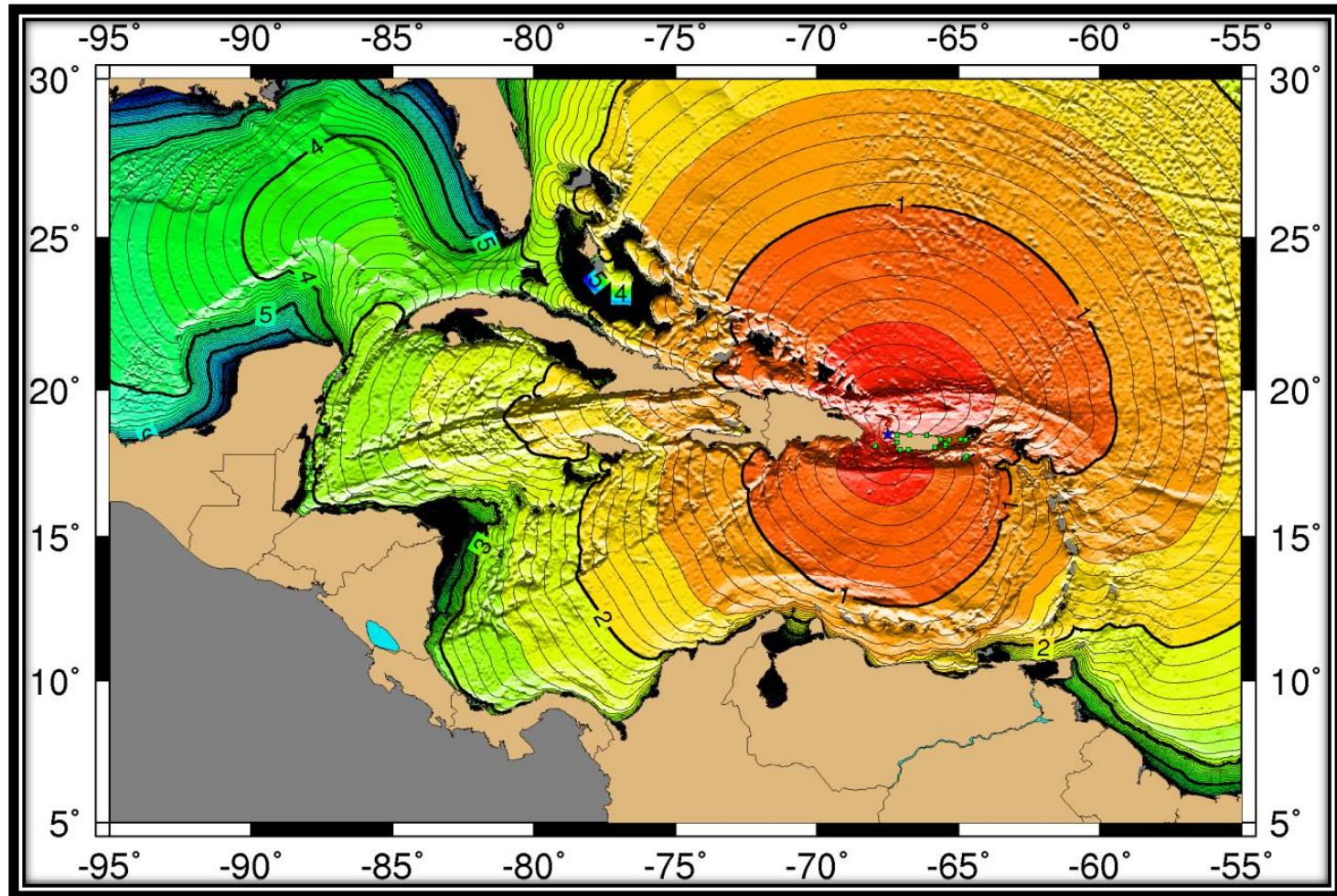


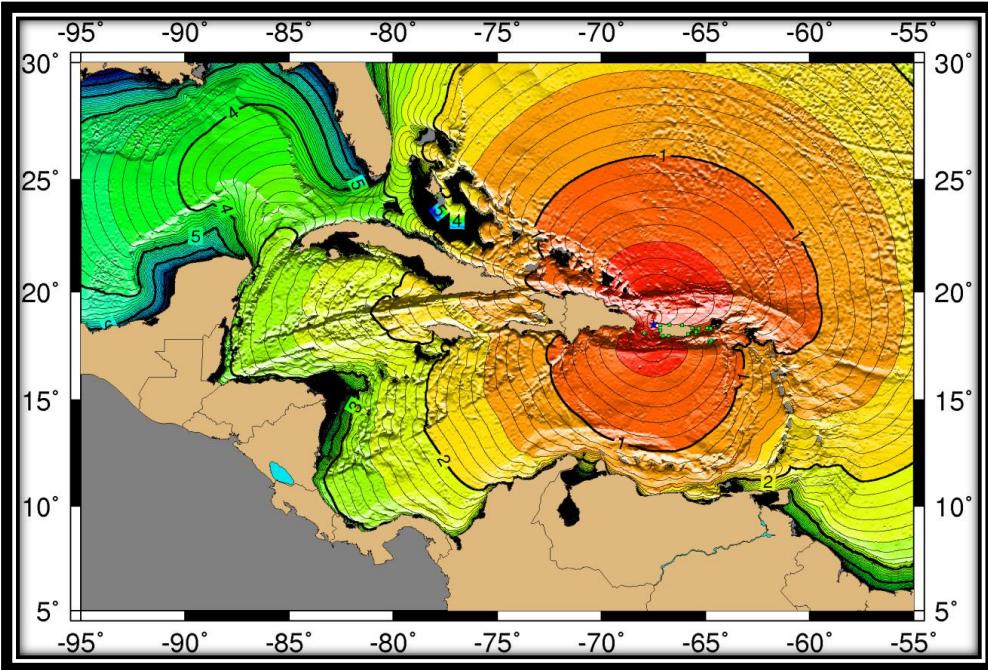
# International Collaboration: A Central Component of the PRSN Tsunami Response Process

