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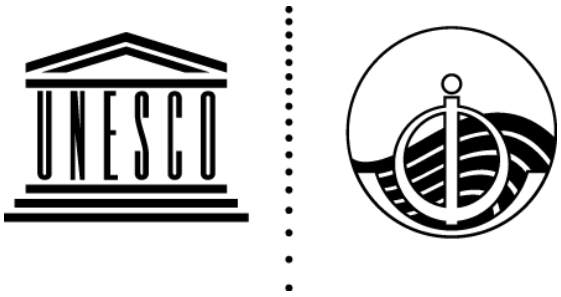

# EXERCISE PACIFIC WAVE 20

## A Pacific-wide Tsunami Warning and Enhanced Products Exercise

## 1 September-30 November 2020

## Summary Report

## Volume 2

UNESCO

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Report prepared by: The Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System (ICG/PTWS)
ICG/PTWS Task Team on PacWave20 Exercise
International Tsunami Information Center

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## 1. EXECUTIVE SUMMARY

Tsunamis are no-notice, fast onset natural hazards that can cause catastrophic impacts. It is impossible to know when or where the next tsunami will hit, but we know that early warnings will save lives. Most of the world's earthquakes and tsunamis occur in the Pacific Ocean and its marginal seas, and through 2021, 70% of the world's fatal tsunamis have occurred there. Local and regional tsunamis occur most frequently, and in the Pacific over history, have been the cause of 99% of tsunami casualties as they will impact shorelines in minutes.

For distant tsunamis, the Tsunami Service Providers provide timely alerts to country National Tsunami Warning Centres who evaluate their own tsunami threat and issue tsunami warnings to their coastal communities. And for local tsunamis, continuous education is essential so that everyone self-evacuates upon recognizing nature's natural tsunami warnings. If people do not evacuate in time, thousands of lives will be lost and massive losses incurred that will have long lasting humanitarian, social and economic impacts.

At its 28th session (ICG/PTWS-XXVIII), Nicaragua, 2–5 April 2019, the Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System approved the conduct of a Pacific Wave Exercise during the last Quarter of 2020 in order to support International Disaster Risk Reduction Day (13 October) and World Tsunami Awareness Day (5 November). PacWave20, the ninth in a series of PacWave exercises which have been conducted biennially since 2006, provided Pacific countries with opportunities to test new products, review tsunami response procedures, test internal and external communication systems, and engage communities.

Because of the global COVID-19 pandemic, first noted in December 2019 and continuing today in 2021, Member States generally were not been able to devote resources sufficient to plan and conduct PacWave20 in the manner originally envisioned (ICG/PTWS-XXVIII.1, Task Team on PacWave20 Exercise, Annex I). Accordingly, the PTWS Steering Committee met virtually in June 2020, and recommended that PacWave20 only test two of the four objectives, namely, communications from the PTWS Tsunami Service Providers to Tsunami Warning Focal Points (TWFP) and National Tsunami Warning Centres (NTWC), and development of tsunami procedures and products by the Central America Tsunami Advisory Centre (CATAC). Other activities were encouraged at the discretion of each country.

A total of 22 countries (including 2 sub-national entities) participated and submitted post-exercise evaluations. The strong majority of responding countries expressed a positive view of the planning and conduct of PacWave20. However, Exercise Planning was in general difficult due to the Pandemic. In some countries, no planning was possible and therefore no meaningful exercise could be done. For countries that did conduct national exercises, the PacWave20 objectives were tested, evaluated and reported, thus enabling lessons to be identified and a number of recommendations have been made to improve readiness and response to a damaging tsunami.

PacWave20 provided valuable feedback from Central American countries along the Pacific to advance the development of the Central America Tsunami Advisory Centre.

The findings from PacWave20 are :

The Live Communication Test from TSPs to Member State TWFPs (Objective a) was successful. PTWC, NWPTAC, SCSTAC Dummy Messages were received in a timely manner. All countries received the message by email, and 35% by GTS .

Due to the Pandemic, many countries did not test national communication and cooperation (Objective b) or national readiness (Objective c) within their country. For countries that did

For communication and cooperation:

- The majority of respondents disseminated the warning message to emergency services and other national and local (provincial, regional, city/district) government agencies, and to a lesser degree science agencies/universities involved in assessment.
- The warning message was disseminated usually by email or SMS. Social media methods of dissemination were also used. Nearly all considered these communication methods timely and appropriate.
- All indicated that the NTWC/NDMO were accurate and clear.

For readiness (evacuation, education and awareness):

- As a result of the exercise, local stakeholders understand better their goals, responsibilities and roles in case of tsunami emergencies, coastal communities are aware of their tsunami risk and are better prepared for tsunami events
- Nearly all respondents have activation and response procedures are in place, know their response role, and have engaged in prior tsunami response planning. Regular exercises are conducted.
- Most have country tsunami emergency response plans for a distant, regional, and local tsunamis. Nearly all plans includes processes to issue Safe-to-Return (All Clear) notices.
- All conduct regular capacity and capability building training on procedures and communication, and conduct exercises top maintain readiness
- While most of respondents indicated that their country has a tsunami mass coastal evacuation plan, only 27% have tsunami evacuation routes and maps are available for all tsunami-vulnerable communities. Only 13% undertook community evacuation, with the most common reason being was the global situation and restrictions due to COVID-19.
- Nearly all have developed and disseminated tsunami-related public education and awareness materials, but only 33% have tsunami curriculum programmes are in place for all levels of education

Due to the Pandemic, few countries tested regional communication and cooperation **(**Objective 3) between countries. The main activities were data sharing, event information sharing and joint PacWave20 exercise (Southeast Pacific 22 October 2021, Central America Pacific Coast. 11 November 2021), South China Sea). Email was the primary method of communication with other countries.

The CATAC Regional Exericise was conducted to Evaluate the format and content of the Central America Tsunami Advisory Centre (CATAC) Products (Objective 4). Respondents indicated that the text and graphical products from CATAC were understood and useful, and assisted with decision-making.

Despite the Pandemic, exercise planning did occur:

- When it was possible, all respondents indicated that
  - Exercise planning, conduct, format and style were very satisfactory. Planning at the international level went better than the planning at national or provincial/local level.
  - Exercise documents / web site were useful and detailed. The Exercise Manual provided an appropriate level of detail, and all the IOC Manual & Guides were useful (Exercises, SOPs, Community Tsunami Evacuations)
- About half used TsuCAT for exercise planning or hazard assessment

- Overall, respondents thought the exercise went well, with particular highlights being the choice of scenarios available, and the opportunity to work through and test tsunami response procedures, SOPs, and communication methods. Several countries highlighted

the enthusiasm of participants. However, other countries noted that key stakeholders were not present

- Overall, several gaps or opportunities for improvement were identified:
  - Coordination with other ICG exercise is needed to allow adequate exercise planning. For 2020, PacWave20 and IOWave20, and also 2018. were too close in timing
  - More proactive engagement with stakeholders earlier on in the planning process, start of the overall planning earlier, and more encouragement of community participation is needed.
  - Because of the pandemic, guidelines for conducting virtual exercises would be useful.

- Review tsunami reporting formats (wave height vs tsunami amplitude). Advocate for increase sea level data sharing
- Additional forecast points requested for French Polynesia

- For the evaluation process, the following gaps or opportunities for improvement were identified:
  - Provide a copy of the completed evaluation form after submission
  - While most indicated that the evaluation form was easy to use, a few suggested that the form was long and should be shortened.
  - Provide options to skip sections that were not exercised by Countries (some Objectives, Exercise Planning and Execution)

National and Regional Reports shared with the ITIC can be found in Annexes III, IV, V, VI and additional video and photos available from the PacWave20 web site.

