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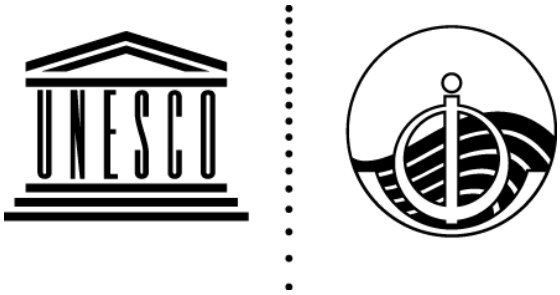

EXERCISE CARIBE WAVE 20

A Caribbean and Adjacent Regions Tsunami Warning Exercise

19 March 2020 (Jamaica and Portugal Scenarios)

Volume 2 Summary Report

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NOTE: The United Nations Educational, Scientific and Cultural Organization (UNESCO) and the Intergovernmental Oceanographic Commission (IOC) pattern the contents of this handbook after the CARIBE WAVE 2011, 2013, 2014, 2015, 2016, 2017, 2018 and 2019 Exercises. Each of these exercises has a handbook published as IOC Technical Series. These CARIBE WAVE exercises followed the Pacific Wave exercises which commenced in 2008 with manual published by the Intergovernmental Oceanographic Commission (*Exercise Pacific Wave 08: A Pacific-wide Tsunami Warning and Communication Exercise, 28–30 October 2008*, IOC Technical Series, 82, Paris, UNESCO 2008). The UNESCO *How to Plan, Conduct and Evaluate Tsunami Wave Exercises*, IOC Manuals and Guides, 58 rev., Paris, UNESCO 2013 (English and Spanish) is another important reference.

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

With special thanks to: Stephanie Soto, Elizabeth Vanacore, Christa von Hillebrandt-Andrade, Marcos Gonzalez, and Karina Tañon.

A Supplement to this Summary Report containing the national responses and various documents related to this Exercise are available at the CTWP website: https://www.weather.gov/ctwp/caribewave20

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Summary

The CARIBE WAVE exercise is conducted within the framework of the UNESCO Intergovernmental Coordination Group for Tsunamis and other Coastal Hazards for the Caribbean and Adjacent Regions (ICG/CARIBE-EWS) with the purpose of improving and validating tsunami readiness. Given the Covid-19 pandemic, the exercise which took place on 19 March 2020 was conducted under very different circumstances than previous years. Instead of promoting a full tsunami exercise, the ICG/CARIBE-EWS of the IOC of UNESCO agreed to focus on the communication systems at the regional level. It was left up to the Member States and Territories to decide if any additional Warning System activity would be carried out and whether to use the simulated messages for one of the two scenarios: Jamaica and Portugal.

Despite the sudden change in scope of the exercise, CARIBE WAVE 20 was held successfully with a participation of forty-four (44) out of its forty-eight (48) Member States and Territories. The high participation rate reflects the importance the countries are giving to tsunami preparedness despite the occurrence of a pandemic. Given the earthquake activity in Puerto Rico, as well as the M 7.8 earthquake off Jamaica, Cuba and the Cayman Islands in January 2020, the expectation was that CARIBE WAVE 20 would surpass the 800,000 participants from 2019. According to TsunamiZone.org, the official registration site, over 102,000 people across the entire Caribbean basin from Bermuda to Brazil signed up to participate. Registered participants included designated CARIBE-EWS Tsunami Warning Focal Points (TWFPs), National Tsunami Warning Centres (NTWCs), government agencies, preparedness organizations, healthcare, businesses and tourism industry. However, with the Coronavirus outbreak, registrations came to a halt and the number of actual participants was much less than the registered number. According to Member State feedback, 4,622 people were directly engaged in 44 Member States and Territories[1].

For the exercise, the Pacific Tsunami Warning Center (PTWC), issued a “Dummy” message at 14h00 to all officially designated Tsunami Warning Focal Points (TWFPs) and National Tsunami Warning Centres (NTWCs). The methods of communication used to disseminate the message were: the World Meteorological Organization Warning Information System (Global Telecommunication System), the Aeronautical Information Replacement System (AISR), NOAA Weather Wire, AWIPS, Fax, Email and Social Media. According to feedback, as well as social media and web posts, the dummy message was successfully sent and received, validating the communication platforms.

[1] Antigua and Barbuda, Barbados, Belize, Brazil, Colombia, Costa Rica, Cuba, Curacao, Dominica, Dominican Republic, France (Martinique, Guadeloupe, Guyane, St. Barthelemy, St. Martin), Grenada, Guatemala, Guyana, Haiti, Honduras, Jamaica, Mexico, Netherlands (Aruba, Bonaire, Saba and Sint Eustatius), Nicaragua, Panama, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Sint Maarten, Trinidad and Tobago, United Kingdom (Bermuda, British Virgin Islands, Cayman Islands and Turks and Caicos), United States (Puerto Rico and the US Virgin Islands) and Venezuela (Bolivarian Republic of).

1. BACKGROUND

The UNESCO/IOC Intergovernmental Coordination Group for the Tsunami and Other Coastal Hazards Warning System for the Caribbean and Adjacent Regions at its Eighth session (ICG/CARIBE-EWS-VIII, Port of Spain, Trinidad and Tobago, 29 April–1 May 2013), decided to conduct exercises named CARIBE WAVE on an annual basis leaving each Member State to define its level of participation. At its Fourteenth session held in Costa Rica (8–11 April 2019), the ICG/CARIBE-EWS recommended that Exercise CARIBE WAVE 20 take place on 19 March 2020, with two hypothetical tsunami scenarios. The first scenario simulates a tsunami generated by a magnitude 8.0 earthquake located along the Enriquillo-Plantain Garden Fault Zone (EPGFZ) off Jamaica, and the second scenario is generated by an 8.5 magnitude earthquake located approximately 270 km off the Portugal coast.

Historical tsunami records from sources such as the NOAA's (US National Oceanic and Atmospheric Administration) National Centers for Environmental Information (NCEI) show that from 1530 to 2018 tsunamis from earthquake, landslide, and volcanic sources have affected the region. According to NCEI, in the past 500 years, at least 82 tsunamis have been observed and approximately 4,500 people have lost their lives from tsunamis in the Caribbean and adjacent regions. Since the most recent devastating tsunami of 1946, there has been an explosive population growth and influx of tourists along the Caribbean and Western Atlantic coasts increasing the tsunami vulnerability of the region (von Hillebrandt-Andrade, 2013).

Recognizing the need for an early warning system, especially after the lessons learned from the 2004 Indian Ocean tsunami, the Intergovernmental Coordination Group for the Tsunami and other Coastal Hazards Warning System for the Caribbean and Adjacent Regions (ICG/CARIBE-EWS) was established in 2005 as a subsidiary body of the UNESCO/IOC with the purpose of providing assistance to all Member States of the region to establish their own early tsunami warning system. The main objective of the CARIBE-EWS is to identify and mitigate the hazards posed by local, regional and distant tsunamis. The ultimate goal is to create a fully integrated end-to-end warning system comprising four key components: monitoring and detection systems, hazard assessment, tsunami related services (dissemination), and community preparedness, readiness and resilience.

