



United Nations  
Educational, Scientific and  
Cultural Organization



Intergovernmental  
Oceanographic  
Commission



National Oceanic  
and Atmospheric  
Administration



International  
Tsunami Information  
Center



CTIC  
Caribbean Tsunami  
Information Centre  
ctic.icc-unesco.org

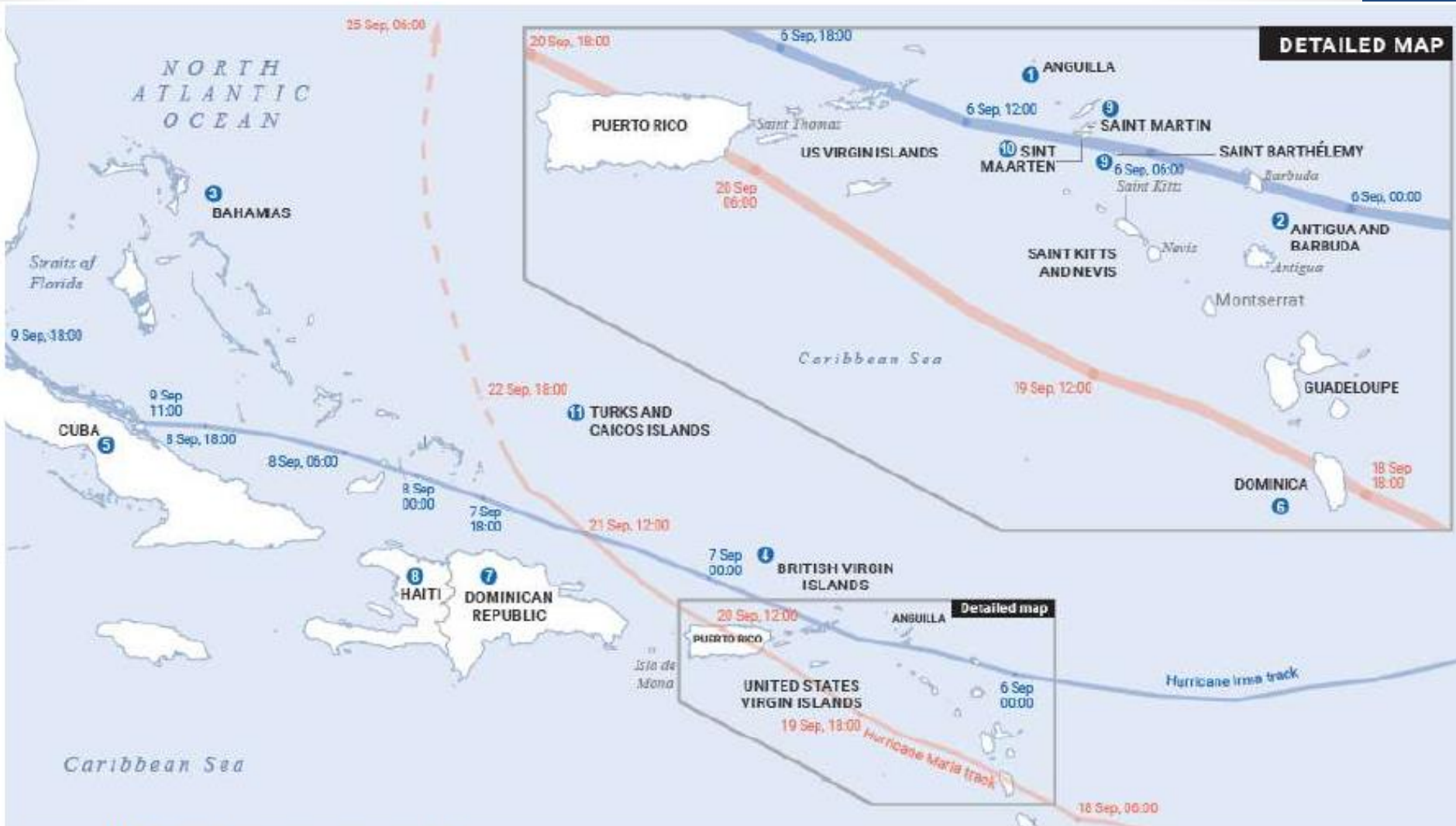


Ministry of Foreign Affairs

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

# 3.4 ICG/CARIBE-EWS Country SOPs – Readiness, Gaps, Actions: 2017 Hurricane Season – Lessons to be Learned

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

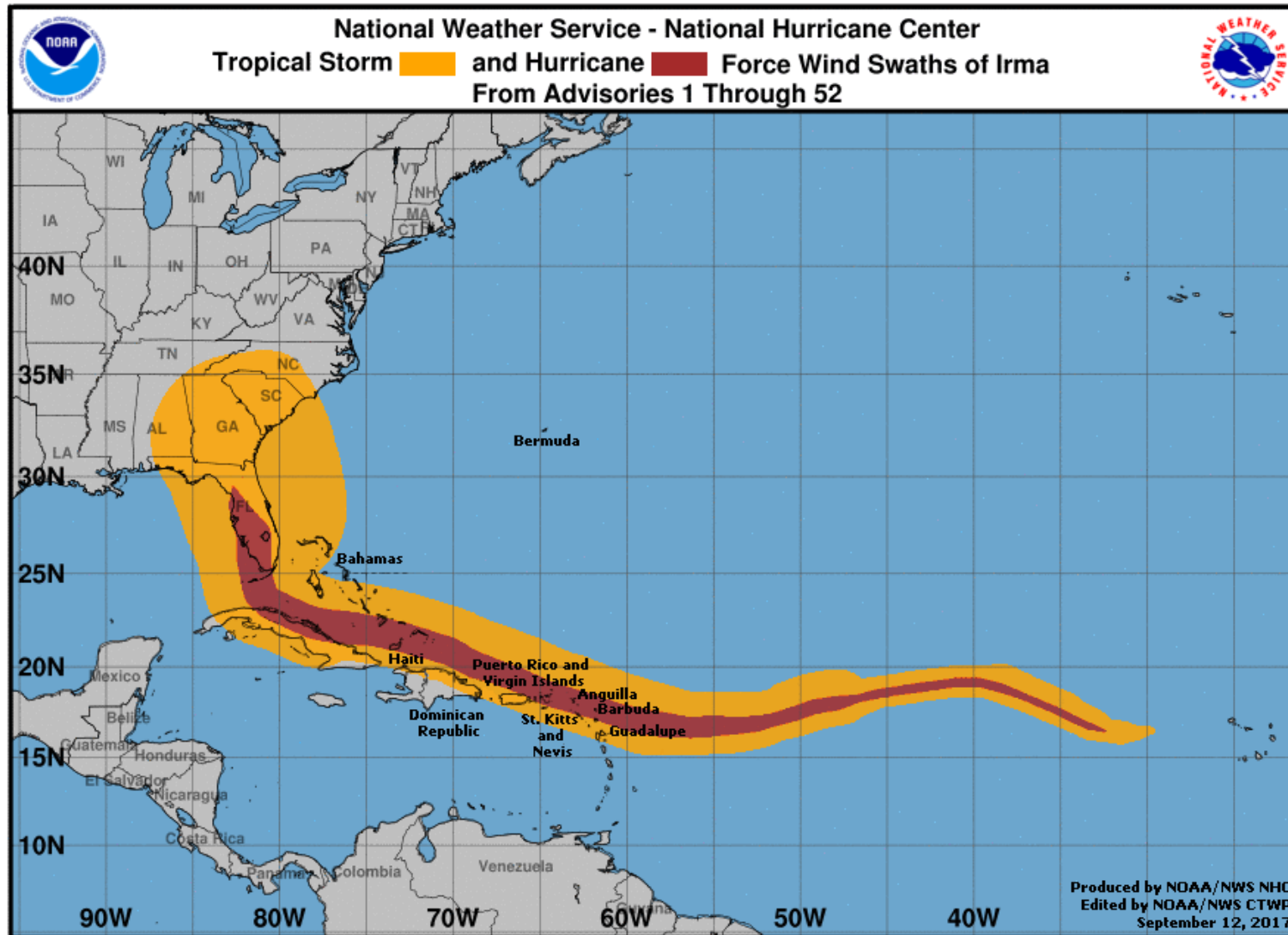


Source: UN OCHA, September 2017

# Irma

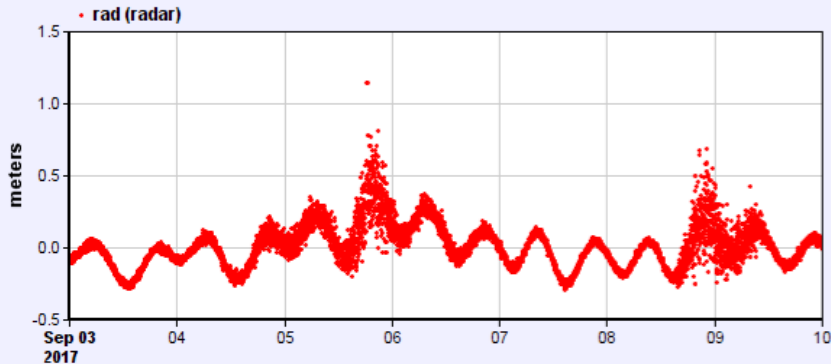
- Became category 5 hurricane in the Eastern Atlantic Ocean on Tuesday September 5, 2017.
- CARIBE EWS States with most significant impact: Antigua and Barbuda, Saint Barthelemy, Saint Martin, Sint Maarten, Guadeloupe, Dominica, St. Kitts and Nevis, Anguilla, Montserrat, British Virgin Islands, US Virgin Islands, Puerto Rico (Sep. 6), Dominican Republic, Turks and Caicos Islands, northern border of Haiti. Cuba, and southeastern Islands of the Bahamas (Sep. 7).
