National Reports will be posted to the ICG/CARIBE-EWS session website.

NATIONAL REPORT
Submitted by TNC of
United States of America
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NOAA/National Weather Service (NWS)

BASIC INFORMATION

1. Tsunami Standard Operating Procedures for a Local Tsunami (when a local tsunami hazard exists)

The standard operating procedures for tsunamis in the United States are largely the same for local, regional, and distant tsunamis. Where there are differences, they are noted here.

What organization identifies and characterizes tsunamigenic events?
The National Oceanic and Atmospheric Administration's (NOAA) Pacific Tsunami Warning Center (PTWC) in Hawaii provides domestic tsunami alert services for Hawaii, American Samoa, Guam and the Commonwealth of the Northern Mariana Islands (CNMI), and Puerto Rico and the U.S. and British Virgin Islands. The NOAA U.S. National Tsunami Warning Center (US NTWC) in Alaska provides domestic tsunami alert services for the continental United States, Alaska, and Canada. Each center serves as the other center's backup.

Both NOAA centers independently characterize potential tsunamigenic events that occur in the Caribbean and Atlantic. To avoid conflicting information, each center is assigned tsunami source regions for which they are authoritative in tsunami warning center products. In this way, the preliminary earthquake parameters that appear in PTWC and US NTWC products are always the same.

What is the threshold or criteria for declaring a potential tsunami emergency?
PTWC issues initial messages based solely on an earthquake's preliminary location, depth, and magnitude determined from a rapid seismic analysis as well as the distance of the earthquake from Puerto Rico and the Virgin Islands in terms of tsunami travel time or kilometers.

Puerto Rico and the Virgin Islands
For earthquakes located further than three hours tsunami travel time from Puerto Rico and the Virgin Islands, PTWC uses the seismic criteria in Table 1 to determine initial products.

Earthquake					Alert Level
Sea	**Land**	**Depth**	**Magnitude**	**ETA**	
Yes	Yes	< 62 miles (100 km)	6.5 - 7.8	> 3 hr	Information statement No threat
Yes	Yes	≥ 62 miles (100 km)	≥ 6.5	> 3 hr	Information statement No threat
Yes	Near Sea	< 62 miles (100 km)	≥ 7.9	> 6 hr	Information statement Potential threat
Yes	Near Sea	< 62 miles (100 km)	≥ 7.9	3–6 hr	Watch

Table 1. Criteria for PTWC initial tsunami products for Puerto Rico/Virgin Islands for distant earthquakes.

Source: Users' Guide Tsunami Warning Products for Puerto Rico, U.S. Virgin Islands, and British Virgin Islands Version 1.21, December 8, 2023.

For earthquakes located within three hours of tsunami travel time of Puerto Rico and the Virgin Islands, PTWC uses the earthquake's proximity to polygons created for populated islands of Puerto Rico and the Virgin Islands and the preliminary seismic parameters in Table 2 to determine initial products.

Earthquake			Alert Level
Source Location	**Depth**	**Magnitude**	
Within 186 miles (300 km) of Puerto Rico/Virgin Islands	< 62 miles (100 km)	4.5-6.4	Information Statement
	≥ 62 miles (100 km)	≥ 4.5	
	< 62 miles (100 km)	≥ 7.1	Warning
	< 62 miles (100 km)	6.5–7.0	Advisory
Between 186 miles (300 km) and 621 miles (1000 km) of Puerto Rico/Virgin Islands	< 62 miles (100 km)	≥ 7.6	Warning
	< 62 miles (100 km)	7.1–7.5	Advisory
> 621 miles (1000 km) of Puerto Rico/Virgin Islands	< 62 miles (100 km)	≥ 7.9	Warning
	< 62 miles (100 km)	7.6-7.8	Advisory

Table 2. Criteria for PTWC initial tsunami products for Puerto Rico and the Virgin Islands for nearby earthquakes.

Notes: If the earthquake has a preliminary depth less than 62 miles (100 km) with preliminary magnitude of 6.5 or greater but does meet location criteria above for an advisory or warning, then only an information statement will be issued indicating no tsunami threat. If the preliminary earthquake depth is greater than or equal to 62 miles (100 km) and the preliminary earthquake magnitude is greater than or equal to 6.5, then only an information statement will be issued indicating no tsunami threat from a deep earthquake.
Source: Users' Guide Tsunami Warning Products for Puerto Rico, U.S. Virgin Islands, and British Virgin Islands Version 1.22. April 28, 2024 (https://tsunami.gov/operations/PRVIUserGuide.pdf)

Once PTWC generates a forecast for an event, alert levels may be revised in supplemental messages to reflect forecast wave heights as shown in Table 3 or based on observed wave heights.

Maximum Expected Rise of Sea Level above the Tide	Alert Level
0–1 feet (0–0.3 m)	None
1–3.3 feet (0.3–1 m)	Advisory
> 3.3 feet (> 1 m)	Warning

Table 3. Criteria for PTWC supplemental text products for Puerto Rico/Virgin Islands

Source: Users' Guide Tsunami Warning Products for Puerto Rico, U.S. Virgin Islands, and British Virgin Islands Version 1.22. April 28, 2024 (https://tsunami.gov/operations/PRVIUserGuide.pdf)

PTWC may increase alert levels if new information justifies such an increase. They will not lower alert levels before impact unless an updated evaluation has a very high level of confidence and there is a clear benefit to lowering the alert. They may lower alert levels after impact as conditions warrant until cancellation.

What organization acts on the information provided by the agency responsible for characterizing the potential tsunami threat?

Puerto Rico and the Virgin Islands

- Puerto Rico Bureau of Emergency Management and Disaster Administration (also a CARIBE-EWS Tsunami Warning Focal Point)
- U.S. National Weather Service San Juan, Puerto Rico, Weather Forecast Office (also a CARIBE-EWS Tsunami Warning Focal Point, Alternate)
- Puerto Rico Seismic Network, University of Puerto Rico at Mayaguez (also a CARIBE-EWS Tsunami Warning Focal Point, Alternate)
- Virgin Islands Territorial Emergency Management Agency (also a CARIBE-EWS Tsunami Warning Focal Point)
- British Virgin Islands Department of Disaster Management (also a CARIBE-EWS Tsunami Warning Focal Point)
- British Royal Police Force (also a CARIBE-EWS Tsunami Warning Focal Point, Alternate)
- U.S. Coast Guard, Sector San Juan

How is the tsunami information (warning, public safety action, etc.) disseminated within your country? Who is it disseminated to?

In general, tsunami information is disseminated from PTWC to the officially designated responsible government agencies in each jurisdiction through a variety of channels as depicted in Figure 1.

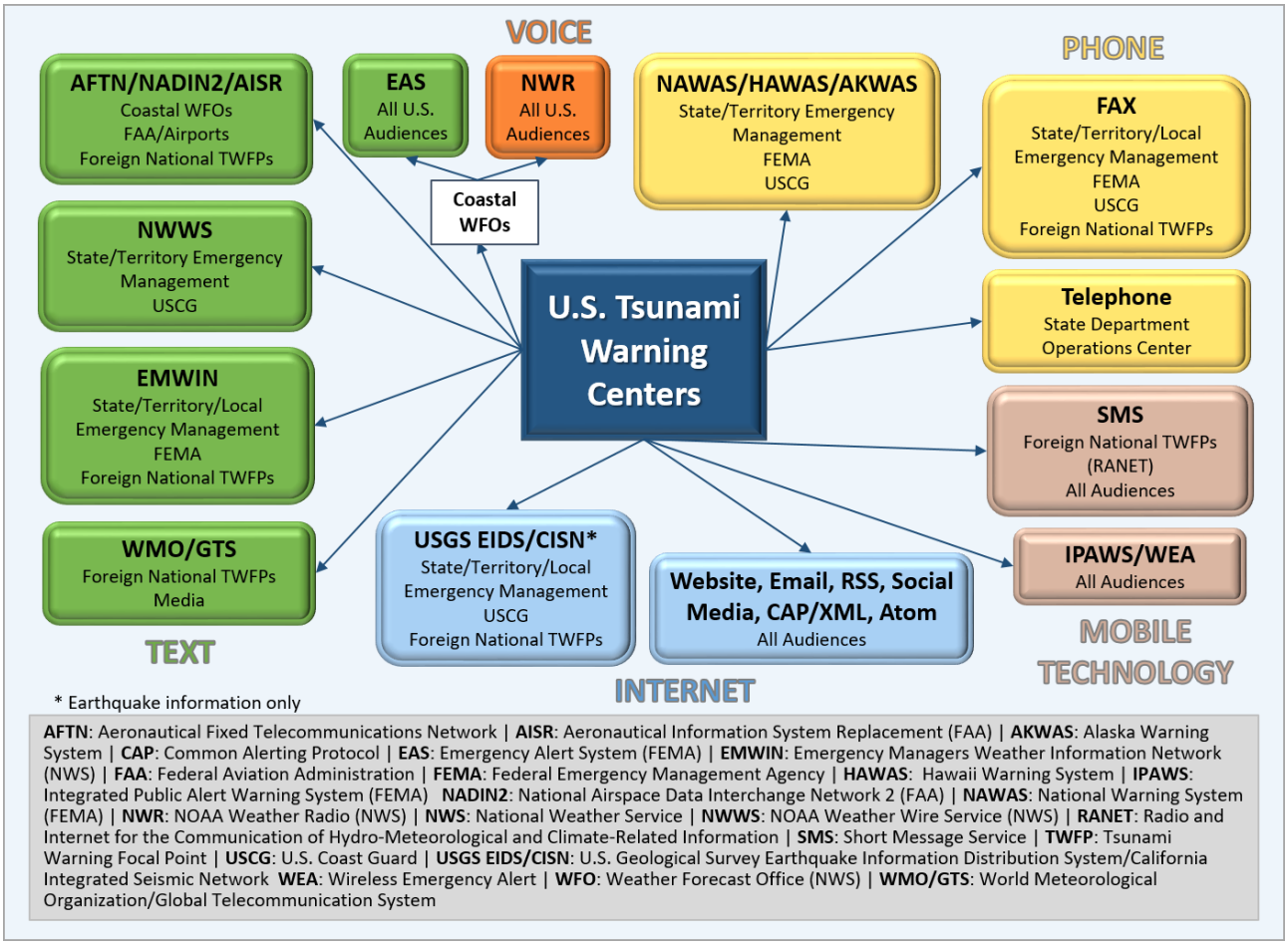

Figure 1. NOAA tsunami warning center dissemination methods.

Puerto Rico and the Virgin Islands

- The Puerto Rico Emergency Management and Disaster Administration Bureau alerts the public (through interoperability systems, sirens, and other means); police, fire, rescue, and other response agencies; and media outlets (Figures 2 and 3)
- The Wireless Emergency Alert (WEA), through FEMA's Integrated Public Alert and Warning System (IPAWS) capability was tested in Puerto Rico on March 20, 2025 as part of CARIBE WAVE 25 exercise.
- The U.S. Virgin Islands Territorial Emergency Management Agency alerts the public (through interoperability systems, sirens, and other means); police, fire, rescue, and other response agencies; and media outlets.
- The US Virgin Islands utilizes Alert VI - mass message notification / Everbridge which reaches 21% of the population (2020 U.S. Census). The U.S. Virgin Islands Territorial Emergency Management Agency (VITEMA) uses WEA/IPAWS which requires FCC approval during training and drills. Capability was tested in Puerto Rico on March 20, 2025 as part of CARIBE WAVE 25 exercise.
- The Puerto Rico Seismic Network (PRSN) provides guidance to the emergency management agencies in Puerto Rico and the Virgin Islands, the media, and the San Juan Weather Forecast Office as well as the Instituto Dominicano de Meteorologia (INDOMET). The PRSN further disseminates official tsunami messages through RSS, email, SMS, web page, social media, phone calls, radio, and more (Figure 2 and 4).
- The U.S. National Weather Service San Juan Weather Forecast Office as TWFP Alternate activates the Emergency Alert System (EAS) for Puerto Rico and the U.S. Virgin Islands to interrupt commercial radio and television with a message and broadcasts tsunami information over NOAA Weather Radio (Figures 2 and 5)
- Upon receipt, the media may also interpret and re-disseminate tsunami information.
- Upon receipt, NOAA's Caribbean Office of the International Tsunami Warning Center (ITIC) may also interpret and re-disseminate tsunami information.

