The UNESCO IOC Tsunami and Other Coastal Hazards Warning System for the Caribbean and Adjacent Regions (CARIBE EWS): Seismic Monitoring Component

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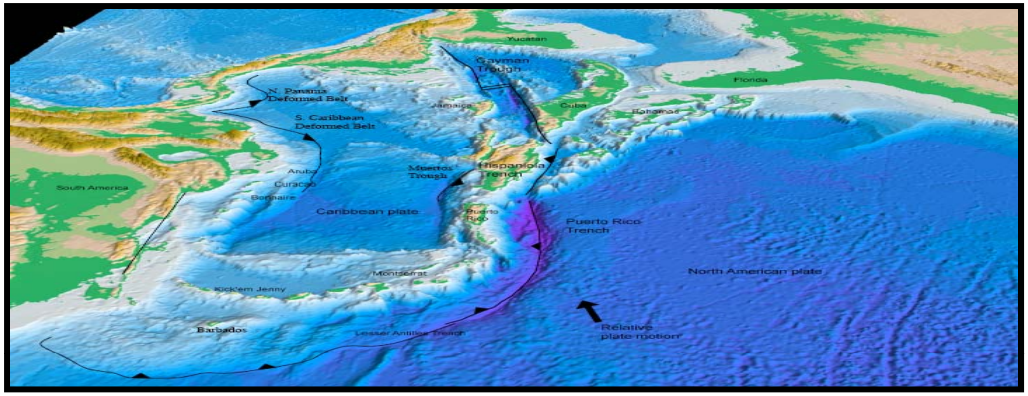
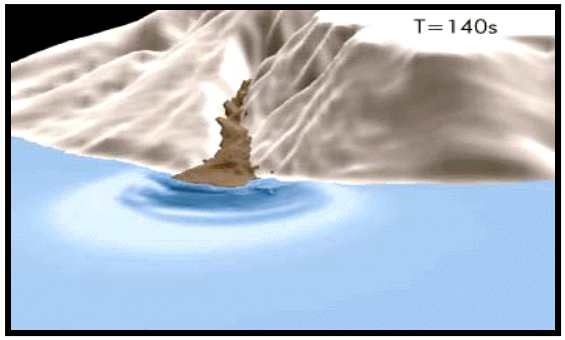
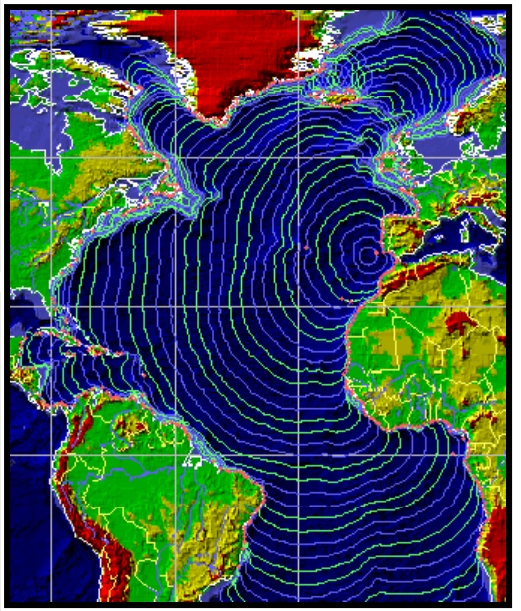
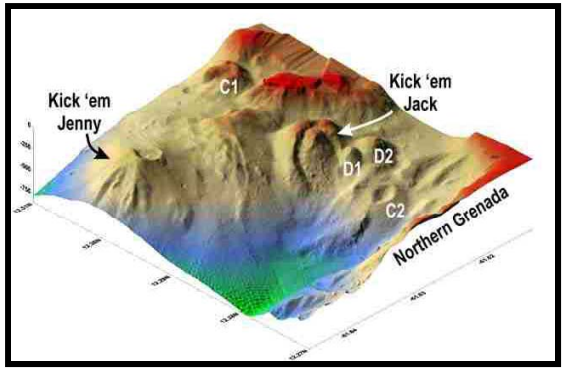
In the Caribbean tsunamis have been a forgotten danger because of nature's infrequency, but the region has a history of tsunamis with its many tsunamigenic sources

- Earthquakes
  (tectonic subduction zones & faults throughout the Caribbean)
- Landslides
  (continental shelves, trenches etc.)
- Volcanoes
  (submarine & land)
- Tele-tsunamis
  (e.g. "Lisboa" Nov. 1, 1755)