- Resulted in the loss of lives, significant damage to homes and critical infrastructure (including seismic and sea level stations and communications)

# Sea Level Observations



Guadeloupe

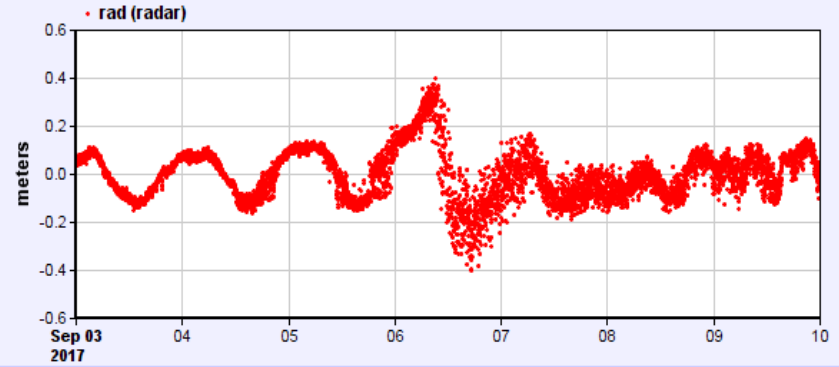
Sealevel at La Desirade Island, Guadeloupe station (offset: 0.709 m)



From 2017-09-03 00:00+00:00 to 2017-09-10 00:00+00:00 © IOC-VLIZ

St. Kitts & Nevis

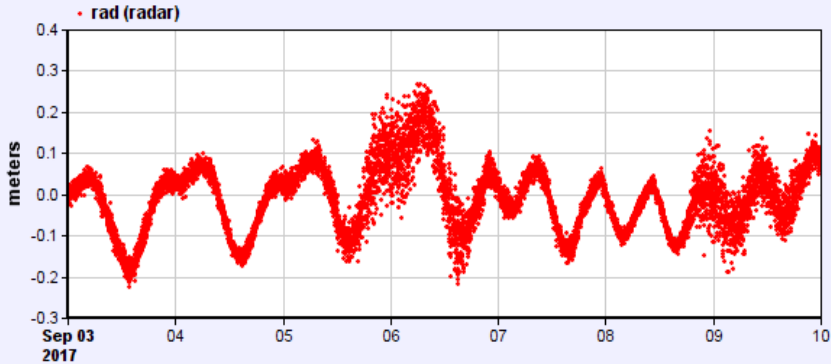
Sealevel at Basseterre (Coast Guard Base) station (offset: -3.006 m)



From 2017-09-03 00:00+00:00 to 2017-09-10 00:00+00:00 © IOC-VLIZ

Guadeloupe

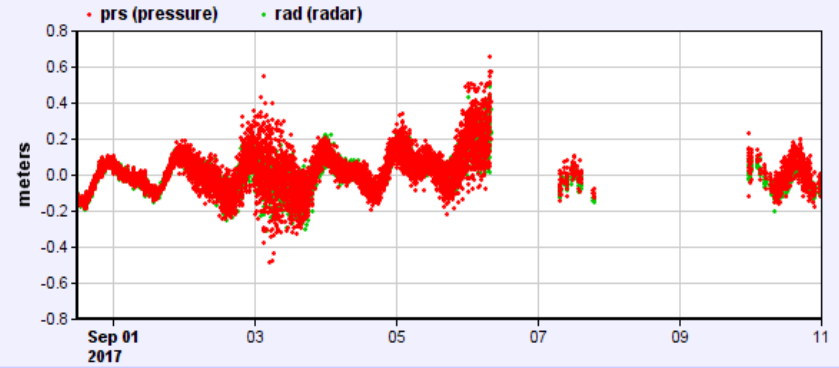
Sealevel at Deshaies, Guadeloupe station (offset: 0.753 m)



From 2017-09-03 00:00+00:00 to 2017-09-10 00:00+00:00 © IOC-VLIZ

France

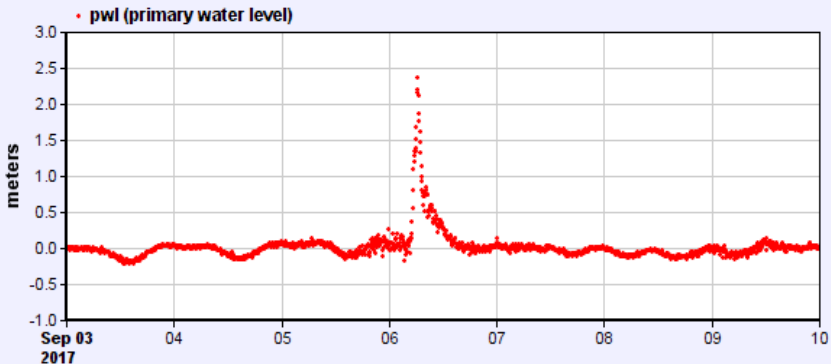
Sealevel at Saint Martin Island station (offset: 0.811 m)



From 2017-08-31 12:00+00:00 to 2017-09-11 00:00+00:00 © IOC-VLIZ

Barbuda

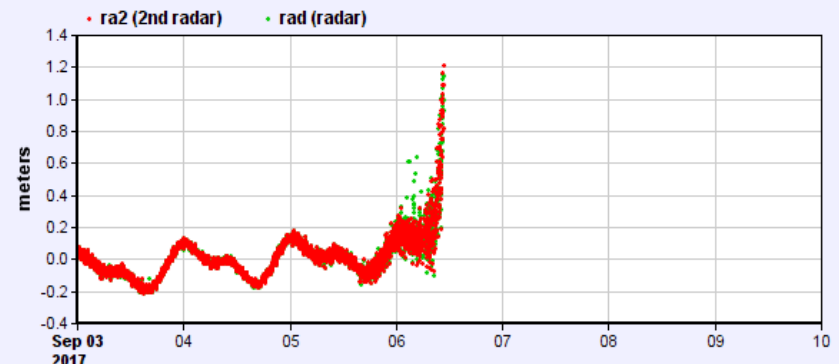
Sealevel at Barbuda station (offset: 0.251 m)