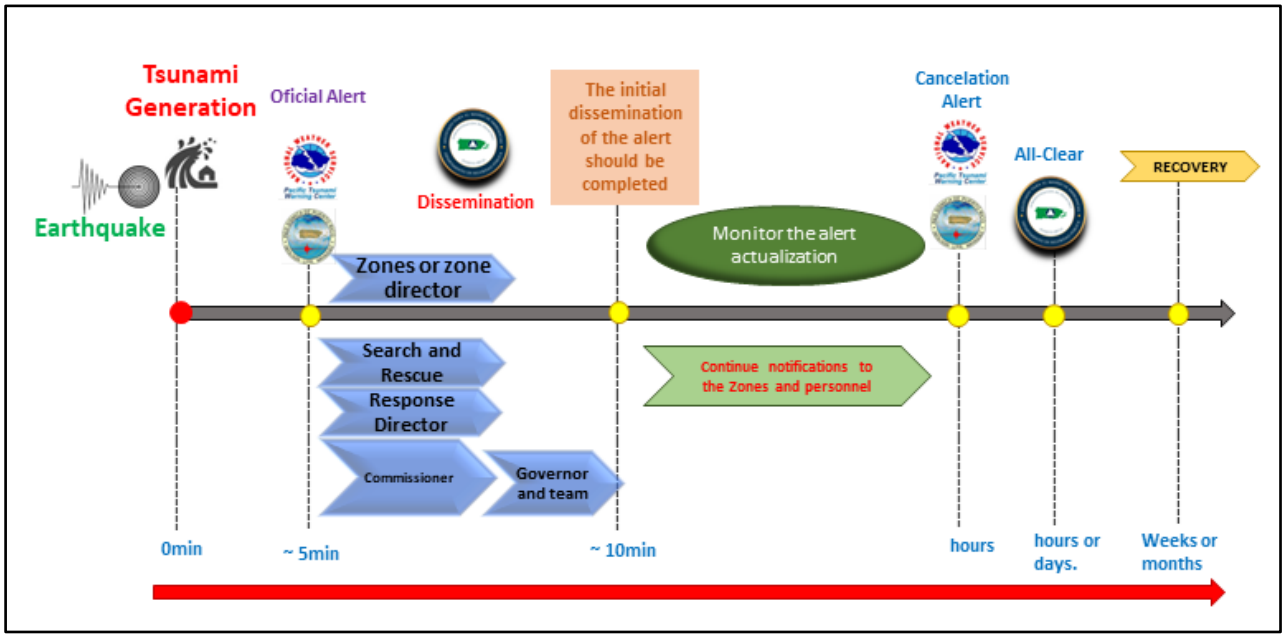

Figure 2. Timeline of Puerto Rico for issuance and dissemination of tsunami alert and updates from event origin time.

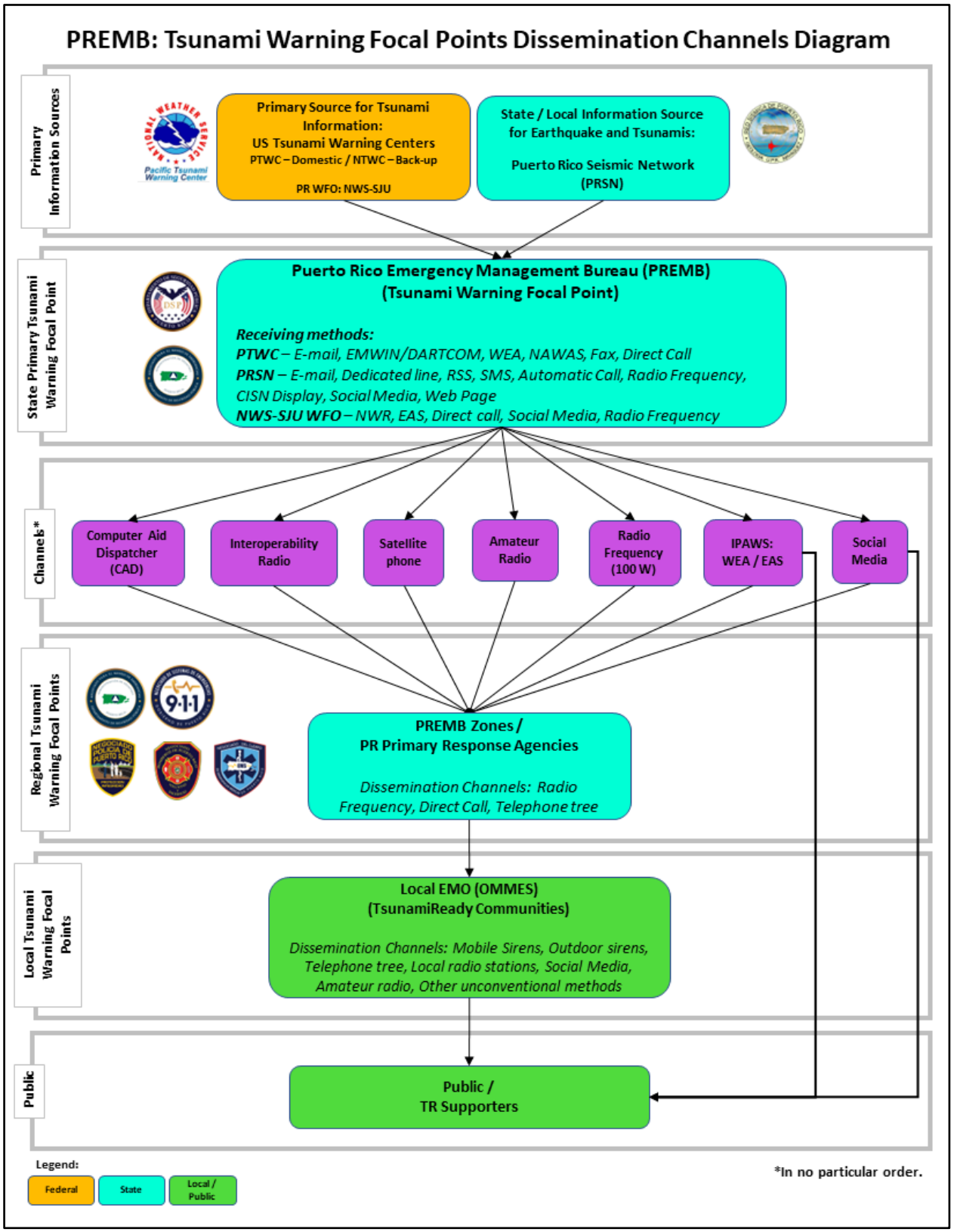

Figure 3. PREMB Tsunami Warning Focal Point Dissemination Flowchart (Rev 2024).

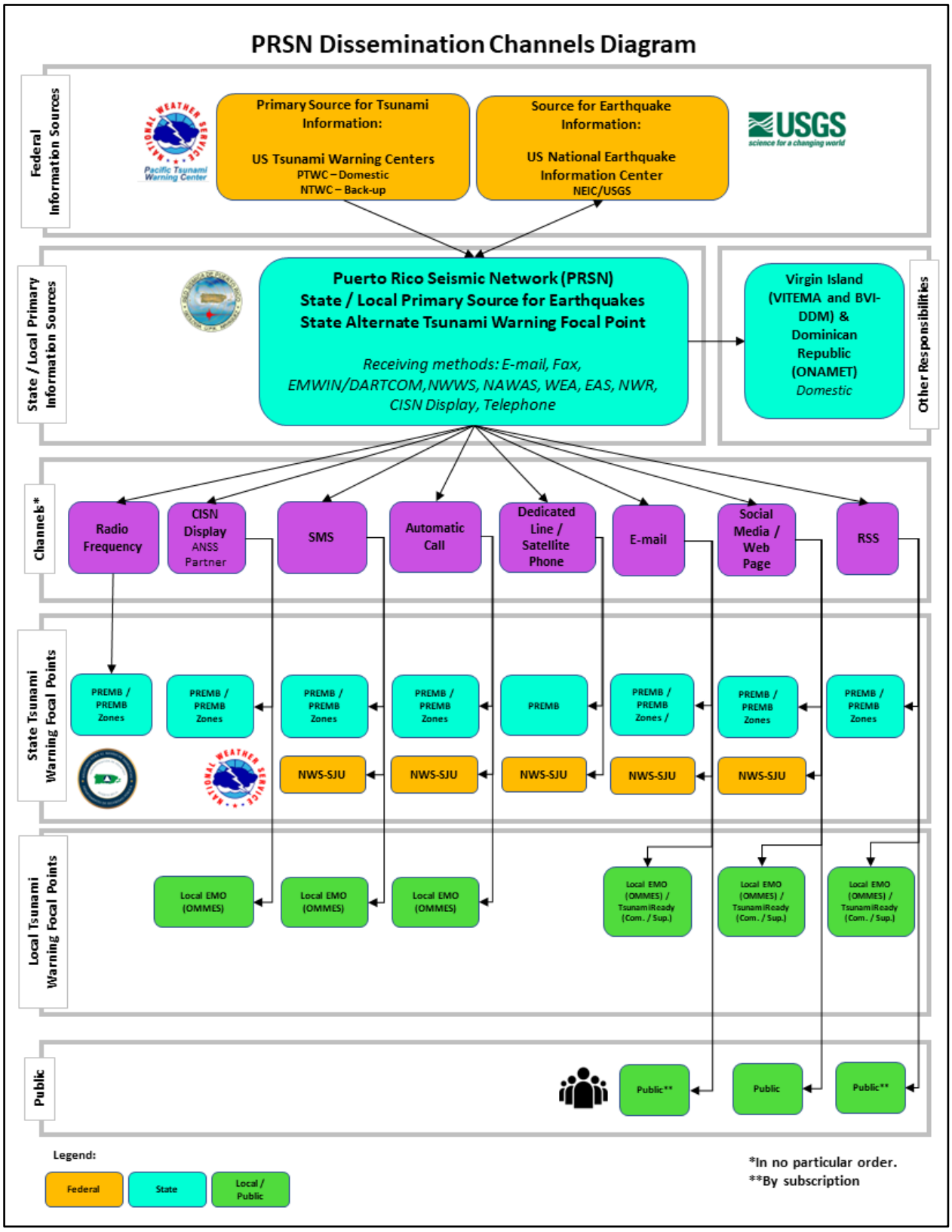

Figure 4. PRSN Tsunami Warning Focal Point Dissemination Flowchart (Rev 2024).

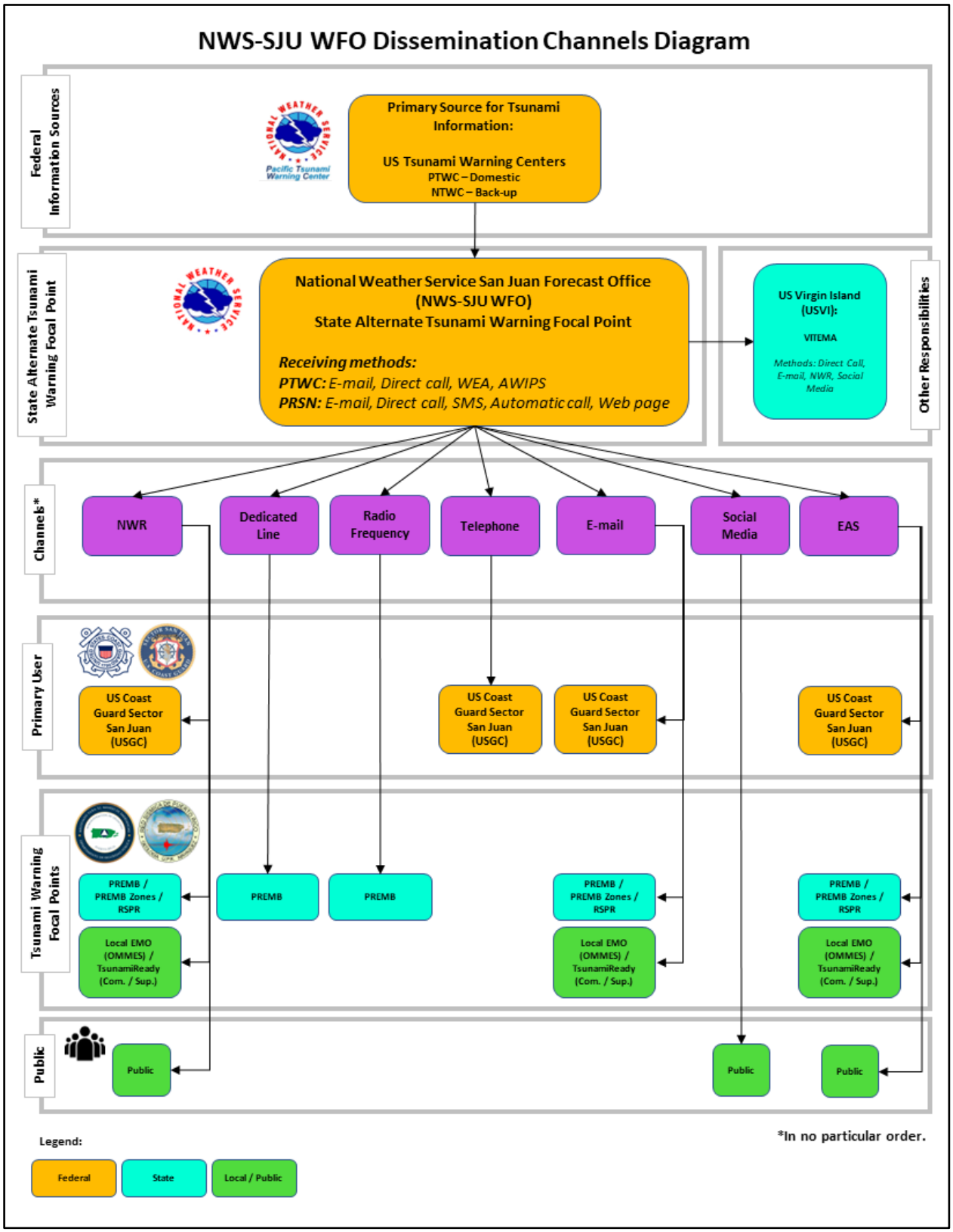

Figure 5. WFO San Juan's Warning Focal Point Dissemination Flowchart (Rev 2024).

