4.4 TWC Operations
Sea Level Monitoring in the Caribbean

Christa von Hillebrandt-Andrade
NOAA-NWS Caribbean Tsunami Warning Program
Sea Level Data

Acronyms
NWS - National Weather Service
EOC - Emergency Operations Center
EMWIN - Emergency Managers
Weather Information Network
GTS - Global Telecommunications System
FOS - Family of Services
ANNEX II

RECOMMENDATIONS

Recommendation ICG/CARIBE-EWS-XII.1

Tsunami Monitoring and Detection Systems

The Intergovernmental Coordination Group for the Tsunami and Other Coastal Hazards Warning System for the Caribbean and Adjacent Regions (ICG/CARIBE EWS),

Considering the report of Working Group 1 on Monitoring and Detection Systems and having reviewed the status of the observational data availability in the Caribbean and Adjacent Regions;

Recommends again the Member States to support the long-term operations of their national and local seismic, sea level and GNSS networks so they can continue to sustain and improve the quality and timeliness of the data for the delivery of optimal tsunami services;

Recommends Caribbean Tsunami Warning Program (CTWP) to continue producing up to date maps and data availability reports based on current sea level and seismic stations contributing to the CARIBE-EWS;

Further considering the updated sea-level detection capability maps, the new sea-level stations recently installed and in the process of being installed in the Eastern Caribbean and Northern Venezuela, and recalling the adopted sea-level requirements and recommendation to co-locate GNSS and sea-level sensors;

Continues to encourage Member States to pursue their efforts to fill the North-Western gap in the sea-level coastal coverage, and further recommends Member States to consider installing offshore tsunami meter buoys so that no tsunami sources in the Caribbean are at more than 30 minutes wave propagation time from the nearest sea-level instrument;

Having recognized in the past ICGs, the potential benefit of high-rate, real-time GNSS data to improve earthquake and tsunami detection and assessment, recommends the addition of proposed requirements for GNSS high rate real-time station to the existing Technical, Logistical and Administrative Requirements of a Regional Tsunami Service Provider for the CARIBE EWS, and subsequently encourages Member States to identify their existing GNSS stations satisfying those requirements and contribute their data to the system;

Decides to establish a Task Team on GNSS with the Terms of Reference attached under Appendix 1 and to elect a Working Group 1 vice-chair for real-time GNSS networks;

Encourages again each Member State to support, share, and contribute to science and technology advances in the fields of tsunami monitoring (including but not only, HF radars, real-time GNSS computation and modeling, accelerometer networks, cabled sea-bed seismometers and tsunameters, real-time robust data sharing);

Recognizes the improvements made in recent years for seismic, sea level, and GNSS monitoring around the Caribbean can be useful for other purposes such as Earthquake Early Warning, rapid distribution of earthquake source parameters and felt reports, astronomical tide prediction, regional sea-level rise, tectonic studies and public information and encourages again open and free distribution of these real-time data;

Notes again the importance of continuous training and capacity building of station and network operators for the sustainability of the observational and detection system and notes also 2016-
Status Sea Level Stations
Sea Level Network Operators in the Caribbean

- US NOAA NOS
- Puerto Rico Seismic Network, UPRM
- University of Hawaii Sea Level Center
- Caribbean Institute of Meteorology and Hydrology
- National University of Mexico
- Colombia Navy
- Colombia Meteorological Agency
- IPGP-France
- SHOM-France
- National Office of Meteorology, Dominican Republic
- Bahamas Met Service
- Smithsonian Institute
- BVI Emergency Management
- Jamaica Met Service
- Curacao Met Services
- National University of Costa Rica
- Guatemala Met Services
- Dominica Emergency Management
- Grenada Met. Services
- Coastal Zone Management Unit of Barbados
- Antigua and Barbuda Met Service
- Belize Met Services
- Trinidad Hydrographic Service
- St. Kitts and Nevis Emergency Management
- St. Vincent and the Grenadines Emergency Management
- Saint Lucia Met Service
- UNAVCO
- Anguilla Department of Disaster Management
- Departamento Meteorologico Aruba
CARIBE EWS Coastal Sea Level Monitoring Stations Progression (1960 – 2020)
Sea Level Stations Panama
Sea Level Station – St. Kitts
St. Kitts Sea Level Monitoring Station
Dominican Republic Sea Level Station
DOMINICAN REPUBLIC
EL PORVENIR, PANAMA
COSTA RICA