From 2017-09-03 00:00+00:00 to 2017-09-10 00:00+00:00 © IOC-VLIZ

Anguilla

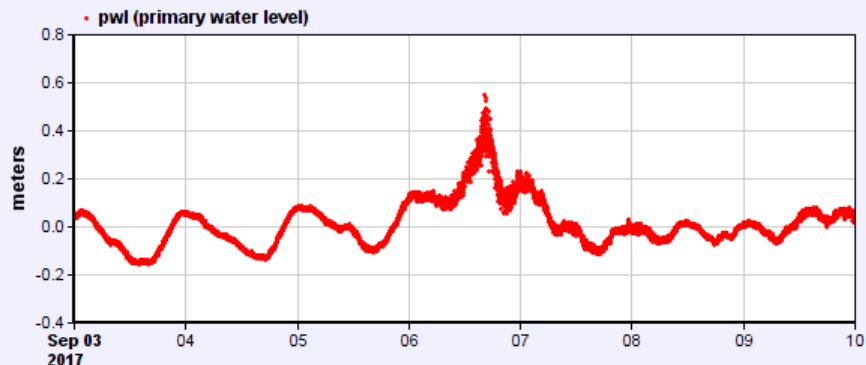
Sealevel at Blowing Point station (offset: 6.919 m)



From 2017-09-03 00:00+00:00 to 2017-09-10 00:00+00:00 © IOC-VLIZ

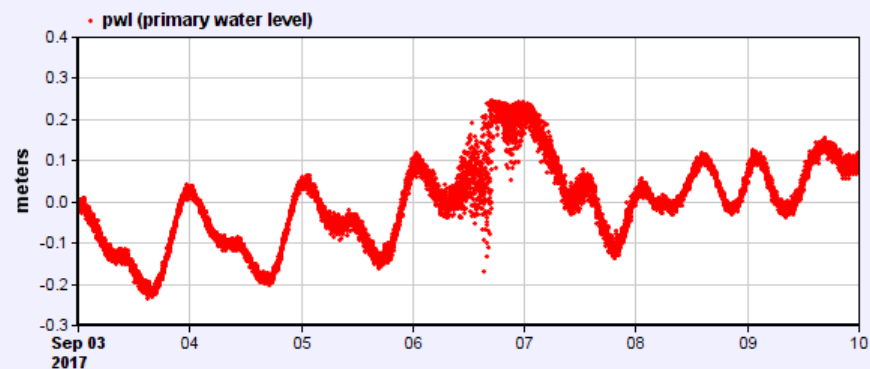
US Virgin Islands

### Sealevel at St\_Croix\_VI station (offset: 0.241 m)



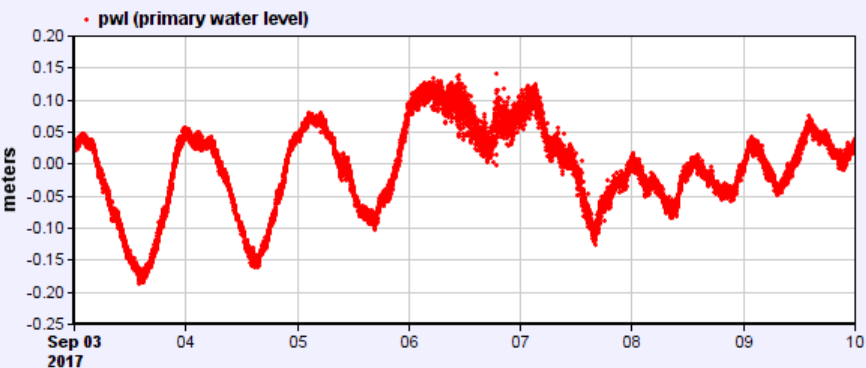
### Sealevel at LameshurBayStJohnVI station (offset: 0.359 m)

US Virgin Islands



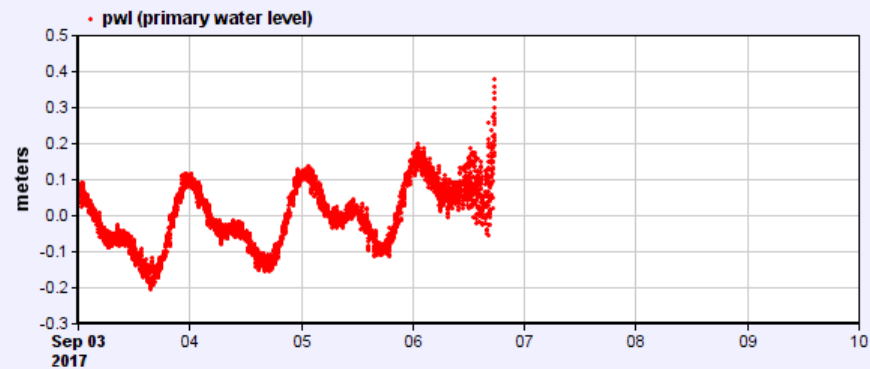
US Virgin Islands

### Sealevel at Limetree\_VI station (offset: 0.229 m)



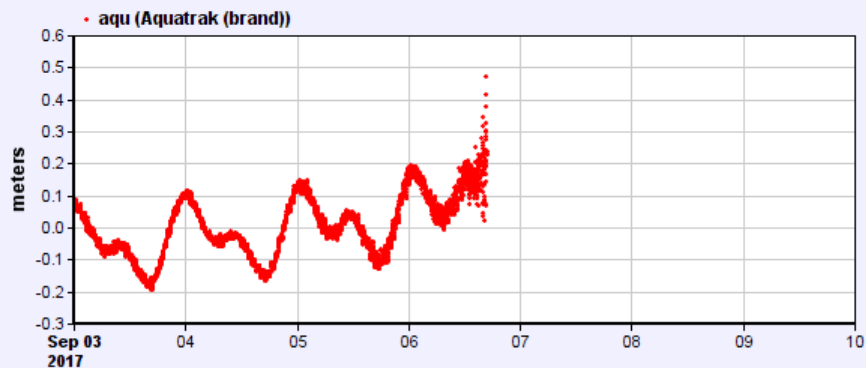
### Sealevel at Charlotte-Amalie\_VI station (offset: -2.857 m)

US Virgin Islands



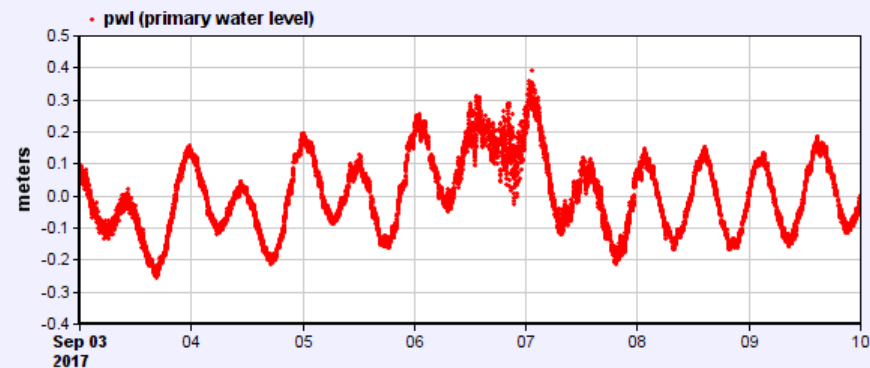
British Virgin Islands

### Sealevel at Tortola station (offset: -2.886 m)



### Sealevel at Isabel Segunda station (offset: -2.489 m)

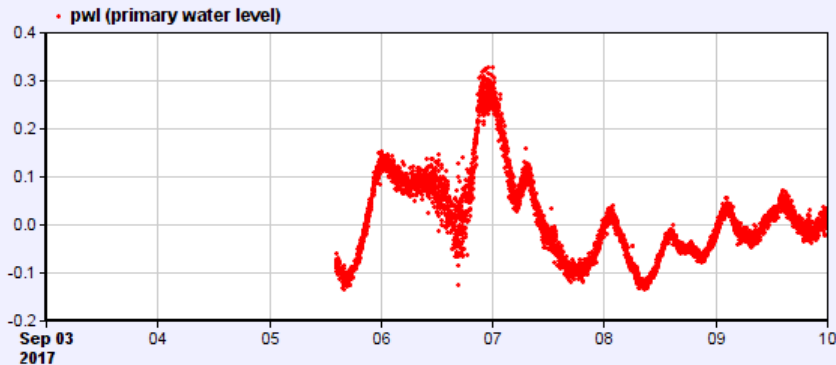
Puerto Rico





Sealevel at Vieques\_PR station (offset: -3.206 m)