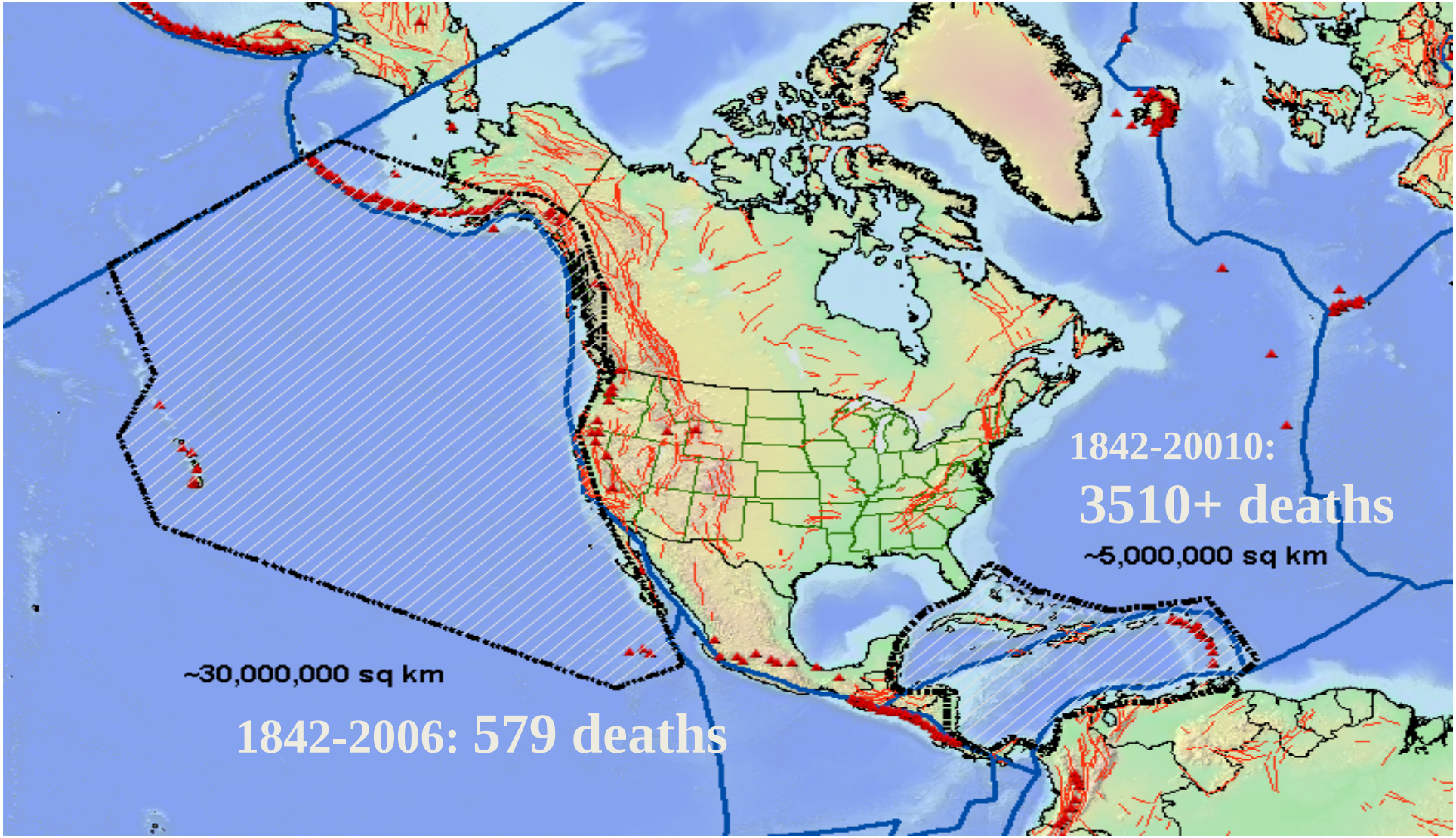


168 Years of Caribbean Tsunami Deaths

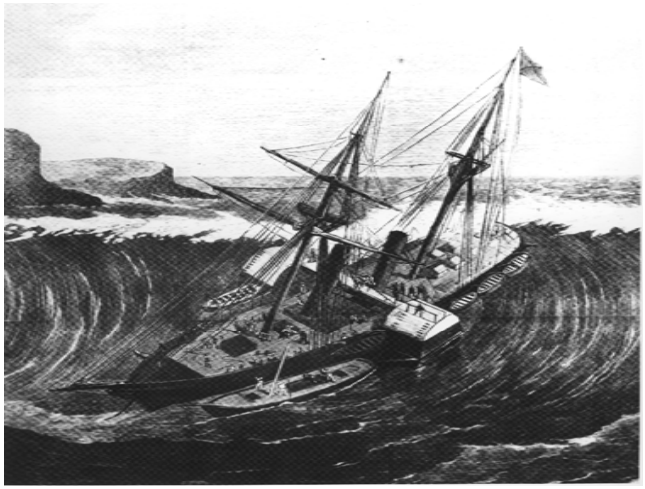
Date	Place	Fatalities
1842	Haiti	300+
1853	Venezuela	600+
1867	Virgin Islands	23
1882	Panama	75+
1906	Jamaica	500
1918	Puerto Rico	140
1946	Dominican Republic(1)	1790
1946	Dominican Republic(2)	75
2010	Haiti	7
TOTAL		**3510**

Ref: ***Caribbean Tsunamis, A 500-Year History from 1498-1998*** by Karen Fay O'Loughlin and James F. Lander (2003: ISBN 1-4020-1717-0); Tsunamis of the Eastern US, NGDC, 2002 Science of Tsunami Hazards, vol 20, #3, pg 120; PRSN on Haiti,2010

The Caribbean basin in only 1/5 the area had nearly 6x more deaths !



