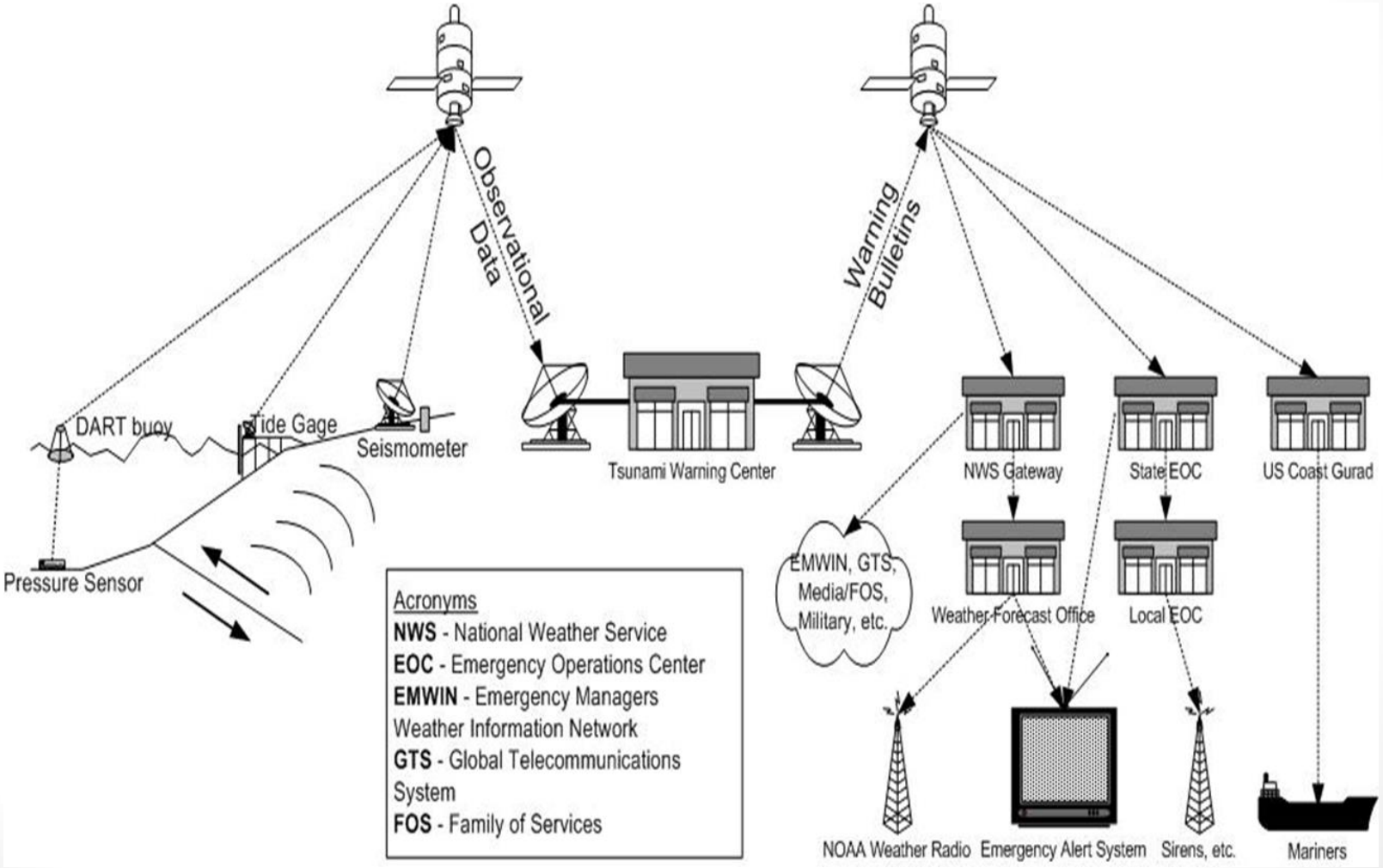
United Nations Educational, Scientific and Cultural Organization | Intergovernmental Oceanographic Commission | National Oceanic and Atmospheric Administration | International Tsunami Information Center | CTWP | CTIC Caribbean Tsunami Information Centre ctic.ioc-unesco.org | National Weather Service Pacific Tsunami Warning Center | Coastal Zone Management Unit Barbados | Ministry of Foreign Affairs

Regional Training Workshop on Pacific Tsunami Warning Center Enhanced Tsunami Products for ICG/CARIBE EWS
31 October – 02 November, 2017
Cartagena, Colombia

4.4 TWC Operations
Sea Level Monitoring in the Caribbean

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

Sea Level Data



Intergovernmental Oceanographic Commission
Reports of Governing and Major Subsidiary Bodies

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

Twelfth Session
Puntarenas, Costa Rica
10–12 May 2017

UNESCO

ANNEX II

RECOMMENDATIONS

Recommendation ICG/CARIBE-EWS-XII.1

Tsunami Monitoring and Detection Systems

The Intergovernmental Coordination Group for the 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 tsunameter 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;

