Caribbean Tsunami Hazards

4.5

Nicolás Arcos

UNESCO/IOC – NOAA International Tsunami Information Center
Introduction

- Historical Tsunamis in the Caribbean
- Paleotsunami research in the Caribbean
  - Anegada and NE Caribbean
  - Boulders
- Tsunami Risk in the Caribbean
The Caribbean has many tsunami-genic sources, most of them short-fused (nearby)...

- **Local and Regional Earthquakes** (tectonic subduction zones & numerous faults)
- **Landslides** (continental shelves, PR trench, coastal slides)
- **Volcanoes** (submarine & land – Kick ‘em Jenny, Montserrat)
- **Tele-tsunamis** (e.g. “Lisbon” Nov. 1, 1755)
Tectonic Framework
Seismicity in the Caribbean
1500-2013 Caribbean Tsunami Events

http://www.ngdc.noaa.gov/hazard/tsu.shtml
Tsunamis in Caribbean

Average is ~3 per decade
# Most Significant Recent Tsunamis

<table>
<thead>
<tr>
<th>Fatalities</th>
<th>Year</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>300</td>
<td>1842</td>
<td>Haiti</td>
</tr>
<tr>
<td>1000</td>
<td>1853</td>
<td>Venezuela (possible that the deaths were due to earthquake)</td>
</tr>
<tr>
<td>30</td>
<td>1867</td>
<td>US Virgin Islands</td>
</tr>
<tr>
<td>100</td>
<td>1882</td>
<td>Panama</td>
</tr>
<tr>
<td>142</td>
<td>1918</td>
<td>Puerto Rico</td>
</tr>
<tr>
<td>1790</td>
<td>1946</td>
<td>Dominican Republic</td>
</tr>
<tr>
<td>75</td>
<td>1946</td>
<td>Dominican Republic</td>
</tr>
<tr>
<td>2</td>
<td>1991</td>
<td>Costa Rica</td>
</tr>
<tr>
<td>7</td>
<td>2010</td>
<td>Haiti</td>
</tr>
</tbody>
</table>

**TOTAL:** 3446
Scenario LANTEX 2009

- M 8.6
- North of Puerto Rico
- Maximum modeled offshore wave height 7.4 m for Aguadilla, although most in 2-3 m range in Puerto Rico and the VI
- The height of the wave on the shore could be double that of the model outputs.
- Travel time first wave: 17 minutes
Scenario LANTEX 2010

- M 7.5
- 170 miles southeast of Boston, generated a landslide
- Maximum modeled offshore wave height 7.5 m for Aguadilla, although most in 2 m range in Puerto Rico and the VI
- The height of the wave on the shore could be double that of the model outputs.
- Travel time first wave: 3 hours
M 7.6 in the USVI Basin, between St. Thomas and St. Croix

Maximum modeled offshore wave height 4.7 m

The height of the wave on the shore could be double that of the model outputs.

Travel time first wave: 1min – 5 hours
Scenario LANTEX 2012

- Two Scenarios. One for the Gulf and one for Atlantic, for the Atlantic scenario, the tsunami is generated by a magnitude 7.7 which triggers in a submarine landslide.

Figure 40. West Florida landslide maximum wave amplitude using 60 arc-seconds grid resolution.

Lantex 2012 - Tsunami Propagation Forecast

Countours of forecasted maximum wave amplitudes [m], detailing tsunami energy propagation.
Scenario CARIBE WAVE 2013

- M 8.5
- North of the Aruba/Bonaire and Curacao islands.
- Rupture area = 300 x 100 km, depth ~ 5-15 km (Figure 1). The evenly distributed slip is of 5.26 meters.
- Wave heights of up to 14 meters in the Dominican Republic
Scenario CARIBE WAVE 2014

- Modeled after 1755 Lisbon
- Mw 9
Contribution of Brian Atwater (USGS) and others...

PALEOTSUNAMI STUDIES IN THE CARIBBEAN
Tsunamis leave geologic records including: sand, boulders, and marine traces.
SIGNS OF A TSUNAMI OR STORM 1650-1800

Inland fields of scattered boulders
Breached beach ridges >2 m high
Widespread sheet of sand, shell, and mud

From Lisbon and Puerto Rico Trench 1945
Laminated microbial-mat peat

Lime-mud cap

Shell gravel with angular limestone granules and pebbles

Shelly mud
Beach ridges
Salt flat

Upside-down brain coral
A Pleistocene Anegada existed 120,000 years ago
Caribbean risk to life from tsunamis has increased dramatically due to coastal population & tourism growth!

For example: Port at Charlotte Amalie Bay, St. Thomas, USVI

November 18, 1867. 30 people lost their lives. Max. wave height 18.1 meters

Same bay in St. Thomas today, with 6 cruise ships in port (4 in foreground, 2 in background) with lives of 25,000+ tourists & residents at risk. 80% of jobs and Gross Territorial Product are Tourism dependent.

On any given day just on the beaches in the Caribbean, it is estimated there are 250,000 people.
Thank You

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