## 2. INTRODUCTION

### 2.1 HISTORICAL TSUNAMIS

Between 1610 B.C. and A.D. 2020, there have been 260 fatal tsunamis and more than 546,000 deaths. The worst catastrophe in history was the 26 December 2004 Sumatra, Indonesia tsunami that killed 228,000 people in 14 Indian Ocean countries and caused $10 billion in damage. The Pacific Ocean and its marginal seas, however, are where 70% of the world's tsunamis occur. For tsunamis in the Pacific, 21% have occurred in Japan, 16% in South Pacific Islands, 7% in North and Central America, 7% in South America, 5% each in Russian Federation, Asia, and Indonesia (Pacific Coast and marginal seas), 4% in Alaska, and less than 1% in Hawaii. 90% of all tsunami deaths in the historic record have occurred in the local or regional area within the first 3 hours of the event. Since 81% of the tsunamis are generated by shallow great earthquakes, shaking and damage from the earthquake is the 1st hazard to address before the tsunami arrives.

In the Pacific and its marginal seas between 2000 and September 2021, there were 179 observed tsunamis, of which 13 were deadly with ten classified as local tsunamis where the first waves arrived within one hour. The greatest casualties resulted from the 11 March 2011 Tohoku, Japan (18,429 persons) and 28 September 2018 Sulawesi (Palu), Indonesia (4340 persons). The greatest damage resulted from the 11 March 2011 (USD $220 billion) and the 27 February 2010 Central Chile (USD $30 billion) tsunamis.

### 2.2 TSUNAMI SERVICE PROVIDERS

The Intergovernmental Oceanographic Commission (IOC) of UNESCO established the International Coordination Group for the Tsunami Warning System in the Pacific (ICG/ITSU, renamed to ICG/PTWS in 2005) in 1965 in response to the 1960 magnitude 9.5 earthquake off the coast of Chile that generated a tsunami killing 2000 people locally, and hundreds in the far field in Hawaii, Japan and the Philippines. The main focus of the Group is to facilitate the issuance

of timely international tsunami threat information through its Tsunami Service Providers (TSP), and advocate for comprehensive national programmes in hazard assessment, warning guidance, and preparedness (*ITSU Master Plan*, 2004; PTWS Medium-Term Strategy 2014-2021, IOC TS 108; PTWS Implementation Plan 2013, vers 4). In 2005, ITSU was re-established as the Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System (ICG/PTWS). For the Pacific, there are three TSPs, and one developing TSP.

The US Pacific Tsunami Warning Center (PTWC), established in 1965 with the start of the Tsunami Warning System in the Pacific, serves as the lead Tsunami Service Provider (TSP) for the PTWS. Because of the Pacific's large size, there are regional TSPs who can improve the timeliness and threat assessment accuracy of regional events.

Japan began operation of its Northwest Pacific Tsunami Advisory Center (NWPTAC) TSP in March 2005, and from April 2006 – November 2019 provided services on an interim basis to the South China Sea. The NWPTAC serves as the TSP for the Northwest Pacific. It provides timely alerts for earthquakes occurring in the Northwest Pacific extending North to South from Russia to the Solomon Islands, and West to East from Thailand to Micronesia.

The South China Sea Tsunami Warning and Mitigation System was approved by Member States in 2013. The South China Sea Tsunami Advisory Center (SCSTAC), hosted by China, commenced full operation on 5 November 2019. It services countries bordering the South China Sea, Sulu Sea, and Celebes Sea.

A regional TSP for Central American countries bordering the Pacific Ocean is currently being developed. In 2015 (ICG/PTWS-XXVI, 2015), Member States accepted the offer of Nicaragua to host and develop the Central America Tsunami Advisory Centre (CATAC) within the framework of the ICG/PTWS, ICG/CARIBE-EWS and TOWS-WG (ICG/PTWS-XXVI.2), and in 2019 (ICG/PTWS-XXVIII), as a PTWS Tsunami Service Provider (User's Guide for the Central American Tsunami Advisory Centre (CATAC), 2019, draft in English and Spanish).

Regional Exercises have been used to develop and test the products of CATAC. The first CATAC regional exercise was conducted in August 2019 (IOC/2019/TS/148 Vol.1, in Spanish). The second exercise was conducted on 11 November 2020 (*Ejercicio Tsunami-CA 20. Ejercicio de alerta de tsunami para América Central: un terremoto lento y tsunam al golfo de Fonseca 11 de noviembre de 2020 (Vol.1)* (IOC Technical Series, 156) part of Exercise Pacific Wave 2020.

## 2.3 INTERNATIONAL TSUNAMI EXERCISES

A Pacific-wide tsunami exercise is an effective tool for evaluating the readiness of PTWS countries and identifying changes that can improve its effectiveness. The international tsunami exercises were first conceived and conducted in 2006 by the ICG/PTWS under the leadership of the PTWS Exercises Task Team with strong contributions from the International Tsunami Information Center (ITIC), PTWC, and Japan Meteorological Agency (JMA). Altogether there have been eight IOC-coordinated international tsunami exercises: Exercise Pacific Wave in 2006 (IOC/INF-1244), 2008 (IOC/2008/TS/82), 2011, (IOC/2011/TS/97Vol.1 and 2); 2013 (IOC/2013/TS/106 Vol.1 and 2), 2015 (IOC/2015/TS/117 Vol.1 and 2), 2016 (IOC/2015/TS/126 Vol.1 and 2), 2017 (IOC/2016/TS/131 Vol.1 and 2), and 2018 (IOC/2018/TS/139 Vol.1 Rev.2 and Vol. 2).

Exercise Pacific Wave 2011, 2013, and 2015 were additionally used to introduce and obtain feedback, test, and validate the new PTWC Enhanced Products which became official on 1 October 2014. Exercise Pacific Wave 2016 and 2017 were used to evaluate experimental NWPTAC Enhanced Products and identify necessary modifications before the JMA Enhanced Products were formally adopted. Exercise Pacific Wave 2017 was also used to support the development of the SCSTAC products. Exercise Pacific Wave 2018 was used to validate the

NWPTAC enhanced products and test the new SCSTAC products.  Exercise Pacific Wave 2020 was used to further develop the services and products of the CATAC.

## 3. EXERCISE PACIFIC WAVE 20

### 3.1 OVERVIEW

The ICG/PTWS, at its 28th session (Barcelo Montelimar, Nicaragua, 2019), approved the conduct of Exercise Pacific Wave 2020 (PacWave20) during the last quarter of 2020 to support International Disaster Risk Reduction Day (13 October) and World Tsunami Awareness Day (5 November) (ICG/PTWS-XXVIII.1).

At the June 2020 virtual meeting of the PTWS Steering Committee, Member States noted that the COVID-19 Pandemic has required significant resources, and as a result, most would not have time to plan and conduct Exercise Pacific Wave 2020 as was originally approved in 2019. Consequently, the PTWS SC reduced the scope of PacWave20 to only test two of the four objectives, namely, communications from the PTWS Tsunami Service Providers to Tsunami Warning Focal Points (TWFP) and National Tsunami Warning Centres (NTWC), and development of tsunami procedures and products by the Central America Tsunami Advisory Centre (CATAC). Other activities were encouraged at the discretion of each country.