Communication Testing

As shown in Figure 2, PTWC confirms communication links with each of the key recipient agencies in Puerto Rico and the Virgin Islands following the issuance of a product – typically about once a month. Agencies also receive the monthly CARIBE-EWS communication tests and the test associated with each year's CARIBE WAVE Exercise.

- PREMB does live WEA test as part of the CARIBE WAVE (March) and ShakeOut earthquake exercises (October). Local emergency management agencies who operate sirens within their jurisdiction are encouraged to do an audible test last Wednesday of every month at 12 pm ET.
- PRSN also tests communication lines monthly and annually as part of the CARIBE WAVE and ShakeOut earthquake exercises.
- WFO San Juan's forecast does live NOAA Weather Radio and EAS test as part of the CARIBE WAVE (March) and ShakeOut earthquake exercises (October).
- VITEMA tests their Tsunami Sirens territory wide the third Thursday of each month at 11am. During the weekly meetings of the Tsunami Working Group the results are analyzed and gaps and success are noted.

How is the emergency situation terminated?

Puerto Rico and the Virgin Islands
PTWC issues a cancellation after an evaluation of water-level data confirms that a destructive tsunami will not impact an area under an alert (warning, advisory, or watch) or that a tsunami has diminished to a level where additional damage is not expected. This does not mean it is safe to return to evacuated areas. Local authorities determine when it is safe (issued all clear) to return based on local information about continuing wave conditions and related hazards such as fires or downed power lines.

2. Tsunami Standard Operating Procedures for a Distant Tsunami (when a distant tsunami hazard exists)

Note: There were no Tsunami Warnings for U.S. Caribbean, Gulf of America, or Atlantic coasts issued by PTWC or U.S. NTWC during the intersessional period.

Seismic Monitoring Network
The United States supports an extensive network of seismic sensors in the Pacific, Atlantic, Caribbean, and Gulf of America. A number of other entities also support earthquake monitoring activities in the Caribbean and adjacent regions.

- The U.S. Geological Survey (USGS) National Earthquake Information Center (NEIC) and Albuquerque Seismological Laboratory coordinate field and monitoring operations to ensure reliable mission-critical data to the tsunami warning centers. One hundred and fifty of these stations are part of the Global Seismographic Network (GSN) and are jointly operated by the USGS, and the EarthScope Consortium. An additional 97 stations in the U.S. are part of the Advanced National Seismic System (ANSS). Seismic station details are provided at the GSN and ANSS URLs listed in Section 9.
- The PRSN, with the support from the Puerto Rico Strong Motion Program (PRSMP), and in partnership with the ANSS, monitors the seismic activity in Puerto Rico and the U.S. and British Virgins Islands. The stations operated by the PR network include 30 seismic stations and more than 100 strong motion stations (75 free-field in Puerto Rico and the Virgin Islands and 12 in nearby countries, including Anguilla and Aruba as well as the Dominican Republic); the broadband stations are equipped with velocity and acceleration sensors. Some stations are equipped with Global Navigation Satellite System (GNSS) displacement sensors.
- In response to the damage caused by 2017 hurricanes, USGS ASL worked with PRSN to upgrade a total of 25 seismic stations. Each site was upgraded with new sensors (posthole broadband seismometer and accelerometer), digitizers, and solar power backups. Twelve (12) of these sites have VSAT connections to PRSN and NEIC to maintain monitoring capability if island wide power and internet go down again. The backbone network of strong motion stations were updated as well, and the communications improved mostly with cell phone circuits and telemetry. The PRSN, with the support from the Puerto Rico Science Trust, installed a network of type-C accelerometers (100 in the first stage), these

equipment, together with the Raspberry Shake network, and the permanent networks of the Island, are being used to study the feasibility of developing an earthquake early warning in Puerto Rico.

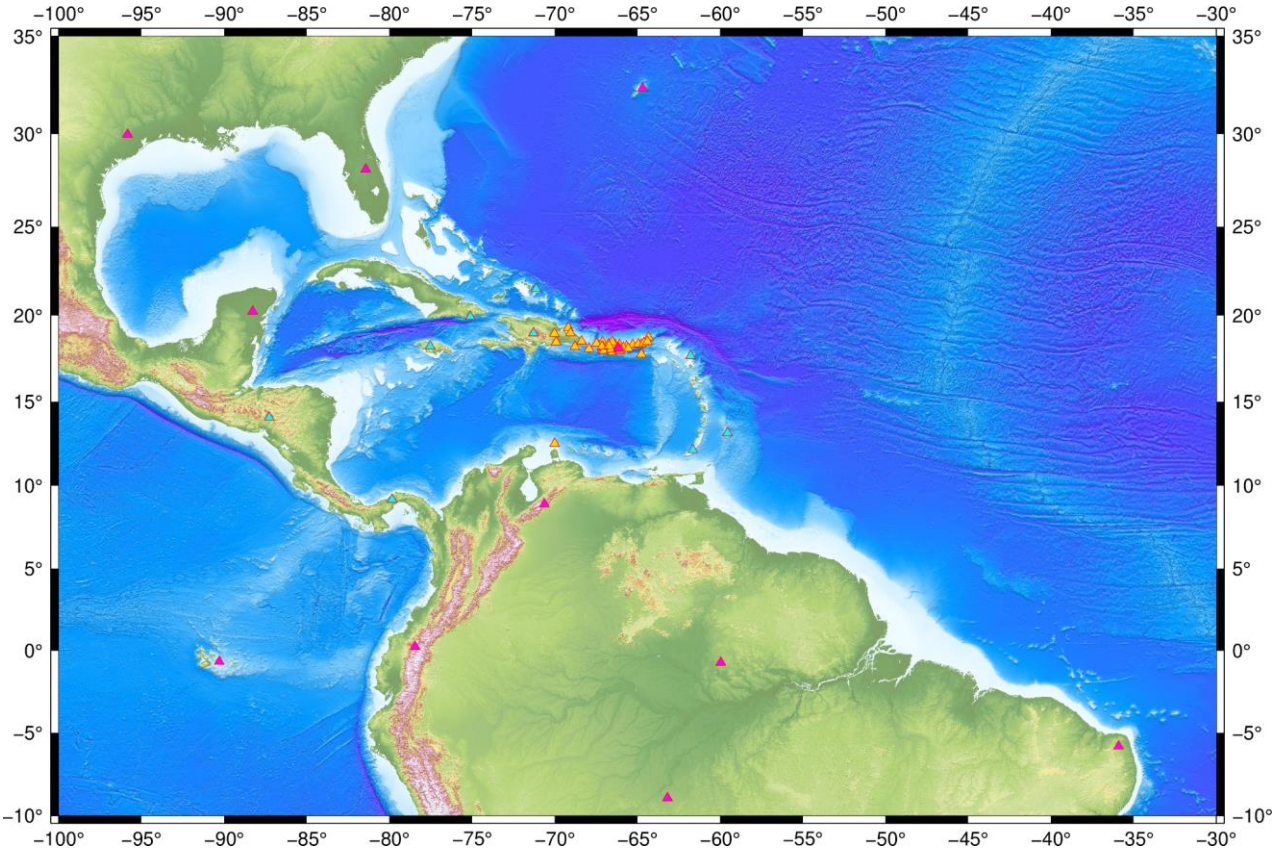

Figure 6.Distribution of seismic instruments supported or operated by PRSN/PRSMP (PR-gold) and the USGS (IIU - magenta, CU-cyan) in the CARIBE-EWS region. A table of these instruments is available as Appendix A (below).

For each situation, please provide the following:

- *What organization identifies and characterizes tsunamigenic events?*
- *What is the threshold or criteria for declaring a potential tsunami emergency?*
- *What organization acts on the information provided by the agency responsible for characterizing the potential tsunami threat?*
- *How is the tsunami information (warning, public safety action, etc) disseminated within country? Who is it disseminated to?*
- *How is the emergency situation terminated?*
- *For Distant Tsunami Procedures:*
  What actions were taken in response to tsunami bulletins issued by PTWC, NWPTAC, and/or SCSTAC during the intersessional period?

3. National Sea Level Network

The United States supports an extensive sea level network in the Pacific, Atlantic, Caribbean, and Gulf of America. In the Caribbean, this includes coastal water-level stations and Deep-ocean Assessment and Reporting of Tsunami (DART) systems as described below and cataloged in Table 5 and 6.

U.S. Caribbean Coastal Water-Level Stations

Coastal water-level stations in the United States are operated by a variety of entities. Many of these stations are part of the international Global Sea-Level Observing System (GLOSS), which is coordinated by UNESCO/IOC. The data from these stations are made available to the NOAA

tsunami warning centers and can be viewed on the UNESCO/IOC Sea Level Data Facility and through programs like Tide Tool, which is run in many CARIBE-EWS tsunami warning centers.

- NOAA's Center for Operational Oceanographic Products and Services operates 11 stations in the Caribbean (Puerto Rico, U.S. Virgin Islands, Bermuda) as part of its National Water Level Observation Network (NWLON). These multi-purpose stations have, at a minimum, a primary and backup sensor and data collection platform. High-frequency 1-minute water-level data are collected and transmitted every six minutes over GOES-East, telephone, IP modem, or Iridium to the tsunami warning centers. The NWLON also includes stations along the U.S. East and Gulf Coasts.
    - Tide gauge data from the NOAA-operated stations are quality controlled (for research), de-tided, and archived at NOAA's National Centers for Environmental Information (NCEI). Data is available for download from an interactive timeline at https://www.ncei.noaa.gov/products/natural-hazards/tsunamis-earthquakes-volcanoes/tsunamis/tide-gauge-data.
- The University of Hawaii Sea Level Center (UHSLC) operates 10 stations in the region and has assisted with installation and maintenance of additional stations when necessary. However, funding from the NOAA/NWS Tsunami Program for the UHSLC to operate these stations has been discontinued, and UHSLC support for these stations—and the Caribbean tide-gauge network in general—will be limited going forward. The UHSLC stations have a primary and backup sensor and sample once per minute. Data is sent over GOES-East or Iridium with a five-minute transmission interval at most locations with no longer than ten-minute intervals.
- With support from NOAA, the government of Puerto Rico and the University of Puerto Rico, the PRSN operates ten stations in Puerto Rico and the Dominican Republic, and help DDM to operate the BVI tide gauge in Tortola These stations transmit data every six minutes over GOES-HRIT, and some of them each minute via internet through an earthworm module using the seedlink protocol. CO-OPS displays the 1 minute data. PRSN will be reinstalling station in Caja de Muertos and installing new stations in Anegada (BVI) and Samana (Dominican Republic). The Smithsonian Institution has installed, operates, and maintains two tsunami-capable water-level stations in Belize and Panama that transmit data every five minutes. The station in Belize is back online as of October 2023.

U.S. Caribbean Deep-ocean Assessment and Reporting of Tsunami (DART) Systems

NOAA's National Data Buoy Center (NDBC) operates 32 DART systems in the Pacific Ocean and 7 in the Atlantic Ocean (including 1 in the Gulf of America and 3 in the Caribbean and adjacent seas region). The DART system technology uses a bottom pressure recorder (BPR), samples the pressure at 15-second intervals and communicates via acoustic link with a surface buoy, and has two data reporting modes, standard and event. In standard mode, DART systems transmit data every six hours with a 15-minute subsampling of the full 15-second sampling intervals.

DART systems will enter event mode if tsunami detection algorithm identifies an event in the BPR or manually by a tsunami warning center. The NDBC's Mission Control Center continuously monitors the DART systems and validates triggers with the Tsunami Warning Centers. In event mode, a DART system delivers several minutes of full resolution data at 15-second intervals followed by one-minute averages. If no further events are detected or if it is not manually reset to event mode, the system reverts to its standard transmission mode after four hours.

NDBC receives DART data via Iridium and reformats it into messages for distribution on the Global Telecommunication System (GTS) and NOAAPORT. Data from the seven Atlantic DART systems goes out under the GTS bulletin header SZNT01 KWNB. NDBC also posts the data to its website. The high-resolution 15-second data is sent to NCEI for, quality control, tidal analysis, and long-term archive. Data is available from an interactive timeline at https://www.ncei.noaa.gov/products/natural-hazards/tsunamis-earthquakes-volcanoes/tsunamis/dart-ocean-bottom-pressure.

Vandalism or unintentional interference to DART systems and other sensors in the region has impacted their operations over the past decade. NOAA is working with international partners under the IOC and World Meteorological Organization (WMO) to educate members of the fishing community and others to combat the incidence of vandalism and interference. Regional marine fisheries organizations are also collaborating to address the issue. All members are encouraged to share the importance of these sensing systems for accurately forecasting tsunamis and vandalism can make vulnerable communities even more at risk.