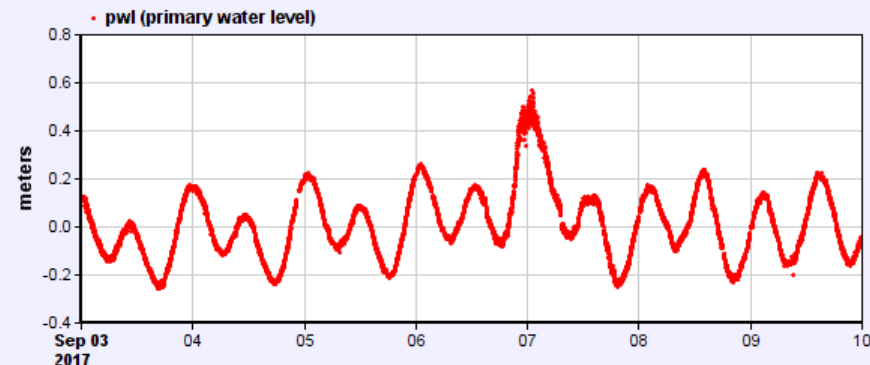
Puerto Rico



From 2017-09-03 00:00+00:00 to 2017-09-10 00:00+00:00 © IOC-VLIZ

Sealevel at San\_Juan\_PR station (offset: -2.604 m)

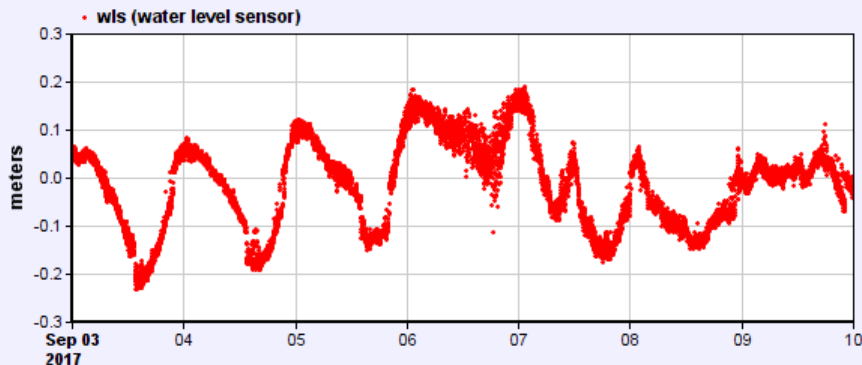
Puerto Rico



From 2017-09-03 00:00+00:00 to 2017-09-10 00:00+00:00 © IOC-VLIZ

Sealevel at Yabucoa Harbor, PR station (offset: -5.922 m)

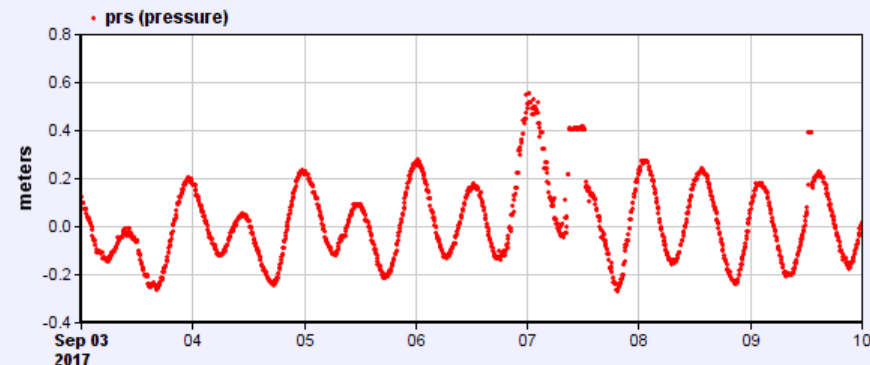
Puerto Rico



From 2017-09-03 00:00+00:00 to 2017-09-10 00:00+00:00 © IOC-VLIZ

Sealevel at Arecibo station (offset: 0.405 m)

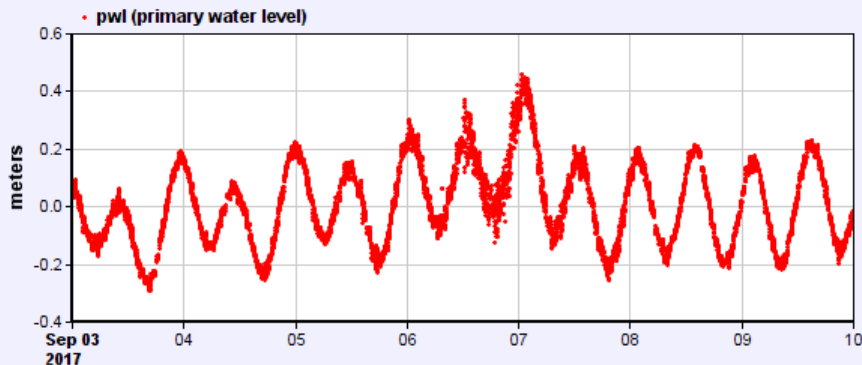
Puerto Rico



From 2017-09-03 00:00+00:00 to 2017-09-10 00:00+00:00 © IOC-VLIZ

Sealevel at Fajardo\_PR station (offset: -2.564 m)

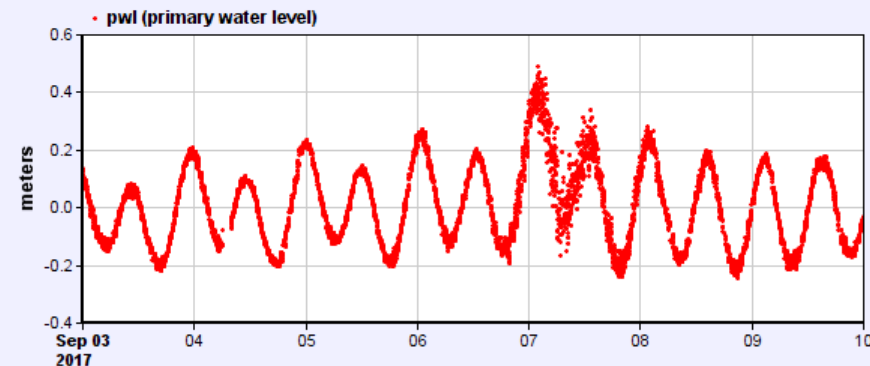
Puerto Rico



From 2017-09-03 00:00+00:00 to 2017-09-10 00:00+00:00 © IOC-VLIZ

Sealevel at Mayaguez\_PR station (offset: -2.794 m)