Lillian Soto-Cordero, Victor Huerfano-Moreno, Benjamin Colon and Javier Charon



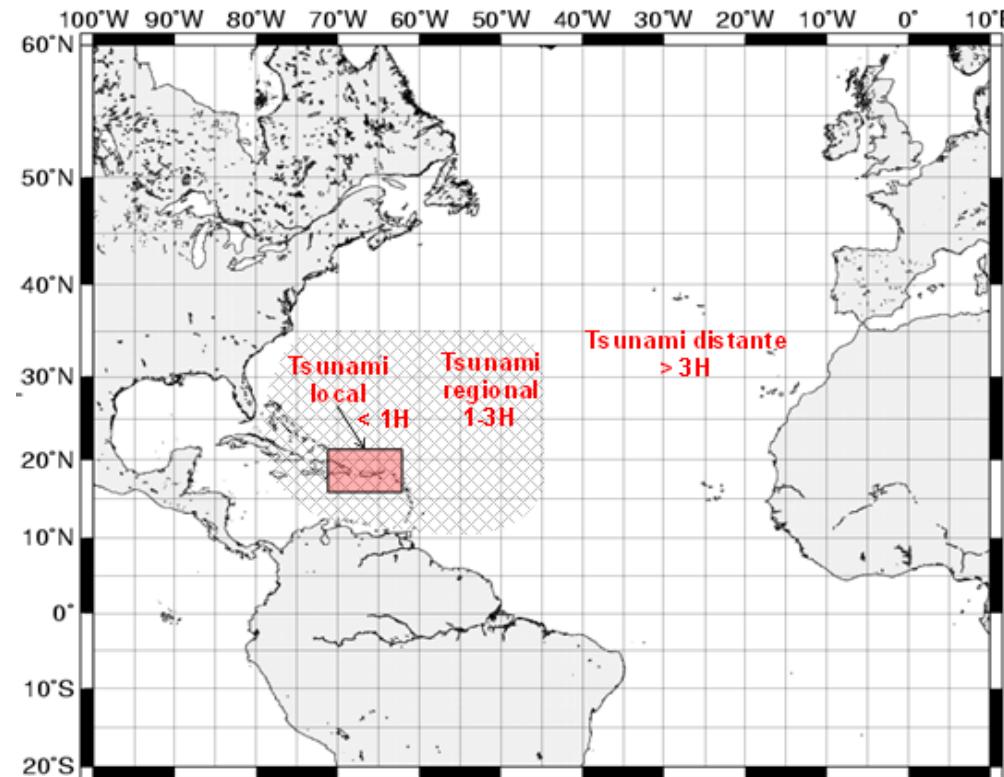
M 7.3   October 11, 1918  
Historical information agrees with ETA's  
Tsunami arrives to Aguadilla - 4 min after event

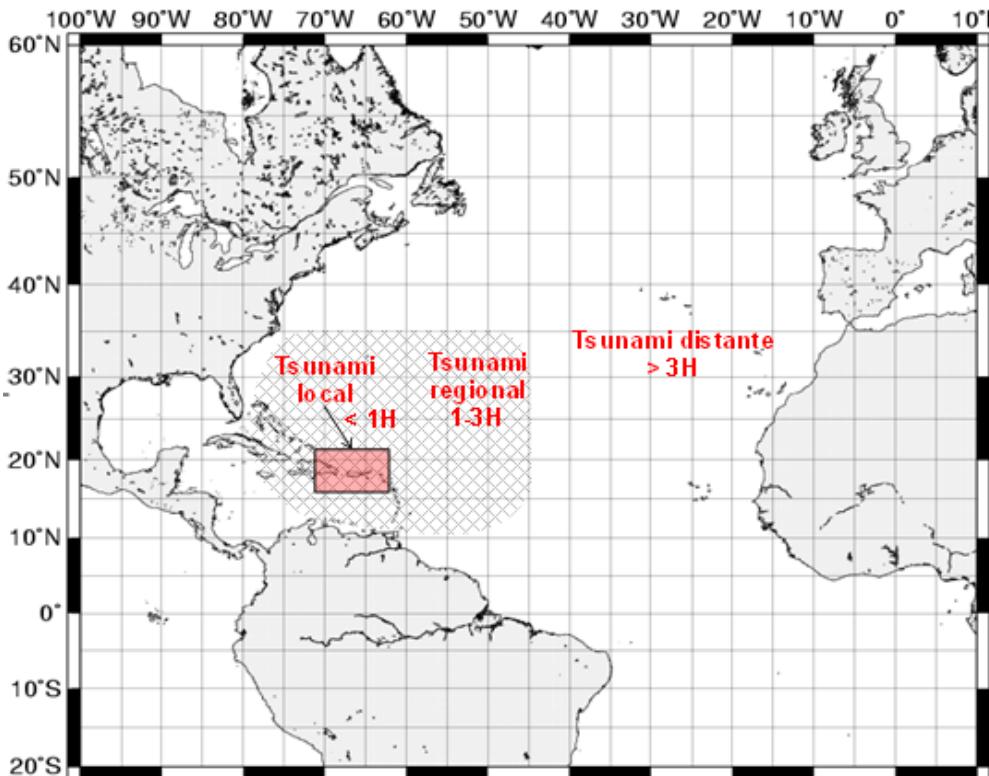
- ❖ Seismic & Sea Level data acquisition
- ❖ Location algorithms
- ❖ Dissemination methods