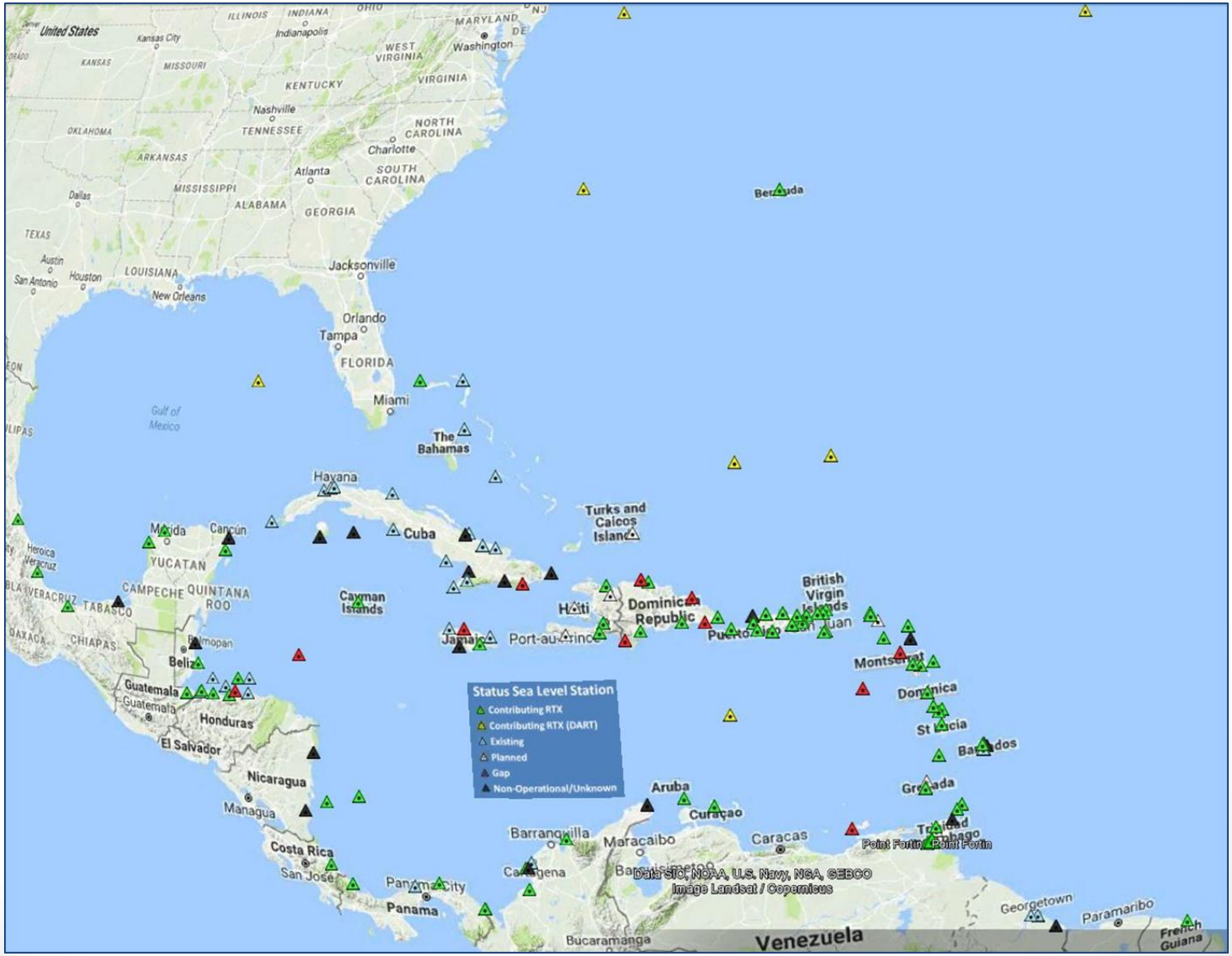
Decides to establish a Task Team on GNSS with the Terms of Reference attached under Appendix 1 and to elect a Working Group 1 vice-chair for real-time GNSS networks;

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 modelling, 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-