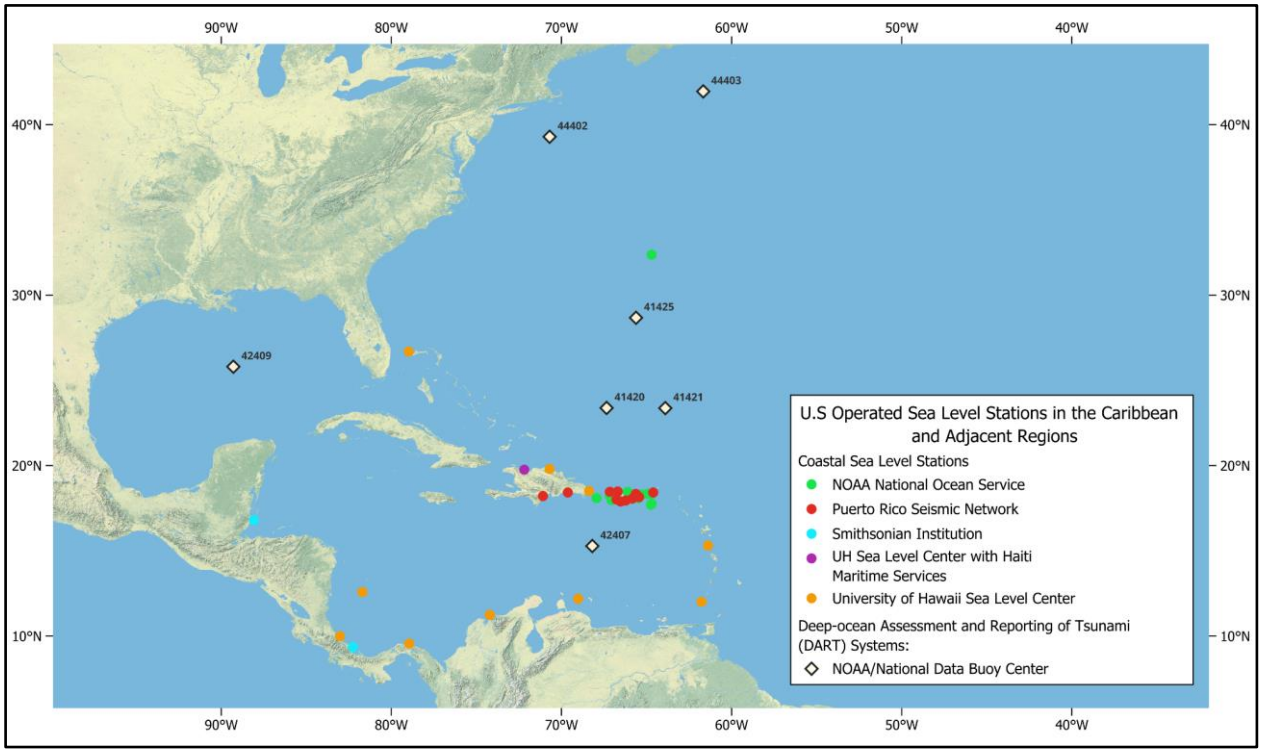

Figure 7: U.S.-operated sea level stations in Caribbean and adjacent regions. The U.S. also operates numerous stations along its Gulf and East Coast that would contribute to the assessment of tsunamis originating in the Atlantic or Gulf regions.

Location	Latitude	Longitude	Status*	Operator
Coastal Water-Level Stations**				
Christiansted Harbor, St. Croix, U.S. Virgin Islands	17.75 N	64.70 W	Fully Operational	NOAA/Center for Operational Oceanographic Products and Services[1]
Lime Tree Bay. St. Croix, U.S. Virgin Islands	17.70 N	64.75 W	Fully Operational	
Lameshur Bay, St. John, U.S. Virgin Islands	18.32 N	64.72 W	Fully Operational	
Charlotte Amalie, St. Thomas, U.S. Virgin Islands	18.34 N	64.92 W	Fully Operational	
Culebra, Puerto Rico	18.30 N	65.30 W	Fully Operational	
Esperanza, Vieques Island, Puerto Rico	18.09 N	65.47 W	Fully Operational	
Magueyes Island, Puerto Rico	17.97 N	67.06 W	Fully Operational	
Mayagüez, Puerto Rico	18.22 N	67.16 W	Fully Operational	
Mona Island, Puerto Rico	18.09 N	67.94 W	Fully Operational	

San Juan, La Puntilla, San Juan Bay, Puerto Rico	18.46 N	66.12 W	Fully Operational	
Bermuda, Biological Station	32.37 N	64.70 W	Fully Operational	
San Andres, Colombia	12.58 N	81.70 W	2 of 3 sensors Fully Operational	University of Hawaii Sea Level Center
Santa Marta, Colombia	11.24 N	74.22 W	Fully Operational	
Limon, Costa Rica	9.99 N	83.02 W	Fully Operational	
Bullen Bay, Curacao	12.19 N	69.02 W	2 of 3 sensors Fully Operational	
Roseau, Dominica	15.31 N	61.39 W	1 of 3 sensors Fully Operational	
Puerto Plata, Dominican Republic	19.80 N	70.70 W	2 of 3 sensors Fully Operational	
Punta Cana, Dominican Republic	18.51 N	68.38 W	Fully Operational	
Prickly Bay, Grenada	12.01 N	61.77 W	2 of 3 sensors Fully Operational	
El Porvenir, Panama	9.56 N	78.95 W	Fully Operational	
Settlement Point, Bahamas	26.69 N	78.98 W	Fully Operational	
Aguadilla, Puerto Rico	18.46 N	67.16 W	Fully Operational	University of Puerto Rico, Mayaguez, Puerto Rico Seismic Network * Operated by INDOMET ** Operated by DDM
Arecibo, Puerto Rico	18.48 N	66.70 W	Fully Operational	
Caja de Muertos, Puerto Rico	17.89 N	66.53 W	Damaged [Not Operational]	
Salinas, Puerto Rico	17.949 N	66.226 W	Fully Operational	
Guayanilla, Puerto Rico	18.01 N	-66.77 W	Fully Operational	
Fajardo, Puerto Rico	18.338 N	65.631 W	Fully Operational	
Isabel Segunda, Vieques Island, Puerto Rico	18.15 N	65.44 W	Fully Operational	
Yabucoa Harbor, Puerto Rico	18.06 N	65.84 W	Fully Operational	
Tortola, British Virgin Islands**	18.42 N	64.61 W	Operational	
Barahona, Dominican Republic*	18.21 N	71.09 W	Operational [with gaps]	
Puerto Caucedo, Dominican Republic*	18.42 N	69.63 W	Not Operational	
Cap-Haitien, Haiti	19.76 N	72.19 W	Not Operational	UH Sea Level Center with Haiti Maritime Services
Bocas del Toro, Panamá	9.35 N	82.26 W	Fully Operational	Smithsonian Institution
Carrie Bow Cay off Belize	16.80 N	88.08 W	Operational [with gaps]	
Deep-ocean Assessment and Reporting of Tsunami Systems				
South Puerto Rico—230 nautical miles southwest of San Juan, Puerto Rico (42407)	15.28 N	68.19 W	Fully Operational (restored 04/01/25)	NOAA/National Data Buoy Center

North Santo Domingo—328 nautical miles north northeast of Santo Domingo, Dominican Republic (41420)	23.38 N	67.35 W	Not Operational	
North St. Thomas—300 nautical miles north of St Thomas, Virgin Islands (41421)	23.37 N	63.90 W	Not Operational	
Southwest Bermuda—200 nautical miles south southwest of Hamilton, Bermuda (41425)	28.67 N	65.62 W	Not Operational	
Southeast Block Canyon—130 nautical miles southeast of Fire Island, New York (44402)	39.29 N	70.70 W	Fully Operational	
Sable Island Bank, Canada (44403)	41.95 N	61.67 W	Not Operational	
Gulf of America–247 nautical miles south of New Orleans, Louisiana (42409)	25.80 N	89.29 W	1 of 2 payloads Fully Operational	

Table 4: U.S.-operated sea level stations in Caribbean and adjacent regions.
** Status as of April 12, 2023*
*** To see other NOAA/Center for Operational Oceanographic Products and Services coastal water-level stations in the Atlantic Ocean, visit https://tidesandcurrents.noaa.gov/tsunami/.*

Location	Latitude	Longitude	Operator	Net_Stat	Sensors	Status*
Anegada, British Virgin Islands	18.73 N	64.33 W	PR	ABVI	Velocity + Acceleration + GPS	No Comms
Tortola, British Virgin Islands	18.42 N	64.62 W	PR	TBVI	Velocity + Acceleration	OK
Virgin Gorda, British Virgin Islands	18.49 N	64.40 W	PR	VGBI	Velocity + Acceleration + GNSS	No Comms
Aguadilla, Puerto Rico	18.47 N	67.11 W	PR	AGPR	Velocity + Acceleration + GNSS	OK
Arecibo, Puerto Rico	18.35 N	66.75 W	PR	AOPR	Velocity + Acceleration + GNSS	OK
St. Croix, U.S. Virgin Islands	17.75 N	64.77 W	PR	CDVI	Velocity + Acceleration + GPS (CORS)	OK
Cerillos Dam, Ponce, Puerto Rico	18.07 N	66.58 W	PR	CELP	Velocity + Acceleration	OK
Cabo Rojo, Puerto Rico	18.01 N	67.11 W	PR	CRPR	Velocity + Acceleration + GNSS	OK
Culebra, Puerto Rico	18.31 N	65.281 W	PR	CUPR	Velocity + Acceleration + GNSS	OK
Manati, Puerto Rico	18.48 N	66.53 W	PR	EMPR	Velocity + Acceleration + GNSS	OK
Guanica, Puerto Rico	17.98 N	66.88 W	PR	GBPR	Velocity	OK

Guaynabo, Puerto Rico	18.31 N	66.08 W	PR	GCPR	Velocity + Acceleration	OK
Humacao, Puerto Rico	18.14 N	65.86 W	PR	HUMP	Velocity + Acceleration + GPS	OK
Isla Caja de Muertos, Puerto Rico	17.89 N	66.53 W	PR	ICMP	Velocity + Acceleration + GNSS	OK
Isla Desecheo, Puerto Rico	18.39 N	67.47 W	PR	IDE	Velocity	OK
Guayama, Puerto Rico	17.97 N	66.11 W	PR	IGPR	Velocity + Acceleration + GNSS	OK
Isla Mona, Puerto Rico	18.08 N	67.93 W	PR	IMPR	Velocity + Acceleration + GNSS	OK
Mayagüez, Puerto Rico	18.18 N	67.09 W	PR	LSP	Velocity	OK
Lajas, Puerto Rico	17.97 N	67.04 W	PR	MLPR	Velocity + Acceleration + GNSS	OK
Vieques, Puerto Rico	18.10 N	65.55 W	PR	MTP	Velocity + Acceleration	OK
Obispado, Ponce, Puerto Rico	18.04 N	66.61 W	PR	OBIP	Velocity + Acceleration	OK
Patillas, Puerto Rico	18.02 N	66.02 W	PR	PDPR	Velocity + Acceleration + GNSS	OK
U Puerto Rico Mayagüez, Puerto Rico	18.22 N	67.14 W	PR	PRSN	Velocity + Acceleration + GNSS	OK
St. John, U.S. Virgin Islands	18.33 N	64.77 W	PR	SJVI	Velocity + Acceleration	No Comms
St. Thomas, U.S. Virgin Islands	18.35 N	64.96 W	PR	STVI	Velocity + Acceleration + GPS	OK
Utuado, Puerto Rico	18.25 N	66.72 W	PR	UUPR	Velocity + Acceleration	OK
Corozal, Puerto Rico	18.32 N	66.36 W	PR	ECPR	Velocity + Acceleration + GNSS	OK
Ceiba, Puerto Rico	18.22 N	65.666 W	PR	FAPR	Strong Motion Seismometer	OK
Salinas, PR	18.029 N	66.235 W	PR	ASPR	Velocity & Acceleration	OK
Punta Cana, Dominican Republic	18.51 N	68.38 W	PR	PCDR	Velocity + Acceleration	OK
Miches, Dominican Republic	18.98 N	69.05 W	PR	MIDR	Velocity + Acceleration	OK
Samana, Dominican Republic	19.29 N	69.19 W	PR	SMDR	Velocity + Acceleration	OK

Isla Saona, Dominican Republic	18.19 N	68.78 W	PR	SADR	Velocity + Acceleration	OK
North Barbuda Island	17.67N	61.79 W	CU	ANWB	Velocity	OK
Gun Hill	13.14 N	59.56 W	CU	BBGH	Velocity	OK
Isla Barro Colorado	9.17 N	79.83W	CU	BCIP	Velocity	OK
Grand Turk	21.51 N	71.13W	CU	GRTK	Velocity	OK
Grenville	12.13N	61.65 W	CU	GRGR	Velocity	OK
Guantanamo Bay	19.23N	75.11 W	CU	GTBY	Velocity	OK
Mount Denham, Jamaica	18.23N	77.53W	CU	MTDJ	Velocity	OK
Presa de Sabenta, Dominican Republic	18.98N	71.29W	CU	SDDR	Velocity	OK
Tegucigalpa	14.06N	87.27W	CU	TGUH	Velocity	OK
Bermuda Institute of Ocean Sciences	32.37N	64.70W	IU	BBSR	Velocity	OK
Disney Wilderness Preserve	28.11N	81.43W	IU	DWPF	Velocity	OK
San Pablo	39.54N	4.35W	IU	PAB	Velocity	OK
Riachuelo	5.83S	35.90W	IU	RCBR	Velocity	OK
Samuel	8.95S	63.18W	IU	SAML	Velocity	OK
Santo Domingo	8.88N	70.63W	IU	SDV	Velocity	OK
Cayey	18.11N	66.15W	IU	SJG	Velocity	OK
Tepich	20.23N	88.28W	IU	TEIG	Velocity	OK
Aruba	12.51N	70.01W	PR	ACPR	Velocity	OK

Table 5: Seismic stations operated by Puerto Rico (PR) including PRSN and PRSMP and the USG (CU (USGS Caribbean Network) and IU (Global Seismic Network) in the CARIBE_EWS region.