**Fast, reliable, effective and redundant**

## Earthquake and Tsunami Monitoring for Puerto Rico and US & British Virgin Islands

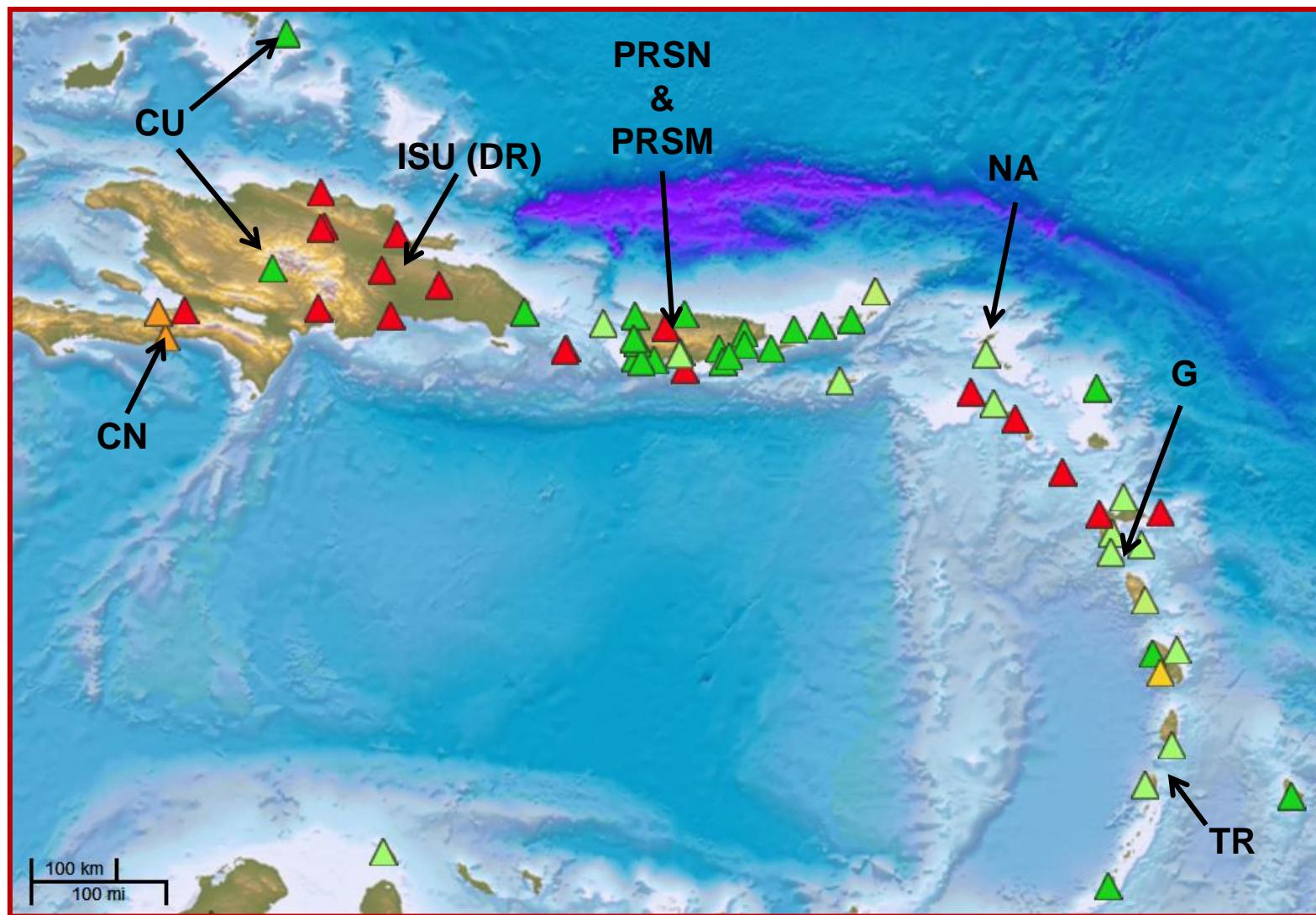




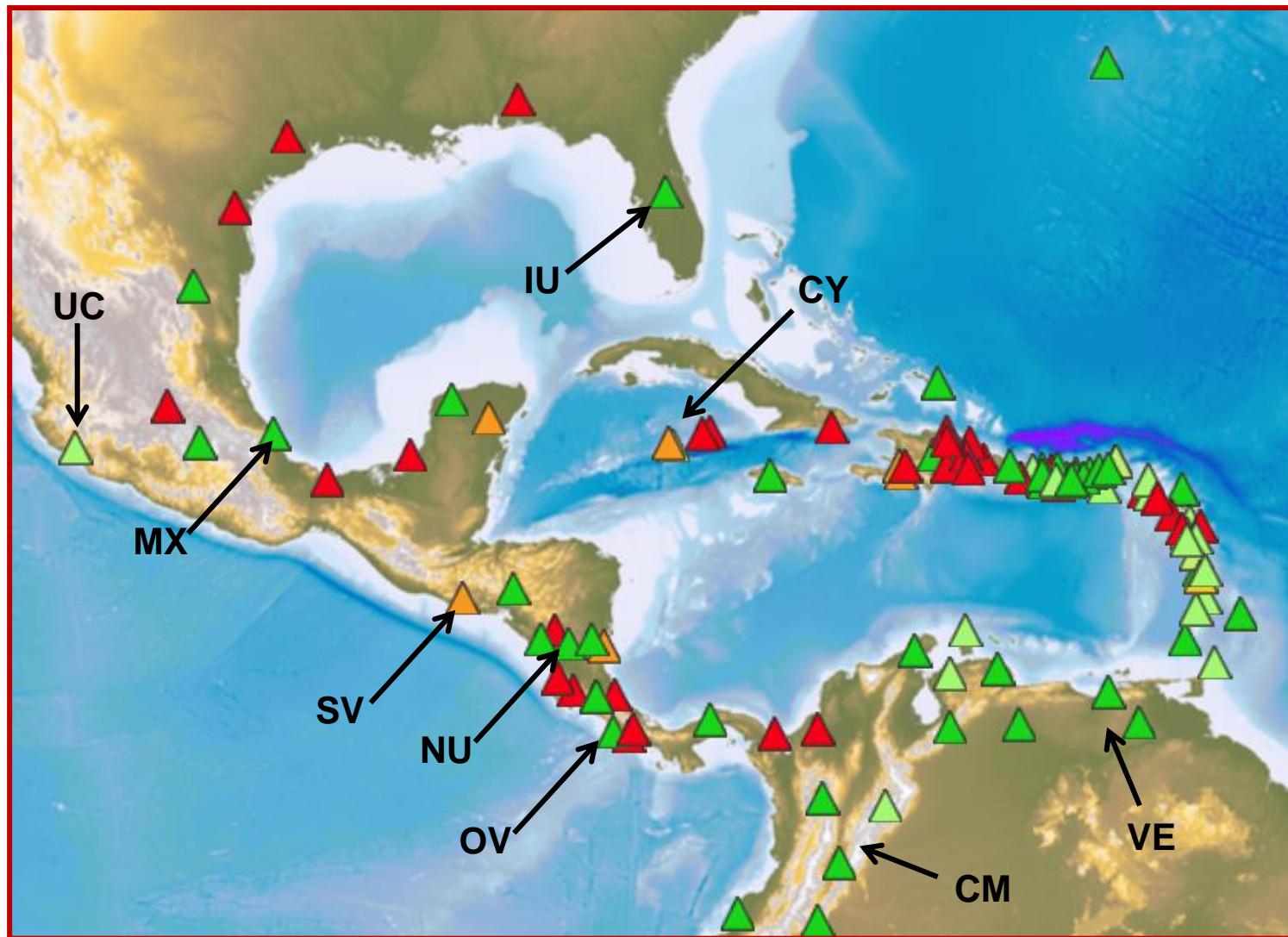
## Earthquake and Tsunami Monitoring for Puerto Rico and US & British Virgin Islands

- ✓ **Fast and reliable Automatic Earthquake Location**
- ✓ **Good azimuthal Station coverage is critical**
  - **140** seismic stations entering on near real-time
  - **25** operated by PRSN & **70** at regional and teleseismic distances