LIMON,
DOMINICA-non operational
Haiti Sea Level Station-Cap Haitien
Sea Level Station Aruba
Sea Level Station Cayman Islands
French Network - Guadeloupe
### Sensores Estaciones EMMA

<table>
<thead>
<tr>
<th>Sensor/Nombre</th>
<th>Unidad de Medida</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperatura Ambiente (temperatura del aire)</td>
<td>°C</td>
</tr>
<tr>
<td>Presión Atmosférica (presión barométrica)</td>
<td>Hpa.</td>
</tr>
<tr>
<td>Radiación Solar (radiación global)</td>
<td>Watts/m²</td>
</tr>
<tr>
<td>Dirección del Viento (dirección del viento)</td>
<td>Grados 0-360°</td>
</tr>
<tr>
<td>Humedad Relativa (humedad del aire)</td>
<td>%</td>
</tr>
<tr>
<td>Precipitación (precipitación acumulada)</td>
<td>mm</td>
</tr>
<tr>
<td>Velocidad del Viento (velocidad del viento)</td>
<td>m/s</td>
</tr>
<tr>
<td>RLS (sensor de nivel de radar)</td>
<td>m</td>
</tr>
<tr>
<td>PLS (sensor de nivel de presión)</td>
<td>m</td>
</tr>
<tr>
<td>Burbujeo (sensor de nivel de presión)</td>
<td>m</td>
</tr>
</tbody>
</table>
Puerto Rico – Red Sismica

Se le añadió un radio WLAN-110-24.

Se le cambió el poste que sostiene el anemómetro y los paneles solares.

Comments:

1. Se intentó restablecer la comunicación, pero no se pudo. Se probó dos radios SierraLink pero el problema continúa.
   Comment by Jose Cancel — March 21, 2010 @ 6:27 am

2. El 5 de abril del 2010 se instalaron un radio WiMax en el manzanares y en la LIPRA, ahora los datos se pueden bajar por una línea adicional de Ethemet.
   Comment by Jose Cancel — May 3, 2010 @ 3:29 pm

3. El 12 de julio del 2010 se le instaló un panel solar de más potencia.
   Comment by Jose C. Cancel — August 15, 2010 @ 6:45 am

4. A esta estación se le añadió un panel solar de más potencia.
   Comment by Jose Cancel — October 7, 2010 @ 7:05 pm

5. El 21 de diciembre de 2011 se le cambió el poste del anemómetro. Se aumentó la altura del mismo de 20' a 40'.
   Comment by Jose cancel — December 22, 2011 @ 11:34 am
### CZMU Sea level Station
**Port St. Charles, Barbados**

<table>
<thead>
<tr>
<th>Station Code</th>
<th>PTSC</th>
</tr>
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<tbody>
<tr>
<td>Lat</td>
<td>13° 15'46.73&quot;N (obtained from google earth)</td>
</tr>
<tr>
<td>Long</td>
<td>59° 38'41.47&quot;W (obtained from google earth)</td>
</tr>
<tr>
<td>Date Installed</td>
<td>Installed November 2012 by CZMU and CIMH.</td>
</tr>
<tr>
<td>Status</td>
<td>Transmitting (power issue needs resolving)</td>
</tr>
<tr>
<td>Operator</td>
<td>Coastal Zone Management Unit, Barbados.</td>
</tr>
</tbody>
</table>