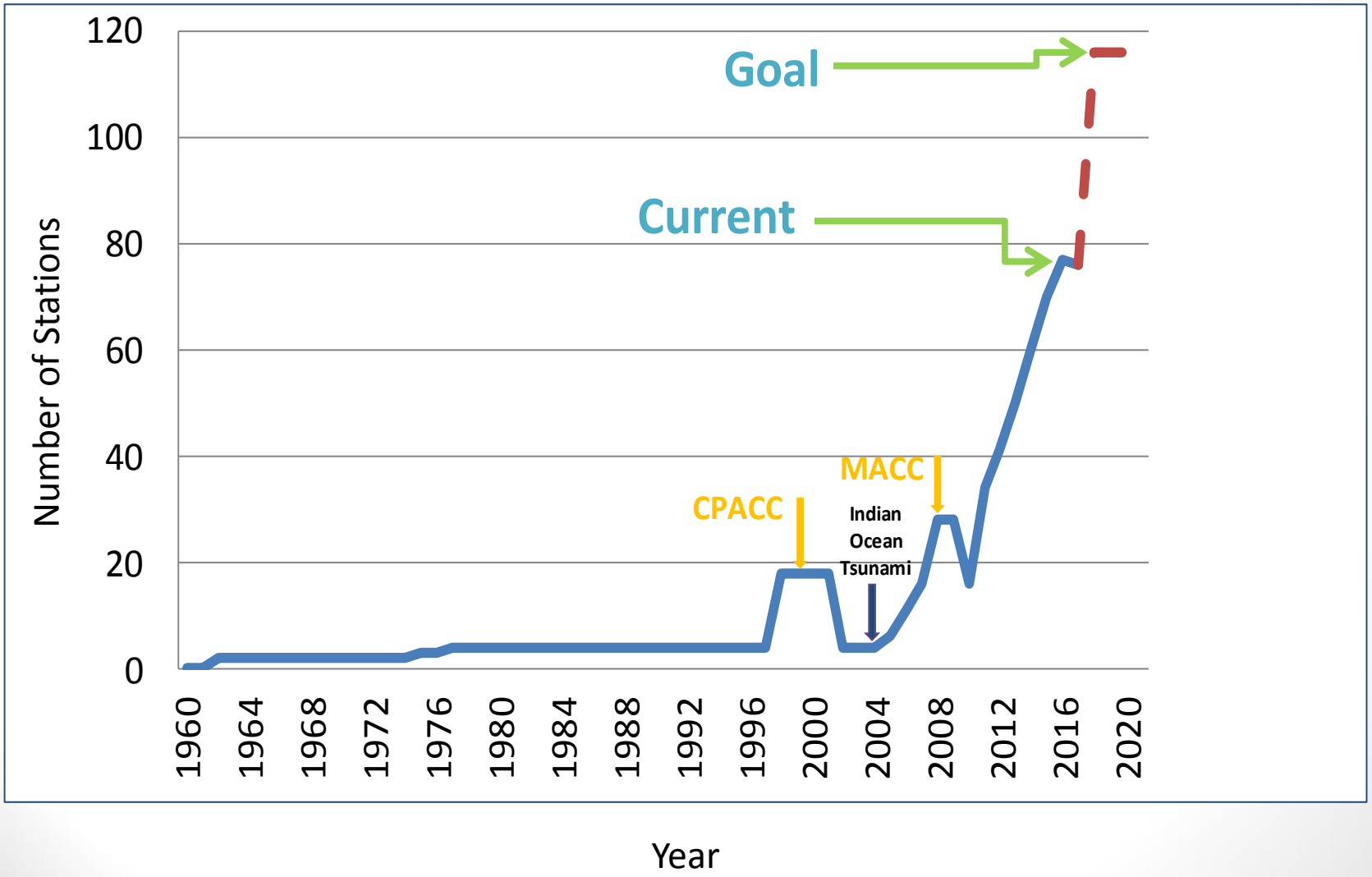
Status Sea Level Stations



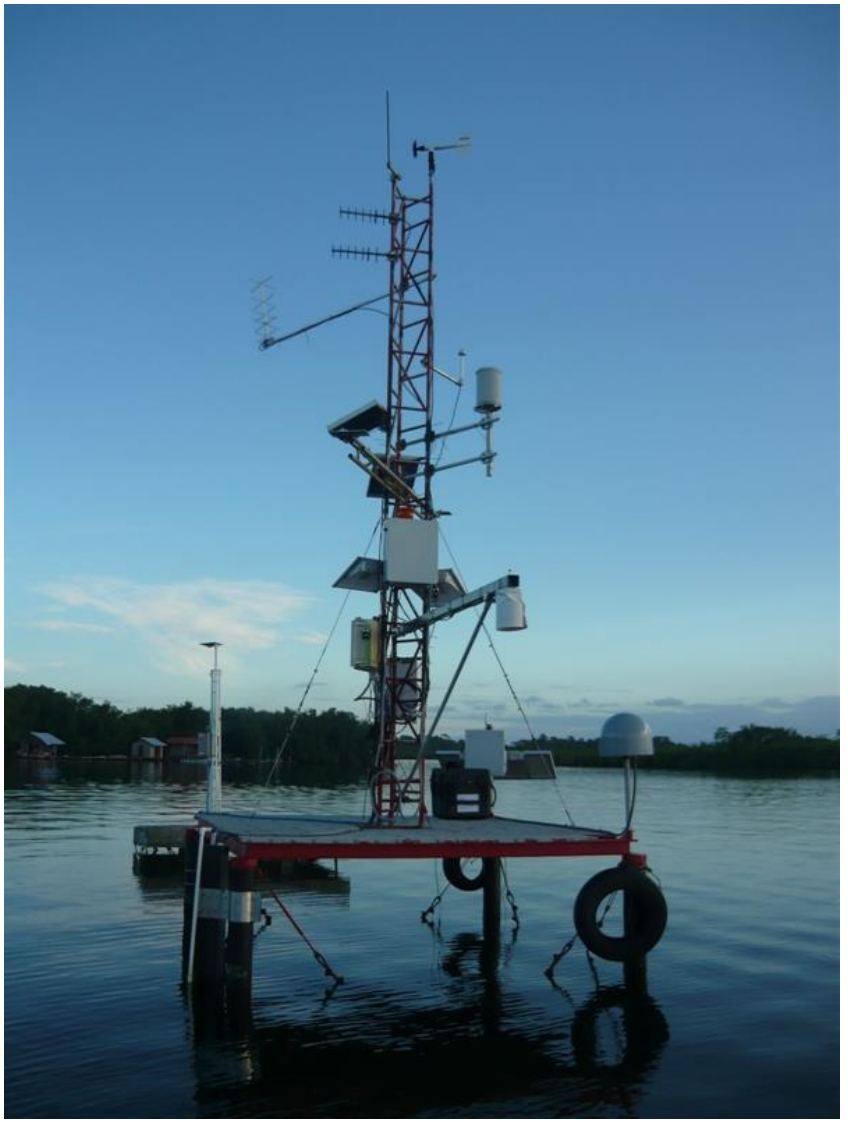
Sea Level Network Operators in the Caribbean SeaLevelStationRequirements-2012.docx