An overview and summary of Exercise Pacific Wave 2020 was published in the Environment Coastal & Offshore (ECO) Magazine Special Issue on UN Decade of Ocean Science for Sustainable Development (Building Tsunami Resiliency in the Pacific: Exercise Pacific Wave Exercises (2006-2020), Chapter 4: A Safe Ocean, May 2021, http://itic.ioc-unesco.org/images/stories/tsunami_exercises/international_exercises/pacwave20/PacWave_ECO_UNDecadeSpecialIssue_may21.pdf)

### 3.2 PARTICIPATION

A total of 24 countries (including 2 sub-national entities) submitted Exercise Pacific Wave 2020 evaluation forms between November 2020 and September 2021. A summary compiling the exercise evaluation responses is provided at Annex II. Pacific countries and sub-national jurisdictions that participated were:

| | |
|---|---|
| • Australia | • Chile |
| • China, China Hong Kong | • Colombia |
| • Cook Islands | • Costa Rica |
| • Colombia | • Ecuador |
| • Ecuador | • El Salvador |
| • Fiji | • France (New Caledonia, Wallis and Futuna) |
| • France (French Polynesia) | • Japan |
| • Republic of Korea | • Malaysia |
| • Marshall Islands | • Mexico |
| • New Zealand | • Nicaragua |
| • Palau | • Philippines |
| • Russian Federation | • Solomon Islands |
| • Tuvalu | • Vanuatu |

This Exercise Pacific Wave20 Summary Report is based on the post-exercise evaluation data as compiled by the PacWave18 PacWave20 Task Team.

## 3.3 CONCEPT AND CONDUCT

### 3.3.1 PURPOSE

The purpose (aim) of Exercise PacWave20 was to test PTWS tsunami service provider arrangements, country preparedness arrangements and operational procedures to respond and recover from a destructive tsunami.

Exercise Pacific Wave 2020 (PacWave20) also supports the development of improved PTWS tsunami products and procedures, including those of the Central America Tsunami Advisory Centre (CATAC).

### 3.3.2 OBJECTIVES

The original objectives for Exercise Pacific Wave 2020 were fourfold:

a) Test communications from the PTWS Tsunami Service Providers to Tsunami Warning Focal Points and National Tsunami Warning Centres of Member States.
b) Test national communication and cooperation, and readiness within the country.
c) Test regional communication and cooperation between Member States.
d) Support the development of tsunami procedures and products by the Central America Tsunami Advisory Center (CATAC) (Only applicable to relevant countries).

As noted above, only objectives (a) and (d) are to be tested during PacWave20.

### 3.3.3 DATES

Exercise PacWave20 was held within the period of 1 September-30 November 2020. Participating countries could choose to run their exercise any time during this period, allowing flexibility to avoid conflict with other important national events.

### 3.3.4 WEBINARS

The ITIC and IOC hosted PacWave20 informational webinars on 28 October 2020 at 1900 UTC and 29 October 2020 at 0300 to answer questions related to the conduct of PacWave20, .

### 3.3.5 DOCUMENTATION

All information related to Exercise PacWave20 was available at the exercise website: http://www.pacwave.info.

The following lists Exercise PacWave20 documents:

- PacWave20 Exercise Task Team - Terms of Reference, Members, IOC ICG/PTWS-XXVIII.1, April 2019 (PDF)
- PacWave20 during COVID-19, Scope reduction, ICG/PTWS Steering Committee, June 2020 (PDF)
- IOC Circular Letter, 2812: Pacific Tsunami Warning and Mitigation System (PTWS) Exercise Pacific Wave 2020 (PacWave20), 5 & 11 November 2020 (21 October 2020, (PDF)
- Exercise Pacific Wave 2020, A Pacific-wide Tsunami Warning and Enhanced Products Exercise, 1 September–30 November 2020. Exercise Manual, Volume 1, IOC Technical Series No 155. UNESCO/IOC 2020 (English) (PDF)
- PacWave20 Overview (29 Oct 2020) (PPT, PDF)
- TSP Communication Test – Exercise Dummy Messages (PTWC, NWPTAC, SCSTAC, CATAC, PacWave20 web site)
- IOC Media Advisory, CATAC Regional Exercise 10 Nov 2020 (PDF, 3.6 MB)

The following lists CATAC documents:

- CATAC Products Area of Service, Aug 2019 (draft 28 Mar 2019, PDF)
- Users' Guide for the Central America Tsunami Advisory Centre (CATAC) (draft 28 Mar 2019, English PDF, Spanish PDF)
- CATAC Regional Exercise Manual (Ejercicio Tsunami-CA-20) 11 Nov 2020 (28 October, Spanish) (IOC TS 156, PDF)
- IOC Circular Letter No. 2814, Operaciones de prueba del Centro de Asesoramiento sobre los Tsunamis de América Central (CATAC) y ejercicio de simulacro CATAC 20 el 11 de noviembre de 2020, como parte de PacWave20. Central America Tsunami Advisory Center (CATAC) trial operations and CATAC 20 exercise on November 11, 2020, as part of PacWave20 (29 Oct 2020, Spanish, PDF)
- IOC Media Advisory, CATAC Regional Exercise, 10 November 2020 (PDF)

The following lists supporting information and tools:

- Exercise Scenario Development and PTWC Product Generation
  - Tsunami Coastal Assessment Tool (TsuCAT) - web site
  - Past PacWave Exercises – web sites
  - PacWave Support information
    - Tsunami Travel Time Maps (HTML)
    - Historical Tsunami & Seismicity Maps (HTML)
- IOC Manual and Guides
  - How to Plan, Conduct, and Evaluate Tsunami Exercises IOC Manual and Guides 58, 2013 (English (PDF), Spanish (PDF))
  - Plans and Procedures for Tsunami Warning and Emergency Management (IOC Manual and Guides 76 rev., 2017, English (PDF)
  - Preparing for Community Tsunami Evacuations: from inundation to evacuation maps, response planning, and exercises, Guide and Supplements (IOC Manual and Guides 82, 2020, English, Spanish) - web site

## 3.4 EXERCISE ACTIVITIES

### 3.4.1 COMMUNICATION TEST

In order to meet Objective a) to test communications from the Tsunami Service Providers to each Member State, a live test occurred at 0000 UTC on 5 November 2020. Member States were asked to note when and how they received the live communications test message and report back through the Post-Exercise Evaluation Survey.

### 3.4.2 CATAC REGIONAL EXERCISE

In order to meet Objective d) to support the development of the CATAC, a CATAC regional exercise was conducted on 11 November 2020. The exercise manual, *Ejercicio Tsunami-CA-20. Ejercicio de Alerta de Tsunami para América Central – 11 de Noviembre de 2020 – Un terremoto lento y tsunami frente al Golfo de Fonseca*) was distributed to CATAC Members States by email and posted to the PacWave20 web site.

### 3.4.3 REGIONAL AND COUNTRY EXERCISE ACTIVITIES

Some countries organized additional PacWave20 activities in line with Objectives (b) and (c). Photos or videos were received from Colombia (National Tsunami Warning Center, Tumaco evacuation), Costa Rica (Virtual tabletop, Bahia at Osa evacuation), and Russian Federation (Sahkalin Tsunami Warning Center and Regional Ministry of Emergency Situations tabletop).

Reports are included as Annexes in this document:

- Regional Working Group for the Southeast Pacific (WG-SEP) on their a regional exercise on 22 October 2021 (Annex III, http://itic.ioc-unesco.org/images/stories/tsunami_exercises/international_exercises/pacwave20/REPORT%20PAC%20WAVE%202020%20PTWS_ENG.pdf),
- Tuvalu on the Fetuvalu Secondary School drill on 19 November 2021 (Annex IV, http://itic.ioc-unesco.org/images/stories/tsunami_exercises/international_exercises/pacwave20/TSUNAMI%20DRILL%20SIMULATION%20%20FETUVALU%20Narrative%20Report%20FINAL28471.pdf),
- Fiji on the USP Labasa and TAFE Campus Tsunami Evacuation Drill on 5 November 2020 (Annex V,http://itic.ioc-unesco.org/images/stories/tsunami_exercises/international_exercises/pacwave20/EPC%20Report%20-%20Labasa%20USP%20Drill47349.pdf ),
- CATAC Regional Exercise 11 November 2020 (Annex VI, http://itic.ioc-unesco.org/images/stories/tsunami_exercises/international_exercises/pacwave20/CATAC_regional%20Exercise20_english%20trans.pdf).