The risk to life from tsunamis has increased dramatically due to coastal population and tourism growth.
Here we see the port at Charlotte Amalie Bay, St. Thomas



20 Foot tsunami, November 18, 1867

Same bay in St. Thomas today with 25,000 lives at risk !

30 people lost their lives on November 18, 1867 in a 20 ft tsunami. Today there can upwards of 15,000 to 25,000 people at risk because of cruise ships. Almost all these people are in the tsunami inundation zone around the bay, beaches and shops.

UNESCO IOC Intergovernmental Coordinating Group for the Tsunami and other Coastal Hazards Warning System for the Caribbean and Adjacent Regions (ICG CARIBE EWS)

- UNESCO/IOC body
- 28 member states, commonwealths, territories
- Established in 2005
- 5 Sessions have been held in Barbados, Venezuela, Panama Martinique and Nicaragua
- Next session: April 2011, Dominican Republic

Main Components of CARIBE EWS

Per recommendation of the Member States

- Working Groups:
  - Monitoring and Tsunami Warning Guidance
  - Tsunami Hazard, Risk and Vulnerability Assessments
  - Communications
  - Preparedness, Readiness and Resilience
- Permanent Bodies
  - Caribbean Tsunami Warning Center-CTWP potential first step
  - Caribbean Tsunami Information Center – to be established in Barbados with funding by the Govt. of Italy
  - Secretariat-Interim location in Paris, France at UNESCO HQ

Caribbean Tsunami Warning Program

- Established by NOAA NWS on February 1, 2010 in Mayagüez, Puerto Rico at the PRSN.
- First step of a phased approach towards the establishment of a Caribbean Tsunami Warning **Center**
- Current focus on increasing availability and quality of seismic and sea level observations
- Provide tsunami education and outreach support
- Support development of web tools for tsunami forecast applications

ICG CARIBE EWS Mission statement for the CTWC

approved June, 2009

- The CTWC will provide a timely and effective **detection and analysis (forecast)** of seismic events and tsunamis, **conduct research and dissemination** of tsunami watch, warnings and advisory products, as well as provide support for **education, outreach and training** to the Caribbean countries, states, territories and Adjacent Regions.

Recommendations of ICG CARIBE EWS for Seismic Monitoring

- Establish Performance Criteria and Requirements for seismic stations
- Each Tsunami National Contact (Government official) has been requested to identify the contact point within the country for seismic, sea level and other observational data
- Develop a training plan for station operators
- Urges member states to upgrade and/or install GPS stations and consider collocation with seismic and sea level stations

Cont. Further Recommendations

- Urges Member States and other stakeholders to provide funding to support the acquisition, installation, maintenance and operation of core seismic and sea level stations contributing data to meet the full needs of the CARIBE-EWS and strengthen the communication systems of the monitoring centres exchanging data with the warning centres to ensure data availability;

Cont. Further Recommendations

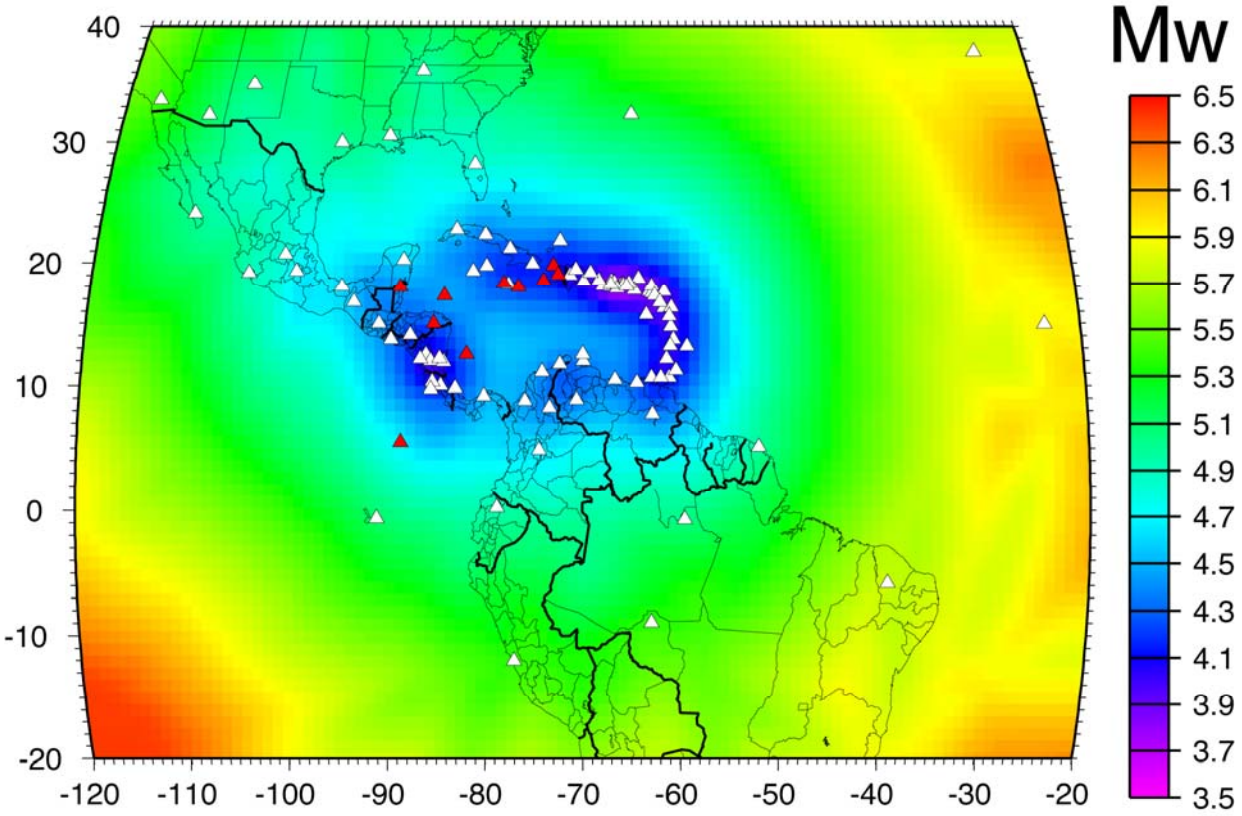
- Welcomes the Memorandum of Cooperation between the CTBTO and IOC to facilitate the access of primary and secondary data to the CARIBE-EWS;
- Encourages that the continuous seismic data be sent to global data centres to facilitate research to improve the understanding of the seismic hazards;