- 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 Meteorlogico Aruba

CARIBE EWS Coastal Sea Level Monitoring Stations Progression (1960 – 2020)

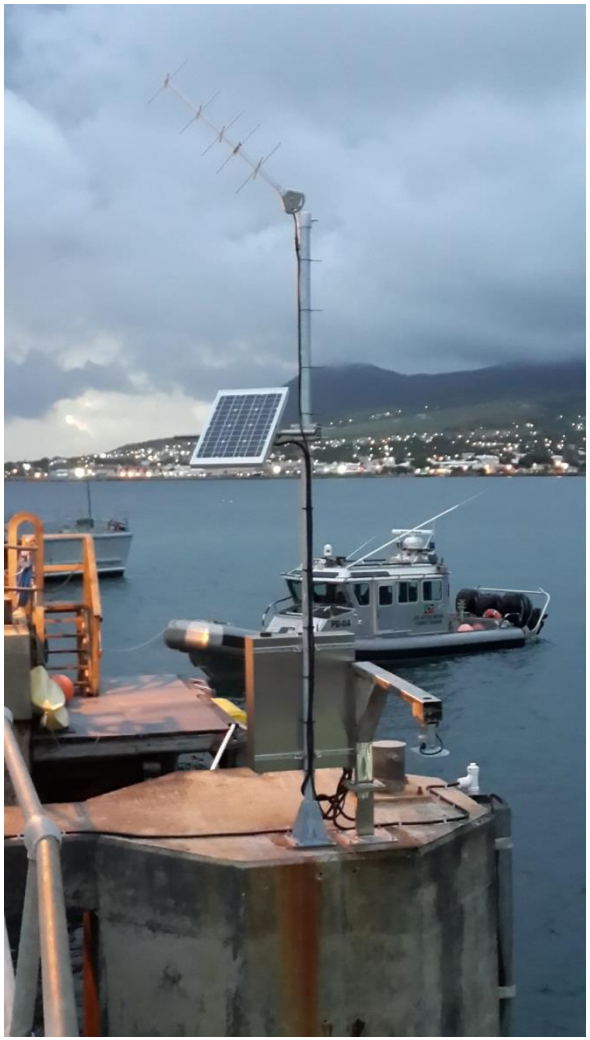


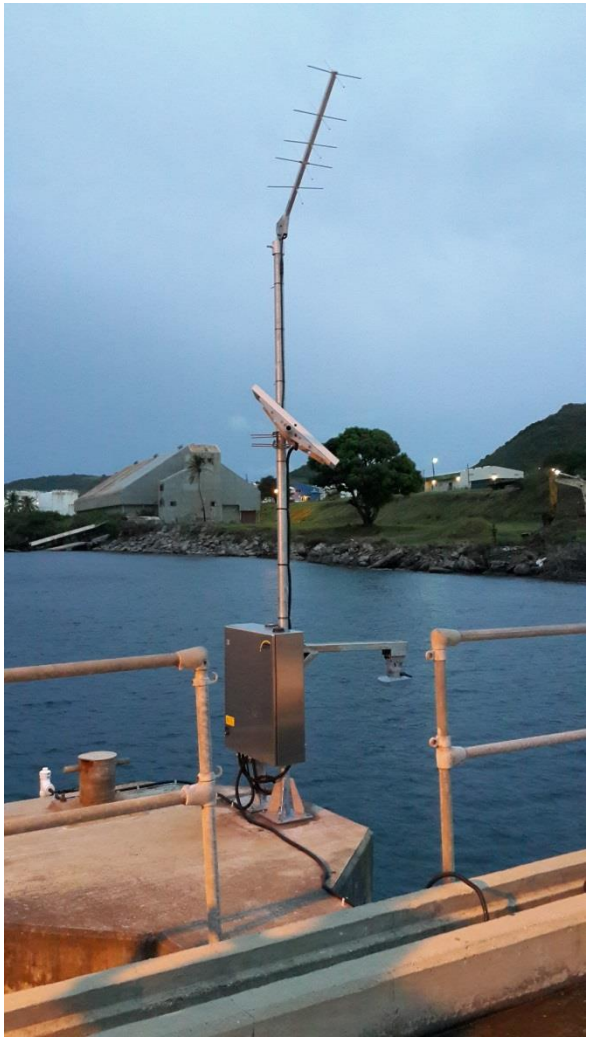
Sea Level Stations Panama



Sea Level Station – St. Kitts

St. Kitts Sea Level Monitoring Station





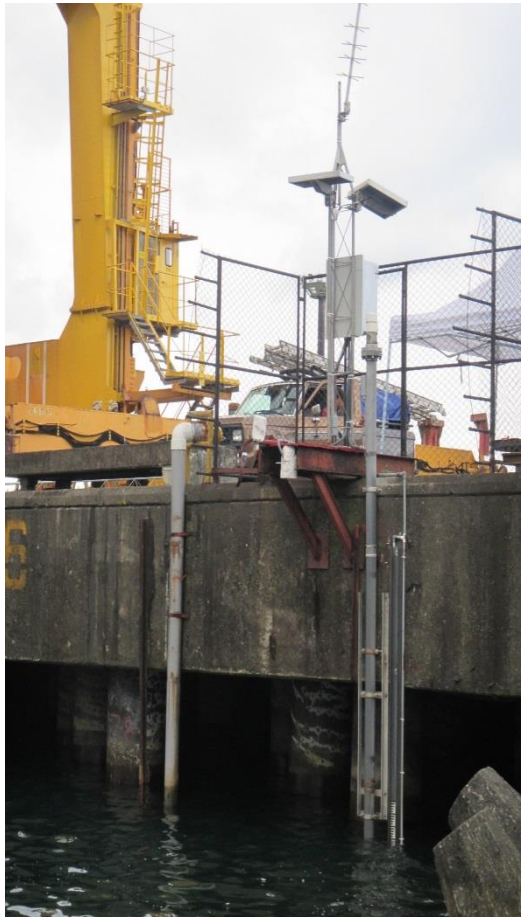
Dominican Republic Sea Level Station

DOMINICAN REPUBLIC

COLOMBIA

EL PORVENIR, PANAMA

LIMON, COSTA RICA

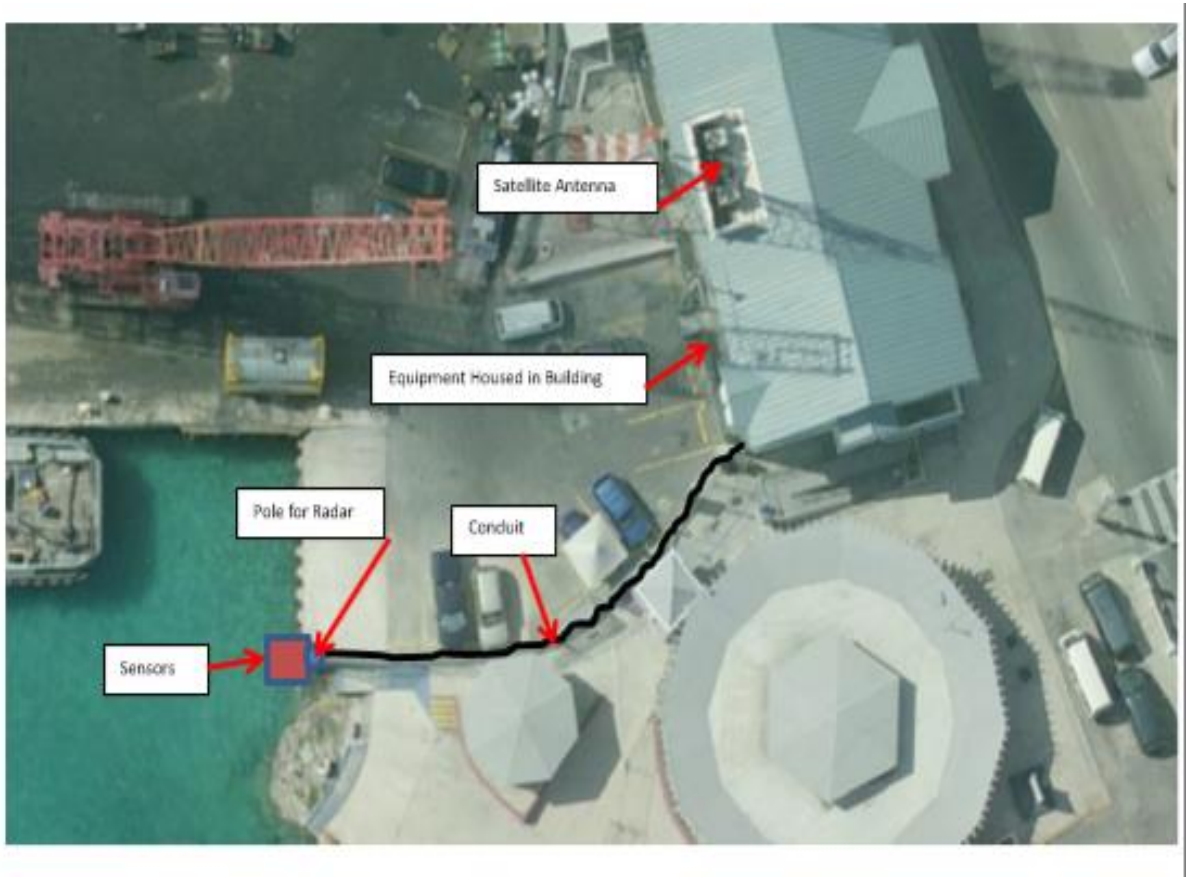


DOMINICA-non operational

Haiti Sea Level Station-Cap Haitien

Sea Level Station Aruba

Sea Level Station Cayman Islands



French Network - Guadeloupe

ESTACIONES METEOROLÓGICAS Y OCEANOGRÁFICAS AUTOMÁTICAS SATELITALES - SMPOMM

Dimar
Dirección General Marítima
Autoridad Marítima Colombiana

SENSORES ESTACIONES EMMAS

SENSOR/NOMBRE	UNIDAD DE MEDIDA
TEMPERATURA AMBIENTE (temperatura del aire)	°C
PRESION ATMOSFÉRICA (presión barométrica)	Hpa.