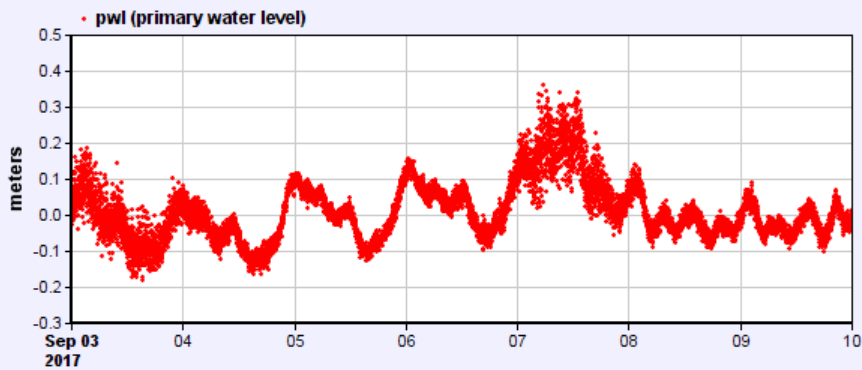
Puerto Rico



From 2017-09-03 00:00+00:00 to 2017-09-10 00:00+00:00 © IOC-VLIZ

Puerto Rico

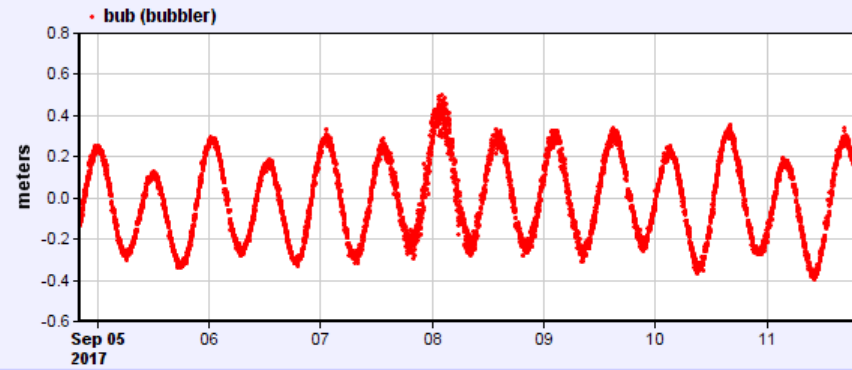
Sealevel at Mona\_Island\_PR station (offset: 0.32 m)



From 2017-09-03 00:00+00:00 to 2017-09-10 00:00+00:00 © IOC-VLIZ

Haiti

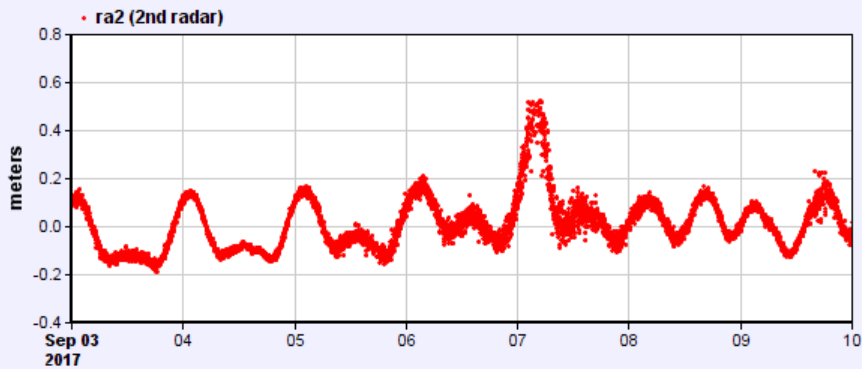
Sealevel at Cap-Haitien station (offset: 1.478 m)



From 2017-09-04 20:11+00:00 to 2017-09-11 20:11+00:00 © IOC-VLIZ

Dominican Republic

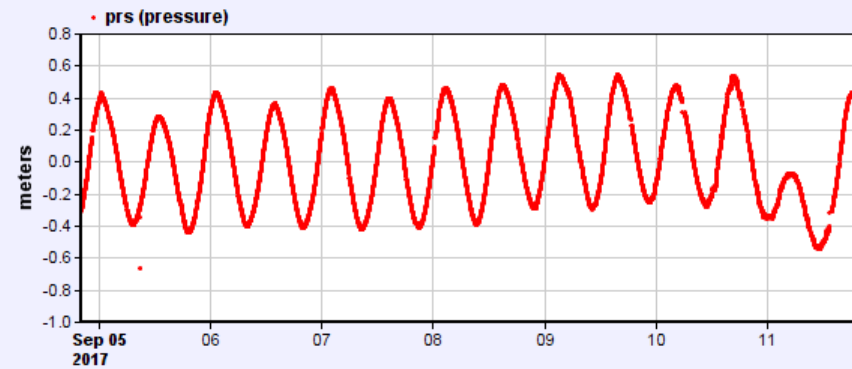
Sealevel at Punta Cana station (offset: 5.657 m)



From 2017-09-03 00:00+00:00 to 2017-09-10 00:00+00:00 © IOC-VLIZ

Bahamas

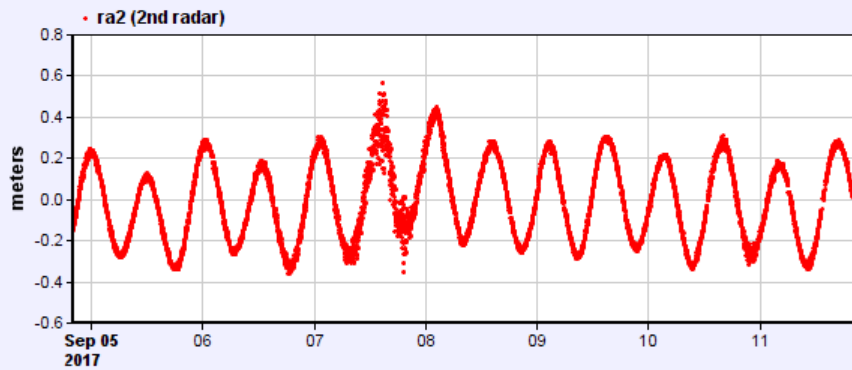
Sealevel at Settlement pt station (offset: 0.6625 m)