All reports and/or additional videos and photos received by ITIC are posted to the PacWave20 web site (www.pacwave.info).

## 4. POST-EXERCISE EVALUATION

The goal of exercise evaluation is to validate strengths and identify opportunities for improvement within the participating countries. This is accomplished by collating supporting data; analysing the data to compare effectiveness against requirements; and determining what changes need to be made.

All participating countries were asked to complete the official Exercise PacWave20 Evaluation Form (IOC TS 155, Vol 1, Annex II) by 21 December 2020. Forms were submitted online by visiting https://www.surveymonkey.com/r/pacwave20_eval

## 5. POST-EXERCISE EVALUATION FINDINGS

A total of 24 countries (including two sub-national entitles) participated in the exercise and submitted evaluation forms. A summary of the findings from the completed evaluation forms is provided in Annex II.

The strong majority of responding countries expressed a positive view of the planning and conduct of PacWave20. However, Exercise Planning was in general difficult due to the Pandemic. In some countries, no planning was possible and therefore no meaningful exercise could be done. For countries that did conduct national exercises, the PacWave20 objectives were tested, evaluated and reported, thus enabling lessons to be identified and a number of recommendations have been made to improve readiness and response to a damaging tsunami. PacWave20 reinforced the integration of TSP products in participant country decision-making processes, and in their Standard Operating Procedures (SOPs).

The findings from PacWave20 by Objective are as follows:

***Objective 1: To test communications from the approved and developing Tsunami Service Providers (PTWC, NWPTAC, SCSTAC, CATAC) to Member States/Countries***

- PTWC, NWPTAC, SCSTAC messages were received in a timely manner. All countries received the message by email, 35% by GTS

***Objective 2a: To test national communication and cooperation within the country.***

- The majority of respondents disseminated the warning message to emergency services (82%) and other national government agencies (64%). Others were science agencies/universities involved in assessment (27%), local government – provincial/regional level (55%), and local government – city/district level (45%).
- The warning message to emergency, national, science, and local government agencies was disseminated by email (58%) or SMS (50)%, Social media methods of dissemination were used by respondents (55%), followed by website and email (27%), sirens (18%), radio (18%), SMS (18%), cell or mobile phone (18%), and Police (18%)/.
- The majority of exercise participants (91%) considered that the communication methods used during the exercise were timely and appropriate.
- 100% of respondents considered that the messages disseminated from the NTWC/NDMO were accurate and clear.

***Objective 2b: To test national readiness within the country.***

*Readiness*

- 94% of respondents have activation and response procedures are in place, know their response role, and have engaged in prior tsunami response planning.
- 100% of respondents indicate that regular capacity and capability building exercises are undertaken to support a national tsunami response. Topics covered were procedures and, communication
- 86% of respondents conduct exercises routinely.

*Response Plans*

- Most (>70%) respondents have country tsunami emergency response plans for a distant, regional, and local tsunamis. Nearly all plans includes processes to issue Safe-to-Return (All Clear) notices.

*Evacuation:*

- While most of respondents indicated that their country has a tsunami mass coastal evacuation plan, only 27% have tsunami evacuation routes and maps are available for all tsunami-vulnerable communities. Only 13% undertook community evacuation, with the most common reason being was the global situation and restrictions due to COVID-19.

*Education and Awareness:*

- Nearly all have developed and disseminated tsunami-related public education and awareness materials, but only 33% have tsunami curriculum programmes are in place for all levels of education

***Objective 3: To test regional communication and cooperation.***

- Few countries (4) engaged in communication and cooperation with other countries in the region for PacWave20. These were for the Southeast Pacific, and South China Sea. The main activities were data sharing, event information sharing and joint PacWave20 exercise. Email was the primary method of communication with other countries.

***Objective 4: To Evaluate the format and content of the Central America Tsunami Advisory Centre (CATAC) Products (ifapplicable for your country).***

- Objective 4 was answered by three Central American countries
- Respondents indicated that the text and graphical products from CATAC were understood and useful, and assisted with decision-making.
- Exercise manual provided by CATAC was very helpful. Only the first scheduled message was received, for future exercises, all the messages shown in the document should be sent.

**GENERAL EXERCISE OBSERVATIONS**

Respondents affirmed that

- local stakeholders understand better their goals, responsibilities and roles in case of tsunami emergencies,
- coastal communities are aware of their tsunami risk and are better prepared for tsunami events and
- the exercise provide an opportunity to improve if gaps in capability and capacity are identified.

Exercise planning.

- Nearly all respondents indicated that exercise planning, conduct, format and style were very satisfactory. Exercise planning at the international level went better than the planning at national or provincial/local level.
- All respondents indicated that the Exercise documents / web site were useful and detailed. The Exercise Manual provided an appropriate level of detail, and all the IOC Manual & Guides were useful (Exercises, SOPs, Community Tsunami Evacuations)
- 53% of the participants (9 countries) used TsuCAT for exercise planning or hazard assessment during the PacWave20.

WHAT WENT WELL?

- Overall, participants thought the exercise went well, with particular highlights being the choice of scenarios available, and the opportunity to work through and test tsunami response procedures, SOPs, and communication methods. Several countries highlighted the enthusiasm of participants. However, other countries noted that key stakeholders were not present

WHAT TO IMPROVE?

- Coordination with other ICG exercise is needed to allow adequate exercise planning. For 2020, PacWave20 and IOWave20, and also 2018. were too close in timing
- Areas to improve will be for more proactive engagement with stakeholders earlier on in the planning process, starting the overall planning earlier, and encouraging community participation
- Develop guidelines for virtual exercises
- Review tsunami reporting formats (wave height vs tsunami amplitude). Advocate for increase sea level data sharing
- Additional forecast points requested for French Polynesia

EVALUATION

- The evaluation process could be improved by making available a copy of the completed evaluation form after submission. Most indicated that the evaluation form was easy to use; a few suggested to shorten the form.
- The online form should have a way for the user to skip sections that were not exercised by Countries (some Objectives, Exercise Planning and Execution)
- A simpler method for entering the number of participants could help – there should be a field to write number in (not yes or no)

Regional and National Exercise Reports shared with the ITIC can be found in Annexes III, IV, V, and VI, and additional video and photos are available at the PacWave20 web site.

## ANNEX I. TASK TEAM ON PACWAVE20

The planning, conduct, and evaluation of Exercise PacWave20 was coordinated by the PTWS Exercise PacWave20 Task team (TT). The Exercise PacWave20 Summary Report and Annexes were compiled by Dr Laura Kong and Carolina Hincapie-Cardenas (International Tsunami Information Center).