National GNSS Networks

The United States is actively pursuing techniques that will enable real-time, dynamic characterization and modeling of earthquake-generated tsunami sources. One of the most promising emerging datasets to accomplish this is the displacement vectors measured by the GNSS (Global Navigation Satellite System). While the United States does not currently have the capability to perform this type of characterization in an operational setting, we continue to support the deployment and maintenance of the underpinning networks. Continuously operating real-time GNSS stations in the United States and the Caribbean region are operated by a number of entities, including EarthScope Consortium that operates the GAGE Facility and Network of the Americas for NSF, NOAA, and the PRSN.

GNSS Network Name	Region	Number of GNSS stations	Number of Stations Providing 1-Hz Data Streams in Real Time to Enhance Caribbean Tsunami Early Warning	Operator
Network of the Americas (NOTA)	U.S./Alaska/ Caribbean/ Mexico	1147	67	GAGE Facility/ EarthScope Consortium
PRSN	Puerto Rico/Virgin Islands	25	20	Puerto Rico Seismic Network
CORS	Worldwide	42 stations: 3 in Caribbean region	0	National Geodetic Survey (NOAA)

Table 6. U.S.-operated GNSS Networks in the Caribbean and adjacent regions.

Figure 8. Caribbean regional GNSS assets within the Network of the Americas (NSF-GAGE Facility operated by the EarthScope Consortium). This includes 67 stations that are currently operational and streaming 1-Hz data which could be utilized for tsunami hazard monitoring.

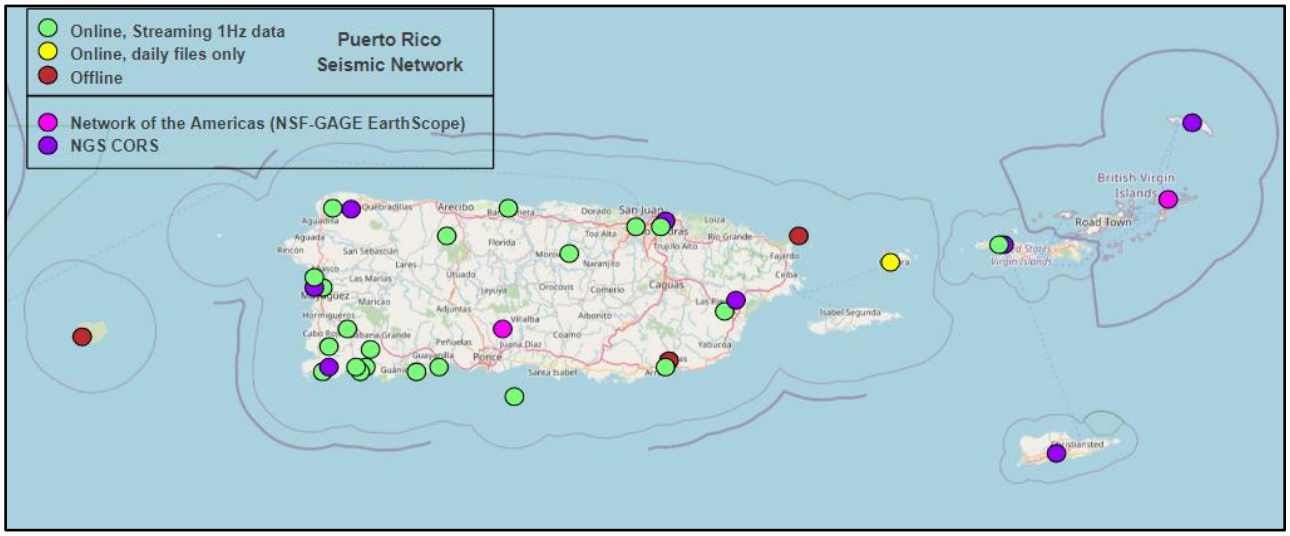

Figure 9. GNSS reference stations within Puerto Rico, the US Virgin Islands, and British Virgin Islands. The majority of these stations are operated by the Puerto Rico Seismic Network, with some from the Network of the Americas and the NGS CORS network.

EarthScope Contribution: The Network of the Americas

The National Science Foundation (NSF)-funded SAGE and GAGE Facilities, are operated by the EarthScope Consortium. EarthScope is a non-profit university-governed consortium funded by the NSF, the National Aeronautics and Space Administration (NASA), and the United States Geological Survey (USGS), manages three large GNSS networks in the western hemisphere. These three networks, known collectively as the Network of the Americas (NOTA), consist of the earthscope Plate Boundary Observatory (PBO), the Continuously Operating Caribbean GPS Observational Network (COCONet), and the Trans-boundary Land and Atmospheric Long-term Observational and Collaborative Network (TLALOCNet) in Mexico.

Most of the RT-GNSS resources that national, regional, or state EEW and TWS will use once fully operational, are cGNSS assets that were funded primarily by the NSF through the previous Earthscope MREFC and GAGE Facility CAs. The construction phase of NOTA is finished, with stations producing high-quality, low-latency GNSS data and data products from 1,147 continuously operating GNSS stations, over 900 of which provide both 1-Hz raw GNSS code and phase data and ambiguity-resolved precise point positions in real time which are required for tsunami warning. Sixty-seven (67) of these real-time stations are located in the Caribbean Basin and currently operational.

The EarthScope Consortium, has tested real-time algorithms to determine Peak Ground Displacement (PGD) from RT-GNSS position estimates (Hodgkinson et al., 2020). For events greater than ~M7, the system worked well and has been able to estimate the “final” magnitude with high accuracy and in a timely way (<300 s) for several events in Alaska, Mexico, and the Caribbean (Hodgkinson et al., 2020).

Puerto Rico Seismic Network Contribution

The PRSN also operates a GNSS network of 25 real-time/high-rate stations (originally) funded by NSF. Ten of them are equipped with alloy receivers and the others with Trimble receivers and antennae. NOAA’s National Geodetic Survey (NGS) also has non-real-time GPS stations in Puerto Rico, the Virgin Islands, Bermuda, and Barbados. Twelve PRSN stations receive 1-Hz position corrections through Trimble's RTX service, and data are shared through the EarthScope server or PRSN earthworm/seedlink system and caster.

At the PRSN, continuous data are simultaneously logged to three sessions with different sampling rates depending on their designated usage. Data is transferred from field sites to the data-collection server on a daily basis and is made available for download through EarthScope's Data Archive. Real-time data is available through a dedicated NTRIP caster. An Earthworm module actively receives RTX (corrected) positions from PRSN remote sites and serves those streams via EW export or seedlink.

4. Information on Tsunami Occurrences

Since the last ICG/CARIBE-EWS meeting in May of 2024 there have been no significant tsunamis impacting the U.S. in the Caribbean or Atlantic region. However, PTWC issued a Tsunami Advisory to Puerto Rico and the Virgin Islands following the February 8, 2025 Mw 7.6 earthquake located south of the Cayman Islands. The Advisory remained in effect for about an hour and a half until the nearest sea-level reading in Mexico verified that there would be no hazardous impacts in Puerto Rico and the Virgin Islands and the Advisory was cancelled. PTWC also issued 5 Tsunami Information Statements to Puerto Rico and the Virgin Islands for nearby potentially felt earthquakes ranging in magnitude from 4.5 to 5.7, and three for two larger earthquakes, one in the Caribbean and two in the Atlantic, that also prompted PTWC TSP Information Statements to the CARIBE-

EWS. For Tsunami Exercises, the U.S., through ITIC-CAR, helped coordinate and participated in the annual CARIBE WAVE Exercises which are further discussed in the narrative.

5. Web sites (URLs) of national tsunami-related web sites

General Resources

- U.S. Tsunami Warning System: https://www.tsunami.gov
- International Tsunami Information Center (ITIC): http://www.tsunamiwave.org; https://tsunami.ioc.unesco.org/en/pacific/itic?hub=48
- International Tsunami Information Center Caribbean Office (ITIC-CAR): https://www.weather.gov/itic-car/
- National Centers for Environmental Information (NCEI) Tsunami Data and Information: https://www.ncei.noaa.gov/products/natural-hazards/tsunamis-earthquakes-volcanoes/tsunamis
- NOAA Center for Tsunami Research/Pacific Marine Environmental Laboratory (PMEL): https://nctr.pmel.noaa.gov/index.html
- Smart Cables ITU Joint Task Force: https://www.itu.int/en/ITU-T/climatechange/task-force-sc/Pages/default.aspx
- JTF International Program Office: https://www.smartcables.org/

Warning Center User's Guides

PR and USVI receive both the domestic and international products from the PTWC. While the domestic products establish the alert levels for PR and USVI, the international products support Impact-based Decision Support Services (IDSS) with additional text and graphical products.

- Users' Guide Tsunami Warning Products for Puerto Rico, U.S Virgin Islands, and British Virgin Islands (Version 1.22, April 28, 2024) https://tsunami.gov/operations/PRVIUserGuide.pdf
- Communication Plan for the Interim Tsunami Advisory Information Service to the Caribbean Sea and Adjacent Regions 23 July 2006 Version. https://www.weather.gov/media/ctwp/PDF/CommunicationsPlanICG-CARIBE_EWS-II-11.pdf
- User's Guide for the Pacific Tsunami Warning Center Enhanced Products for the Tsunami and other Coastal Hazards Warning System for the Caribbean and Adjacent Regions (CARIBE EWS, 2017). https://www.weather.gov/media/ctwp/PDF/Users%20guide%202017.pdf (a new, updated Edition will be available in May 2025)

Seismic Information

- U.S. Geological Survey (USGS) Earthquakes Hazard Program: https://earthquake.usgs.gov/earthquakes/
- Puerto Rico Seismic Network (PRSN): http://redsismica.uprm.edu
- Earthscope CARIBE EWS Virtual Seismic Network: http://ds.iris.edu/gmap/#network=_CARIBE_EWS&planet=earth
- Earthscope Data Management Center (DMC) https://ds.iris.edu/ds/nodes/dmc/
- International Tsunami Information Center Caribbean Office - Caribbean Tsunami Warning Program (Seismic Stations Reports and Maps): http://iticcar.org

Sea Level Tools/Information

- Center for Operational Oceanographic Products & Services Tsunami website https://tidesandcurrents.noaa.gov/tsunami/
- International Tsunami Information Center (Tide Tool) For more information or for the files for this program please send an email to itic.tsunami@noaa.gov International Tsunami

Information Center Caribbean Office (Sea Level Stations Reports and Maps): https://www.weather.gov/itic-car/

- National Data Buoy Center (NDBC) DART Program: https://www.ndbc.noaa.gov/dart/dart.shtml, https://www.ndbc.noaa.gov/obs.shtml
- NOAA/NOS's Tides and Currents (for the Caribbean/Puerto Rico): https://tidesandcurrents.noaa.gov/tsunami/
- University of Hawaii Sea Level Center (UHSLC): https://uhslc.soest.hawaii.edu/network/
- National Centers for Environmental Information (NCEI) Long-term Archive of NOAA Water-level Data: https://www.ncei.noaa.gov/products/natural-hazards/tsunamis-earthquakes-volcanoes/tsunamis/dart-ocean-bottom-pressure
- https://www.ncei.noaa.gov/products/natural-hazards/tsunamis-earthquakes-volcanoes/tsunamis/tide-gauge-data

6. Summary plans of future tsunami warning and mitigation system improvements.

Tsunami detection and measurement. The United States continues to work toward a near-real-time, direct tsunami detection and measurement capability. If realized, we expect this will yield significant improvement in tsunami forecast accuracy. We expect this capability will consist of analyzing and integrating a number of discrete real-time data inputs, including traditional seismic waveforms and w-phase CMT calculations, but also place increasing emphasis on direct deep ocean and coastal sea-level readings and added emphasis on determining coseismic deformation through GNSS offset data.

DART 4G: NOAA's 4th generation of DART is currently being deployed. It provides a more robust communications and mooring capability, and through the use of seismic band-pass filters, allows the bottom pressure recorder to be placed much closer to the seismic source than was possible with previous generations. This presents the opportunity to make direct tsunami detections within 10s of minutes as opposed to 1 hour, provided the instruments are properly relocated and densified. Final upgrades to firmware are necessary to activate 4G filtering, but NOAA is exploring a revised DART deployment grid to take advantage of the 4G capability to include the CARIBE EWS region.

GNSS Update: To facilitate incorporation of GNSS into TWC operations, the NOAA Center for Tsunami Research NCTR) has built a testbed at the Pacific Marine Environmental Laboratory (PMEL) in Seattle, WA for testing algorithm development done at various academic institutions into a prototype operational analysis system. As of Q3 of fiscal year 2022 the testbed has been detecting and characterizing small events. The Geodetic First Approximation of Size and Time (GFAST) system has been installed at NOAA's Tsunami Warning Centers and testing and training continues. PMEL are also working to study the use of the Ionospheric Total Electron Content (see Research section, below). PRSN is working in the implementation of the GNSS-IR methodology GNSS-IR Site Map.