From 2017-09-04 20:17+00:00 to 2017-09-11 20:17+00:00 © IOC-VLIZ

Dominican Republic

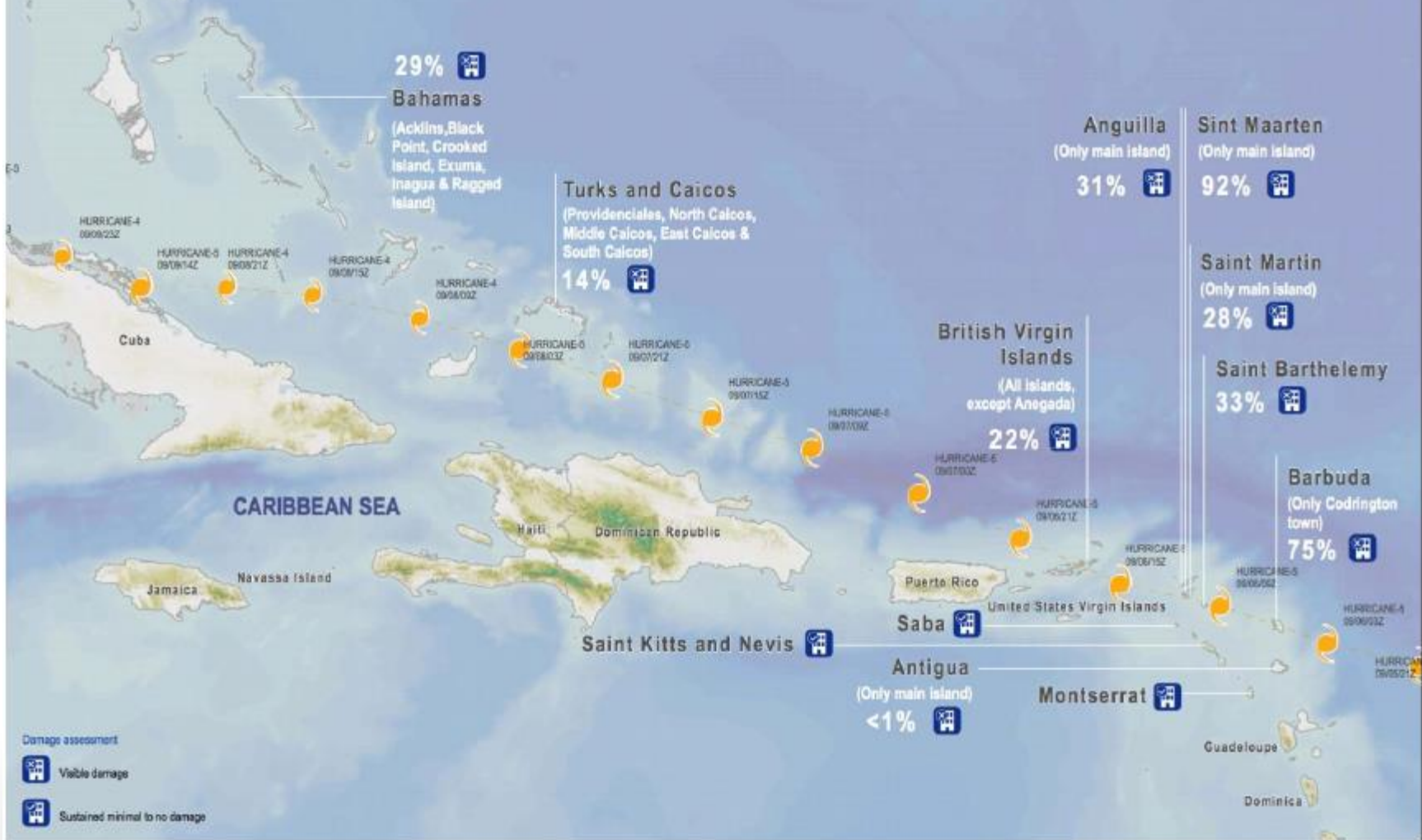
Sealevel at Puerto Plata station (offset: 4.895 m)



From 2017-09-04 20:07+00:00 to 2017-09-11 20:07+00:00 © IOC-VLIZ



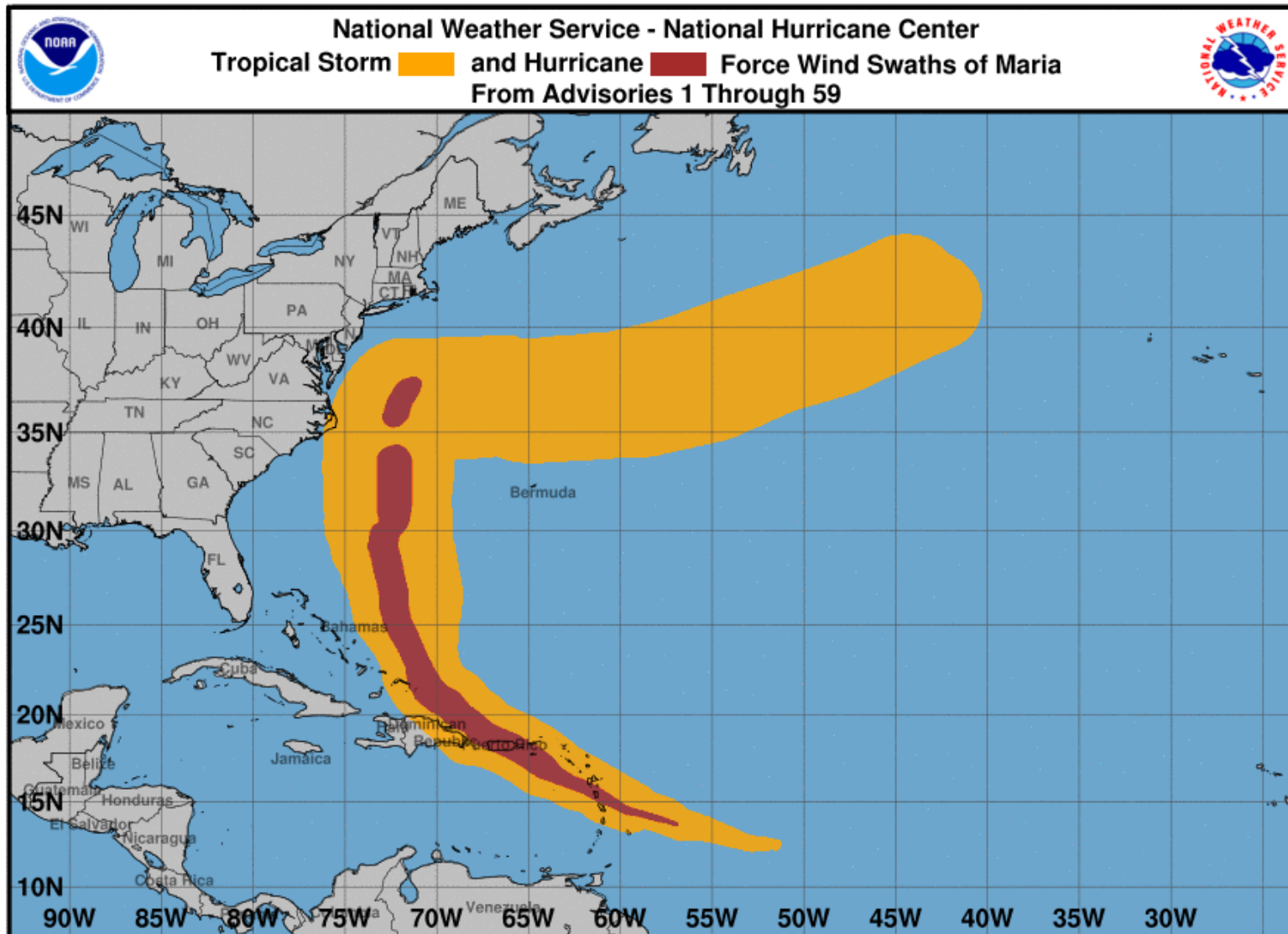
# COMPREHENSIVE SATELLITE-DETECTED BUILDING DAMAGE OVERVIEW IN THE CARIBBEAN ISLANDS AS OF 15 SEPTEMBER 2017



# Maria

- Became a category 5 hurricane near the Leeward Islands on Monday September 18<sup>th</sup>, 2017.
- Hurricane Maria impacted Dominica (Sep. 18), Antigua and Barbuda, Montserrat, St. Kitts and Nevis (Sep. 19) and Puerto Rico and the Virgin Islands (Sep 19 – 20), Dominican Republic (Sep. 20-21)
- Resulted in the loss of lives, severe damage and destruction to infrastructure in various islands, “catastrophic flooding” in several areas and loss of utility services and infrastructure (including seismic and sea level stations and comms).

# Maria Wind Track



# Hurricane Preparedness Tips from National Hurricane Center

- Gather Information
  - Contacts
  - Risk Analysis
- Plan and take action
  - Supplies kit
  - Emergency plans
- Health and Environment
  - CDC, FDA, EPA guidelines for safety during disasters
- Evacuation
- Recover
  - Waiting until areas are declared safe
  - Gradual process

# CDEMA Coordination with International Partners through the RRM



CDEMA worked with international partners and World Food Programme (WFP) to re-establish the food ration for the population.



In collaboration with ITU, TSF, military engineers and communications companies, the communication networks have been gradually reconnected.



Reconstruction and removal of debris is an urgent and relevant area where CDEMA has worked in collaboration with UNDP and militaries.



Urgent needs on shelter and temporary housing are being addressed with international partners such as USAID/OFDA, IOM and militaries.



CDEMA has worked with various international actors to reestablish access to water.



CDEMA has collaborated with UNICEF, UNFPA, UNWOMEN on social protection issues and focused on the security problems with RSS and other military assets available in the region.