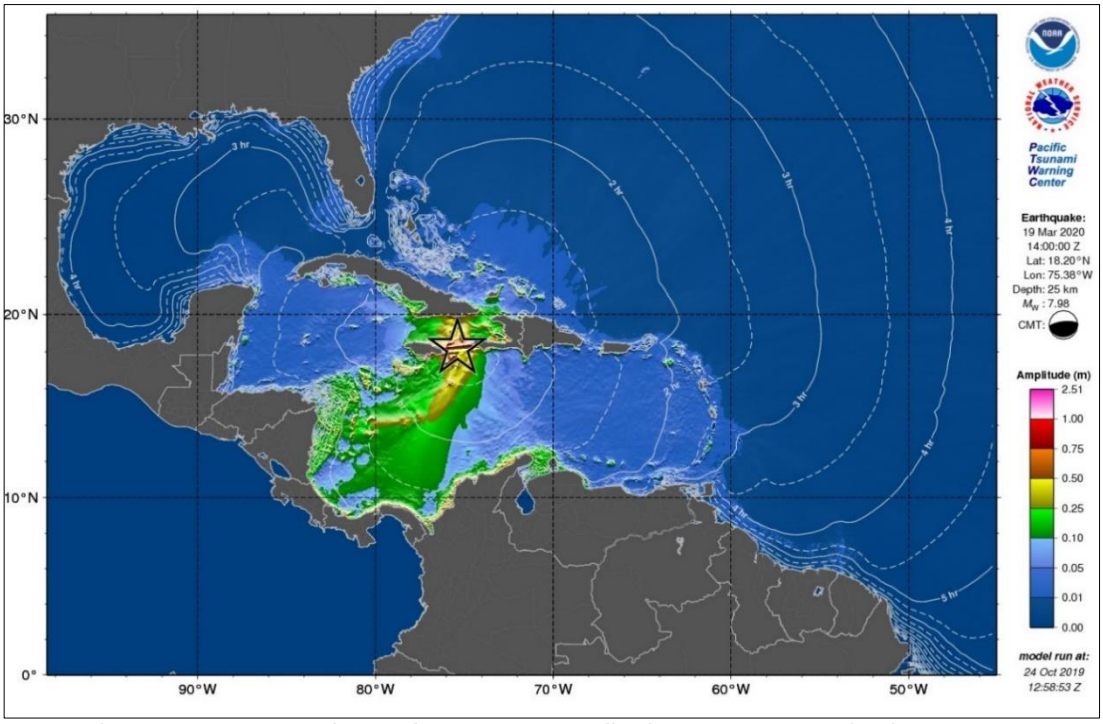

Figure 1. PTWC maximum deep-ocean amplitude map generated using RIFT for Jamaica scenario.

The CARIBE WAVE 20 exercise provided simulated threat tsunami messages from the PTWC triggered by two hypothetical earthquakes: (i) 8.0 Mw with an epicentre at 18.2ºN, 75.3ºW located at the Enriquillo-Plantain Garden Fault Zone (EPGFZ) off Jamaica (Figure 1) and (ii) 8.5 Mw with an epicentre at 36.0ºN, 10.7ºW located approximately 270 km off the Portugal coast (Figure 2).

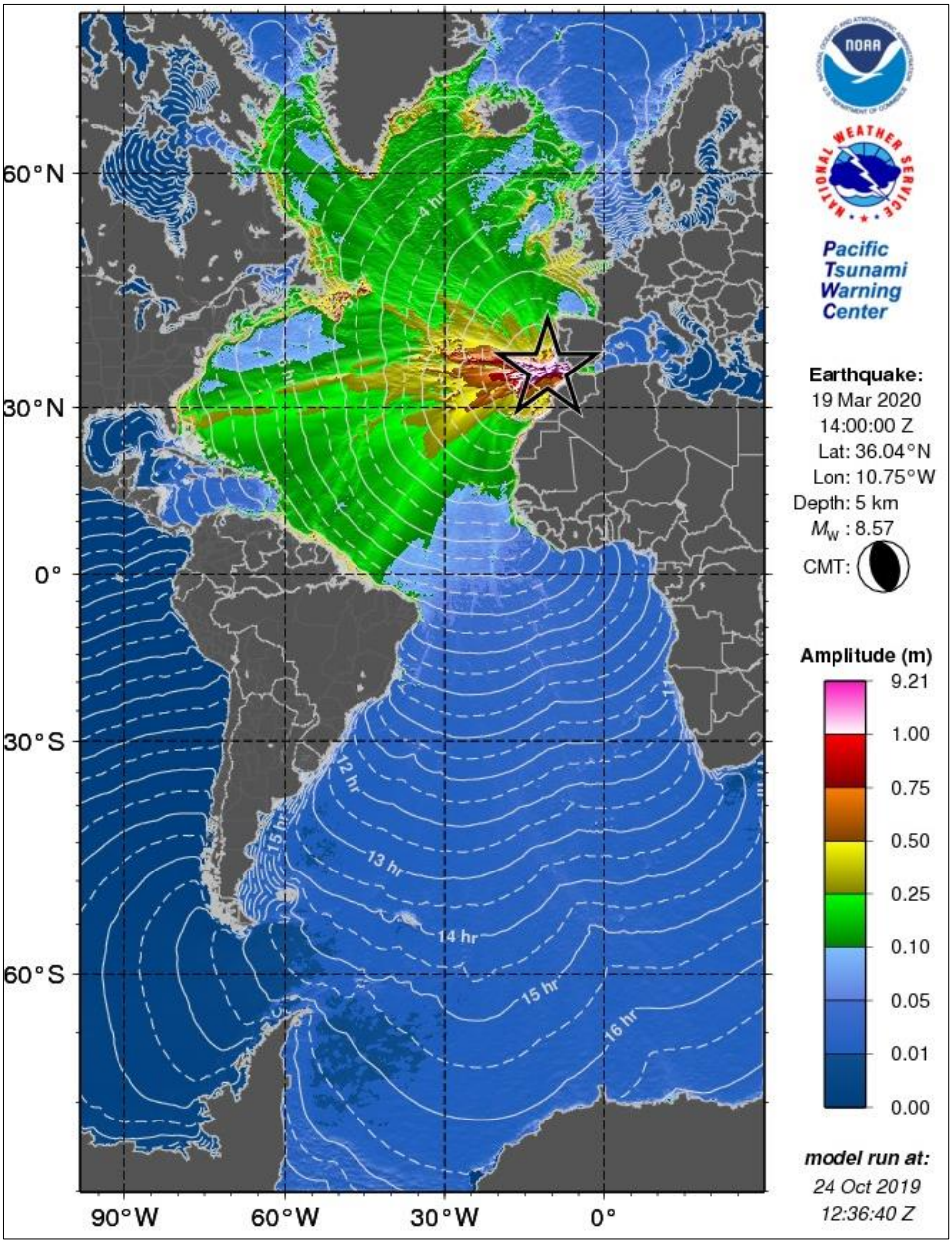

Figure 2. PTWC maximum deep-ocean amplitude map generated using RIFT for Portugal scenario.

2. EXERCISE CONCEPT

2.1 PURPOSE

The purpose of the exercise was to improve tsunami warning system effectiveness in the Caribbean and adjacent regions. The exercise provided an opportunity for emergency management organizations throughout the region to exercise their operational lines of communications, review their tsunami response procedures, and promote tsunami preparedness. Regular exercising of response plans is critical to maintain readiness in case of an emergency. This is particularly true for the Caribbean and adjacent regions, where

tsunamis are infrequent but can be of very high impact. However, given the Covid-19 pandemic situation, the scope of the exercise was reduced to focus on communication lines at a regional level.

2.2 OBJECTIVES AND GOALS

Each organization developed its objectives for the exercise depending on its level of involvement in the scenario. There were two principal overarching objectives for the exercise where only the first objective was addressed during the CARIBE WAVE 20 exercise given the pandemic circumstances.

1. Exercise and evaluate communications between Regional Tsunami Service Provider and Members States/Territories.

a. Validate the issuance of Tsunami products from the PTWC.

b. Validate receipts of Tsunami products by CARIBE-EWS Tsunami Warning Focal Points (TWFPs) and/or National Tsunami Warning Centres (NTWCs).

2. Evaluate the tsunami procedures and programmes within Members States/Territories.

a. Validate readiness to respond to a tsunami.

b. Validate the operational readiness of the TWFPs/NTWCs and/or the National Disaster Management Office (NDMO).

c. Improve operational readiness. Before the exercise, ensure appropriate tools and response plan(s) have been developed, including public education materials.

d. Validate that the dissemination of warnings and information/advice by TWFPs and NTWCs, to relevant in-country agencies and the public is accurate and timely.

e. Evaluate the status of the implementation of the pilot CARIBE-EWS Tsunami Ready recognition program.

ICG/CARIBE-EWS has established metrics to evaluate the goals of the exercise (Table 1). Only 92% of Member States and Territories submitted the Post-Exercise Survey.

Goals	2013 Results	2014 Results	2015 Results	2016 Results	2017 Results	2018 Results	2019 Metrics	2019 Results	2020 Metrics	2020 Results
TWFP receive the dummy message	98%	94%	90%	84%	95%	100%	100%	89%	100%	97%
Participation of Member States of ICG/CARIBE-EWS with designated focal warning point	94%	98% (including two MS/ Territory unofficial)	100%	100%	100%	97%	100%	100%	100%	92%
Community involvement (including agencies beyond TWFP)	75%	75%	66%	73%	82%	77%	95%	66%	95%	38%
Number of participants	44,000	191,000	191,420	332,812	679,985	643,403	+10%	793,353	+10%	4,622
Countries who participate submit exercise questionnaire	90%	100%	91%	100%	100%	91%	100%	82%	100%	92%
Members State and territories are satisfied with exercise								82%	100%	76%

Table 1. Goals and Metrics.