SMART Cables: The Science Monitoring And Reliable Telecommunications (SMART) Cables integrate environmental sensors directly into submarine telecommunications infrastructure, creating dual-purpose cables that both transmit data and monitor oceanic conditions crucial for tsunami detection. SMART Cables incorporate seismic, pressure, and temperature sensors at repeater stations spaced approximately 60-120 km apart along submarine cable routes. This strategic placement enables high-resolution, real-time monitoring of seafloor movements and pressure changes that indicate tsunami formation and propagation. Unlike traditional tsunami detection systems that rely on surface buoys, SMART Cables offer continuous monitoring from the seafloor with immediate data transmission through existing telecommunications networks. Recent technological developments have brought SMART Cables closer to widespread implementation.

The proof of concept has been delivered with the InSEA Wet Demo in front of the coast of Sicily, Italy (Guralp and Global Marine supplied this system). Two pioneering SMART Cable projects are now advancing toward construction: the TAM-TAM cable, which will connect New Caledonia and Vanuatu with 4 SMART modules along its 400 km route, and the Atlantic CAM system in Portugal, which will form a ring connecting Lisbon, the Azores, and Madeira with 20 SMART modules. (These two systems will be delivered by Alcatel Submarine Networks). Potential future suppliers include Subsea Data Systems, HMN, SUBCOM, Xtera and NEC.

For the CARIBE EWS region specifically, SMART Cables present a tremendous opportunity to enhance tsunami detection and warning capabilities. The Caribbean's complex seismic environment, with multiple fault systems and submarine landslide potential, makes rapid and accurate tsunami detection particularly challenging. SMART Cables would complement the existing network of DART buoys and coastal sea-level stations by providing continuous, high-resolution monitoring in deep-ocean environments where tsunamis first form. By integrating sensors into planned commercial cable infrastructure, tsunami monitoring capabilities can be deployed at a fraction of the cost of standalone systems. This dual-use approach maximizes return on investment while enhancing the resilience of both telecommunications networks and tsunami warning systems. Partnerships between tsunami warning agencies, telecommunications companies, and regional stakeholders will be essential for advancing SMART Cable implementation in the Caribbean. Strategic deployment along key routes could improve warning times for coastal communities throughout the region, potentially saving lives and reducing economic losses from future tsunami events.

As the technology continues to mature and initial implementations demonstrate success, the CARIBE EWS should prioritize developing a coordinated regional strategy for SMART Cable integration, identifying priority routes for sensor deployment, and building capacity for utilizing this transformative technology in tsunami warning operations.

U.S. Tsunami Warning Center (TWC) Alignment. The U.S. National Weather Service (NWS) is undertaking a comprehensive redesign of the U.S. Tsunami Warning System in order to both improve capabilities and ensure 100% failover capability between the two TWCs. This includes designing and building a comprehensive Common Analytic System (CAS) to ensure both TWCs are working from the same scientific and procedural baseline when a tsunami event occurs. The first major milestone is the transition of legacy TWC messaging generation software to NWS supported architecture in mid/late 2025. Having the same operational hardware ensures that the process of message creation and seamless backup capabilities will be possible, once the appropriate testing and evaluation activities is complete.

The second goal of the redesign is to ensure that NWS tsunami core partners, such as U.S. State and territorial emergency management agencies and international core partners (Pacific and Caribbean country national tsunami warning centers and emergency management agencies, tsunami warning focal points, and tsunami national contacts) receive consistent and reliable IDSS designed to meet their needs to provide warnings and public safety. IDSS is defined broadly to encompass both routine (non-event) and episodic (event) services. Routine IDSS activities prepare in advance for the next tsunami, and can encompass training (informational, operational, hazard risk assessment, response, etc), exercises, education, and awareness. Episodic IDSS activities in real time during the actual event to ensure that the TWC products are received and understood, and so enable core partners to make more informed public-safety decisions.

Progress on new Tsunami.gov Public Webpage. The long-standing tsunami.gov website (https://www.tsunami.gov/) is undergoing a major redesign of the current functionality. The new prototype webpage remains under development with a goal of improved usability, enhanced functionality, and more dynamic methods to display, download, and ingest data from the site. Among the improvements is a dynamic GIS-based web display of recent notable and/or current seismic events. Metadata and issued products will be more readily available and displayed in a more aesthetically appealing manner to review event data in dashboard offering. Overall, the new

prototype webpage is easier to navigate and contains more information about recent past events, activities relevant to U.S. and international partners and customers, and archived, historical cases.

Hazard Simplification for NWS Tsunami Headline Products. The U.S. National Weather Service (NWS) is evaluating the effectiveness and clarity of the current headline terms for tsunami messages (Watch, Advisory, and Warning). This is a supplemental effort to a larger study for these terms for other weather-based service program areas (i.e. Winter, Public, Fire, Marine, and Tropical) that was performed a few years prior. This project is utilizing a range of social, behavior, and economic sciences) to assess the effectiveness of current tsunami hazard messaging (i.e., headline terms, messaging body) via a survey of members of the public, core partners, and stakeholders. This project includes the development and deployment of a survey instrument, testing the current terms, potential new terminology, and other options for improved messaging. Headlines and messages tested in this study must be compatible with established dissemination and communications methods. Domestic CARIBE EWS products will not be adjusted at this time, as the NWS is aware that many countries have followed and adopted U.S. NWS domestic alert messages.

Seismic Monitoring.

- The U.S. supports an extensive Global Seismograph Network (GSN) in the Pacific, Indian Ocean, Atlantic, Caribbean, and Gulf of America. The U.S. Geological Survey (USGS) National Earthquake Information Center (NEIC) and Albuquerque Seismological Laboratory coordinate field and monitoring operations to ensure reliable mission-critical data to the tsunami warning centers. One hundred and fifty of these stations are part of the Global Seismographic Network (GSN) and are jointly operated by the USGS and the EarthScope Consortium. In addition to the GSN stations, 97 U.S. backbone stations are part of the Advanced National Seismic System (ANSS). Over the last several years the primary sensors at many of the GSN stations have been upgraded to the latest generation of very broadband seismometers. To obtain real-time data from the USGS, email David Mason (dmason1@usgs.gov). To access realtime or archived data from Earthscope visit https://ds.iris.edu/ds/.
- The PRSN is working with the Dominican Republic to maintain the four seismic stations operated there. In Puerto Rico, the PRSN is planning the installation of one new broadband seismic station.
- The PRSN released two new software modules to feed a central Earthworm system with real-time data streams from tide gauge satlink data servers and RTX GNSS corrected data messages. There are plans to install one GNSS - IR station.
- The ITIC-CAR in coordination with the PTWC, PRSN, Earthscope, network operators and CARIBE EWS Working Group (WG) 2, will continue to prepare and share monthly maps on seismic data availability at PTWC.

Sea level monitoring. The ITIC-CAR in coordination with the PTWC, PRSN and the IOC Sea Level Monitoring Facility, network operators and CARIBE EWS Working Group 2 will continue to prepare and share monthly maps on sea level data availability at PTWC and biannual reports on CARIBE EWS sea level stations through the intersessional period. ITIC-CAR looks forward to reviewing the reports with the WG 2 and the way forward.

- The PRSN is working with the Dominican Republic to maintain two tsunami-capable tide gauges. Plans are to install a new Tide Gauge station in the province of Samana. Also, a new tsunami-capable tide gauge will be installed in the British Virgin Island of Anegada.

Map Viewers

- The NCEI Natural Hazards Viewer is currently being re-designed using modern web technologies/frameworks. Users will see increased performance/responsiveness, better usability on mobile devices, and improved accessibility.
- NCEI continues to update the Caribbean and Adjacent Regions Tsunami Sources and Models (CATSAM) map viewer.
- The PRSN Tsunami Map Tool.

- NOS operates a Coastal Flood Exposure Mapper. The information in this product is based on the Roadmap for Adapting to Coastal Risk approach to assessing coastal hazard risks and vulnerabilities. The mapper enables users to explore maps that show people, places, and natural resources exposed to coastal flood hazards (including tsunamis) and create a collection of maps to share and communicate about flood exposure. Tsunami hazard zones are included in the product.

Seismic Hazard Map for Puerto Rico and the U.S. Virgin Islands

- The USGS National Seismic Hazard Model Project (NSHMP) has been working on the 2025 Puerto Rico and the U.S. Virgin Islands (PRVI) National Seismic Hazard Model (NSHM) update.A public workshop to present the draft model components and results was held in August, 2024 in Puerto Rico. The draft final model has been completed, reviewed by the public and several supporting articles have been submitted journals for publication. The final update is expected to be released in the second half of 2025.

Digital Elevation Models (DEM).

- DEMs are available via the NCEI Thredds data server, NCEI Coastal Relief Model or NOAA's Digital Coast.
- Additional updates to development processes and innovations included DEM validation using IceSat-2 elevation photons data and improvements to spatial metadata and DEM uncertainty grids. Current DEM development processes are documented in Amante, C.J.; Love, M.; Carignan, K.; Sutherland, M.G.; MacFerrin, M.; Lim, E. *Continuously Updated Digital Elevation Models (CUDEMs) to Support Coastal Inundation Modeling*. Remote Sens. 2023, 15, 1702. https://doi.org/10.3390/rs15061702. DEM and ancillary data product development code available at https://github.com/ciresdem/cudem.

US TsunamiReady® Program

- NOAA will continue to support renewals of 50 communities and 15 TsunamiReady Supporters recognized by the US National Weather Service in Puerto Rico and the US Virgin Islands, including the strengthening of local and territorial capabilities.

UNESCO IOC Tsunami Ready Programme

- ITIC-CAR with US funding facilitated the recognitions of Laborie, Saint Lucia and Portsmouth, Dominica. ITIC-CAR with US funding completed the tsunami hazard assessments for Antigua and Barbuda and Saint Lucia.
- ITIC-CAR provides on request guidance to member states in the implementation and renewal of Tsunami Ready communities. The International Tsunami Information Center (ITIC) Tsunami Ready website was transitioned to the UNESCO/IOC Tsunami Programme website TsunamiReady.org). ITIC-CAR provided an intern (Lapenta Scholar) to conduct the TR survey of stakeholders that have been recognized since 2019. This work was coordinated with CTIC and the Tsunami Ready task team and was completed in August 2024.
- Dr. Laura Kong, Director of ITIC, is the Chair of the UNESCO/IOC Tsunami Ready Coalition. The purpose of the Coalition is to create awareness of the program and identify contributions to support TR initiatives. The Coalition's strategic plan was approved for recommendation to the IOC Assembly at the TOWS in February 2025.
- TIC has prepared/supported videos highlighting implementation of the Programme in several recognized communities in the Caribbean (Barbados, Saint Vincent and the Grenadines and Dominica https://www.youtube.com/channel/UCFeJ5u2-zNiH7FYF-b8yHxg.

Capacity Enhancement and IDSS

- ITIC conducted its 2-week ITIC Training Programme on Tsunami Early Warning Systems, including the PTWC Enhanced Products and Tsunami Ready in Hawaii in August 2023 for 21 Pacific and 5 Caribbean countries, and in Chile in August 2024 for 18 Pacific and Caribbean countries hosted by the Chilean Hydrographic and Oceanographic Service (SHOA), who serves as the ITIC Associate Director.

- ITIC, as an IOC Ocean Teacher Global Academy Specialized Training Center (OTGA STC), will develop online and hybrid training courses, available to all CARIBE EWS Member States, and globally. The courses are developed in coordination with the IOC Tsunami Resilience Section. Courses that are currently available are:
    - UNESCO-IOC Tsunami Awareness (6-hr online, self-paced), since July 2024
    - UNESCO-IOC Tsunami Ready (3-hr online, self-paced), since January 2025
      Course that are planned will support the PTWS Tsunami Warning Center Minimum Staff Competencies Training Course, which is envisioned to be comprised of the above courses, and additionally planned for 2025 are:
    - Science Core Knowledge in earthquakes and tsunamis (online, self-paced)
    - Tsunami Warning Center and Emergency Response Standard Operating Procedures (online and blended, based on ITIC in-person training courses)
    - Communicating Risks using the IOC Tsunami Service Provider Tsunami Products, including from the PTWC (online, self-paced).
      Future courses planned are other ITIC in-person training courses, such as
    - Tsunami Maps, Plans, and Procedures, including inundation mapping (TEMPP) (160-hr online/blended) [Planned].
      The ITIC is currently developing course modules in partnership with Member States with advanced tsunami warning centers, such as PTWC.
- ITIC will continue to develop and distribute educational and decision-support based resources.
- ITIC and PMEL continue to develop and distribute the Tsunami Coastal Assessment Tool, TsuCAT, to assist countries in hazard assessment, response planning, and in conducting exercises (scenario development, PTWC message generation, exercise situational injects).
- ITIC will continue to collaborate with all Caribbean countries in coordination with CTIC to organize and provide training in tsunami warning, response, and evacuation planning and warning decision support tools, facilitate Tsunami Ready implementation, and support outreach and awareness-building activities.
- The USGS has developed a tool for Pedestrian Evacuation Modelling which has been used by Puerto Rico to help determine the best routes for evacuation and the selection and placement of vertical evacuation structures. Subject to funding availability the USGS/PRSN may be able to provide training on these tools.