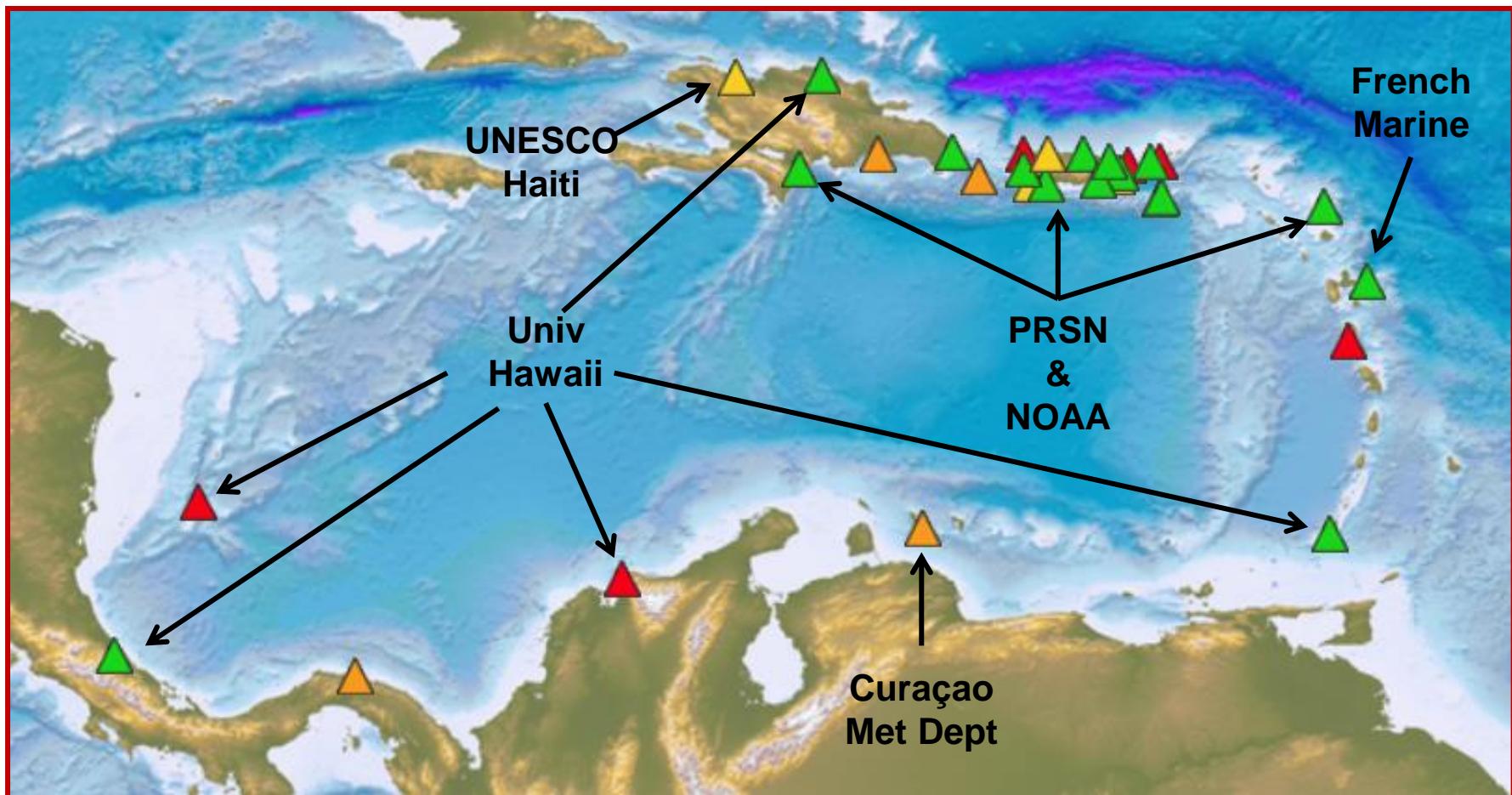
Seismic Data  
Exchange



Seismic Data  
Exchange



Sea Level Data  
Exchange



## Instrumentation Installation

Haiti, 2011  
PRSN and Haiti Personnel



### Installation of Seismic and Tide Gauge stations in:

- **Aruba (S)**
- **Colombia (TG)**
- **Dominican Republic (S, TG)**
- **Haiti (TG)**