**Communications**

<table>
<thead>
<tr>
<th>GOES PID</th>
<th>BAB00078</th>
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<tbody>
<tr>
<td>WMO Header</td>
<td>SOBR10</td>
</tr>
<tr>
<td>GOES Channel</td>
<td>219</td>
</tr>
<tr>
<td>Transmit Period</td>
<td>5 mins</td>
</tr>
<tr>
<td>Sampling Rate</td>
<td>1 min</td>
</tr>
</tbody>
</table>

**GOSS Station ID**

<table>
<thead>
<tr>
<th>DCP</th>
<th>Satlink2 V2 Transmitter/Logger (SL2-G312-V2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>GPS (timing)</td>
<td>Yes</td>
</tr>
<tr>
<td>GPS (high precision for positioning)</td>
<td>No</td>
</tr>
</tbody>
</table>

**Sensor**

<table>
<thead>
<tr>
<th>Sensor #1</th>
<th>ACCULEVEL SUBMERSIBLE TRANSDUCER (needs replacing)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensor #2</td>
<td>Accubar Bubble Gauge</td>
</tr>
<tr>
<td>Sensor #3</td>
<td>RADAR (RLR-0003-1)</td>
</tr>
<tr>
<td>Met Sensors</td>
<td>None</td>
</tr>
</tbody>
</table>
The tidal stations operated by the Hydrographic unit are Microcom GTX data loggers with the ability to transmit real time data to GOES.
Barbuda
DART

http://www.ndbc.noaa.gov/dart.shtml
The goal of CARIBE-EWS is that all tsunamis in the region be detected within 30 minutes.
Sea Level Network Status

- Impacts because of Irma and Maria
  - Anguilla – became operational in August, 2017
  - Turks and Caicos (installed by August, 2017)
  - Mayaguez, PR
  - Caja de Muertos, PR
  - St. Thomas
  - Tortola

- The DART buoy of the Caribbean was recovered from adrift on 6/8/17, service restoration will be announced. Currently the North Santo Domingo and mid Atlantic DARTs are adrift
Severe thunderstorms over the Midwest and Great Lakes, Excessive Heat over the Southwest U.S.

Severe thunderstorms will be possible over the upper Midwest and Great Lakes region on Thursday. Some of the storms will be capable of damaging winds, large hail, heavy rainfall, and a few tornadoes. Additional severe weather and heavy rainfall will be possible over the Middle Atlantic region. Excessive heat will continue over the Southwest U.S. with highs near 120 degrees. Read More >

INVENTORY OF SEA LEVEL STATIONS

Caribbean Tsunami Warning Program

Sea Level Stations Reports (read-only excel files)

2017:
- January - May

2016:
- February - December

SLS Network Operators Conference Calls

Notes:
- March 16, 2017

Recordings:
- July 07, 2016 - TideTool: Software to Analyze GTS Sea-Level Data
- September 15, 2016 - Sea Level Station Monitoring Facility (SLMF) and Sea Level Station Catalog (SSC)
- November 17, 2016 - Leveling

CTWP Website - http://www.weather.gov/ctwp/stations
Stations to be considered for adding to GLOSS
IOC and CME-NOC Programme: Training Course for Operators of Sea Level Stations in the Caribbean and Adjacent Regions. Castries, Saint Lucia (2016)

Tidal Analysis for Port-Au-Prince, Haiti, radar gauge using JASL software
Maintenance Challenges

- Maintenance
  - Biogrowth
  - Sedimentation
- Power
- Sensor malfunction
- Vandalism
Opportunities – Multiple Applications

• Tsunami detection
• Storm surge
• Climate Change
• Seiches - Meteotsunamis
• Coastal Zone Management
• Navigation
• Bathymetric studies/Maritime Surveys
Other Sea Level Considerations

- Success in increasing and sustaining more stations – Member State engagement and new stakeholders/donors (e.g., Smithsonian Institution, UNAVCO, Monaco, Brazil, St. Vincent and the Grenadines)
Thank You

Christa von Hillebrandt-Andrade
NOAA-NWS Caribbean Tsunami Warning Program