CARIBE WAVE Exercise

- The ITIC-CAR and PTWC will continue to coordinate and support this annual tsunami exercise, including the development of simulated products, handbook and reports, the conduct of webinars, survey, website (caribewave.org) and registration system (https://www.tsunamizone.org/).
- Locally the PRSN, the PR Bureau for Emergency Management (PRBEM), the NWS WFO in San Juan and VITEMA will continue to coordinate locally, participate and promote the participation in CARIBE WAVE.

World Tsunami Awareness Day (WTAD)

- ITIC supports World Tsunami Awareness Day by providing still and moving visuals and documentation, and subject matter expertise.
- Using all available social media platforms, the PRSN, the PR Bureau for Emergency Management (PRBEM) and VITEMA participate and promote the participation in the WTAD.

UN Decade of Ocean Science

- NOAA will continue to support and be actively engaged in the UN Decade of Ocean Science for Sustainable Development through Programmes, Projects, and Contributions which have been proposed, or are under the IOC's Ocean Decade Tsunami Programme (ODTP)
- NOAA will continue to advocate for the development and implementation of SMART Cables, and other emerging technologies that support direct detection and measurement in support of tsunami early warning

- NOAA will continue to advocate and support (as funding permits) the implementation and maintenance of UNESCO/IOC Tsunami Ready Recognition Programme, including the Chairing of UNESCO/IOC Tsunami Ready Coalition by Dr. Laura Kong, Director of ITIC.
- ITIC-CAR will continue to engage in the coordination of the UN Decade of Ocean Science for Sustainable Development in the Western Atlantic (WTA), including participation in the WTA Working Group for Safe Ocean and the endorsed Decade Project, Integrating Coastal Hazards Early Warning Systems (iCHEWS) and its parent program, Coast Predict.

Outreach, Education, and Communications
- ITIC and ITIC-CAR will continue to distribute educational and decision support resources. ITIC-CAR will continue to support the IOC Caribbean Tsunami Information Center (CTIC) mission activities, including collaborating for tsunami training in warning, response, and evacuation planning and warning decision support tools, Tsunami Ready, and outreach and awareness building.
- ITIC-CAR will continue to distribute Tsunami Rules Brochure in Braille and large format text.

Technology Warning Communications
- NOAA will continue to support the GEONET CAST Americas as an additional method to receive Tsunami products from the Pacific Tsunami Warning Center.
- NOAA Currently supports EMWIN as an additional method to receive Tsunami products from the Pacific Tsunami Warning Center.
- ITIC-CAR will continue to support ICG CARIBE EWS WG 3 and the Inventory of Tsunami Warning Dissemination and Communication Systems.

NATIONAL PROGRAMMES AND ACTIVITIES INFORMATION

7. EXECUTIVE SUMMARY

During the last intersessional period, the U.S. has focused on improving tsunami detection, measurement and forecasting capabilities in the Caribbean as well as supporting advanced mitigation and preparedness efforts. To accomplish its domestic and international missions, there is active ongoing collaboration between and thru NOAA line offices and programs (NWS, PTWC, ITIC, including its Caribbean Office, PMEL, NCEI, NCEP, NOS, NTHMP, San Juan Weather Forecast Office (WFO)), other US Agencies (USGS, FEMA), Puerto Rico and USVI academic and government agencies (PRSN, PREMB, VITEMA, UVI), UNESCO-IOC bodies (CARIBE-EWS, IOCARIBE, OD) and CARIBE EWS Member States. While funding for the domestic efforts comes from agency budgets, activities in these territories are commonly funded by territorial budgets, NTHMP, and FEMA unless there are identified or known constraints.

Tsunami forecast and warning operations continued as normal with one alert-level event on February 8, 2025. PTWC confirmed communications over all circuits and with key partner agencies following each message issuance.

The United States continues to work toward tsunami detection and source characterization. Efforts include:
- Continued testing of the **4th Generation of DART** with advanced seismic noise filtering to allow for near-field placement.
- Continued testing and development of advanced **geodetic analysis** in tsunami source estimation using GNSS station static offsets. We expect initial capability to use this technique operationally within 2 years.
- Continuing to investigate tools to rapidly compute **EQ focal mechanism via the W-phase method**, and supporting research regarding tsunami detection using the ionospheric **total electron content** (TEC) methodology.
- Supporting the continued development of **SMART cables** to augment legacy tsunami detection and measurement networks.

The U.S. National Weather Service (NWS) is also undertaking a comprehensive re-design of the Tsunami Warning System. This includes the alignment of tsunami detection, measurement and forecasting procedures between U.S. TWCs, and proactive efforts to provide IDSS to core partners, such as U.S. emergency management agencies, and Pacific and Caribbean national agencies responsible for tsunami warning, such as national tsunami warning centers and emergency management agencies.

CARIBE WAVE 25 was conducted on March 20, 2025. ITIC-CAR supported the CARIBE EWS CARIBE WAVE Task Team to develop the format, create the handbooks and with the coordination of the registration, webinars and post-exercise evaluation tool and prepared the draft media and final reports. The PTWC provided the exercise messages. PRSN, NWS Forecast Office San Juan, PRBEM and VITEMA were actively engaged in the local coordination. Of the almost 500,000 persons participating in the exercise, 172,124 participants were registered from Puerto Rico and 18,144 from USVI on the USG supported TsunamiZone.org.

There are currently 50 TsunamiReady communities in Puerto Rico (47) and US Virgin Islands (3) and 15 TsunamiReady supporters in Puerto Rico. The San Juan International Airport became the second airport to be recognized in the US in October 2024. The renewal cycle is 4 years. https://www.weather.gov/TsunamiReady/communities.

ITIC conducted outreach activities in which tsunami guidance is provided, including its 2-week ITIC Training Program in Tsunami Early Warning Systems held in Chile in 2024. PMEL, ITIC, and PTWC continued the development of new features in the TsuCAT software and made it available to training participants. New features for V4.4 (released August 2024) include the addition of automated, customized exercise injects. PMEL continued to maintain and update ComMIT modeling tools for tsunami inundation simulations. New version ComMIT 1.8.3 has been released and has been used for several IOC training and tsunami hazard assessment activities in the Pacific and Caribbean regions. ITIC also developed online training as an IOC Ocean Teacher Global Academy Specialized Training Center for Tsunamis, with courses available in 2024 as UNESCO-IOC Tsunami Awareness and in 2025 UNESCO-IOC Tsunami Ready. TIC has created informational training videos on the PTWC Products for the Pacific and Caribbean (English, French, Spanish), PTWC Product Staging for the Caribbean and Pacific (English), and a narrative video on PTWC TWC Operations for a Pacific earthquake. Videos are available for viewing and download from the ITIC Vimeo site (*Password: training).*

With funding from US, ITIC-CAR supported the UNESCO/IOC Tsunami Ready recognitions of Portsmouth, Dominica and Laborie,Saint Lucia. Tsunami hazard assessments were also completed for Anguilla, Antigua and Barbuda and Saint Lucia. ITIC CAR is providing routine support for the Tsunami Ready renewals of, Anguilla and Omoa and Tornabe/Tela, Honduras and initial recognition of Barbuda, Antigua and Barbuda, Belize City, Belize, and Choiseul, Saint Lucia. It also supported the update of the CARIBE EWS Tsunami rules brochure. The brochure will be printed in Braille and large format text. An audio file with description of images has been produced for the children's book, Tori and Teo.

The US looks forward to celebrating 20 years of achievements and advances of the CARIBE-EWS. Together with the Member States and Observer organizations it is also committed to addressing challenges to achieve the goal of 100% of communities are warned and prepared for and resilient to tsunamis by 2030.

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8. NARRATIVE

Focus Areas

The US is focused on facilitating implementation of the IOC Tsunami Ocean Decade Framework developed by the UN Ocean Decade Tsunami Programme (ODTP) Scientific Committee. This will

focus on two primary areas: (1) exploration and development of instrumentation and techniques to more rapidly detect and measure tsunamis independent of generating source; and, (2) ensuring capacities lifted across the region to enable the ODTP goal of *100% communities at risk are prepared for and resilient to tsunamis* through programs like the UNESCO IOC Tsunami Ready Recognition Programme. More specifically we will strive to accomplish this by:

- Detection and Measurement
    - Advocate full sharing of available data at time and space resolutions necessary for tsunami detection and measurement.
    - Determine spatial and temporal resolutions necessary to detect and measure tsunamis from all sources.
    - Identify candidate new capabilities to be tested and possibly deployed within the region.
    - Consider new research initiatives to add detection and measurement capabilities not current developed (eg Ionospheric TEC).
    - Identify instrumentation and or communications investments can make in order to contribute to the CARIBE EWS Rapid Tsunami Detection and Measurement initiative.
- Risk Assessment, Warning Communications and Preparedness and Response
    - Advance the understanding of tsunami risk and hazard assessments from all sources of tsunamis.
    - Ensure that all people at risk from a tsunami are alerted and reinforce the warning messages.
    - Maintain and augment the number of communities in the US and globally that are recognized by the US National Weather Service or UNESCO as Tsunami Ready.
- Support multi hazard early warning alignment by linking hazard-specific systems together.
- Apply an inclusive approach by providing a balanced platform for gender and generational participation.

Improved tsunami detection and source characterization. These efforts include:

- Continued testing of the 4th Generation of DART with advanced seismic noise filtering to allow for near-field placement.
- Continued testing and development of advanced **geodetic analysis** in tsunami source estimation using GNSS station static offsets. We have implemented this ability in operations as experimental at both Tsunami Warning Centers and are in a one-year testing and evaluation phase.

Tsunami Warning Center Operations

There were no significant changes to PTWC's domestic procedures or operations. However, there were some minor product changes to add Universal Geographic Codes with corresponding area descriptions to the headers of all PTWC's products for Puerto Rico and the Virgin Islands, and to have the area description given in Spanish in all the Spanish-language versions of the products. A summary of products issued is contained in Section 8.

U.S. DART Systems

DART station 44402, 130 nautical miles southeast of Fire Island, NY, continues operational as of April 2024 as well as 1 of 2 payload of DART 42409 south of New Orleans. NDBC repaired DART station 42407 South Puerto Rico, 230 nautical miles southwest of San Juan, Puerto Rico. Stations 41421, which is located 300 nautical miles north of Saint Thomas, Virgin Islands; station 42407, 230 nautical miles southwest of San Juan, PR, station 41425, 200 miles south southwest of Mamilton, Barbumeda, Station 44403, Sable Island Bank are scheduled for repair in 2025.

Technology and Warning Communications

GEONETCAST-AMERICAS (GNC-A)

- GEONETCast Americas (GNC-A) is a near real time, global network of satellite broadcasts that disseminate meteorological and environmental data, products, and emergency communications to users. Because it is a standalone system that can be powered by a portable generator, GNC-A does not require internet service or commercial power to provide data to users and can be a reliable, timely way to receive information, especially during emergency situations.
- NOAA-NESDIS maintains the GNC-A broadcast. Data, products and information on the broadcast are provided for transmission by various countries, organizations, and users. Tsunami and other weather warning products take priority and are broadcast first.
- I UNESCO/IOC in support of CARIBE WAVE 25 exercise hosted a webinar on this system. To address the need for repairs and troubleshooting on stations, the GNC-A Forum was highlighted as a resource. In addition a WhatsApp Group for users to discuss things was created. Another resource is INPE GNC-A Website (Brazil).
- Information on GNC-A was made available during CARIBE WAVE 25 webinar 2.
- CARIBE WAVE 25 Dummy Message was transmitted successfully over GNC-A.

Emergency Managers Weather Information Network (**EMWIN**).

- High Rate Information Transmission/Emergency Managers Weather Information Network (HRIT/EMWIN) – HRIT/EMWIN is a NOAA-provided broadcast available from either GOES-R series East/West satellites. Both satellite broadcasts, in addition to EMWIN, re-broadcast DCS (https://www.noaasis.noaa.gov/GOES/GOES_DCS/goes_dcs.html) sensor data and a selection of high-resolution GOES imagery in LRIT format. GNC-A, with higher bandwidth, offers more products.
- The NWS EMWIN satellite broadcast and FTP file server services fully transitioned to the US NWS Enterprise Architecture at College Park, MD and Boulder, CO in December 2020. This transition enabled the EMWIN broadcast stream to be transmitted via the GOES-East (GOES-16, 75.2° West) and GOES-West (GOES-17, 137.2° West) satellites through the NESDIS HRIT/EMWIN broadcast service (1694.1 MHz) using Virtual Channels 20, 21 and 22.
- With the introduction of the GOES-16/17 HRIT/EMWIN modified broadcast format, EMWIN users had to replace their legacy EMWIN receivers with HRIT receivers if they desired to continue receiving products over a satellite broadcast. Unfortunately, the major EMWIN legacy satellite receiver manufacturers did not pursue the manufacture of affordable HRIT/EMWIN receiving systems due in part to the reported likelihood of interference from new G5 cell phone service upstarts in the recently auctioned adjacent radio frequency spectrum. Existing EMWIN users were left with a limited number of alternatives: (1) investing in a high-end commercial HRIT/EMWIN receiver costing upwards of 10x the price of the previous receiver, (2) constructing a hobbyist EMWIN receiving systems from parts and software and support the systems locally, or (3) looking elsewhere for dissemination services to meet the local information requirements. Consequently, a large segment of the EMWIN user community transitioned to alternate systems and services to receive timely alerts and warnings including, among others, the NWS NOAA Weather Wire Service (NWWS) and its associated internet dissemination service, and the NESDIS GEONetcast-Americas satellite broadcast service.
- The NWS continues to investigate alternatives for the legacy EMWIN ByteBlaster Internet dissemination service which could not transition into the US NWS Enterprise Architecture at College Park, MD and Boulder, CO due to an inability to meet IT operational compliance requirements.
- Many users now only have access to EMWIN over internet, not satellite. The PRSN has installed several satellite based systems purchased from DARTCOM.
- Information on EMWIN was made available during CW 25 webinar 2
- CARIBE WAVE 25 Dummy Message was transmitted successfully over EMWIN
- More HRIT/EMWIN Broadcast Information (https://www.noaasis.noaa.gov/ and https://www.weather.gov/emwin/)
- Questions regarding the content of the EMWIN data service, including the selection and addition of products should be addressed to nws.emwin.support@noaa.gov.