Performance Criteria of CARIBE EWS Seismic Network

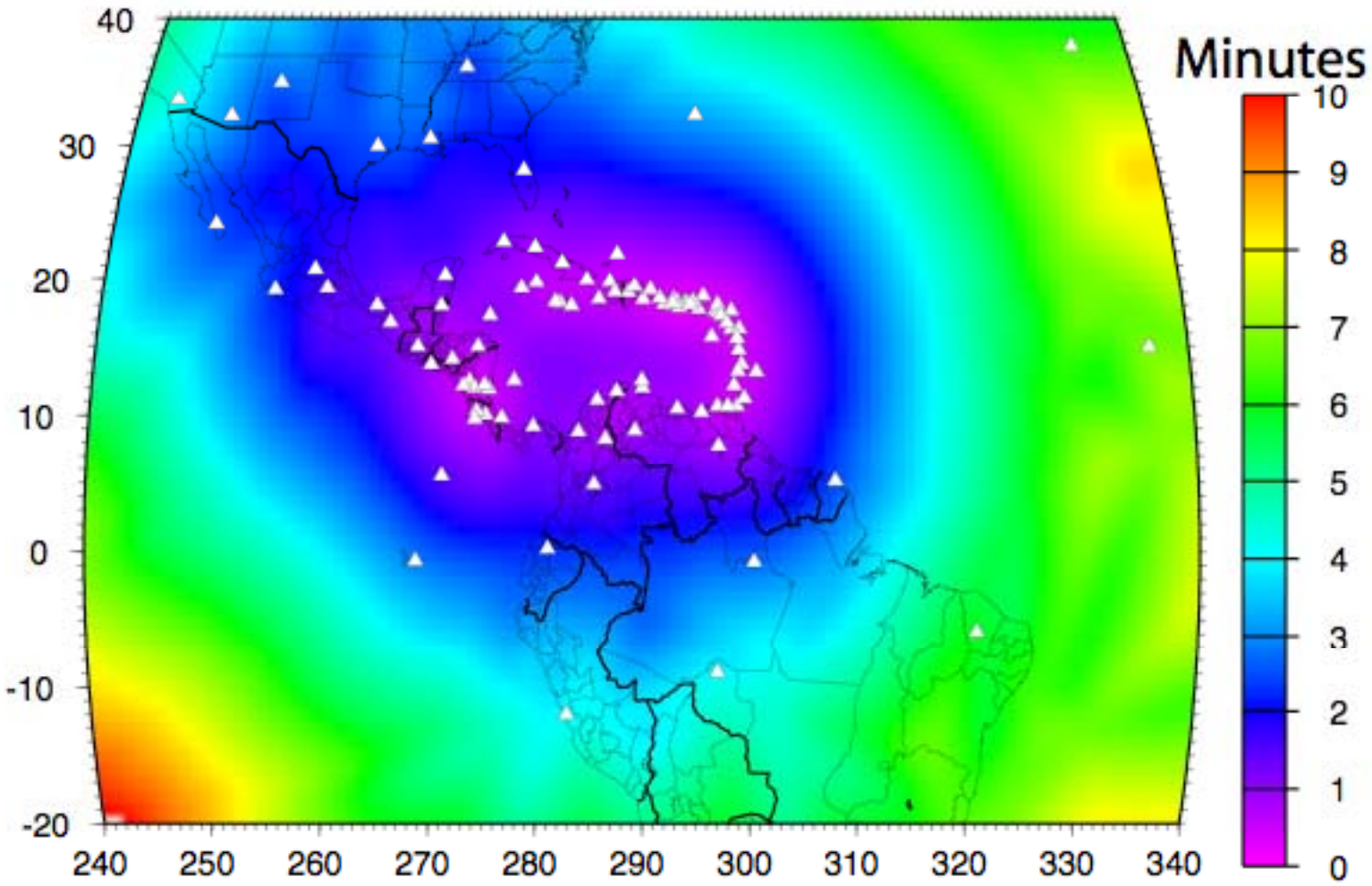
- Caribbean Region: **Detection within 1 minute** for all earthquakes in the region of **magnitude 4.5 or greater** with initial hypocenter error of up to **30 km within two minutes**.
- Adjoining Regions: **Detection within 1 minute** for all earthquakes in the region of **magnitude 6.0 or greater** with initial hypocenter error of up to **30 km within** 3 minutes.