RADIACIÓN SOLAR (radiación global)	Watts /m2
DIRECCIÓN DEL VIENTO (dirección del viento)	Grados 0-360°
HUMEDAD RELATIVA (humedad del aire)	%
PRECIPITACIÓN (precipitación acumulada)	mm
VELOCIDAD DEL VIENTO(velocidad del viento)	m/s
RLS (sensor de nivel de radar)	m
PLS (sensor de nivel de presión)	m
BURBUJEO (sensor de nivel de presión)	m

Puerto Rico – Red Sismica

Se le añadio un radio WILAN-110-24.

Se le cambio el poste que sostiene el anenometro y los paneles solares

Comments »

1. Se intento reestablecer la comunicacion, pero no se pudo. Se probo dos radios (Satlink) pero el problema continua.

   Comment by Jose Cancel — March 21, 2010 @ 4:22 am

2. El 5 de abril del 2010 se instalo un radio Wilan en el mareografo y en la UPRA. Ahora los datos se pueden bajar por una linea adicional de Ethernet.

   Comment by Jose Cancel — May 3, 2010 @ 3:29 pm

3. El 12 de julio de 2010 se le inslatalo un panel solar de mas potencia.

   Comment by Jose D. Cancel — August 15, 2010 @ 6:46 pm

4. A esta estacion se le añadio un panel solar de mas potencia.

   Comment by Jose Cancel — October 7, 2010 @ 7:08 pm

5. El 21 de diciembre de 2011 se le cambio el poste del anenometro. Se aumento 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

Station Code:	PTSC
Lat	13° 15'46.73"N (obtained from google earth)
Long	59° 38'41.47"W (obtained from google earth)
Date Installed	Installed November 2012 by CZMU and CIMH.
Status	Transmitting (power issue needs resolving)
perator:	Coastal Zone Management Unit, Barbados.

Communications	GOES
GOES PID	BAB00078
WMO Header	SOBR10
GOES Channel	219
Transmit Period	5 mins
Sampling Rate	1 min
GLOSS Station ID	
DCP	Satlink2 V2 Transmitter/Logger (SL2-G312-V2)
GPS (timing)	Yes
GPS (high precision for positioning)	No
Sensor #1	ACCULEVEL SUBMERSIBLE TRANSDUCER (needs replacing)
Sensor #2	Accubar Bubble Gauge
Sensor #3	RADAR (RLR-0003-1)
Met Sensors	None