- Questions regarding the GOES HRIT/EMWIN Broadcast, for example apparent outages or missing products, can be addressed to hrit.manager@noaa.gov.
- For HRIT/EMWIN broadcast issues impacting user operations, especially outside of work hours, please contact the ESPC 24/7 Helpdesk at ESPCOperations@noaa.gov or (301) 817-3880.

Inventory of Tsunami Warning Dissemination and Communication systems.
ITIC-CAR supported ICG CARIBE EWS WG 3 in the finalization of an Inventory of Tsunami Warning Dissemination and Communication systems and a survey to Member States on training needs.

Tsunami Research Projects and Publications

GNSS

- The NOAA Center for Tsunami Research continues to conduct research and develop software to incorporate the GNSS technology into the Short-term Inundation Forecasting for Tsunamis (SIFT) model. The GFAST system was installed at NOAA Tsunami Warning Centers, with Fastlane data feeds from Central Washington University. Peak Ground Displacement magnitude estimates are fed into SIFT within 90 seconds of origin time, and Finite Fault estimates within 3 minutes.
- NASA's Jet Propulsion Laboratory is developing the GNSS-based Upper Atmospheric Real-time Disaster Information and Alert Network (GUARDIAN) system, a near-time-time ionosphere-based disaster monitoring capability.
  It relies on monitoring measurements of the ionospheric total electron content (TEC) obtained through ground-based GNSS stations. This technique is particularly valuable because it allows the monitoring of disasters in a radius of about 1200 km around each station. The only delay in detection is the time it takes for sounds, (infrasound or gravity waves) to travel from the Earth's surface to the ionosphere – 8 to 40 minutes depending on the type of event or wave.
- The GUARDIAN system relies on three main components: the real-time collection of data and computation of observables, the automatic detection of disaster-related perturbations in those observables, and possible creation of relevant warnings. The architecture and the first component are described by Martire *et al.* (2023, 10.1007/s10291-022-01365-6). A publicly-accessible portal intended for subject matter experts displays near-real-time GNSS-based TEC measurements and first-order analytics. GUARDIAN is based on technologies originally developed using JPL's Global Differential GPS (GDGPS) system, also utilizes real-time GNSS stations as part of the International GNSS Service (IGS) - all ensuring open-access and high-quality observations. AI-based automated detections have been demonstrated (Luhrmann *et al.*, 2025, 10.1007/s10291-024-01808-2) and will be implemented in the pipeline shortly. The GUARDIAN system's primary objective is to provide augmentation to already existing tsunami early warning systems. However, the technique may also be also applicable to monitoring other types of events including volcanic eruptions, various space weather phenomena, earthquakes, and anthropogenic hazards.
- The UPRM and the PRSN are working in an effort to study the use of the GNSS - Interferometric Reflectometry (GNSS-IR).

Other

- Jelis Sostre (ex student contractor at ITIC-CAR), Christa von Hillebrandt, with sea level network operators and users published published the scientific paper "Characterizing sea level and barometric disturbances in the Caribbean and adjacent regions from the Hunga Tonga-Hunga Ha'apai 2022 eruption', in Ocean and Coastal Research. https://doi.org/10.1590/2675-2824073.23202
- Updates to NCEI's DEM development processes and innovations included DEM validation using IceSat-2 elevation photons data and improvements to spatial metadata and DEM uncertainty grids. (See Section 10, above).
- The PRSN completed a regional study toward the implementation of a rapid tool to compute the focal mechanism via the W-phase method. Their results show the performance of the

algorithms and the capability to improve the regional detection of larger tsunamigenic earthquakes. Also, two new software modules were developed to feed a central Earthworm system with real-time streams from tide gauge satlink data servers and RTX GNSS corrected data messages.

- With the support of the NTHMP, Puerto Rico continues developing a Probabilistic Tsunami Hazard Analysis (PTHA) for the island concentrating on the off-shore fault sources. There is a preliminary version complete based on sources from both Powell Center and CARIBE-EWS experts meetings. The PTHA is being expanded to include a logic tree based on the 2025 USGS Seismic Hazards Analysis for the PR and USVI region. The ultimate aim is to include the PTHA in future ASCE building codes.
- Puerto Rico, USVI, and Virgin Islands were included in FEMA's updated National Tsunami Risk Index (NRI) for tsunamis.

Improved tsunami documentation.

- The global historical tsunami event and run-up database interface has been updated to include a "data dashboard." The dashboard will be able to answer common questions and improve in consistency on data related to historical tsunami occurrences: https://www.ngdc.noaa.gov/hazel/
- NCEI's Image database has added over 150 images from 6 tsunami events since 2024, with ITIC being a major contributor. https://www.ngdc.noaa.gov/hazardimages/#/
- NCEI is collaborating with the University of Colorado Library to scan and catalog tide gauge records from microfilm rolls of tsunami events prior to 1994. Six of the 13 uncatalogued microfilm rolls have been scanned by NCEI to produce 3,548 TIFF images. Once catalogued and archived, these records will become searchable and discoverable online.

Tsunami Mitigation Activities and Best Practices

- ITIC maintains an office in Mayaguez, PR (ITIC-CAR) to support Puerto Rico and the USVI, as well as the greater Caribbean and its CTIC. It conducts virtual and in-person outreach activities, including trainings, in which tsunami guidance is provided.
- Puerto Rico and the US Virgin Islands have been recognized as TsunamiReady® by the National Weather Service since 2016 and 2014, respectively. Within Puerto Rico there are 47 TsunamiReady communities, while for the USVI the total number is 3. The renewal cycle is 3 years. https://www.weather.gov/TsunamiReady/communities
- In addition to the TsunamiReady communities, there are fifteen TsunamiReady supporters in Puerto Rico. https://www.weather.gov/tsunamiready/communities
- Through specific funded National Tsunami Hazard Mitigation Program (NTHMP) tasks, the Puerto Rico Seismic Network (UPRM), the Puerto Rico Emergency Management Bureau, and VITEMA have received support for TsunamiReady renewal activities.
- FEMA, through hurricane recovery and mitigation funding, has also supported activities associated with the TsunamiReady guidelines.
- PMEL, in collaboration with the USGS, has completed a pedestrian evacuation study and increased the number of sources used in the USVI tsunami hazard assessment in support of the FEMA effort to reclassify the USVI National Risk Index. https://www.sciencedirect.com/science/article/pii/S221242092500113X?via%3Dihub
- Puerto Rico has held meetings and prepared a guidance document on vertical evacuation for tsunamis and is updating the tsunami guidelines for the maritime community.
- PRSN, PREMB, VITEMA and ITIC-CAR routinely participate in outreach activities and provide tsunami guidance.
- PRSN with NOAA/NTHMP funding provided for specific tasks, including updating of the following:
  - Tsunami Media tool kit (Spanish)
  - Tsunami maritime guidance (in Spanish)
  - TsunamiMap tool for online access to tsunami inundation, community pedestrian models, evacuation and signage information.
  - Coordinating a protocol and a pilot effort to include the Amateur Radio associations into the tsunami alerting system.

- In 2024, ITIC CAR with CTIC updated the Tsunami Rules brochure in English and Spanish. It is being printed in Braille and large text. This is the second printing in Braille and the first in large text.NCEI and ITIC updated its Global Historical Tsunami, Significant Earthquake, and Significant Volcanic Eruption posters to 2023. As well as being general public outreach materials, the posters are used as historical references for experts and as a way to communicate to the media during an event. The posters are distributed to warning and response personnel by the ITIC and are available digitally through both NCEI and the ITIC. Hard copies available on request. http://itic.ioc-unesco.org/index.php?option=com_content&view=article&id=1672&Itemid=2698
- NCEI and ITIC developed the *Historical Tsunami Effects: 2004 Indian Ocean Tsunami* Poster.
- PMEL, ITIC, ITIC-CAR and PTWC continued the development of new features in the TsuCAT software and made it available to some of the training participants. TsuCAT v4.4 supports tsunami hazard assessment and tsunami exercises using the PTWC Products; the newest feature adds the option to automatically produce customized exercise injects. http://itic.ioc-unesco.org/index.php?option=com_content&view=category&layout=blog&id=2239&Itemid=2763
- The website of ITIC-CAR is hosted by the NWS: http://iticcar.org
- NCEI and ITIC updated the Historical Tsunami Effects: Caribbean, Central America, Mexico and Adjacent Regions (1530–2023) Poster with event through March 2023. Additional regional maps are available for regions near the Tonga Trench, New Guinea and Bismarck Trenches, and New Hebrides Trenches
- ITIC maintains YouTube Channel for sharing of videos https://youtu.be/a6_ZiRItqOM. In addition to PTWC products and staging videos are on the ITIC Vimeo site https://vimeo.com/showcase/8956022, Password: training
- ITIC has online training as an IOC Ocean Teacher Global Academy Specialized Training Center for Tsunamis. Courses available in 2025 are *Tsunami Awareness and Tsunami Ready,* Ocean Teacher Global Academy - Disaster Risk Reduction.
- As part of ITIC CAR project, with funding from USG, Laborie, Saint Lucia and Portsmouth, Dominica and , were recognized in September 2024.
- ITIC-CAR participated in the UNESCO/IOC Tsunami Ready recognition of Cahuita, Costa Rica.
- ITIC-CAR and PMEL/NCTR presented the results of a Tsunami Ready tsunami hazard assessment for Antigua and Barbuda.
- The International Tsunami Information Center (ITIC) conducted its 2-week ITIC Training Programme on Tsunami Early Warning Systems, including the PTWC Enhanced Products and Tsunami Ready in Chile in August 2024 for 18 Pacific and Caribbean countries hosted by the Chilean Hydrographic and Oceanographic Service (SHOA), who serves as the ITIC Associate Director.
- ITIC-CAR delivered in person training on Tsunami Early Warning Systems and the PTWC Enhanced Products, Tsunami Evacuation Planning and the UNESCO IOC Tsunami Ready Recognition Programme in Puerto Rico and USVI.

Tsunami Exercises and Communication Tests

CARIBE WAVE 2025

- Puerto Rico and the U.S. Virgin Islands participated in the CARIBE WAVE 25 exercise on March 20. It was both a domestic and international exercise and consisted of two exercise scenarios (Jamaica and Portugal). The scenario chosen was Portugal. The PTWC prepared simulated domestic messages for this scenario, in addition to the international messages. According to TsunamiZone.org, (up from 475,044 in 2024) people from Bermuda through Brazil were registered to participate. From Puerto Rico, 172,124 (up from 136,010) people were registered, while for the USVI, the number was 18,144 (down from 23,672).
- For both exercises, the PTWC issued one dummy message at the start of the exercise that was followed by the simulated products, which were sent according to the scenario each country had selected. In Puerto Rico and the U.S. Virgin Islands, activities included communication tests, activation of the Emergency Alert System (EAS), testing the use of radio operators to disseminate information, and drills. The exercise was coordinated at the regional

level by the ICG/CARIBE-EWS's CARIBE WAVE Task Team. The ITIC Caribbean Office served as exercise coordinator, with documentation, website, communication and webinars. Also, all reports and documentation for the exercise are now posted on the website of the International Tsunami Information Center. Locally the exercise was coordinated by the PRSN, the Puerto Rico Emergency Management Bureau, the San Juan WFO, and the Virgin Islands Territorial Emergency Management Agency. PRSN's contribution included providing support and guidance to local stakeholders to participate in the exercise. The University of Southern California (USC) supported the TsunamiZone.org registry web tool, which is funded through the National Tsunami Hazard Mitigation Program.

- The U.S. looks forward to participating in and supporting the CARIBE WAVE 26 exercise as well as supporting coordination through its Caribbean Office of the ITIC.

Communication Tests

- Puerto Rico and the U.S. Virgin Islands also participated in international CARIBE EWS tsunami communication tests with PTWC.
- PTWC's domestic communication tests with Puerto Rico and the Virgin Islands will resume in 2025 following a hiatus caused by the mis-interpretation of VTEC codes by third-party alerting vendors.
- Puerto Rico and the U.S. Virgin Islands participated in international tsunami communication tests with PTWC.
- Puerto Rico Seismic Network has implemented a local monthly test.
- Puerto Rico municipalities conduct a silent test of its sirens every first Wednesday of the month and audible test on the last Wednesday of every month.
- USVI does monthly tests and holds weekly meetings to review the status of its siren systems and coordination of communication tests.

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