2.3 TYPE OF EXERCISES

The CARIBE WAVE 20 was planned for Caribbean countries to carry exercises at various scales of magnitudes and sophistication. In lights of the implications due to the coronavirus emergency, the exercise only focused on communications. Communication tests were carried out to validate the issuance and receipt of the messages distributed by the Pacific Tsunami Warning Center (PTWC), the Regional Tsunami Service Provider. A majority of National and local Offices of Emergency Management (OEM) decided to postpone the tabletop exercises and drills for when the Covid-19 situation improved.

According to the Member States, the number of participants in the exercise was 4,622 people throughout the Caribbean and Adjacent Regions. The participants in the ninth annual regional tsunami exercise hailed from 44 out of 48 Member States and Territories. It represented a participation rate of 92% of all the Member States of the UNESCO Intergovernmental Coordination Group for Tsunamis and other Coastal Hazards Warning System for the Caribbean and Adjacent Regions (CARIBE-EWS). This year the level of participation was notably impacted by the Covid-19 pandemic, however this level of participation represents the high enthusiasm from the CARIBE-EWS Members States to participate despite the trying situation. The circumstances helped preparedness organizations to develop and test the communication portion of the exercise in light of a current emergency such as a pandemic.

Exercises simulated the development, training, testing, and evaluation of Disaster Plans and Standard Operating Procedures (SOPs). The reported exercises included communication systems tests (Figure 3).

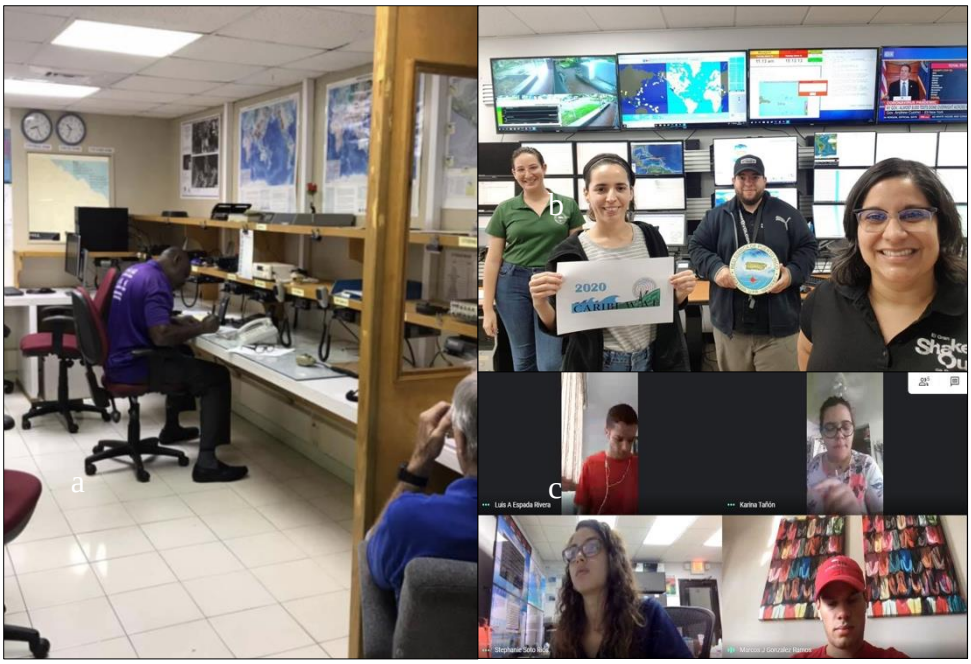

Figure 3. Examples of the communication portion of the exercise as part of the CARIBE WAVE 20: Barbados (a), Puerto Rico Seismic Network (b) and Caribbean Tsunami Warning Program (c).

3. EXERCISE OUTLINE

3.1 GENERAL

The tsunami messages that were issued for this exercise by the PTWC were based on two hypothetical earthquakes (Figure 4) with the following hypocentre parameters:

(i) Jamaica Earthquake Scenario:

Origin Time	14:00:00 UTC March 19, 2020
Latitude	18.2ºN
Longitude	75.3ºW
Magnitude	8.0 – M_w
Depth	25 km

(ii) Portugal Earthquake Scenario:

Origin Time	14:00:00 UTC March 19, 2020
Latitude	36.0ºN
Longitude	10.7ºW
Magnitude	8.5 – M_w
Depth	5 km

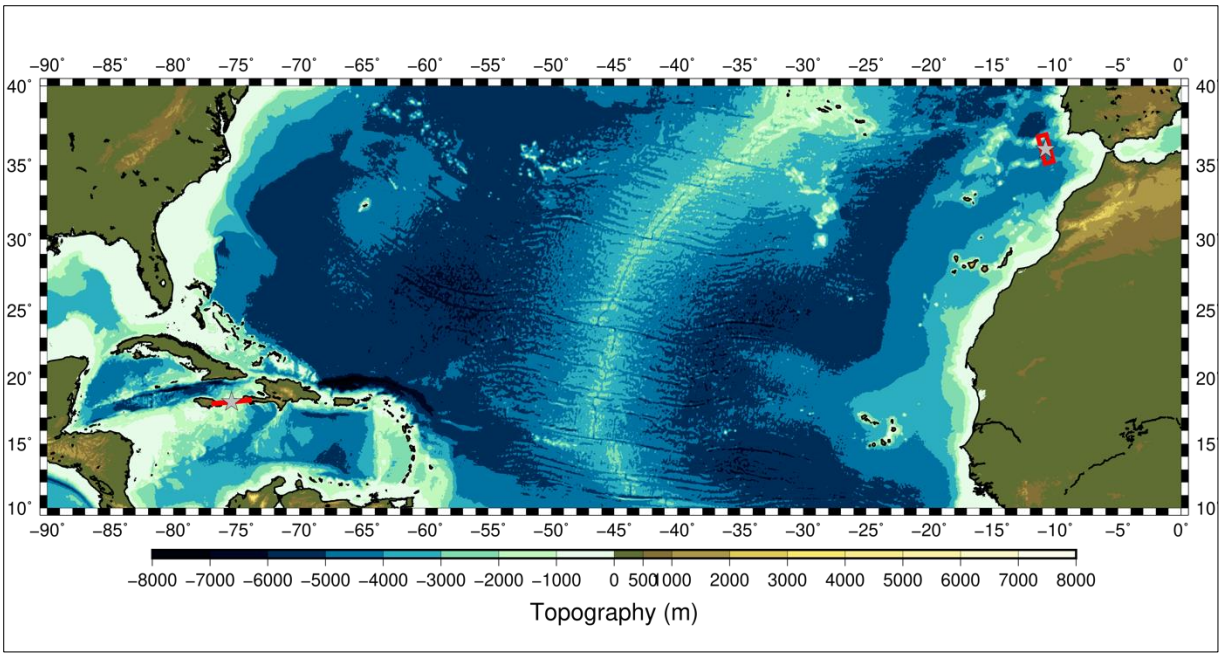

Figure 4. Map of the CARIBE WAVE 20 scenarios. Stars indicate epicentral locations and the red boxes indicate the map view of the ruptured fault segments. The figure is underlain by etopo1 model of Amante and Eakins (2009). This figure was generated using The Generic Mapping Tool (GMT) (Wessel et al., 2013).

Messages Issued by the PTWC

Member States were required to select one scenario by 6 March for the 2020 exercise. Those who did not select any scenario, the organizers decided for which scenario the PTWC would send the products. Given the sudden change in scope of the exercise, the PTWC issued only the Dummy (start of exercise) message all over the standard broadcast channels (WMO/AWIPS IDs WECA41 PHEB/TSUCAX) to start the CARIBE WAVE 20 exercise at 1400 UTC on 19 March 2020. The simulated messages prepared by PTWC for each of the scenarios were made available in the Exercise Handbook. Any further dissemination and additional activities was left up to the corresponding national and local authorities.