5 Station Mw detection threshold for 121 CORE stations

analysis performed by D. McNamara, USGS

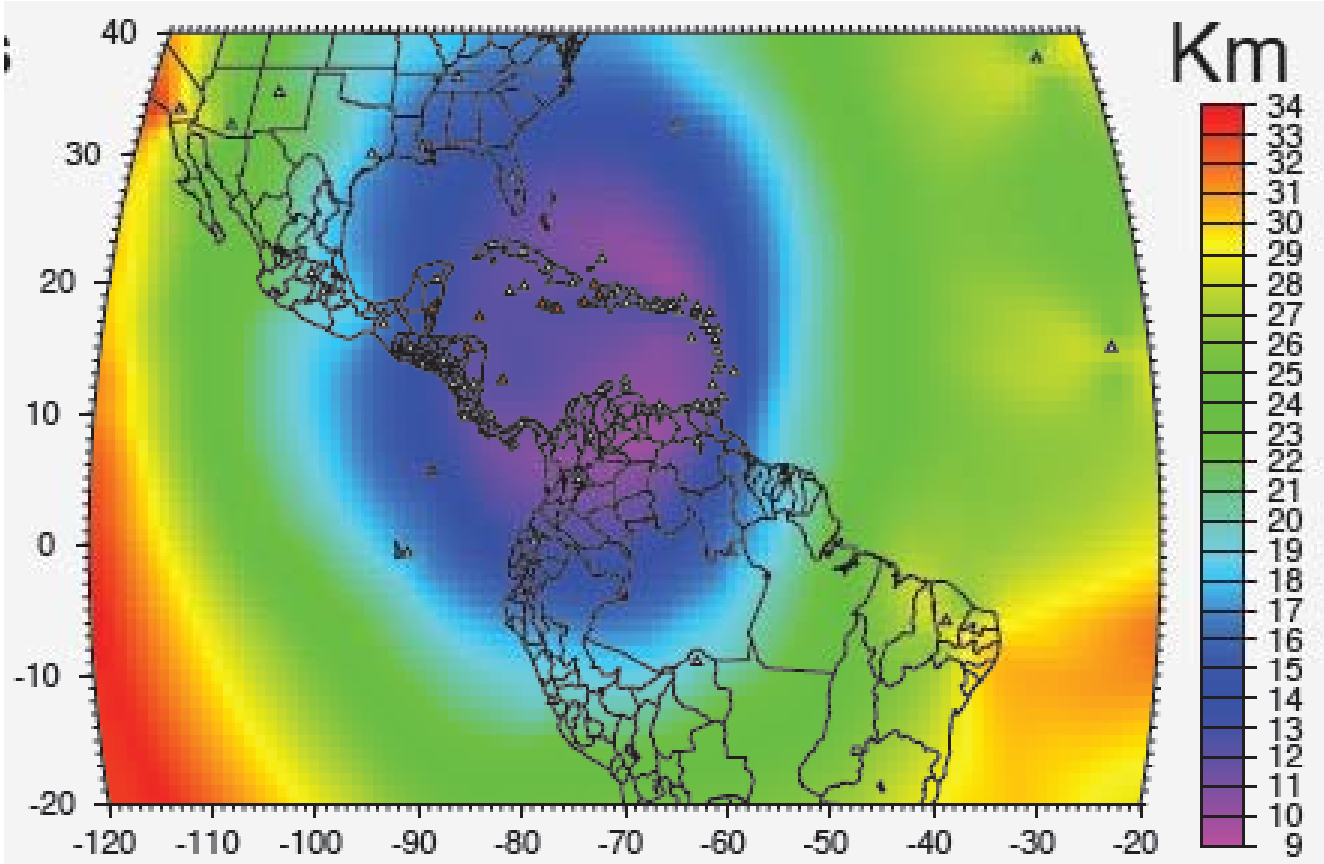


5 Station P-wave detection time
for 121 CORE stations
Analysis performed by D. McNamara, USGS



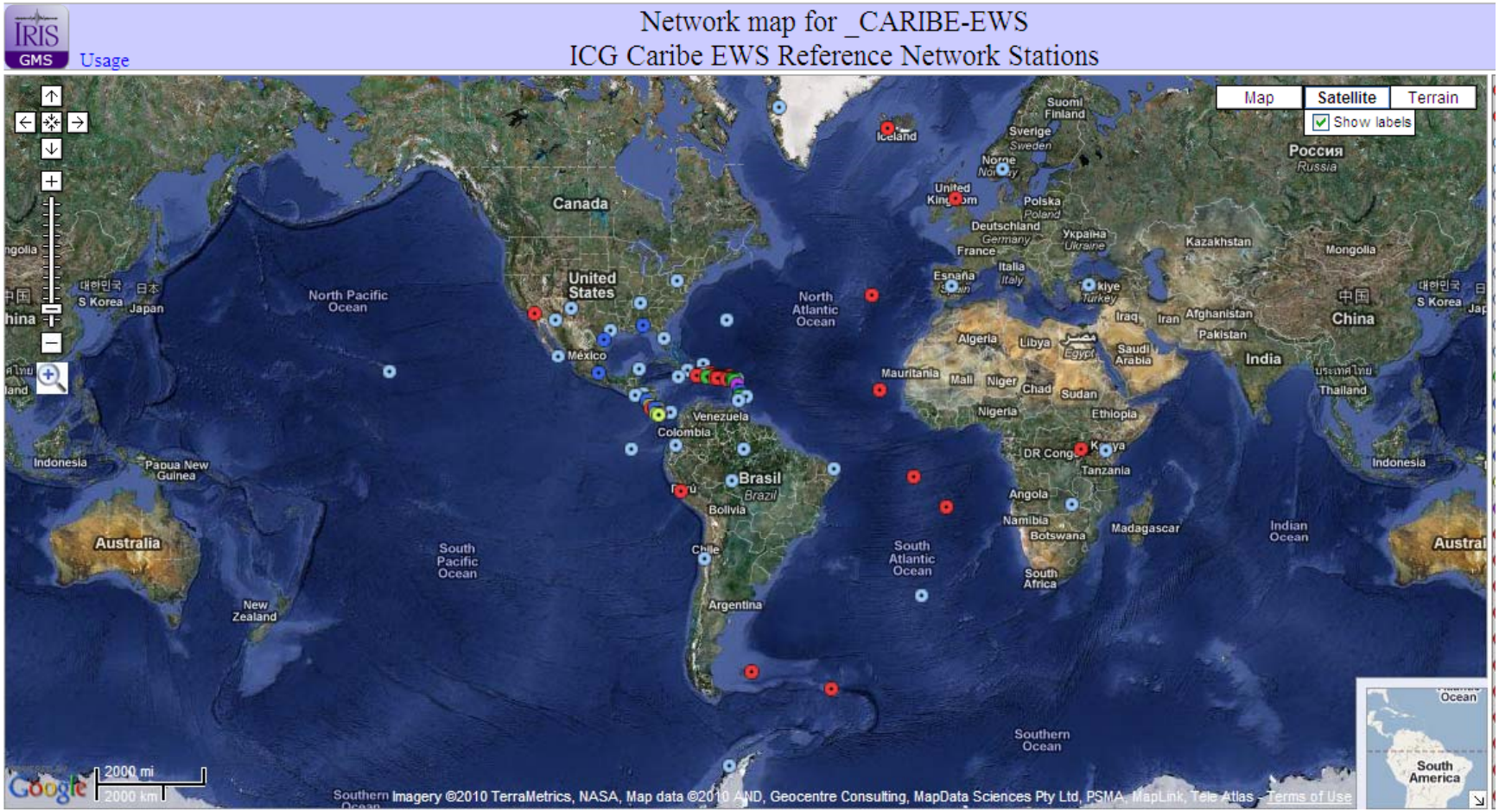