CDEMA has provided support to several ministry of health and received collaboration with PAHO/WHO and CARPHA to restore health facilities and provide medical supplies.



CDEMA made efforts in collaboration with military and with WFP and other international agencies to mobilize ships and aircrafts to deliver relief assistance.

**Dominica – Actions Undertaken:**

The following tasks were conducted by CDRU:

- Management of relief efforts at Woodbridge Bay Port, Warehouse 2.
- Distribution of relief supplies to the following communities, organisations and shelters:  
 Discore/Slyvania Village □ Kalinago territory □ Marigot Village □ Pichetin Village □ Vielle Case Community □ Agape home for the elderly □ Home for at risk children □ Madicrest Baptiste Church □ Police □ Prison □ Hospital □ Ministry of Finance □ Ministry of Education □ Ministry of Works □ Customs Department □ Solid Waste Management □ Prime Minister's Office □ Port Management Office □ Financial Complex □ Paix Boude Private Home Shelter □ Penville Shelter □ Dominica State College Shelter □ Ford Cole Community Shelter □ Cordwall Pentecostal Shelter □ Southwest District Shelter □ River Road and Roseau Central □ Roseau Valley □ La-Pain Village □ Calihest (Plet-McPiere) Village □ Broche Village □ Rose Hill □ Kings Hill Community □ Bells Village □ Dominica Import and Export Company; □ Petro Caribe; □ Caulisible Shelter □ Lewisville Shelter □ Grand Bay Shelter □ Layos
- Distribution of a number of supplies comprising 7 food hampers, 16 tarpaulin, 568 canvases, 670 cases of water and 15 bags of flour to persons at the sea port
- Conducted damage assessments in Kalinago Reserve, 500 houses assessed in the Kalinago Territory to date (Concord, Sineki, St. Cyr, Monkey Hill, Bataka, Gaulete), Salybia is pending
- Preliminary results show that more than 75% are damaged at level 3-4
- Government of Dominica requested extension of the CDRU and COST

The following tasks were completed by Engineering Operations by the Artisans:

- Collected materials from Astraphan for the Inland Revenue Building and entered them into inventory
- Installed shutters at the Electoral Office
- Removed some of the electrical fittings from the Inland Revenue Building as part of the process to commence repairs to the roof and ceiling
- Installed a tarpaulin on the residence of the Cabinet Secretary
- Conducted an assessment at the EOC in Jimmit and provided a list of plumbing materials to be purchased
- Materials were allocated for jobs at the Grammar School
- Erected a flag pole to fly RSS flag at main entrance of Grammar School
- Removed, straightened and replaced gate 2 at the Grammar School
- Built a water drain cover for an open man hole at Grammar School
- Conducted checks and rectified leaks at Grammar school after water was restored
- Constructed and installed bathroom doors on the second floor of the Grammar School
  
- COST continues to support EOC operations
- SAR team continues to support the fire and ambulance services (mainly repairs to public buildings and clean-up activities).

**PHASE 3 – Disaster recovery Operations:**

Support to Participating States:

- Ensuring the conduct of the Post Disaster Needs Assessment (PDNA) in collaboration with partners. This will help reconstruction
- Ensuring in coordination with national, regional and international response organisations, an After Action Review is conducted and a report is produced. This will help to rebuild the level of preparedness of the country and will enhance the national, regional and international response for future events
- Ensure early recovery activities are planned and implemented to ensure the continuity of operations of the government and the private and social sectors.
  - Support of Ms. Jennifer Worrell, former National Disaster Coordinator
- In coordination with the affected country and with regional and international donors, prepare proposals for reconstruction and recovery projects based on the PDNA reports



- Based on reports and lessons learned, revise and enhance the RRM, the RCP, the SRFPs', the RCC's, the SRCCs and the regional and international organisations' response and recovery plans to ensure there is a better coordination and better response for future events.
- RRM review was previously planned and will be undertaken
- Continue promoting preparedness and mitigation measures in a continuous manner to ensure vulnerability and response capacity do not decrease with time.
- Continue to support states through the Programming Areas of the CDEMA Coordinating Unit

#### **CDEMA/CARICOM LEGACY PROJECTS**

- As we move into the early recovery phase CDEMA is proposing undertaking a project for each of the most significantly impacted states as a legacy of support.
- Some financial support is already available through donations but more support needs to be generated

#### **Barbuda**

- ❖ Noting the displacement and recognising there will be some space required for decision-making, undertaking support to the displaced population focussing on:  
The most vulnerable (single female headed families, elderly and disabled) through:
  - Voucher Grants for grocery and hygiene supplies
  - Rent Grant support

#### **British Virgin Islands**

Through initial consultation with the BVI on emerging needs

- ❖ A Transitional Social Protection Programme the government intends on implementing to assist those persons who were adversely impacted by Hurricane Irma.
- ❖ Supporting the Education dimension of such a venture
- ❖ Focus on efforts to assist educational provisions for children with special needs.

#### **Dominica**

Housing support to the Kalinago Territory of Dominica to benefit up to 1000 families focussing on the most vulnerable (single female headed families, elderly and disabled) through:

- ❖ Donation of roofing material through a voucher system
- ❖ Reconstruction of up to 40 homes

This is being made possible through a pledge of 100,000 tons (300,000 sq. ft.) of galvanized sheeting and some pledged cash contribution