3.2 MASTER SCHEDULE (EXERCISE SCRIPT)

CARIBE-EWS Tsunami Service Provider (PTWC) issued the initial Dummy message on 19 March 2019 at 1400 UTC. This message was used to test communications with Tsunami Warning Focal Points (TWFPs) and National Tsunami Warning Centres (NTWCs). In an ordinary exercise, would have marked the beginning of the exercise. The transmission methods used to send the dummy message were GTS - WIS (WMO Information System), EMWIN, AISR, NWWS, Email, Fax and AWIPS (Advanced Weather Interactive Processing System), using header IDs WECA41 PHEB/TSUCAX. As in past years, the most common methods to receive the Dummy message were the Email and Fax (Figure 5).

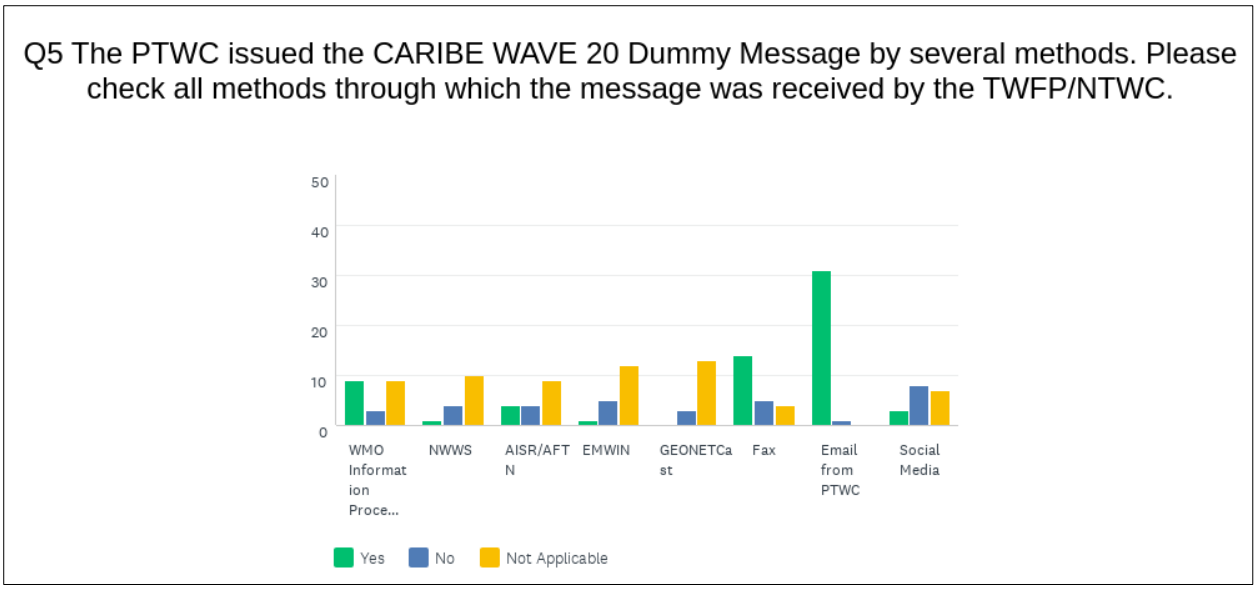

Figure 5. Methods that the CARIBE-EWS TWFPs/NTWCs used to receive the Dummy message by the PTWC.

3.3 ACTIONS IN THE CASE OF A REAL EVENT AND FALSE ALARMS

No significant real events and false alarms were reported by the Member States and Territories during the exercise. No actions were thus required.

3.4 REGISTRATION PROCEDURE

As for past exercises, the CARIBE-EWS teamed up with TsunamiZone.org for online registration (Figure 6). The link used for the registration was http://www.tsunamizone.org/register/. Under the “Register Here” Tab, participants were able to sign up and choose among the three major categories:

1. Myself and/or my family,
2. My school, district, college/university, or childcare centre, and
3. My organization, department, or agency (including TNCs. TWFPs and NTWCs). Emergency Management Organizations (EMOs) were encouraged to promote this registration system.

Most people registered directly on the TsunamiZone.org which is an open registration system available during the whole year. As of 13 April 2020, 102,755 people had registered (Table 2). Nevertheless, according to Member States who answered the post-exercise survey the estimated number of people actually participating were much less, 4,622 (Table 3).

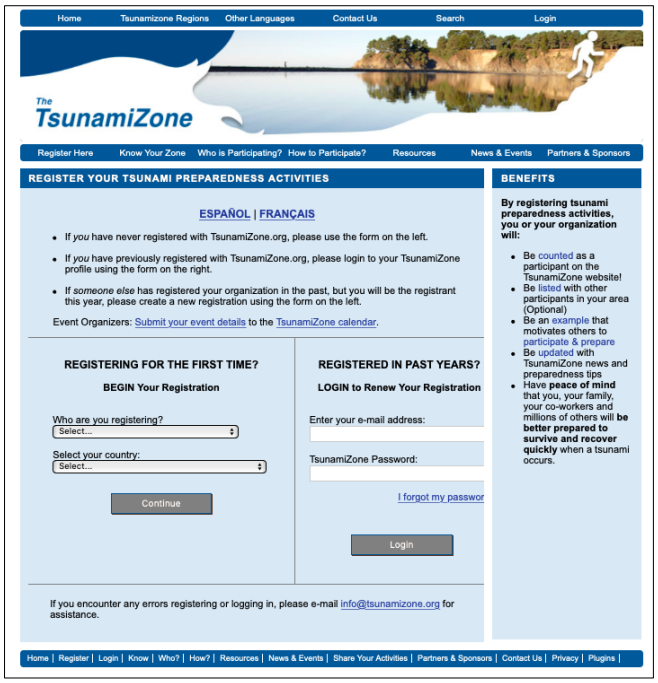

Figure 6. Registration by categories and country for the CARIBE WAVE 20 Regional Tsunami Exercise.

Category	Number of Participants
Individuals/Families	750
Childcare and Pre-Schools	280
K-12 Schools and Districts	14,172
Colleges and Universities	8,216
Government*	40,209
Businesses	2,046
Hotels and Other Lodgings	410
Healthcare	1,308
Senior Facilities/Communities	50
Disability/AFN Organizations	208
Non-Profit Organizations	836
Neighbourhood Groups	166
Preparedness Organizations	32,305
Faith-based Organizations	60
Museums, Libraries, Parks, etc.	15
Volunteer/Service Clubs	1
Youth Organizations	0
Agriculture/Livestock	0
Volunteer Radio Groups	87

*This includes TWFPs and TNCs

Category	Number of Participants
Science/Engineering Organizations	495
Media Organizations	0
Other	1,141
Total	**102,755**

Table 2. List of registrants and participants by Categories on TsunamiZone.org in the Caribbean (as of 06/02/2020)

Country		Participants according to Member States	Participants according to Tsunami Zone
Antigua and Barbuda		1*	0
Bahamas		0	14
Barbados		2	507
Belize		1*	5
Brazil		5	13
Colombia		1	4
Costa Rica		4	39
Cuba		350	174
Dominica		2	440
Dominican Republic		1,547	1,547
France (Martinique, Guadeloupe, Guyane, St. Barthelemy, St. Martin)		5*	888
Grenada		1,000	21,591
Guatemala		20	30
Guyana		1*	0
Haiti		100	840
Honduras		1*	0
Jamaica		1*	3
Mexico		811	1,001
Netherlands	Aruba	1*	14
	Bonaire, Saba, Sint Eustatius	10	43
	Curacao	500	22

Country		Participants according to Member States	Participants according to Tsunami Zone
	Sint Maarten	1*	0
Nicaragua		90	90
Panama		1*	12
Saint Kitts and Nevis		1*	6,000
Saint Lucia		1*	80
Saint Vincent and the Grenadines		15	200
Suriname		0	0
Trinidad and Tobago		26	60
United Kingdom	Anguilla	0	1,250
	Bermuda	6	12
	British Virgin Islands	1*	264
	Cayman Islands	1*	171
	Montserrat	0	9
	Turks and Caicos	1*	6
United States	Puerto Rico	100	10,994
	US Virgin Island	10	1,177
Venezuela		5	55,255
TOTAL		**4,622**	**102,755**

Table 3. List of participants by Country/Territory (as of 06/02/2020)
*Countries that did not provided a participation number but were part of the communication portion of the exercise.