Task Team Members (official):

- Dr. Laura Kong, ITIC, USA (Co-Chair)
- Mr. Emilio Talavera, INETER, Nicaragua (Co-Chair)
- Ms. Jo Guard, New Zealand
- Dr. Chip McCreery, PTWC, USA
- Mr. Anthony Blake - SWP – SPC SOPAC
- Dr. Silvia Chacon CA-PAC
- Mr. David Coetzee - WG 3 Chair, NEMA, New Zealand
- Ms. Viviana Dionicio, Colombia
- Dr. Ji Min Lee, Republic of Korea
- Dr. Yuelong Miao, Bureau of Meteorology, Australia
- Dr. Jerome Aucan, IRD, France-New Caledonia
- Dr. Viacheslav Gusiakov, Russian Federation
- Mr. Ryosuke Sakakibara, JMA
- Mr. Robert Greenwood, Bureau of Meteorology, Australia
- Cdr. Carlos Zuniga, SHOA, Chile
- Dr. Wilfried Strauch – Chair, ICG/PTWS, INETER, Nicaragua

ICG/PTWS-XXVIII.1 Task Team on PacWave20 Exercise

Terms of Reference:

1. Design and carry out a ninth Exercise Pacific Wave 2020 with the following characteristics:
    - An exercise shall be conducted with the aim to test PTWS tsunami service provider arrangements, and Country preparedness arrangements and operational procedures to respond and recover from a destructive tsunami.
    - An exercise shall be conducted with the following objectives

a) Test communications from the PTWS Tsunami Service Providers to Tsunami Warning Focal Points and National Tsunami Warning Centers of Member States.

b) Test national communication and cooperation, and readiness within the country.

c) Test regional communication and cooperation between Member States.

d) Support the development of tsunami procedures and products by the Central America Tsunami Advisory Center (CATAC).

2. Exercise Pacific Wave 2020 (PacWave20) will:

- Take place in the months of September through to November 2020 to support International Disaster Risk Reduction Day (13 October) and World Tsunami Awareness Day (5 November).
- Be conducted as a series of regional exercises organized through the PTWS Regional Working Groups where applicable, with support from the PTWS TSPs and ITIC, involving all PTWS countries as part of the regular biennial Pacific Wave exercise conducted since 2006.
- Be conducted to include one live communications test from the PTWS TSPs to Member States on 5 November 2020.
- Be conducted to include exercise activities over and above a table top exercise. Possible exercise variations include:

  a) Consider conducting in real time during the daytime working hours with full staffing, or simulating minimal staff during night time or weekend hours

  b) Consider testing country capability to carry out their warning and response responsibilities for the situation where one or more PTWS TSPs is not able to provide guidance in a timely manner.

  c) Consider conducting the exercise down to the community level, including where possible including an extensive public awareness campaign.

  d) Consider the Sendai Framework for Disaster Risk Reduction Global Sendai Framework for Disaster Risk Reduction seven global targets and four priorities for action, World Tsunami Awareness Day and/or the UN Decade of Ocean Science for Sustainable Development in designing the exercise.

- The exercise shall be announced by the IOC to Member States at least 240 days in advance of the exercise date.
- The exercise manual will

  a) Include information on each regional exercise

  b) Inform Member States on the availability of exercise products for their region, including instructions to Member States regarding the distribution dates,

  c) Include instructions to Member States regarding their participation and the evaluation instrument be prepared with content and structure similar to what was prepared for previous Pacific-wide exercises, but considering lessons learned and any need to collect additional information.

  d) Be distributed by the IOC to Member States at least 180 days in advance of the exercise date.

- Participating Member States will be asked to complete and return the evaluation instrument no more than 21 days following the exercise.

3. Prepare the Summary Report for the exercise, compiling a list of recommendations and the list of actions from the findings for consideration by the ICG/PTWS-XXIX.
4. Members invited from the ICG/PTWS Member States and Regional Working Groups, SPC, PTWC, NWPTAC. SCSTAC and CATAC. Task Team co-chairs to be elected by the ICG.

## ANNEX II. POST-EXERCISE EVALUATION COMPILATION

This Annex contains a compilation of the responses provided by countries to the Exercise PacWave20 post-exercise evaluation form. Altogether, 24 countries (including two sub-national entities) submitted evaluation forms between November 2020 and September 2021.

Surveys were completed online through the Survey Monkey online survey and questionnaire tool, or submitted by transmission of the completed survey file to the PacWave20 Co-Chairs. Several countries submitted multiple evaluations to reflect the participation and experience of these agencies. Where submissions were from different agencies within the same country, these were combined into a single survey to facilitate compilation. The online survey was available in English at https://www.surveymonkey.com/r/pacwave20_eval. Only the section corresponding to the objective 4 was translated into Spanish. The survey was divided into four sections according to the PacWave20 objectives, and evaluation statements and questions focused on different components of the warning and response process.

For each question, a short statement is provided that summarises the responses, and this is followed by comments provided by the countries.

Note that in June 2020 the PTWS Steering Committee (SC), noting the difficulty of conducting Exercise Pacific Wave 2020 as was originally planned in 2019 given the COVID-19 global situation, recommended that PacWave20 only tested Objectives 1 and 4.
Accordingly, PacWave20 consisted of:

1. TSP-to-TWFP and NTWC communication test on 5 November 5 2020; and
2. CATAC regional exercise on 11 November 2020.

Other activities were encouraged but at the discretion of each country.

1. Overall Country and Agency Participation

| | **Country** | **Agency** |
|---|---|---|
| 1 | Australia | Australian Bureau of Meteorology |
| 2 | Chile | Hydrographic and Oceanographic Service of the Chilean Navy |
| 3 | China<br><br>China - Hong Kong | National Marine Environmental Forecasting Center (NMEFC)<br>Hong Kong Observatory (HKO) |
| 4 | Colombia | Dirección General Marítima (DIMAR) |
| 5 | Cook Islands | Cook Islands Meteorological Service |
| 6 | Costa Rica | SINAMOT |
| 7 | Ecuador | Instituto Oceanográfico y Antártico de la Armada del Ecuador |
| 8 | El Salvador | Ministerio de Medio Ambiente y Recursos Naturales (MARN) |
| 9 | Fiji | Ministry of Lands and Mineral Resources, Mineral Resources Department (MRD) |
| 10 | France (New Caledonia, Wallis and Futuna) | Institut de Recherche pour le Développement, Centre de Nouméa (IRD) |
| 11 | France (French Polynesia) | Centre Polynésien de Prévention des Tsunamis (CPPT) |
| 12 | Japan | Japan Meteorological Agency (JMA) |
| 13 | Republic of Korea | Korea Meteorological Administration (KMA) |
| 14 | Malaysia | Malaysian Meteorological Department |

| | | |
|---|---|---|
| 15 | Marshall Islands | RTS Weather Station - Kwajalein |
| 16 | Mexico | Centro de Alerta de Tsunamis (CAT) |
| 17 | New Zealand | National Emergency Management Agency (NEMA)) |
| 18 | Nicaragua | Instituto Nicaragüense de Estudios Territoriales (INETER) |
| 19 | Palau | Palau National Weather Service |
| 20 | Philippines | Philippine Institute of Volcanology and Seismology (PHIVOLCS) |
| 21 | Russian Federation | Federal Service of Russia for Hydrometeorology and Environmental Monitoring<br>Federal Environmental Emergency Response Centre of Roshydromet Research and Production Association «Typhoon» |
| 22 | Solomon Islands | Solomon Islands Meteorological Services |
| 23 | Tuvalu | Tuvalu Meteorological Service |
| 24 | Vanuatu | Vanuatu Meteorology and Geo-hazards Department (VMGD), Vanuatu Tsunami Warning Centre (VTWC) |

2. Central America – Pacific Coast Participation

All countries participates in the CATAC Regional Exercise of Exercise PacWave20. Only El Salvador, Nicaragua and Costa Rica submitted post-exercise evaluations.

**Objective 1: *To test communications from the approved and developing Tsunami Service Providers (PTWC, NWPTAC, SCSTAC, CATAC) to Member States/Countries.***

*Objective 1 was answered by 23 of 24 respondents*

### 1.1 Did your country Tsunami Warning Focal Point receive the PTWC, NWPTAC, SCSTAC, and/or CATAC Exercise Dummy message?