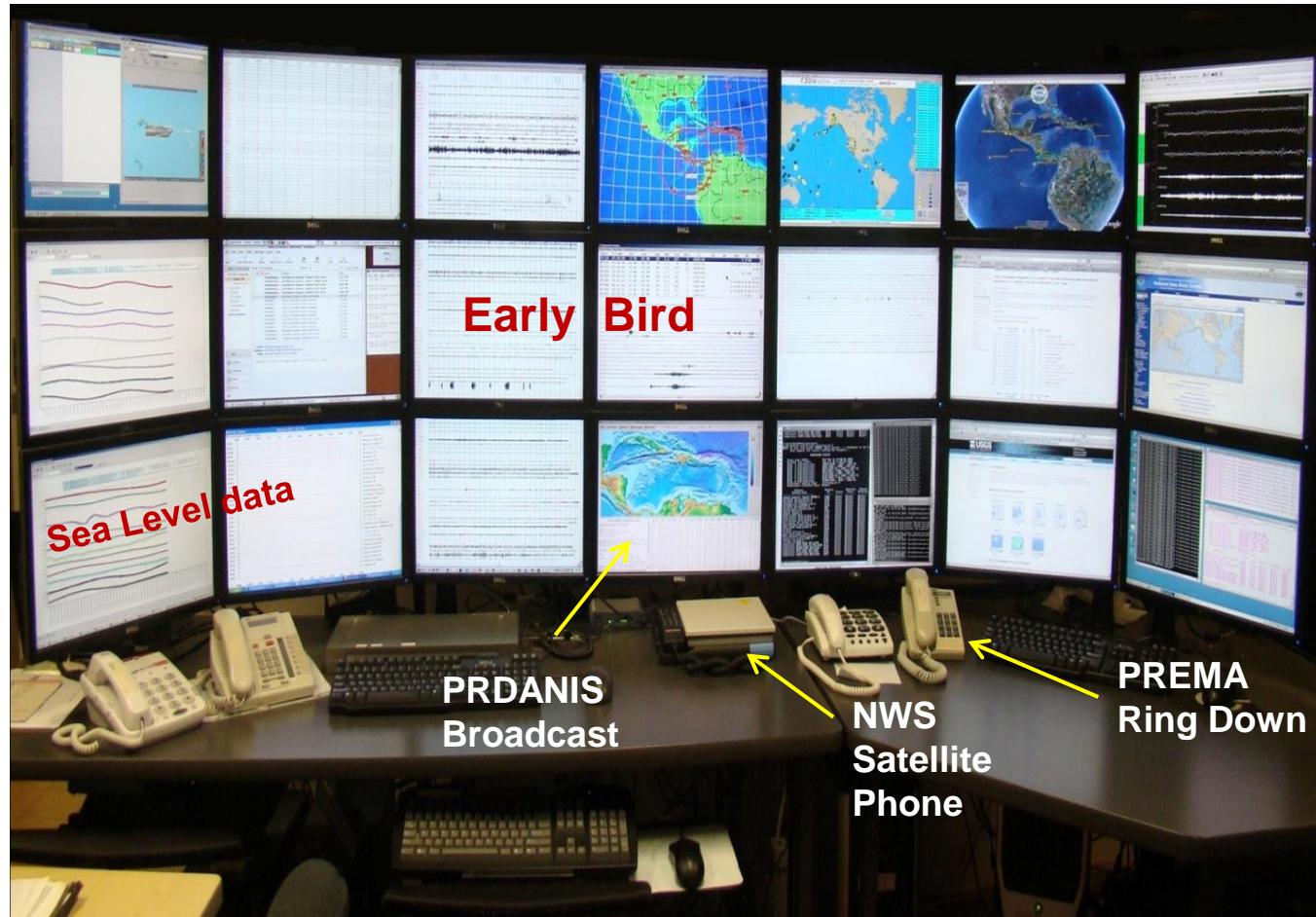


Dominican Republic, 2008  
PRSN and ONAMET

Colombia, 2012  
PRSN and University of  
Hawaii and Colombia  
Naval personnel

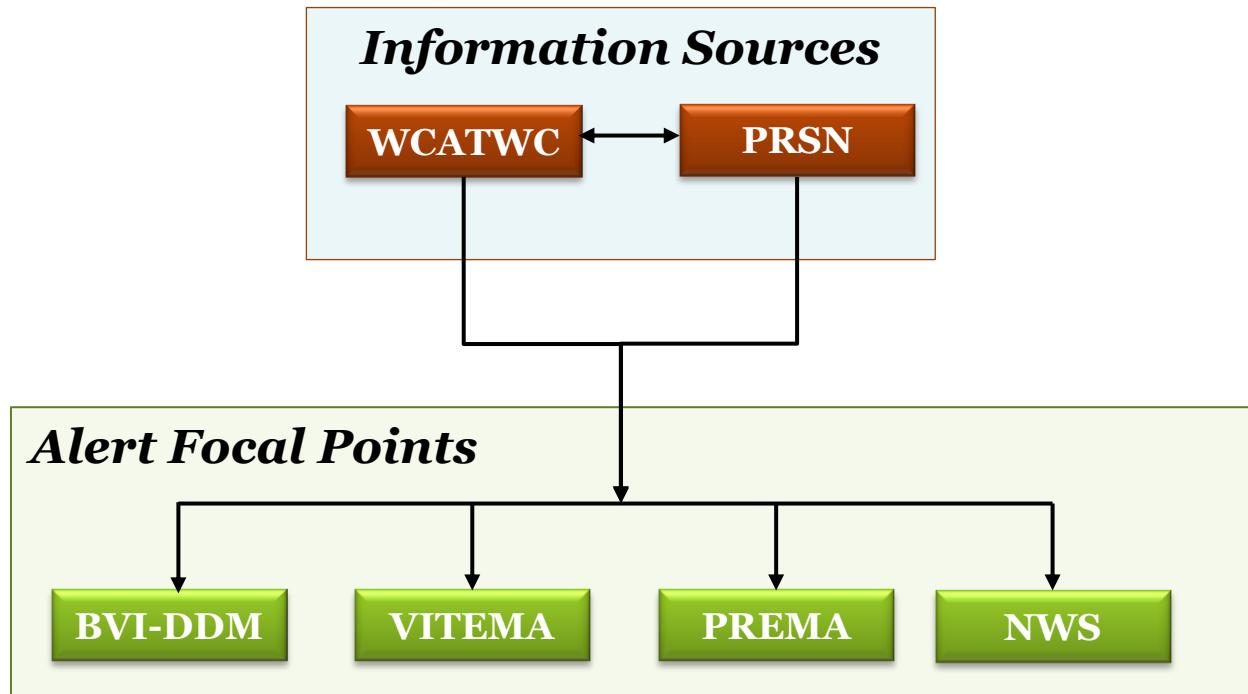


## Software and Dissemination Tools



Long standing collaboration with the West Coast Alaska Tsunami Warning Center (WCATWC) has resulted on the incorporation of the WCATWC early warning system (*EarlyBird*) into PRSN operations