3.5 STATUS OF SEA LEVEL STATIONS DURING EXERCISE

An analysis of sea level stations status was carried out by the NOAA Caribbean Tsunami Warning Program (CTWP) as part of the CARIBE WAVE 20 Regional Tsunami Exercise. This allowed a snapshot of the availability of sea level data. The PTWC provided simulated forecasted maximum wave heights for 45 CARIBE-EWS stations in the simulated bulletins. Only about 73% of these sea level stations were online on the IOC Sea Level facility during the exercise period (Figures 7 and 8). Several stations reported in the simulated products have not been in operation for many years. Similarly, the Tide Tool system used by many Tsunami Warning Centres had around 73% of stations available to display estimated times of arrival (Figures 9 and 10). DART had 4 of 7 stations streaming data in the Caribbean/Gulf and Atlantic thru the National Buoy Centre (Figure 11).

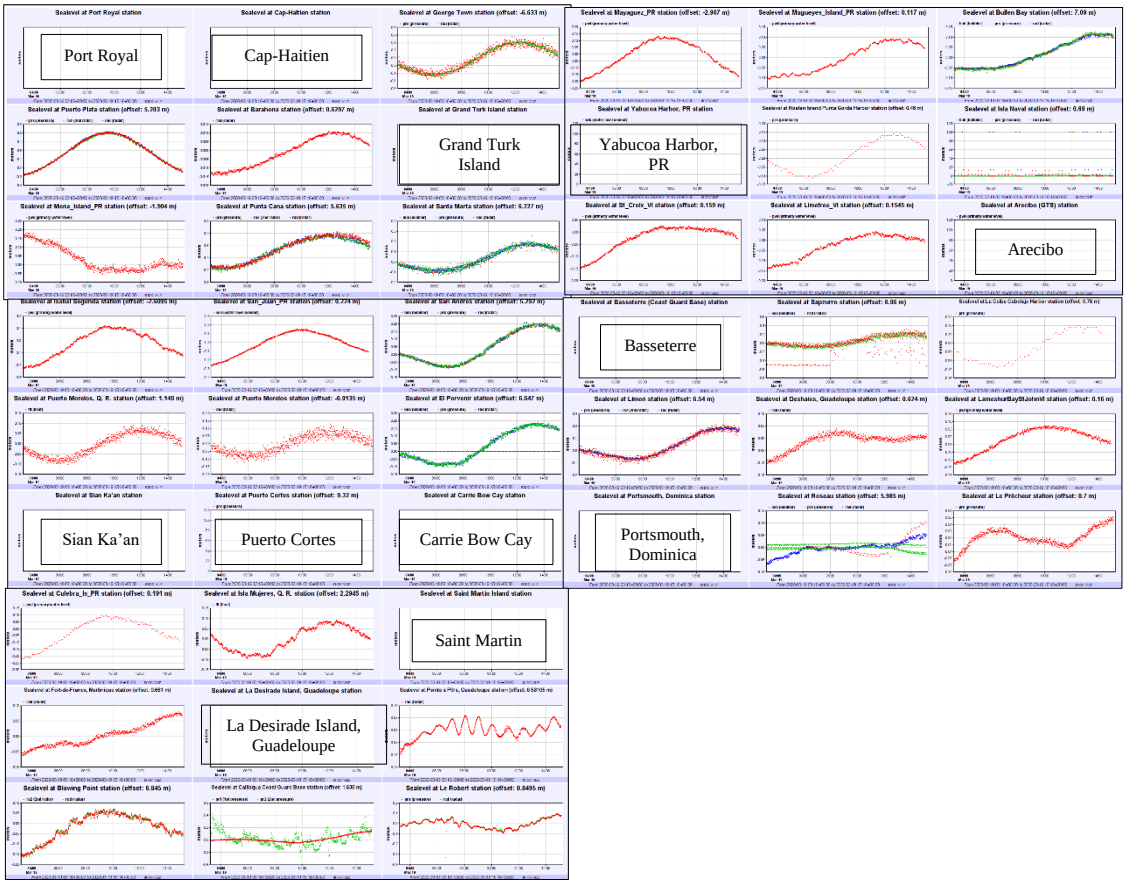

Figure 7. Sea level screen shot from 45 CARIBE-EWS coastal sea level stations during the CARIBE WAVE exercise. Stations for which the name of the station is provided, and not the wave form, are stations that had no data on the IOC Sea Level Monitoring Facility.

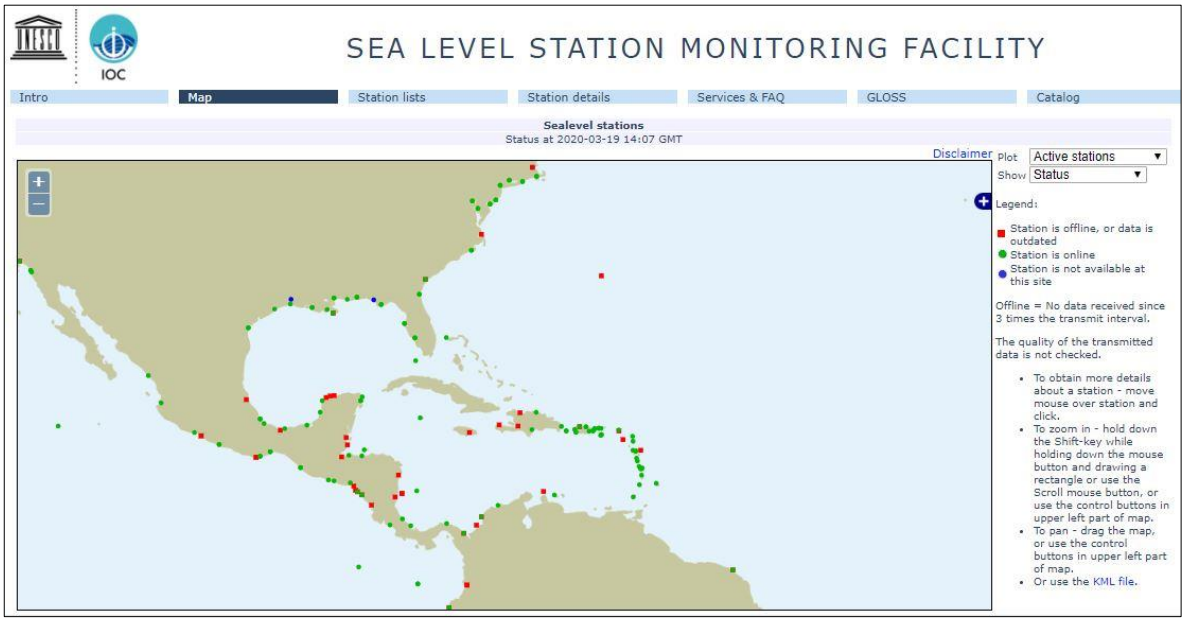

Figure 8. Screenshot showing IOC Sea Level facilities operating during the CARIBE WAVE 20 exercise. In green are stations for which data were available, red dots are for station for which there were no data.

3.6 RESOURCES

Although Emergency Management Organizations (EMOs) had advance notice of the exercise and some elected to set up a special dedicated shift to allow normal core business to continue uninterrupted, it was suggested that realistic resource levels be deployed in order to reflect some of the issues that are likely to be faced in a real event. Considering the pandemic, agencies were requested to adjust the exercise to their best convenience.

This year Elizabeth Vanacore was the Exercise Chair; while Alberto Lopez, Ivan Wong, Matt Hornback and Richard D Koehler were the scientific experts that helped in the determination of the Jamaica scenario; and Maria Ana Viana Baptista was the scientific expert for the Portugal scenario. The CTWP coordinated the exercise for CARIBE-EWS.