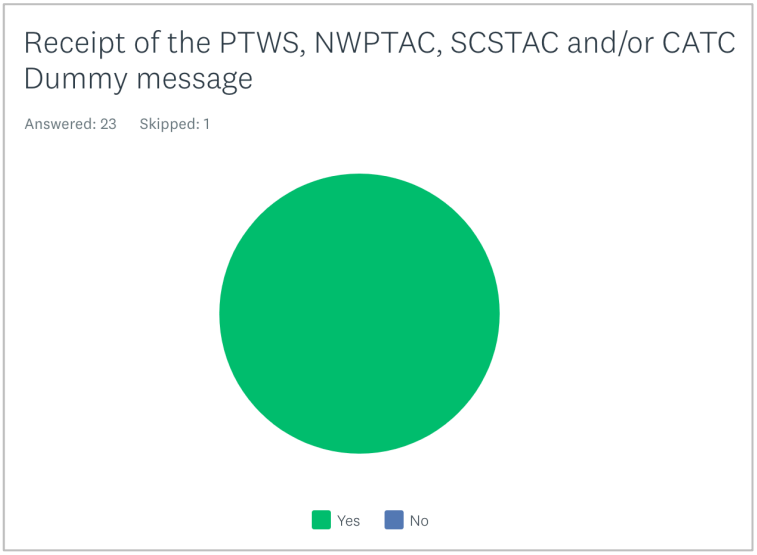



**Figure 1: Receipt of the Dummy message (text product).**

*Summary:*

- *All respondents to this question indicated that the Dummy message was received.*

*Comments:*

- PTWC Test DUMMY Message for PacWave20 exercise was received at 0000 UTC NOV 5 2020 (Chile).
- Message was well received. (Fiji)
- Satisfied (Cook Islands)
- The mail was received with a delay of 2 minutes (El Salvador)
- Received by email on Thursday, 5 November 2020 1:01pm NZDT (New Zealand)
- All the TWFPs in New Caledonia have received the message (France N-CWF)

*Summary:*

- PTWC, NWPTAC, SCSTAC messages were received in a timely manner.
- A few countries reported large delays for unknown reasons.
- One country who completed the evaluation did not report when the dummy message was received.

### 1.2 If yes, please select which Tsunami Service Provider you received the Exercise Dummy message from:

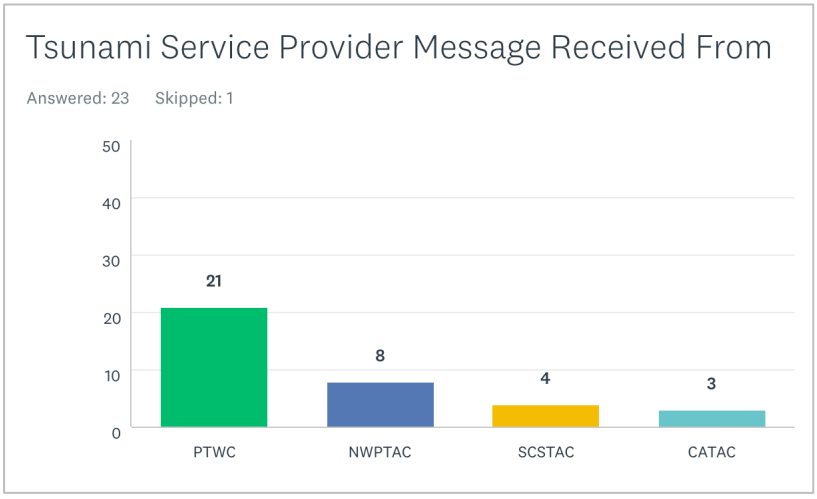



**Figure 2: Where the Dummy tsunami message was received from**

*Comments:*

- Test message for PacWave20 exercise was received at 0000 UTC Wednesday Nov 5 2020 (Chile).
- All good (Cook Islands).
- ptwc@ptwc.noaa.gov (New Zealand).

**1.3 If you received an Exercise Dummy message, when did you receive the message(s)? Please state the time in UTC:**
*Received time of dummy message sent on 5 November 2020*
*Inconsistent responses marked by **

| Country | Received Time |
|---|---|
| Australia | 00:00:14 (GTS); 00:00:26 (GTS); 00:01:00 (email) (PTWC)<br>00:00:12 (GTS) UTC (NWPTAC) |
| Chile | 00:00 UTC Wednesday Nov 5 2020 |
| China | 00:00:43 UTC (PTWC)<br>00:00:09 UTC (NWPTAC) |
| China, Hong Kong | 00:02 UTC (PTWC)<br>00:00 UTC (NWPTAC)<br>00:01 UTC (SCSTAC) |
| Colombia | 00:02 UTC (PTWC) |
| Cook Islands | 00:00Z wed 5 Nov 2020 (PTWC) |
| Costa Rica | 00:01 (PTWC)<br>00:58 (CATAC) * |
| Ecuador | 12:06 UTC (PTWC) * |
| El Salvador | 16:02 UTC (CATAC) * |
| Fiji | 22:31 November 3rd 2020 UTC (PTWC) * |
| France - French Polynesia | 05/11/2020 00:00 UTC (NWPTAC) |
| France - New Caledonia | Nov 5 2020, 00:01 UTC (PTWC) |
| Japan | 00:00 UTC (PTWC)<br>00:00 UTC (SCSTAC) |
| Republic of Korea | 2020.11.05. 00:01:54 UTC (PTWC)<br>2020.11.05. 00:00:36 UTC (NWPTAC) |
| Malaysia | 00:03 UTC (PTWC)<br>00:00 UTC (NWPTAC)<br>00:01 UTC (SCSTA) |
| Marshall Islands | 05 Nov 2020 00:01 (PTWC) |
| Mexico | 18:01 UTC (PTWC) |
| New Zealand | 00:01 UTC 5 Nov 2020 (12:01am)(PTWC) |
| Nicaragua | 00:00 UTC (PTWC)<br>00:00 UTC (CATAC) |
| Palau | Email: 00:01Z Fax: 09:13Z (PTWC)<br>Email: 00:00Z Fax: 09:09Z (NWPTAC) |
| Philippines | Nov 5, 2020 – 00:01Z (PTWC)<br>Nov 5, 2020 – 00:00Z (NWPTAC)<br>Nov 5, 2020 – 00:01Z (SCSTAC) |
| Russia | 00:00/00:08 UTC (PTWC)<br>00:00/00:03 UTC (NWPTAC) |
| Tuvalu | First Tuesday of the month (PTWC) * |
| Vanuatu | 00:01 UTC (PTWC) |

### 1.4 How did you receive the message(s)? Please tick methods.

*Summary:*

- One hundred percent of the countries reported they received the message by email.
- GTS was the next most common form of receipt (35%).
- Other methods of receipt include Fax and AFTN.

