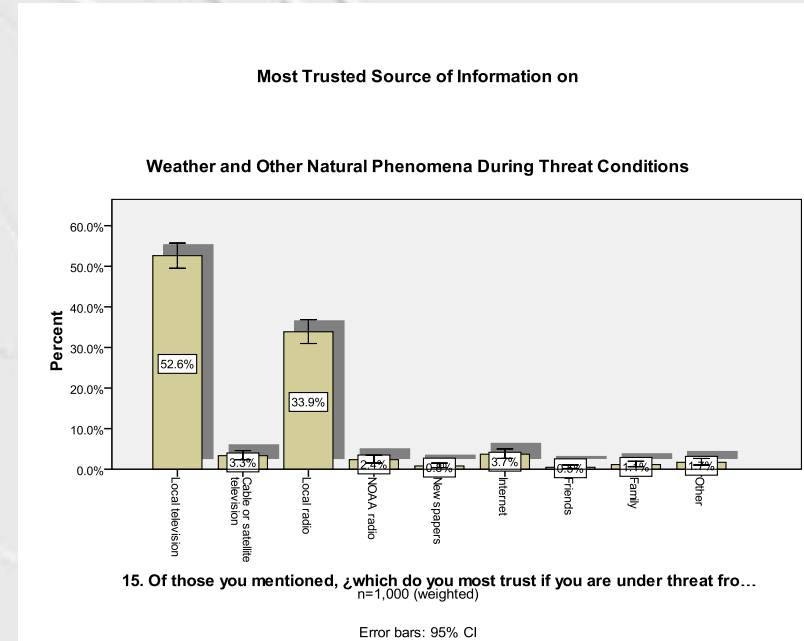
➤ PRSN efforts appear to have been largely successful in terms of communicating knowledge about tsunami risks to the exposed population of PR.

●However, findings suggest that more direct efforts to contact and inform the public within the exposed area by distributing maps and brochures and placing tsunami signage are at least somewhat effective in increasing public knowledge about the tsunami threat.

●On the other hand, efforts to reach the population by teaching children seem to be less effective. Respondents with school aged children showed no increase in knowledge or preparedness when compared to those without them.

●The LANTEX exercise itself had an effect on knowledge. However, this effect seems to decay rapidly with the passage of time. This latter effect was smaller for respondents who recall having received information from the PRSN.

●However, as to be expected from the literature on the topic, though respondents who recall receiving information are better informed, this knowledge does not necessarily translate into substantially increased preparedness for a tsunami event.



## ITEM 6

**Task 6.5. Prepare a tsunami response plan for the Summer 2010 Caribbean and Central American Games (Mayaguez and Western Puerto Rico).**





## **ITEM 7**

**Task 7.1 Maintain and improve protocol for the participation of Puerto Rico in monthly communication tests of the Tsunami Warning and create awareness of tsunami protocol for Puerto Rico.**

- **ATWC/PRSN Warning Points Protocol**
- **State Protocol**
- **ATWC report ?**

**Task 7.2. Participate in annual end to end communication tests. Organize/participate/conduct state and local planning meetings/activities, table top and full scale exercises as part of the NTHMP communication test and other local tests.**

- **LanTex**
- **TOPPOF ( Earthquake/Tsunami Top Officials Exercise)**
- **Local EAS exercise**
- **Vigilant Guard Exercise**
- **FEMA Catastrophic**
- **The Great Puerto Rico ShakeOut (October, 2012)**
- **PORT and Tourist Authority,**
- **ITIC/DHS/FEMA Training (2012 ?)**

**Task 7.3 Maintain and improve local tsunami warning and reception capabilities.**

- **22 Warning Sirens (DHS)**
- **14 EMWIN Systems Installed and 10 to go,**
- **PRSN EMWIN Workshops**
- **250+ NOAA Radios**
- **EMNet + CAP System (SFO, ATWC?)**
- **5 PRSN BroadCast Systems, RSS Notifier.**

## ITEM 8: TSUNAMIREADY COMPONENT

**Task 8.1 Assist tsunami threatened communities to meet the TsunamiReady requirements.**

- 20 TsunamiReady municipalities, 45% of PR coastal areas (44), recognized.
- Four are in the final stages to be recognized.
- Nine are in the process: East Coast
- TsunamiReady local law
- 1000+ Tsunami Signs





# ITEM 8: TSUNAMI READY COMPONENT

**Task 8.2. Organize and Convene Puerto Rico first Tsunami Ready Summit with participation local, national and Caribbean stakeholders (May 2010, Mayaguez).**

- TsuInfo Alert, V. 12, No 13, June 2010.