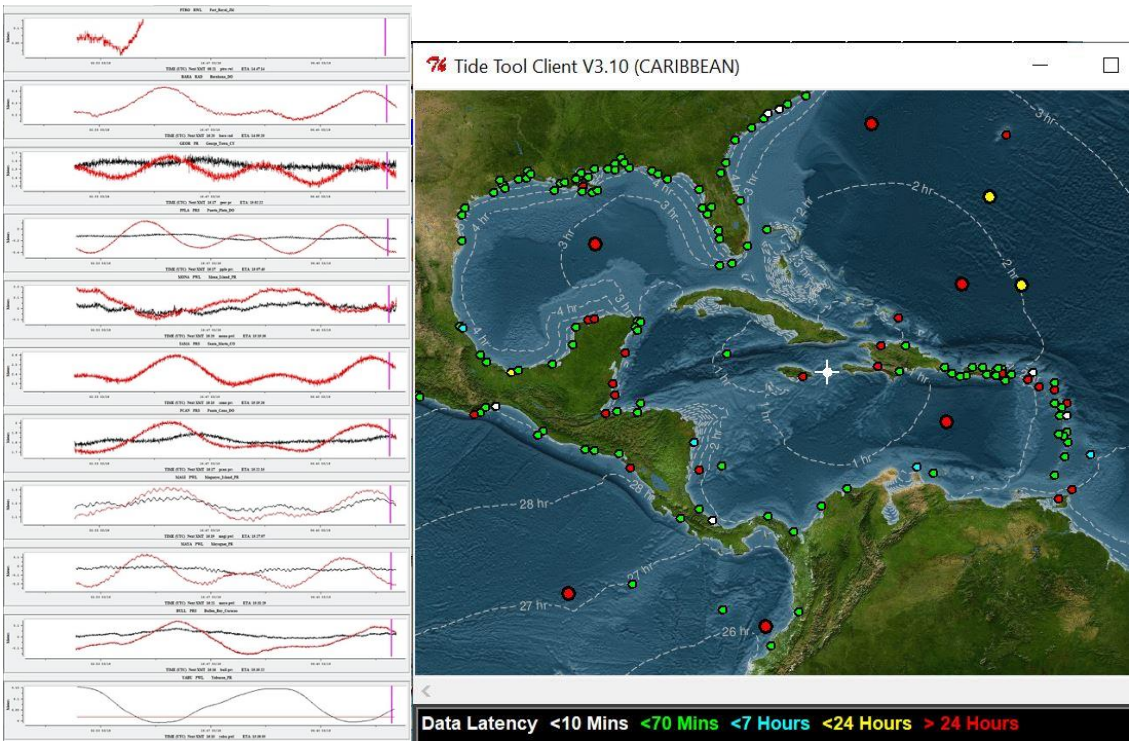

Figure 9. Screenshot from Tide Tool data for the CARIBE WAVE 20 Jamaica Scenario

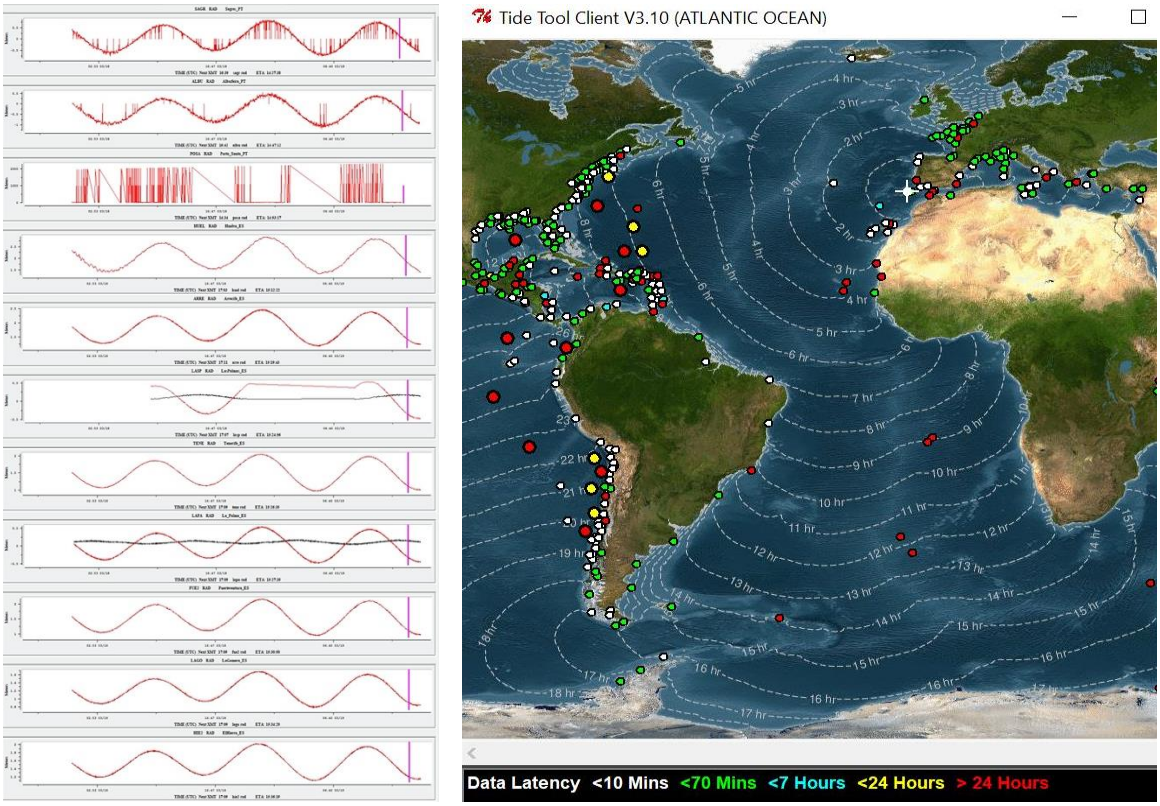

Figure 10. Screenshot from Tide Tool for the CARIBE WAVE 20 Portugal Scenario.

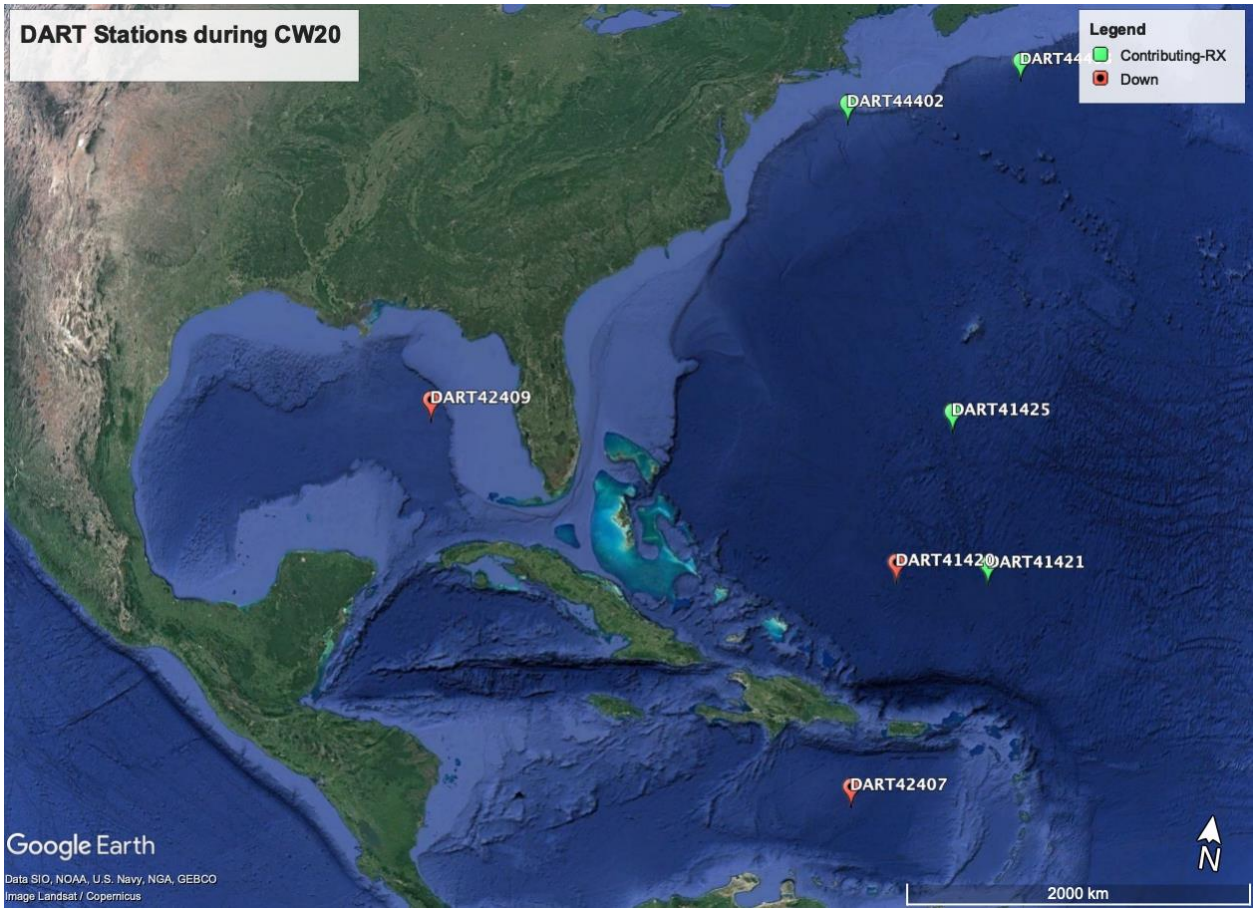

Figure 11. Map of operational and non-operational status of the DART's on 19 March 2020