## Dissemination of Eq & Tsunami Information

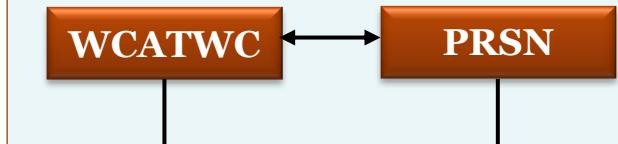


**PRSN complements**

**WCATWC:**

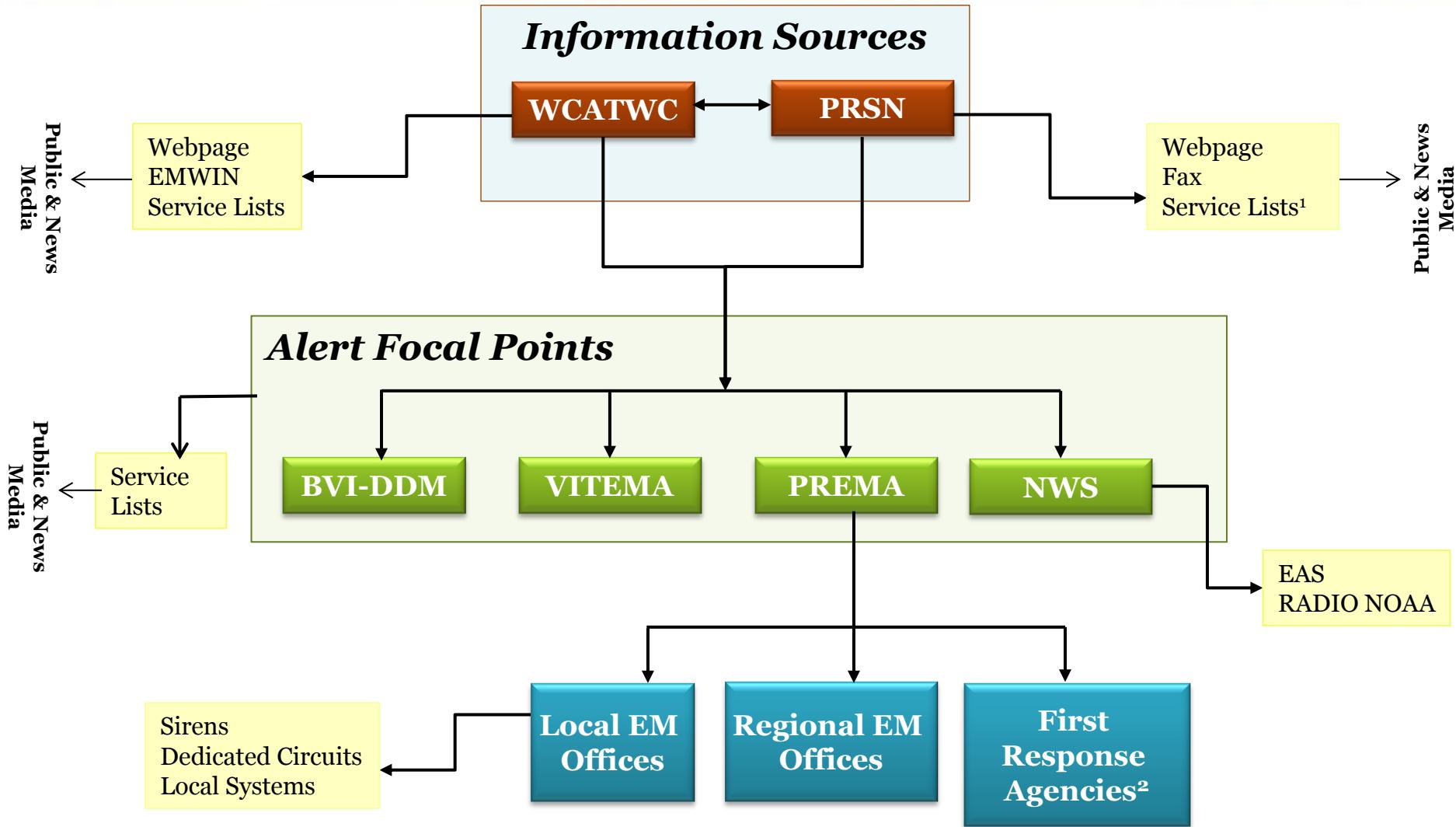
- **bilingual** (Spanish-English) service.
- Alert messages **simple, concise and “to the point”**.
- Dissemination **dedicated phone lines**.
- Use of **ham radio** (emergency frequency only).

***Information Sources***



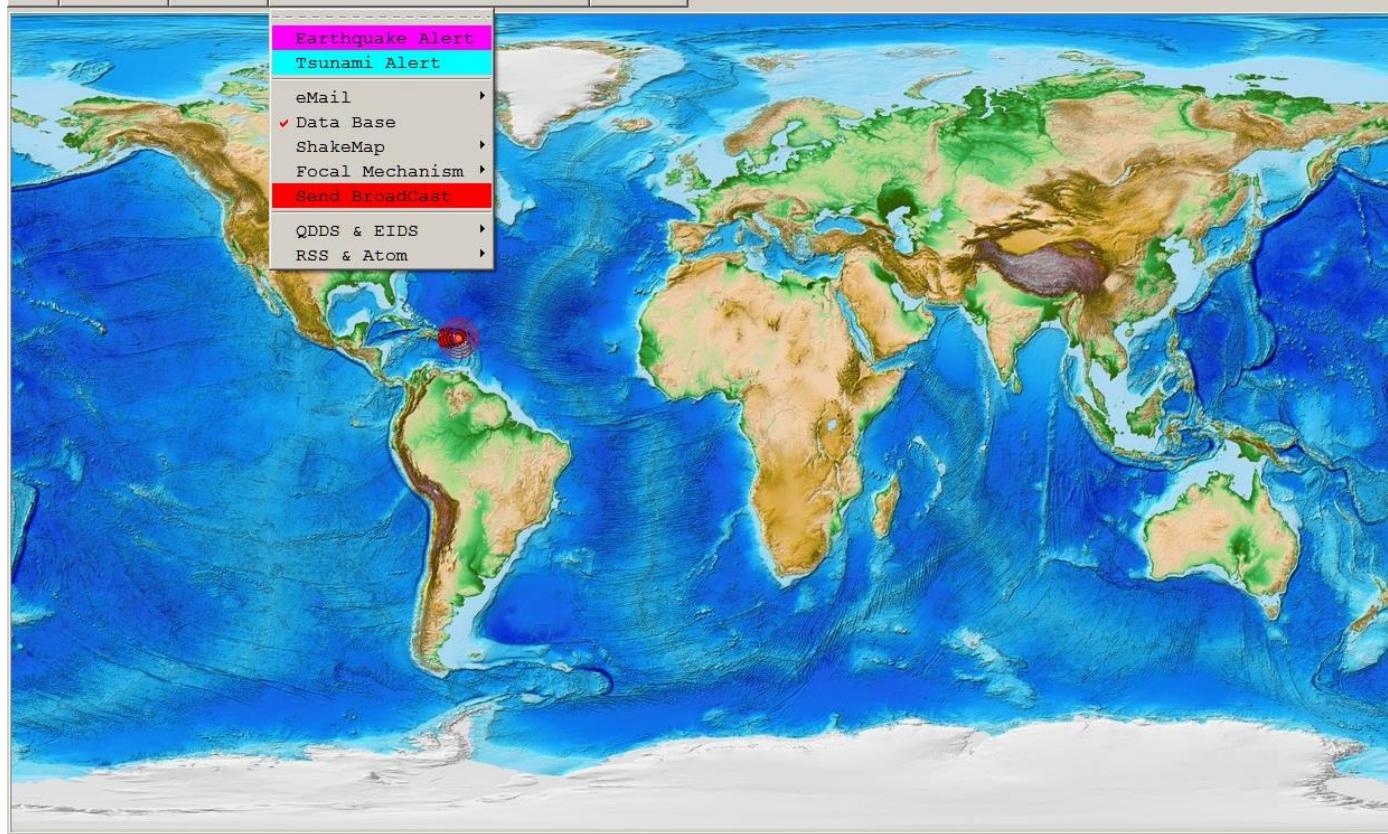
***Alert Focal Points***





1. They include email lists, text messages lists, RSS, etc.

2. They include : Police, Fire Department, National Guard and Medical Emergencies Personnel. PREMA will determine which agencies will be notified according to the Tsunami Alert Level in place.



