Papers and reports can be downloaded from Woodshole.er.usgs.gov/staffpages/utenbrink/selectedbiblio
Papers and reports can be downloaded from Woodshole.er.usgs.gov/project-pages/Caribbean

USGS research of tsunami sources in Caribbean, Atlantic, and Gulf of Mexico funded by the USGS and by the US-NRC with help from NOAA

Regional Assessment of Tsunami Potential in the Gulf of Mexico
Report to the National Tsunami Hazard Mitigation Program
2009

NRC/USGS Workshop Report: Landslide Tsunami Probability
Convened August 18-19, 2011 at the USGS Woods Hole Science Center, Woods Hole, MA
By Eric L. Geist and Uri S. ten Brink

The Atlantic and Gulf of Mexico

Evaluation of Tsunami Sources with the Potential to Impact the U.S. Atlantic and Gulf Coasts
An Updated Report to the Nuclear Regulatory Commission
By Atlantic and Gulf of Mexico Tsunami Hazard Assessment Group
2008
Recurrance interval based on analysis of historical earthquakes
Subduction zone-related earthquakes only in a 415-km-long segment

<table>
<thead>
<tr>
<th>Year and magnitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>1897 6.5</td>
</tr>
<tr>
<td>1915 6.4</td>
</tr>
<tr>
<td>1916 6.8</td>
</tr>
<tr>
<td>1917 7.0</td>
</tr>
<tr>
<td>1918 7.3</td>
</tr>
<tr>
<td>1920 6.5</td>
</tr>
<tr>
<td><strong>1943 7.8</strong></td>
</tr>
<tr>
<td><strong>1946 7.9</strong></td>
</tr>
<tr>
<td>1946b 7.5</td>
</tr>
<tr>
<td>1946c 7.0</td>
</tr>
<tr>
<td>1948 7.3</td>
</tr>
<tr>
<td>1953 7.1</td>
</tr>
<tr>
<td>2003 6.4</td>
</tr>
</tbody>
</table>

Total moment release = 400 yrs slip perpendicular accumulation at 4 mm/y
No known subduction earthquakes in Virgin Islands and Lesser Antilles

tsunami simulation from a subduction earthquake (Wei et al., in prep.)

- **Reported tsunami from 1690 earthquake**

- **5 Apr 1690 M\textsubscript{L} 7.5**

- **8 Feb 1843 M\textsubscript{L} 7.8**

- **May 2, 1787 M\textsubscript{L} 6.9±0.35**

- **Location of reported intensity**
- **Preferred intensity center**
- **68% location confidence**
- **Magnitude contours**
GPS measurements and models suggest NO strain accumulation toward a future mega-earthquake north of Puerto Rico and the Virgin Islands.

Small red arrows - Motion of GPS sites relative to interior Caribbean plate reference. Velocity measured continuously over 3-5 years. Blue arrows – model fit.
Evidence for tsunami overwash: (1) Remnants of breached sand ridges. Ridges are 3 m high; (2) Fields of cobbles and boulders up to 0.8 km from nearest shore; (3) Sand and shell layer extend 1.5 km south of ridges. (Atwater et al., 2012)

Dated > 1650 AD (Watt et al., 2012)
Coral-Boulder Ages

<table>
<thead>
<tr>
<th>Group</th>
<th>$^{14}$C yr BP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Younger</td>
<td>890±25 to 1020±25</td>
</tr>
<tr>
<td>Older</td>
<td>1150±35 to 1240±20</td>
</tr>
<tr>
<td>Outlier</td>
<td>1960±40</td>
</tr>
</tbody>
</table>

Map showing locations of reefs and boulders.
Muertos Trough

Tsunami potential from Muertos Trough

Vanuatu (New Hebrides)

Northern Panama Deformation Belt (NPDB)
1867 Virgin Islands earthquake and tsunami

Caused the U.S. to postpone the purchase of the Virgin Islands for 50 years.

$1B estimated damage from a similar event today.

M ~7.2
The source of the 1918 tsunami was previously thought to be an M7.2 earthquake. The source region of the tsunami was identified due to landslide material at depths of 915-1830 m (Taber & Reid, 1919). The landslide region could be active fault? and the possible epicenter of the 1918 earthquake. The landslide source of the 1918 tsunami could be due to a volume of 150 m^3 and thickness of 150 m. The missing material due to landslide is observed in the diagram.
Atlantic Continental Margin: Where to watch out for earthquakes that can cause landslides

Calculated maximum distance to failure, $r_{\text{max}}$ as a function of earthquake magnitude and slope

Earthquake region that can generate landslide tsunamis is limited to outer shelf and slope
Relative Dating

- Cross-Cutting Relationships – Scarp/debris & Canyon/Debris
Absolute Dating

- *Atlantic – Southern New England*

- Turbidite Facies

- *19,638 ± 265 yrs*
Gulf of Mexico Earthquakes and landslides

USGS NEIC catalog: 1970-present; d <= 35 km
Harvard CMT focal mechanisms

1880 M~6
NorteCubana fold and trust belt (inactive)

1982 Ms4.9

Gulf of Mexico

Salt domes
De Soto Canyon

Florida Panhandle

Mississippi Delta

Eastern Mississippi Fan