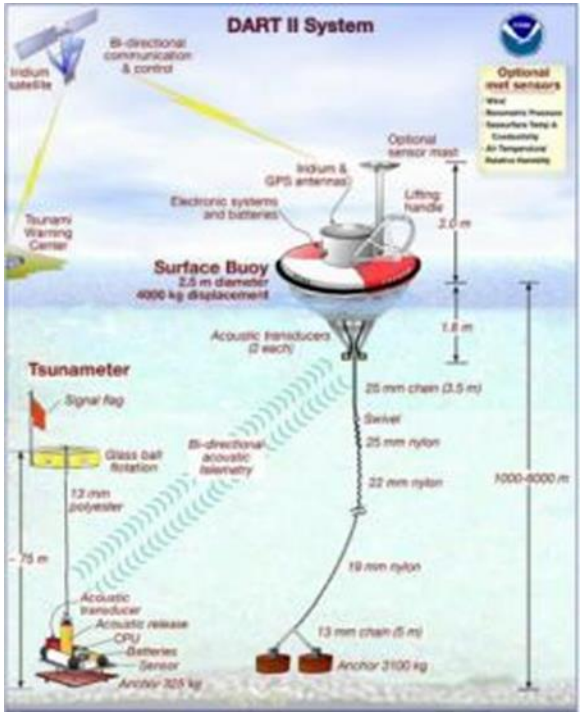
Trinidad and Tobago Sea Level Stations

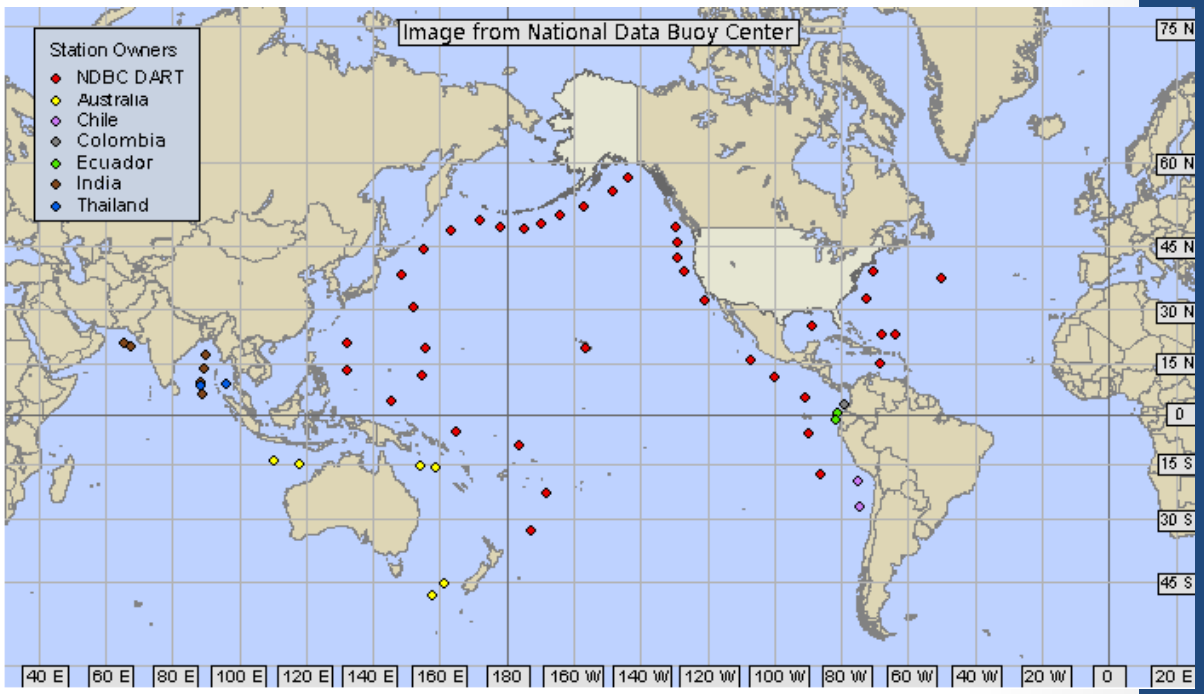
- **The tidal stations operated by the Hydrographic unit are Microcom GTX data loggers with the ability to transmit real time data to GOES.**