3.7 MEDIA ARRANGEMENTS

One advantage in conducting exercises is that it provides a venue to promote tsunami awareness. The exercise offers an opportunity to collaborate with the media and disseminate more broadly information on the warning system. However, the 2020 exercise took place under different circumstances than previous years. The beginning of this year was marked by increased seismic activity in the Caribbean region, especially to the south of Puerto Rico and to the east of Jamaica. This seismic activity shed a light on the risk that tsunamis can pose to the Caribbean region in the event of an earthquake. For this reason, it was expected that the CARIBE WAVE exercise would have more participants than previous years. The hashtag tracker Brand24 was used to monitor #CaribeWave20 from 22 February to 23 March and its data supported the high turnout expectations: Social media posts reached over 850,000 people worldwide (Figure 12). Emergency management agencies from countries such as the British Virgin Islands (UK), Venezuela, and St. Kitts and Nevis informed citizens through online article publications that their country would participate in the exercise on 19 March. The National Weather Service San Juan Forecast Office and the Caribbean Tsunami Warning Program (CTWP), as well as the Puerto Rico Seismic Network (PRSN) also published informative posts related to tsunami awareness in preparation for CARIBE WAVE.

The outbreak of the Covid-19 virus, however, meant that the original plans for the exercise had become unfeasible. The scope of the exercise was reduced to a communications test. Participating countries then determined if they were going to conduct any follow-up activities. Martinique (France), Guadeloupe (France), Puerto Rico (USA), Barbados, and the British Virgin Islands (UK) disseminated this change of plans and informed the public of their specific situation. Grenada's National Disaster Management Agency (NaDMA), for example, said the exercise would be postponed. These notifications serve as reminders of the importance of tsunami preparedness even though most people could not physically participate in the exercise. The Caribbean Tsunami Warning Program verified that the test message from the Pacific Tsunami Warning Center was issued by contacting a tsunami focal point in Puerto Rico and monitoring PTWC's social media posts.

During the exercise, text messages and tweets about the start of the exercise were displayed on PTWC and CTWP accounts (Figure 13).

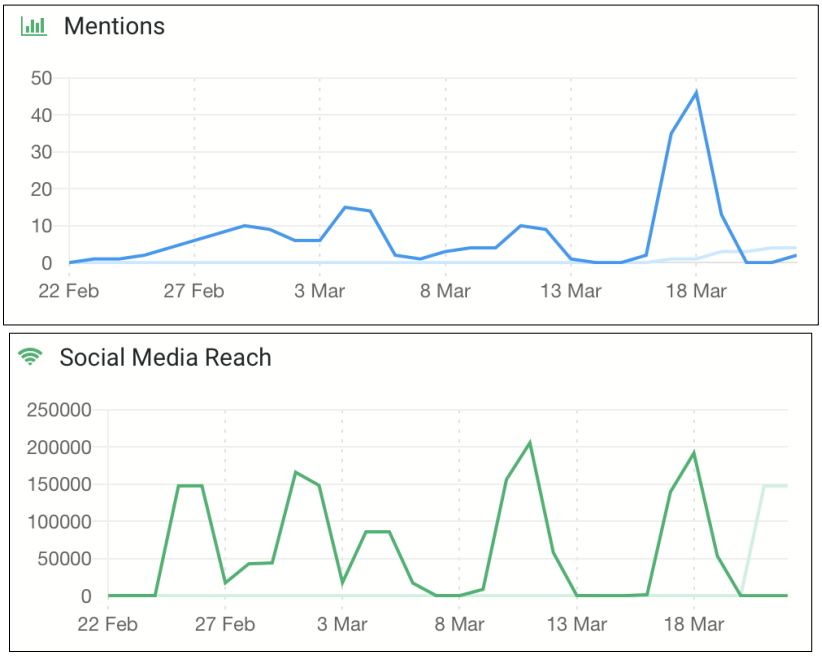

Figure 12. Graphs showing the #CaribeWave and #CaribeWave20 trending between the 22 February and 23 March 2020.

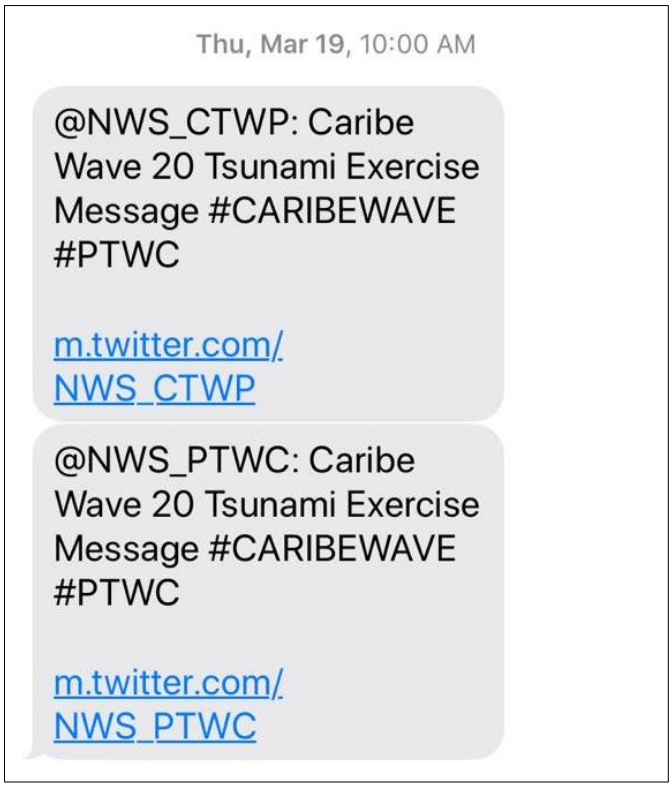

Figure 13. Text Messages about the start of CARIBE Wave 20 exercise.

3.8 POST-EXERCISE EVALUATION

In light of the implications of Covid-19, the questionnaire was reduced for all participating countries to only provide feedback on the exercise communication test portion. This feedback assists the ICG/CARIBE-EWS in the evaluation of CARIBE WAVE 20 and the development of subsequent exercises and helps response agencies document lessons learned. The survey contained 12 questions and was conducted by the IOC/UNESCO using the Survey Monkey service. Thirty-four (34) surveys were completed representing the feedback from 92% of the Member States (MS) and Territories[3].

Considering the circumstances of the pandemic, the survey was available from the start of the exercise on 19 March and extended through 11 May. Overall, the results indicated that the Dummy (Start of Exercise) message was received by 33 Member States, representing 97% of the CARIBE-EWS Member States and Territories. There was a strong dependency on email and fax for the reception of products from the PTWC, although several countries indicated problems with the fax. The message was received by most countries within the first 1-2 minutes, and few countries reported delays. Despite Covid-19, 38% of the Member States indicated that the TWFP/NTWC issued messages to relevant in-country agencies. The exercise planning at a regional level went well under extenuating circumstances, resulting in a 76% of satisfaction of Member States and Territories, and a total participation of 4,602 people from the Caribbean. The questions as well as the answers and comments are contained in the Supplement available at the CTWP website. This evaluation contains valuable

[3] Countries and Territories answering the post-exercise survey: Antigua and Barbuda, Barbados, Belize, Brazil, Colombia, Costa Rica, Cuba, Curacao, Dominica, Dominican Republic, France (St. Martin), Grenada, Guatemala, Guyana, Haiti, Honduras, Jamaica, Mexico, Netherlands (Aruba, Bonaire, Saba and Saint Eustatius), Nicaragua, Panama, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Sint Maarten, Trinidad and Tobago, United Kingdom (Bermuda, British Virgin Islands, Cayman Islands, Turks and Caicos), United States (Puerto Rico and the US Virgin Islands) and Venezuela (Bolivarian Republic of).

information about the communication test portion and gives to the ICG/CARIBE-EWS group insights to address the objectives of the exercise.