Theoretical Earthquake Location Error

Analysis performed by D. McNamara, USGS

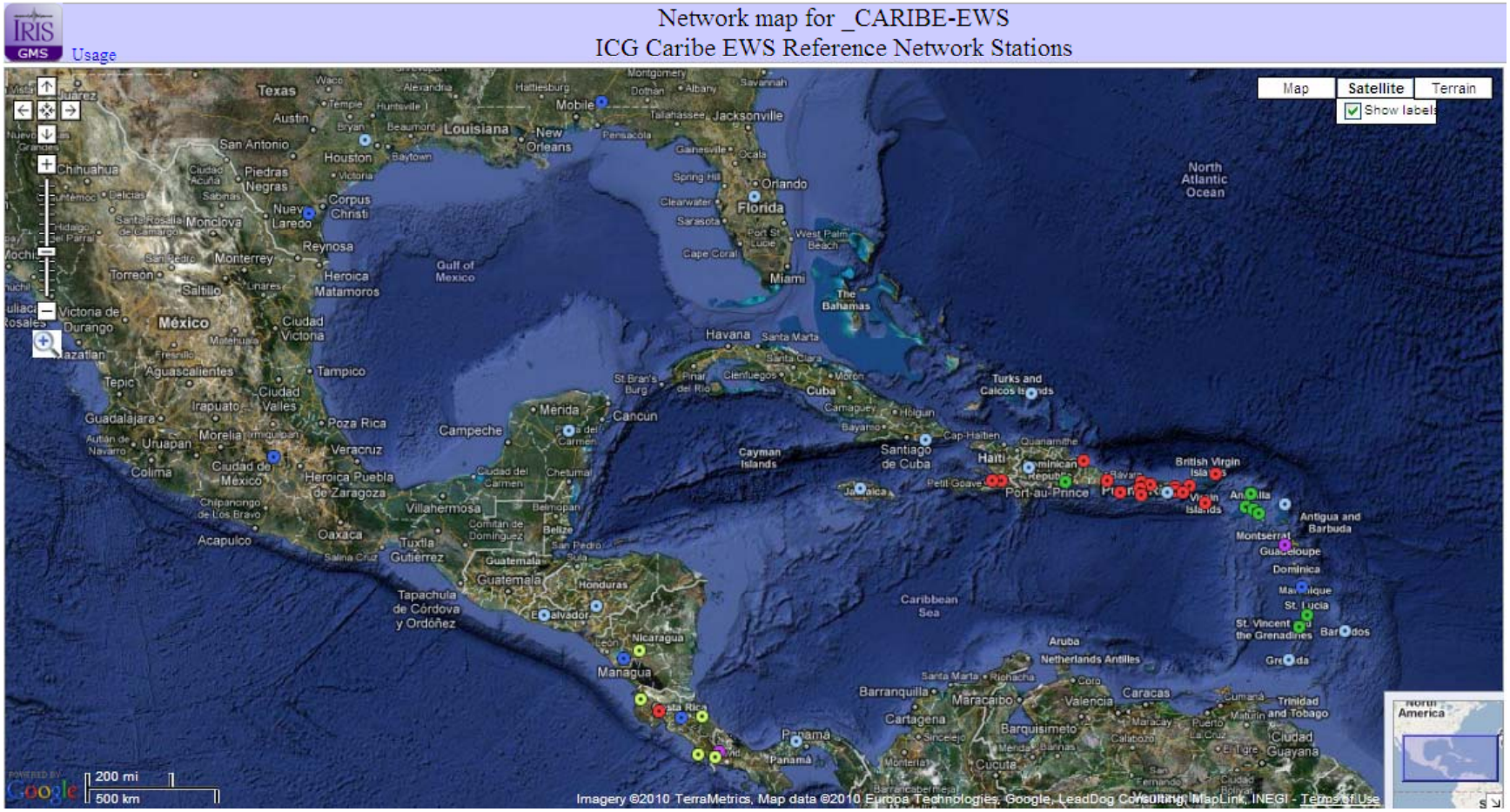


The map above shows the theoretical earthquake location error for complete 121 station core network. We map the length of the major