**CARIBE EWS**  
**Communication Test**  
**– September 2017**

## PTWC Communication Test for the CARIBE-EWS

Sent 09/27/2017 at 17:00 UTC

## FAXES

## ANTIGUA AND BARBUDA

17:04 FAX 2684624606 DELIVERED 002.4 MINS 005 PGS 01 ATMPS

## ARUBA

17:04 UTC 0112975837328 DELIVERED 001.8 MINS 005 PGS 01 ATMPS

## BAHAMAS

17:05 UTC 2423265456 DELIVERED 002.0 MINS 005 PGS 01 ATMPS

17:16 UTC 2423563739 DELIVERED 002.5 MINS 005 PGS 04 ATMPS

17:04 UTC 2423775275 DELIVERED 002.1 MINS 005 PGS 01 ATMPS

## BARBADOS

17:31 UTC 2465350029 CANCELLED DISCONNECTED

## BELIZE

17:04 UTC 0115012252101 DELIVERED 001.7 MINS 005 PGS 01 ATMPS

## CANADA

17:04 UTC 9024264873 DELIVERED 001.6 MINS 005 PGS 01 ATMPS

## COLOMBIA

17:28 UTC 0115723336961 CANCELLED BUSY SIGNAL

17:34 UTC 0115723393223 CANCELLED NO ANSWER

## COSTA RICA

17:07 UTC 01150622203977 DELIVERED 005.5 MINS 005 PGS 01 ATMPS

17:07 UTC 011506222315757 DELIVERED 005.1 MINS 005 PGS 01 ATMPS

## CUBA

17:29 UTC 0115377937577 CANCELLED BUSY SIGNAL

## CURACAO

17:30 UTC 01159998682699 CANCELLED BUSY SIGNAL

17:32 UTC 01159998683999 DELIVERED 003.8 MINS 005 PGS 05 ATMPS

## DOMINICA

17:29 UTC 7674482883 CANCELLED BUSY SIGNAL

## DOMINICAN REPUBLIC

17:35 UTC 8092317213 CANCELLED NO ANSWER

17:10 UTC 8095932601 DELIVERED 004.7 MINS 005 PGS 02 ATMPS

17:07 UTC 8095979842 DELIVERED 004.9 MINS 005 PGS 01 ATMPS

## FRANCE

17:05 UTC 011590590896075 DELIVERED 003.3 MINS 005 PGS 01 ATMPS

17:28 UTC 011596596512940 CANCELLED BUSY SIGNAL

17:18 UTC 011596596639955 DELIVERED 004.0 MINS 005 PGS 04 ATMPS

## GRENADA

17:04 UTC 4734441574 DELIVERED 001.8 MINS 005 PGS 01 ATMPS

## GUATEMALA

17:26 UTC 0115022261321 CANCELLED BUSY SIGNAL

17:13 UTC 01150222613246 DELIVERED 007.7 MINS 005 PGS 03 ATMPS

17:25 UTC 0115022261326 CANCELLED BUSY SIGNAL

## GUYANA

17:06 UTC 0115922261460 DELIVERED 003.8 MINS 005 PGS 01 ATMPS

17:06 UTC 0115922612284 DELIVERED 003.9 MINS 005 PGS 01 ATMPS

## HAITI

17:26 UTC 01150922501163 CANCELLED BUSY SIGNAL

## JAMAICA

17:05 UTC 8767543229 DELIVERED 002.2 MINS 005 PGS 01 ATMPS

17:10 UTC 8769248670 DELIVERED 003.8 MINS 005 PGS 03 ATMPS

## NICARAGUA

17:34 UTC 01150522491082 CANCELLED NO ANSWER

17:06 UTC 01150522809931 DELIVERED 004.2 MINS 005 PGS 01 ATMPS

## PANAMA

17:28 UTC 0115073160042 CANCELLED BUSY SIGNAL

17:33 UTC 0115075235558 CANCELLED NO ANSWER

## SAINT KITTS AND NEVIS

17:34 UTC 8694664305 CANCELLED NO ANSWER

17:04 UTC 8694665310 DELIVERED 002.0 MINS 005 PGS 01 ATMPS

17:15 UTC 8694697759 DELIVERED 001.9 MINS 005 PGS 04 ATMPS

## SAINT LUCIA

17:04 UTC 7584523064 DELIVERED 001.9 MINS 005 PGS 01 ATMPS

17:04 UTC 7584537334 DELIVERED 001.7 MINS 005 PGS 01 ATMPS

17:29 UTC 7584549705 CANCELLED DISCONNECTED

## SAINT VINCENT AND THE GRENADINES

17:04 UTC 7844571691 DELIVERED 002.0 MINS 005 PGS 01 ATMPS

## SINT MAARTEN

17:34 UTC 7215426526 CANCELLED NO ANSWER

## SURINAME

17:11 UTC 011597474320 DELIVERED 007.6 MINS 005 PGS 02 ATMPS

## TRINIDAD AND TOBAGO

17:04 UTC 8686409746 DELIVERED 001.9 MINS 005 PGS 01 ATMPS

17:04 UTC 8686694009 DELIVERED 002.0 MINS 005 PGS 01 ATMPS

17:04 UTC 8686694727 DELIVERED 001.7 MINS 005 PGS 01 ATMPS

## UK ANGUILLA

17:30 UTC 2644973134 CANCELLED DISCONNECTED

17:33 UTC 2644977056 CANCELLED NO ANSWER UK

## UK BERMUDA

17:06 UTC 4412935062 DELIVERED 002.1 MINS 005 PGS 01 ATMPS

17:04 UTC 4412936658 DELIVERED 001.9 MINS 005 PGS 01 ATMPS

17:16 UTC 4412971530 DELIVERED 003.1 MINS 005 PGS 04 ATMPS

UK BRITISH VIRGIN ISLANDS

17:27 UTC 2844686141 CANCELLED BUSY SIGNAL  
17:26 UTC 2844942024 CANCELLED BUSY SIGNAL

UK CAYMAN ISLANDS

17:06 UTC 3459465020 DELIVERED 003.6 MINS 005 PGS 01 ATMPS  
17:04 UTC 3459494386 DELIVERED 001.9 MINS 005 PGS 01 ATMPS

UK MONTSERAT

17:35 UTC 6644912465 CANCELLED NO ANSWER

UK TURKS AND CAICOS

17:27 UTC 6499414532 CANCELLED NO ANSWER  
17:27 UTC 6499461230 CANCELLED NO ANSWER  
17:32 UTC 6499464372 CANCELLED NO ANSWER

US VIRGIN ISLANDS

17:04 UTC 3407132075 DELIVERED 002.2 MINS 005 PGS 01 ATMPS  
17:26 UTC 3407156726 CANCELLED BUSY SIGNAL

PUERTO RICO

17:26 UTC 7872537802 CANCELLED BUSY SIGNAL  
17:27 UTC 7875230823 CANCELLED NO ANSWER  
17:26 UTC 7876521154 CANCELLED BUSY SIGNAL

VENEZUELA

17:31 UTC 011582122579860 CANCELLED NO ANSWER  
17:07 UTC 011582126628372 DELIVERED 003.5 MINS 005 PGS 02 ATMPS

17:01 [marcelo.seluchi@cemaden.gov.br](mailto:marcelo.seluchi@cemaden.gov.br)

NOT DELIVERED BRAZIL



# Coastal Impacts (Puerto Rico)

El Mani, Mayagüez



Rincón





# Tsunami Signs Survived

Mayagüez, PR



Rincón, PR





# Some Sirens Survived, Others Did Not

Mayaguez



Isabela



# Tropical Storm/Hurricane Nate

- October 4-11, 2017
- Affected the CARIBE EWS MS of Nicaragua, Costa Rica, Guatemala, Panama, Honduras, and El Salvador, Mexico (Yucatan Peninsula), Cayman Islands and Cuba
- Flooding
- Revealed the need for better land use planning and the enforcement especially in rebuilding/reconstruction



# Lessons Learned With Input of Participants

- Need for redundancy in communication platforms (Internet data can be lost)
- Need for COOP (Continuity of Operations Plan)/Backup Centers— eg PRSN devolved to USGS and Mexico NTWC after the Sept. EQ devolved to their backup Center
- Utility of EMWIN for receiving alerts given the satellite capability
- Need to consider alternates outside ones jurisdiction, especially in SIDS where there may be no agency that can provide service
- Sea level gauges installed for tsunami were useful for storm surge observations
- Tsunami awareness can help even during a storm. In PR the Mayor used the Tsunami Sirens to get people that were not wanting to evacuate, to evacuate during Maria (saving lives)

# Cont.

- Lessons for installation of Signage and Sirens
- Empowerment of communities/institutions helps with the relief efforts, especially in situations of loss of communication or very fast developing events
- More education is required so people can understand the vulnerability of structures, eg. that a building can survive hurricane force winds, does not necessarily mean that it can withstand wave impact
- Impact on access to food/commodities/flights/medical care need alternatives that were observed in the Hurricanes could also be experienced for tsunamis

# Cont.

- Security issues, law enforcement needs
- Need to consider impacts on people
- DM and Head of Government are also affected by the event despite of preparation efforts, this can impact relief and recovery efforts
- Radio stations can help with the dissemination of information, but it would be useful to have protocols on the type of information.
- Issues in managing incoming relief support, consider military vs humanitarian needs
- Curfews, different views, when they should be implemented
- 72 hours vs longer times to be self sufficient (10-14 days)
- Shelters, EQ/Tsunami vs Hurricane – security, hygiene, health, humanitarian needs

# Cont.

- Ham radio operators/amateur radio operators can also help with communications
- Role on Social Media
- Relationship between DM and Media Practicioners, being accessible to the media is very important.
- Role of Radio/TV
- Emergency Broadcast Radios
- Opportunity to educate and prepare better, new risk reduction initiatives. Eg. DR – Empowerment of Local Authorities after H. Georges. Improve communication, political vs scientific/technical information issues. Financial tools could also be used.





United Nations  
Educational, Scientific and  
Cultural Organization



Intergovernmental  
Oceanographic  
Commission



National Oceanic  
and Atmospheric  
Administration



International  
Tsunami Information  
Center



CTIC  
Caribbean Tsunami  
Information Centre  
ctic.icc-unesco.org



Pacific Tsunami  
Warning Center



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

# Thank You

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