In addition, the survey provided Member States an opportunity to provide additional feedback on the exercise (Table 4). The comments received confirm how Covid-19 impacted the scope of the national and local exercises. Nevertheless, several countries highlight the opportunity the exercise provided to test tsunami protocols and Dominica and US Virgin Islands were even able to do a tsunami drill/walk.

Country	Comments
Belize	The CARIBE WAVE 20 Tsunami Exercise would have been a joint exercise between the National Meteorological Service of Belize (NMS), National Emergency Management Organization (NEMO) and City Emergency Management Organization (CEMO), but due to the Pandemic, everything was cancelled. These organizations will be looking forward to the CARIBE WAVE 21 Tsunami Exercise.
Brazil	This is the first time I am participating. Therefore, I have many doubts, questions, and uncertainty. I believe with time things can get better. I also believe the exercises help improve the chain of information.
Colombia	Given the Covid-19 situation, Colombia was not able to perform the tabletop exercise with the National Tsunami Warning System, as it was originally planned. However, it was postponed for when the situation improved.
Costa Rica	Unfortunately, we only performed a communication test with CNE and an internal exercise at SINAMOT, due to the State of Emergency the country has right now. Hope to be able to perform more activities later in the year.
Cuba	A virtual exercise was carried out from the source of the earthquake in Jamaica, in Havana, Barbacoa and Santiago de Cuba, during which models were run and the level of preparedness for the possibility of the occurrence of tsunami was evaluated. The improvement of the modelling, seismic and sea level monitoring was carried for early warning and risk studies.
Curacao	We planned an exercise program for the island of Curacao. However, due to the pandemic, we could not proceed with the exercise. We did communicate with our public through social media and local media about Tsunami hazards.
Dominica	The exercise was carried out without any difficulties. A national school earthquake drill was also planned and executed on the 19th.
Dominican Republic	It is important that the CARIBE WAVE involves through the agencies all the countries of the region that are participating in this exercise.
Grenada	This year's CARIBE WAVE, Grenada did a communication test due to Covid-19. Everyone that registered received the message in a timely manner. Everything went smoothly. Grenada had planned before Covid-19 to fully evacuate western part of the island, including the gas companies and schools along the western part of the island. Also, for the parishes that were tsunami ready to participate and exercise their tsunami plans, including Carricou and Petite Martique.

Country	Comments
	The event was successful and hopefully 2021 will be a better year for everyone. Please stay safe and protect one self.
Guyana	Due to the Covid-19 measures, a decision was made to postpone the exercise to a later date. The local Civil Defense body will be carrying out a multi-hazard exercise at a later date and that opportunity will be used to incorporate the Tsunami information. The TWFP/NTWC did go through the established protocol for a Tsunami event.
Haiti	Sorry. It was impossible to realize the CARIBE WAVE in Haiti. There was going to be a simulation exercise with evacuation in Fort-Liberte. Unfortunately, we couldn't make it because of the situation and awareness for Covid-19.
Jamaica	Fairly good.
Nicaragua	This exercise was carried out only at table level, due to the global problem of the Covid-19.
Netherlands (Aruba)	Hope we do this another time after Covid-19 doing.
Netherlands (Bonaire, Saba, and Sint Eustatius)	Even with the Covid-19 situation, we decided to go ahead with the exercise, basically because it involved just the communications part. The local governments cancelled further exercise activities that involved people gatherings, if any. For the islands that decided to participate, the exercise went well. We could communicate the simulated tsunami threat as expected.
Panama	I needed more information about the procedure. I didn't know we were supposed to receive just one message.
Saint Lucia	Due to the Covid-19 pandemic, focus was shifted to plans for country response and work schedule changes.
Saint Vincent and the Grenadines	The NTWC St. Vincent and the Grenadines conducted a tabletop exercise with key stakeholders and exercised its new protocols with the Meteorological Services and the Police. Several scenarios were developed using the exercise trigger and a warning was given for players to exercise their decision making and actions.
Trinidad and Tobago	As a communications test, everything went as expected. The only limitation was that our secondary medium (via fax), did not receive the message.
UK (Bermuda)	The timing of the arrival of the Dummy message into all expected communications formats was timely. It is a shame the full exercise couldn't be carried out this year, but hopefully a return to normal business by next year.
UK (British Virgin Islands)	Went well.
UK (Cayman Islands)	It seems bizarre and worrying that we didn't receive any messages!
USA (Puerto Rico)	Due to the Covid-19 emergency and the active seismic sequence in Southern Puerto Rico, we decided to run just the communication exercise with the emergency agencies within the region. The exercise ran in a timely manner with good participation of agencies.

Country	Comments
USA (US Virgin Islands)	Even though we were unable to have a mass gathering to participate in the actual group drill, we were able to have a walk-through of evacuation routes and staging areas.

Table 4. General statements on CARIBE WAVE 20 Tsunami Exercise experience from countries that participated.

4. REFERENCES

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ANNEX I

LIST OF ACRONYMS

AWIPS	Advanced Weather Interactive Processing System
CTWP	US National Weather Service Caribbean Tsunami Warning Program
EMO	Emergency Management Organizations
EMWIN	Emergency Management Weather Information Network
EPGFZ	Enriquillo-Plantain Garden Fault Zone
GTS	Global Telecommunication System
ICG/CARIBE-EWS	Intergovernmental Coordination Group for the Tsunami and Other Coastal Hazards Warning System for the Caribbean and Adjacent Regions
IOC	Intergovernmental Oceanographic Commission of UNESCO
NaDMA	Grenada's National Disaster Management Agency
NCEI	US National Centers for Environmental Information. Previously called National Geophysical Data Center (NGDC
NDMO	National Disaster Management Office
NOAA	US National Oceanic and Atmospheric Administration
NTWC	National Tsunami Warning Centres
OEM	Offices of Emergency Management
PTWC	Pacific Tsunami Warning Center
SOP	Standard Operating Procedures
TNC	Tsunami National Contact
TWFP	Tsunami Warning Focal Point
UNESCO	United National Educational, Scientific, and Cultural Organization

IOC Technical Series

No.	Title	Languages
1	Manual on International Oceanographic Data Exchange. 1965	(out of stock)
2	Intergovernmental Oceanographic Commission (Five years of work). 1966	(out of stock)
3	Radio Communication Requirements of Oceanography. 1967	(out of stock)
4	Manual on International Oceanographic Data Exchange - Second revised edition. 1967	(out of stock)
5	Legal Problems Associated with Ocean Data Acquisition Systems (ODAS). 1969	(out of stock)
6	Perspectives in Oceanography, 1968	(out of stock)
7	Comprehensive Outline of the Scope of the Long-term and Expanded Programme of Oceanic Exploration and Research. 1970	(out of stock)
8	IGOSS (Integrated Global Ocean Station System) - General Plan Implementation Programme for Phase I. 1971	(out of stock)
9	Manual on International Oceanographic Data Exchange - Third Revised Edition. 1973	(out of stock)
10	Bruun Memorial Lectures, 1971	E, F, S, R
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12	Oceanographic Products and Methods of Analysis and Prediction. 1977	E only
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27	Ocean Observing System Development Programme. 1984	E, F, S, R
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34	Bruun Memorial Lectures, 1987: Recent Advances in Selected Areas of Ocean Sciences in the Regions of the Caribbean, Indian Ocean and the Western Pacific. 1988	Composite E, F, S
35	Global Sea-Level Observing System (GLOSS) Implementation Plan. 1990	E only

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36	Bruun Memorial Lectures 1989: Impact of New Technology on Marine Scientific Research. 1991	Composite E, F, S
37	Tsunami Glossary - A Glossary of Terms and Acronyms Used in the Tsunami Literature. 1991	E only
38	The Oceans and Climate: A Guide to Present Needs. 1991	E only
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41	Marine Debris: Solid Waste Management Action for the Wider Caribbean. 1994	E only
42	Calculation of New Depth Equations for Expendable Bathymerographs Using a Temperature-Error-Free Method (Application to Sippican/TSK T-7, T-6 and T-4 XBTS. 1994	E only
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