Barbuda

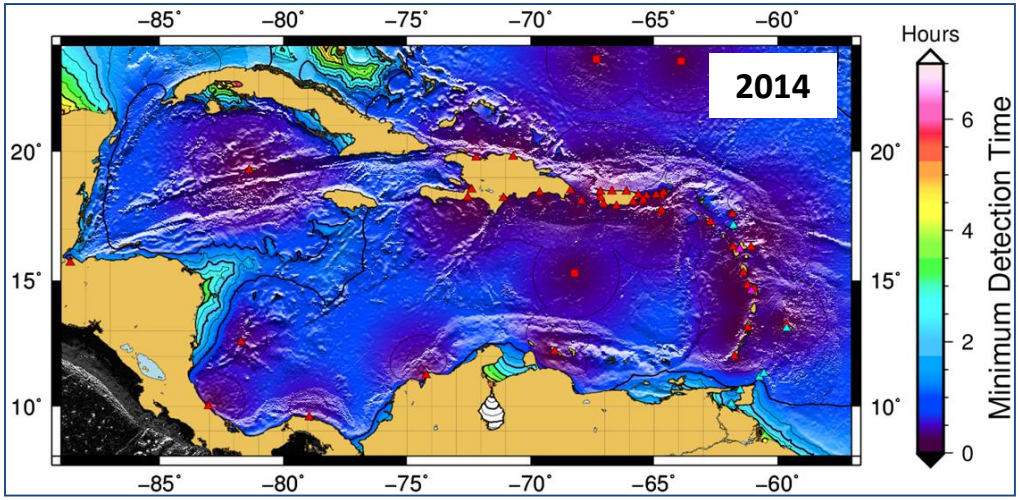
DART

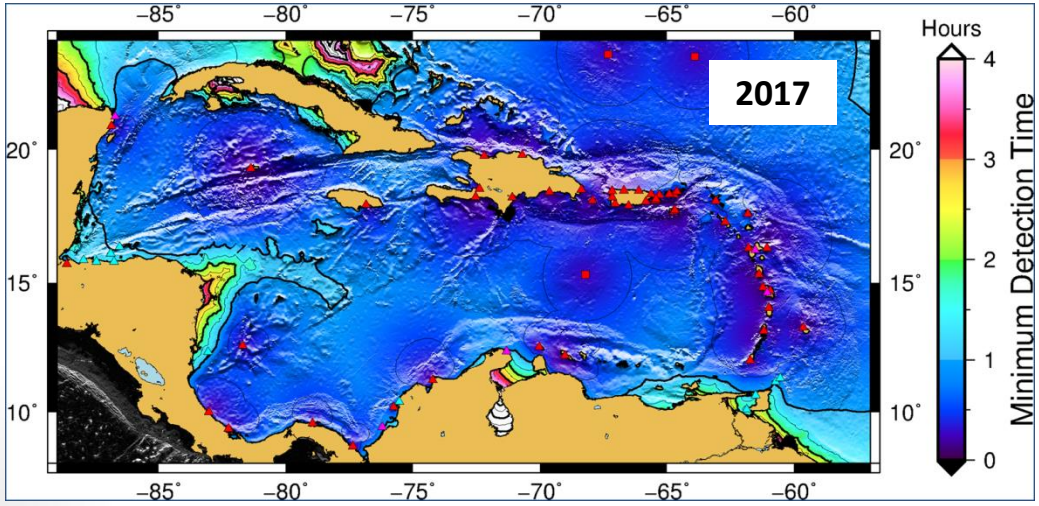
http://www.ndbc.noaa.gov/dart.shtml





Sea Level Data Contributions





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

NATIONAL WEATHER SERVICE

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

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Local forecast by "City, St" or ZIP code

Enter location ... Go

Location Help

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

Weather.gov > Caribbean Tsunami Warning Program > INVENTORY OF SEA LEVEL STATIONS

Caribbean Tsunami Warning Program
National Program

Carib. Sea Level Stations | Seismic Stations | CARIBE EWS | Preparedness/Education | CARIBE WAVE | About CTWP

Sea Level Stations Reports (read-only excel files)

2017:

- January - May

2016:

- February - December

Stations Map

SLS Network Operators Conference Calls

Notes:

- March 16, 2017

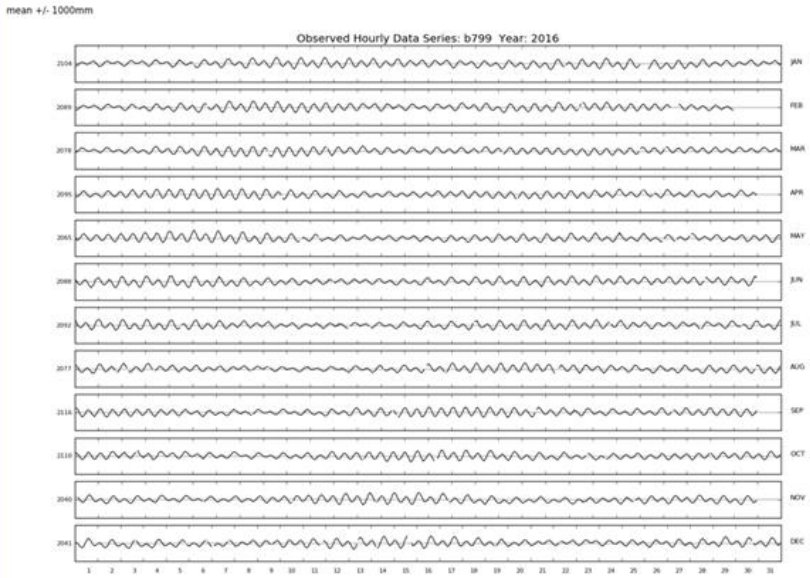
Recordings:

- 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
- January 31, 2017 - Maintenance & Operations: Microwave Radars and Pressures Sensores

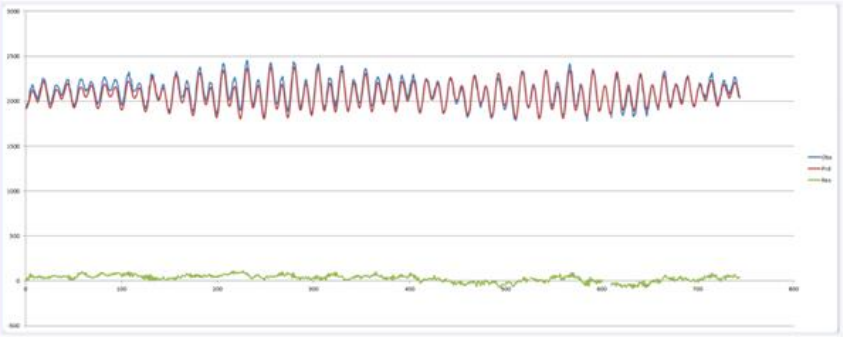
CTWP Website - http://www.weather.gov/ctwp/stations

Stations to be considered for adding to GLOSS

IOC and CME-NOC Programme Taining Course for Operators of Sea Level Stations in the Caribbean and Adjacent Regions. Castries, Saint Lucia (2016)



Observed Hourly data from radar gauge for 2016



Tidal prediction for 2016.
Blue represents observed tides, Red represents the predicted tides and Green represents residuals

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 (eg. Smithsonian Institution, UNAVCO, Monaco, Brazil, St. Vincent and the Grenadines)

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Thank You

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