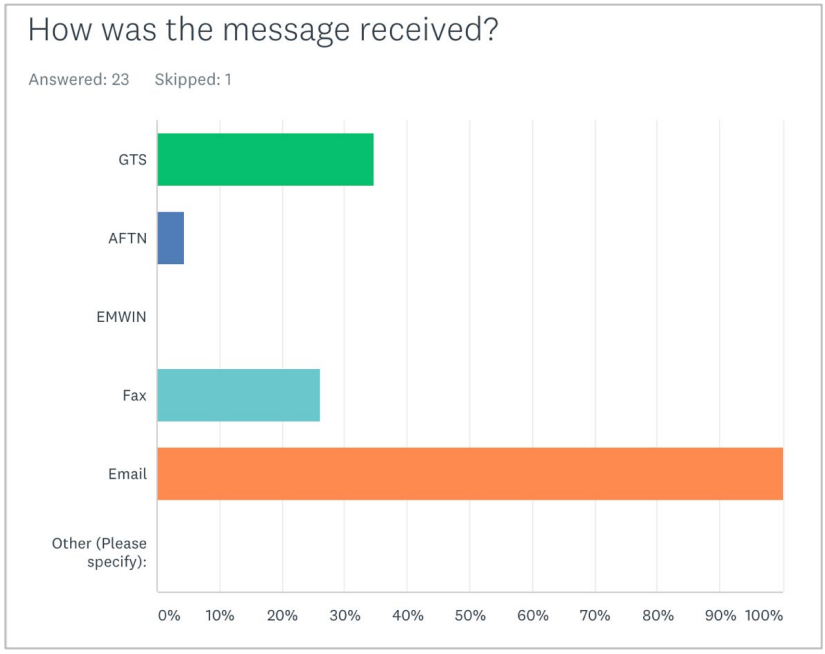



**Figure 3: Methods of receiving the PTWC Dummy message (more than one option could be chosen).**

### Objective 1 Comments

- Communication Test from PTWC to Chile was successfully received at 0000 UTC Wednesday Nov 5 2020 (Chile).
- 1. There were no failures when receiving messages. 2. The quality of the messages received is satisfactory (FEERC, Russia Federation).
- Fax and Email - PTWC, Email and GTS - NWPTAC, GTS – SCSTAC (Malaysia).
- Test communications from PTWC to Fiji NTWC was successful. (Fiji).
- Well achieved this objective 1. This is the only scope in Australia for taking part in the PacWave20. so no answer will be provided to subsequent survey question (Australia).
- All good (Cook Islands).
- We were able to receive the dummy messages through our official email at almost the same time. However, we failed to receive it from our telefax due to the changes in the telefax numbers from (+632) 9271087 to (+632) 89271087 - Data Receiving Center and from (+632) 89298366 to (+632) 89298366 -- Office of the Director (Philippines).

- Swift and precise delivery of messages from PTWC and other regional centers has been confirmed (Japan).
- The objective has been reached (French Polynesia).
- The email communication test worked, only it had a delay of 2 minutes (El Salvador).

***Objective 2: To test national communication and cooperation, and readiness within the country.***

**Objective 2a: *To test national communication and cooperation within the country.***

*Objective 2a was answered by 11 respondents*

### 2.1 The warning was disseminated to?

*Summary:*

The majority of participants in the exercise disseminated the warning message to emergency services (82%) and other national government agencies (64%). Only 18% provided the warning message to the public as part of the exercise. Other agencies the warning message was shared with were science agencies/universities involved in assessment (27%), local government – provincial/regional level (55%), and local government – city/district level (45%).

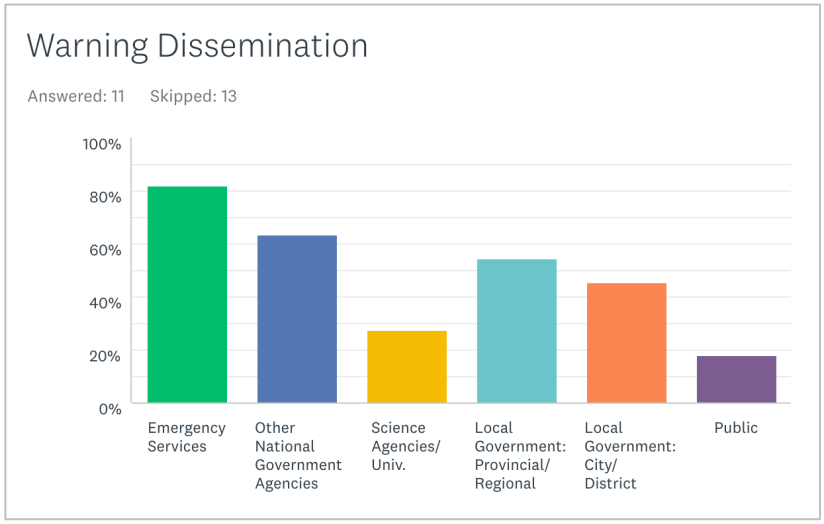



**Figure 4: Where the warning was disseminated to.**

*Destinations*

- SHOA took part as Technical organism in charge of evaluating the Tsunami Threat and the National Emergency Management Agency (ONEMI) as public Agency in charge of communicating the Threat Assessment to the general public. The latter participated for the first time in a regional exercise to increase the familiarization of their on-duty staff with PTWC products and text messages (Chile).
- CNE called SINAMOT but there were no further actions (Costa Rica).
- The warning was not disseminated to Emergency services (Ecuador).
- NDMO, Media, Police (Tuvalu).

- 16 / 14 (FSRH/FEERC, Russia).
- National Disaster Management office (NDMO)  NDMO disaster clusters  Port Vila Land Transport Emergency  Vanuatu Red Cross Society  Radio stations (Vanuatu).
- No dissemination (Malaysia).
- 7 main  contacts (Fiji).
- None (Japan).
- French Polynesia NDMO (French Polynesia).
- Only with the other dependencies of the institution, since the exercise was internal (El Salvador).
- TWFP in New Caledonia (and Wallis & Futuna) include :  -Emergency services (Civil Defense and Maritime Rescue coordination Center)  -Science agencies involved (IRD) (France N-CWF).

**2.2 What time was the warning sent to the agency or agencies or public listed in the previous question?**

*Summary:*

Due to the large time period allowed for PacWave20 to be held within, the times the warning messages were distributed vary greatly among the countries who participated in the exercise.

| Country | Time Warning Sent |
|---|---|
| Russia | 5 November, 00:02 UTC (FSRH) / 00:04 UTC (FEERC) |
| French Polynesia | Exercise began 12 November at 18:14 UTC, first warning sent to NDMO at 18:30 UTC. |
| Colombia | 22 October 12:10 UTC |
| Chile | October 22nd at 12:06 UTC |
| Fiji | 4 November, 21:10 UTC |
| El Salvador | 11 November, 16:06 UTC |
| Korea | 25 November 06:01 UTC |
| Vanuatu | 04 November 23:05 UTC |
| Hong Kong, China | 5 November 02:08 UTC |
| Mexico | 5 November 01:00 UTC |

*Comments:*

- N/A (Costa Rica).

**2.3 How did you send the warning to emergency, national, science, and local government agencies?**

*Summary:*

The majority of participants in the exercise disseminated the warning message to emergency, national, science, and local government agencies by email (58%) or by SMS (50)%. Fax and Radio were used too (33%). Other methods of dissemination (not listed in the survey, see few comments) were chosen by respondents (42%).