## EARTHQUAKE INFORMATION

DATE AND TIME:  
 2013/03/14 15:03:21.29 (UTC)  
 2013/03/14 11:03:21.29 (LOCAL)

PRSN-ID: 20130314150321

BULLETIN: 00

EB-ID: 0000 CORR: 00

QDDS-ID: 13073002

LATITUDE: 19.0553  
 LONGITUDE: -64.965  
 DEPTH: 28 Km  
 MAG: 2.95 M<sub>l</sub> - 4 AVERAGE

DISTANCES:  
 76.76 Km NW of Anegada, BVI  
 78.61 Km N of Charlotte Amalie, USVI

REGIONS:  
 FE: VIRGIN ISLANDS  
 PR: Sombrero Seismic Zone

GAP: 250 RMS: 0.31  
 ERH: 2.98 ERZ: 21.65  
 MIN. DISTANCE: 75.8

P-PHASES: 7 S-PHASES: 6  
 ABVI PR BHZ A 75.8 118 99 EP- 1 3  
 TBVI PR SHZ A 79.7 152 98 EP+ 1 3  
 CUPR PR BHE A 89.3 203 97 EP- 1 3  
 CUPR PR BHE A 89.3 203 97 ES 1 4  
 MTP PR BHZ A122.9 211 94 EP- 1 3  
 MTP PR BHE A122.9 211 94 ES 1 5  
 CBYP PR BHZ A128.0 228 94 EP+ 1 3

EVENT/RSS/EMAIL/SMS COMMENT

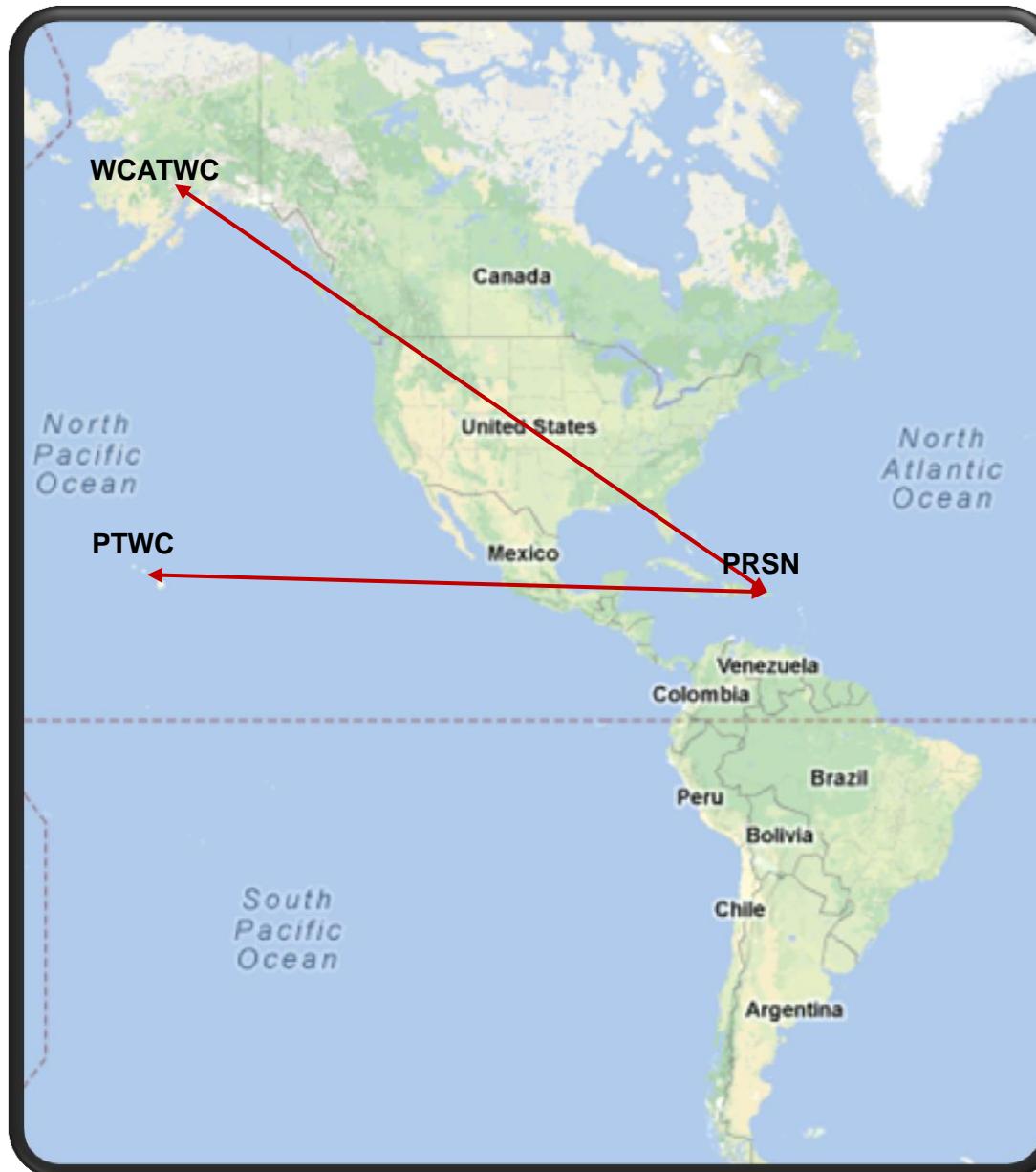
ID-Corr	Date	UTC-Time	Lat.	Lon.	Depth	P's	RMS	GAP	Mb-No	M1-No	MS-No	Mwp-No	Mw-No	P	Loc	FE	PR
0000-00	2013/03/14	15:03:21.29	19.0553	-64.965	28	13	0.31	250	0.00-00	2.95-4	0.00-00	0.00-00	0.00-00	2	1	91	24
0000-00	2013/03/14	07:21:36.83	18.0611	-65.1051	8	8	0.17	309	0.00-00	2.47-4	0.00-00	0.00-00	0.00-00	2	1	90	27
0000-00	2013/03/14	05:23:04.13	17.9208	-65.4608	12	16	0.09	197	0.00-00	2.18-6	0.00-00	0.00-00	0.00-00	2	1	90	27
0000-00	2013/03/13	10:58:01.01	19.5363	-67.8905	33	0.28	256	0.00-00	3.31-7	0.00-00	0.00-00	0.00-00	0.00-00	2	1	89	14
0000-00	2013/03/12	16:35:07.44	18.5423	-64.2975	25	15	0.18	348	0.00-00	2.72-6	0.00-00	0.00-00	0.00-00	2	1	91	25
0000-00	2013/03/12	12:24:50.49	18.4243	-67.3728	10	6	0.04	256	0.00-00	2.12-3	0.00-00	0.00-00	0.00-00	2	1	89	11
0000-00	2013/03/12	16:35:07.44	18.5423	-64.2975	25	15	0.18	348	0.00-00	2.72-6	0.00-00	0.00-00	0.00-00	2	1	91	25
0000-00	2013/03/12	11:15:00.34	18.1068	-67.1106	17	6	0.10	274	0.00-00	1.57-3	0.00-00	0.00-00	0.00-00	2	1	89	8
0000-00	2013/03/12	06:51:42.63	18.9323	-68.0351	83	0.45	338	0.00-00	3.38-11	0.00-00	0.00-00	0.00-00	0.00-00	2	1	89	20