axis of the error ellipse in km. For this preliminary analysis we assume Surface source and use a P-wave fist arrival at each real-time station.

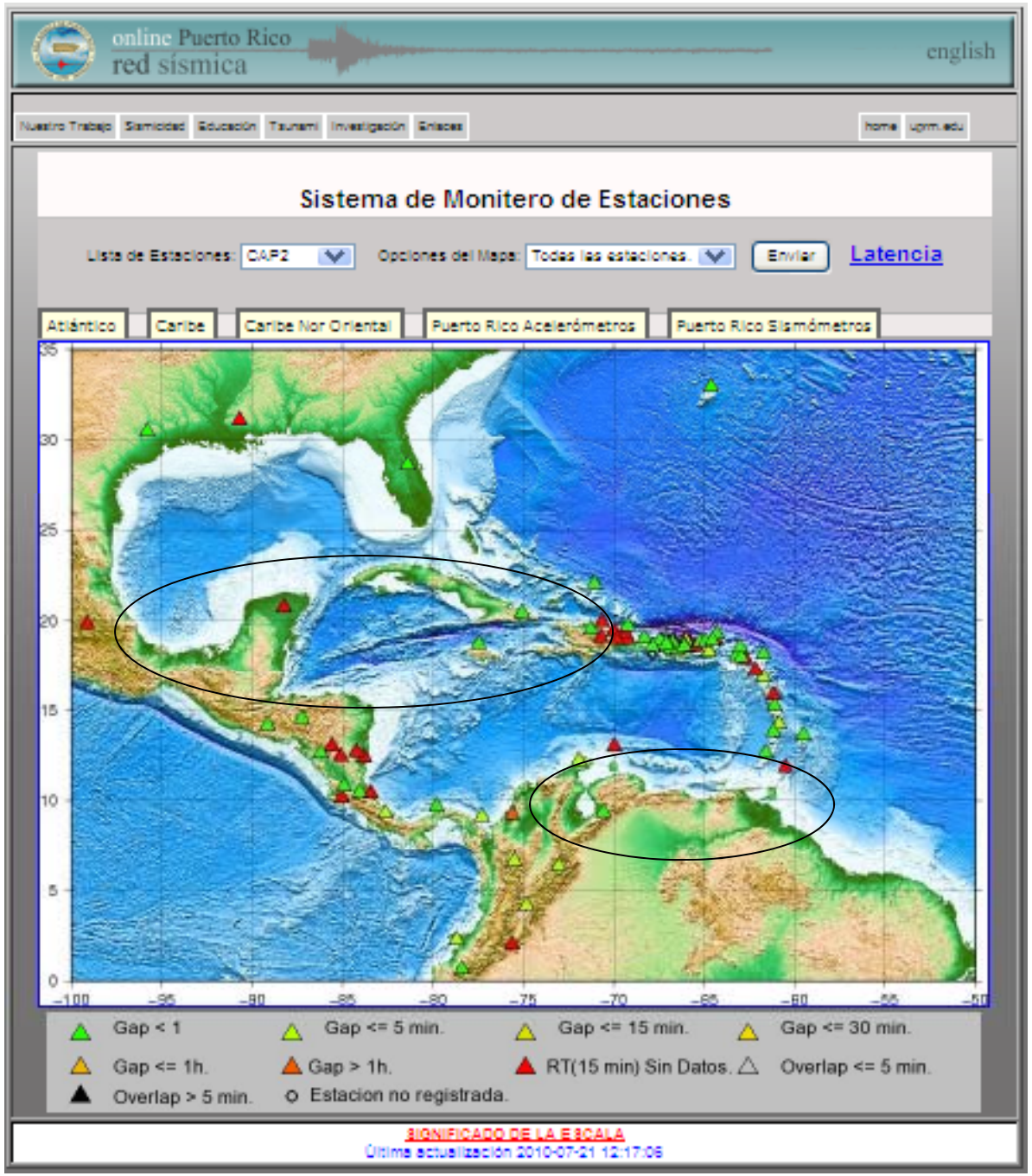
CARIBE EWS Virtual Seismic Network at IRIS DMC (http://www.iris.edu/vnets)



Zoom of Caribbean stations in CARIBE EWS IRIS Virtual Seismic Network



Caribbean Seismic Data Availability at PRSN

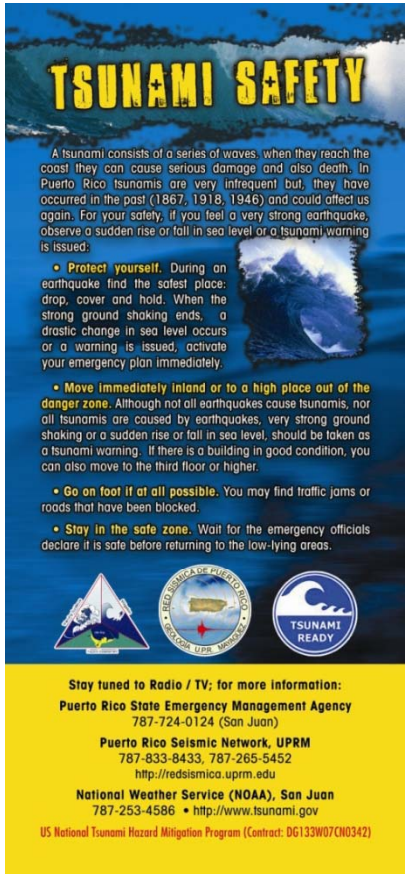


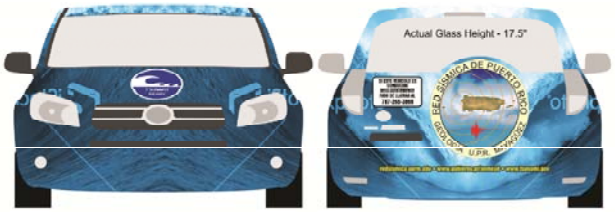
Communications and Dissemination

- 24 hour capability of communities to rapidly receive and disseminate emergency information messages

Social media, SMS, web sites…

Education, Outreach and Preparedness





Our Mission: Save lives, property and livelihood…

Thank you

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Seismic Station Requirements of ICG CARIBE EWS

approved June, 2009

CHARACTERISTICS	MINIMUM REQUIREMENTS	OPTIMAL REQUIREMENTS
Sensor type	BB Seismometer	BB Seismometer and Accelerometer
Station type	Vertical Component	Three-component each instrument
Accuracy of Location of Sensor	<100 m, horizontal < 20 m, elevation	<10 m, horizontal < 10 m, elevation
Calibration	System gain know to 10%	Full –frequency response know to 10%
Sampling rate	20 sps (seismometer)	100 sps for both instruments
Frequency Range (flat response)	0.1 to 20 sec	0.02 to 240 seconds Dc to 50 Hz
Seismometer noise	≤5 dB below the low noise model (NLNM), between 0.2 and 5 Hz	≤10 dB below the low noise model (NLNM), between 0.1 and 10 Hz
Dynamic Range	>120dB	>136dB
Absolute Timing Accuracy	<10 ms	<10 ms
Delay in Transmission to Warning Centre	<30 seconds	<10 seconds
Timely Data Availability	>95%	>95%
Data transmission protocol	Compatible with the TWC, maximum data frame length 20s	Compatible with the TWC, maximum data frame length 10s
Data transmission	Continuous	Continuous
Communications Infrastructure	Internet or VSAT	VSAT, Internet