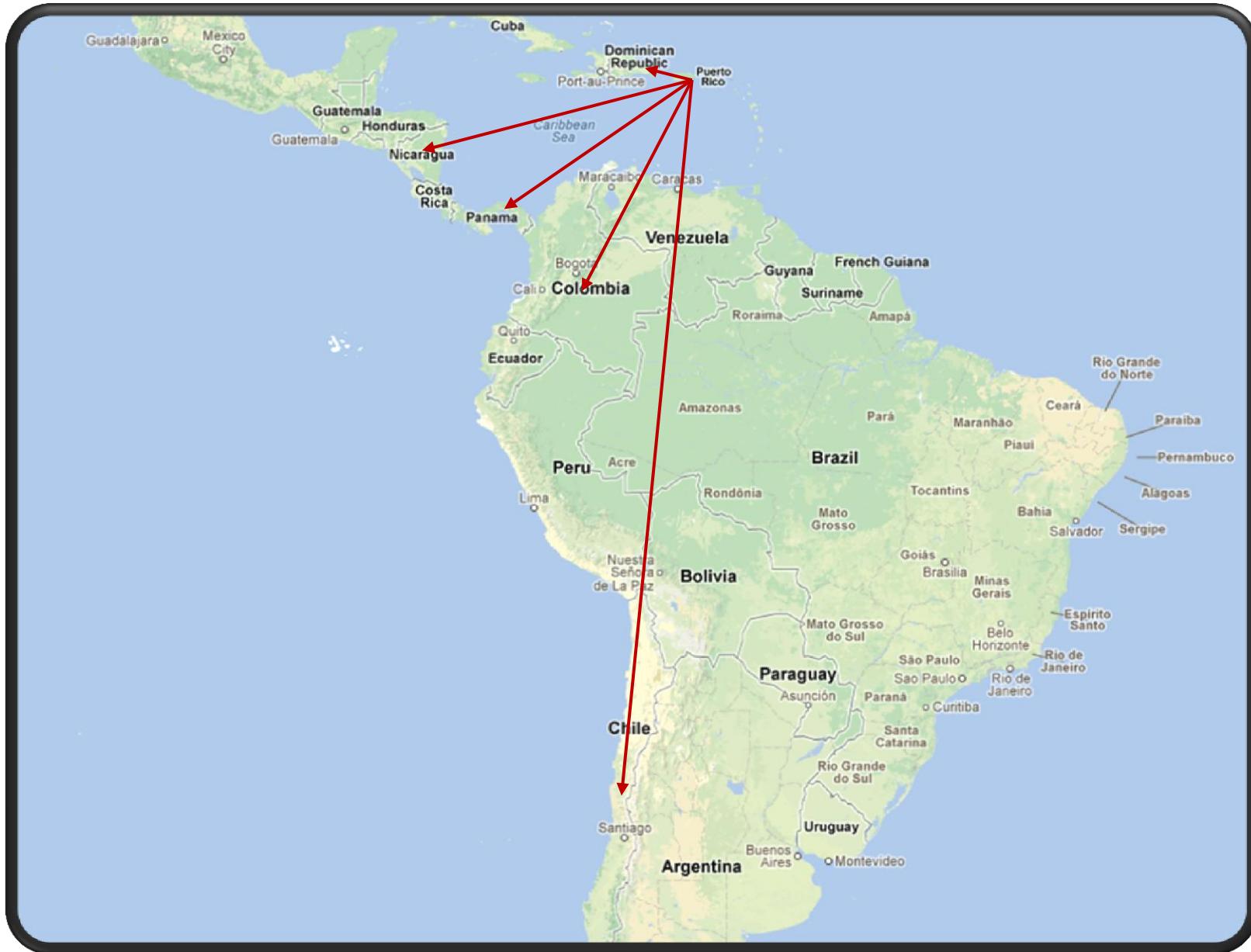
PRDANIS Broadcast Client

E.g. Haiti Eq

## EarlyBird & Location Algorithms



## EarlyBird Installation, Configuration & Training



## Training & Workshops

### Tsunami Response Procedures In-house Training (2011)

- Secretaría de Marina de México
- Haiti Meteorological Service



Real-Time  
Seismic Inversion  
Workshop  
2011

## Training & Workshops



Workshop	Year	Co-sponsors	Participants
<b>Real-Time Seismic Inversion</b>	October 2011	UNESCO/IOC-GLOSS	International -mainly from Caribbean nations
<b>Tsunami Media Kit</b>	2012, 2011		PR News Media
<b>Port operators workshop</b>	November 2010	NSF/NOAA	PR & Caribbean nations
<b>Caribbean Tsunami Ready Summit</b>	May 2010	NOAA	PR & Caribbean nations
<b>Caribbean Training Course for Operators of Seismic Stations</b>	February 2010	UNESCO/IOC-GLOSS	PR & Caribbean nations

## Collaborative Research and Publications

Paper Published on ***Science of Tsunami Hazards (2009)***

### **NOAA/WCATWC Atlantic Ocean Response Criteria**

Whitmore, P., ten Brink, U., Caropolo, M., Huerfano-Moreno, Knight, W., Sammler, W. and, Sandrik, A.

NOAA/WCATWC

US Geological Survey

Puerto Rico Seismic Network, University of Puerto Rico at Mayaguez

NOAA/National Weather Service: North Carolina, Virginia and Florida Offices

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NOAA/WCATWC  
US Geological Survey  
Puerto Rico Seismic Network, University of Puerto Rico at Mayaguez  
NOAA/National Weather Service: North Carolina, Virginia and Florida Offices

Paper Submitted to **BSSA**

### **One-dimensional reference velocity model and earthquake relocation in Puerto Rico Island**

Zhang, Q., Lin, G., Huerfano, V. A. and , Soto-Cordero, L.

Department of Marine Geology and Geophysics, University of Miami

Department of Geology, University of Puerto Rico, Puerto Rico Seismic Network