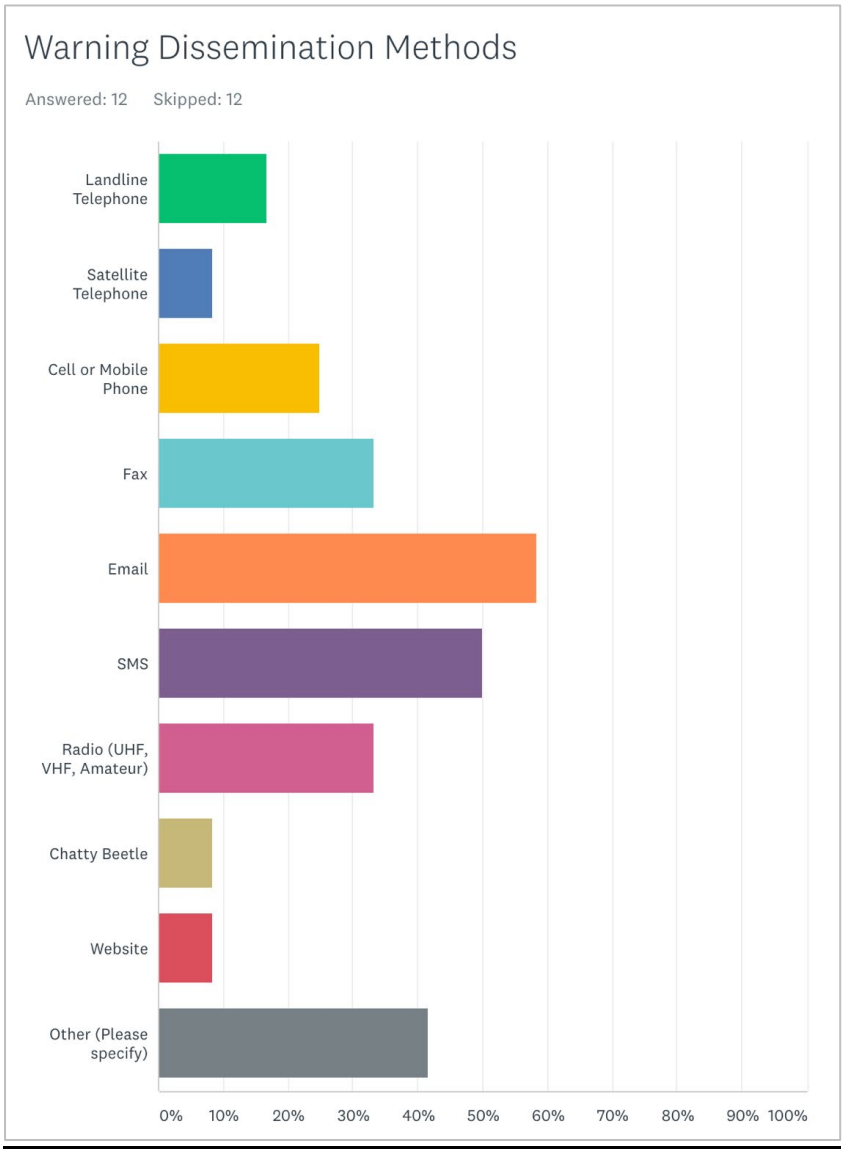



**Figure 5: How the warning was disseminated to emergency, national, science and local government agencies.**

*Comments*

- Web based chat portal (Chile).
- Hardcopies dispatch to NDMO, Police & Media (Tuvalu).
- GTS (Russia).
- N/A (Malaysia).
- VHF radio link has been tested (French Polynesia).

## 2.4 How did you send the warning to the public?

*Summary:*

Compared with how the warning message was disseminated to agencies, other methods of dissemination (as wechat and a microblog) were chosen by respondents (55%) but the majority wanted to indicate that the warning was not disseminated to the public as part of their exercise. Website and email were the second option by countries (27%) and sirens (18%), radio (18%), SMS (18%), cell or mobile phone (18%), and Police (18%) were also used during the PacWave20.

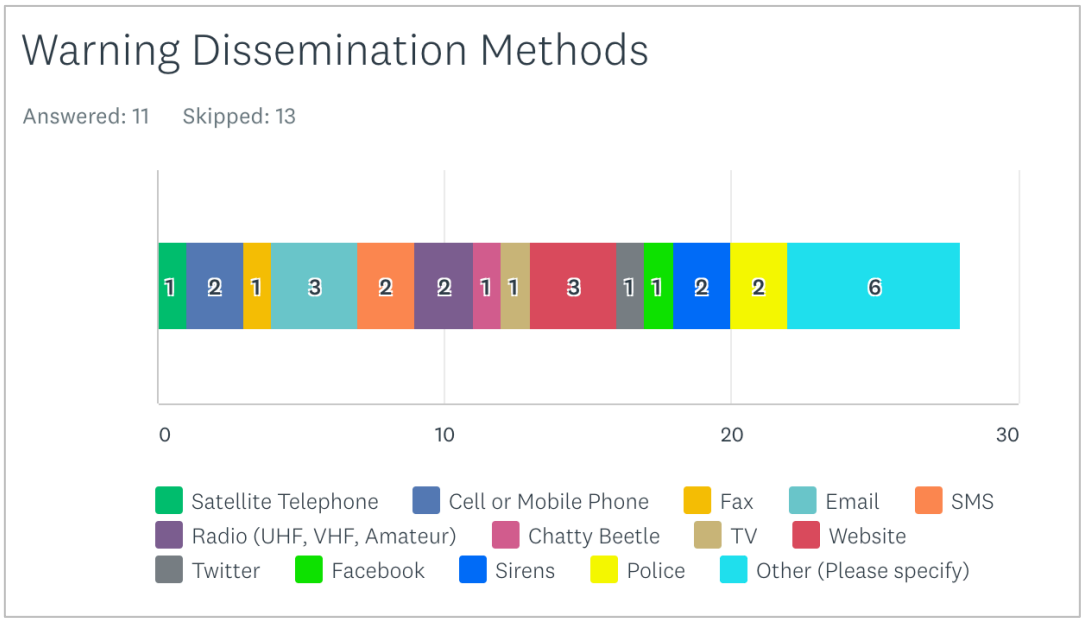



**Figure 6: How the warning was sent to the public.**

*Comments*

- No way (FEERC, Russia).
- wechat, microblog (Hong Kong, China).
- N/A (Malaysia).
- Public not involved in PACWAVE exercise (French Polynesia).
- Doesn't apply (Mexico).
- This message didn´t send to the public o community (Colombia).

### 2.5 Based on feedback from agencies, were the communication methods timely and appropriate?

*Summary:*

The majority of exercise participants (91%) considered that the communication methods used during the exercise were timely and appropriate.

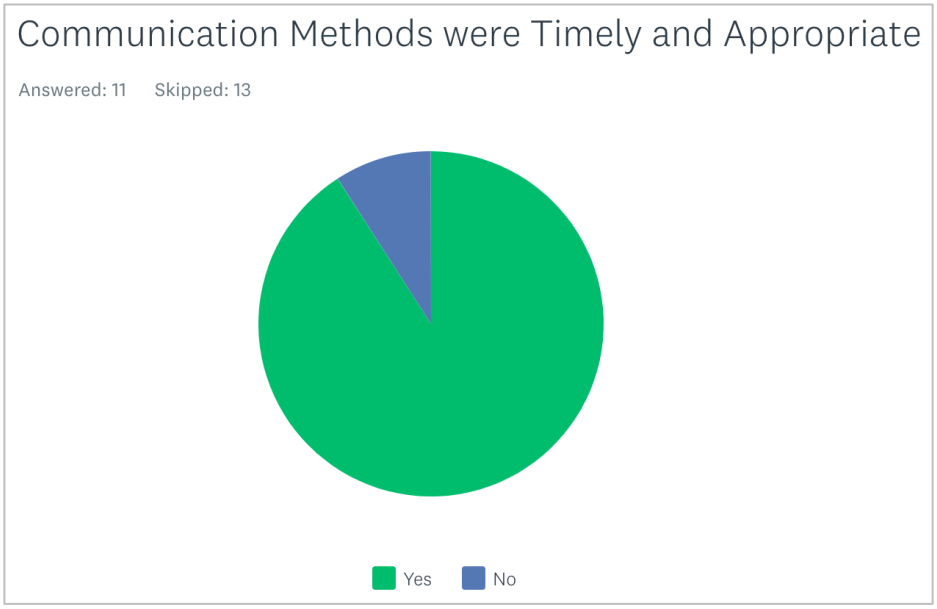



**Figure 7: Communication methods were timely and appropriate.**

### 2.6 Based on feedback from agencies, were the message(s) disseminated from the NTWC/NDMO accurate and clear?

*Summary:*

All the respondents (100%) considered that the messages disseminated from the NTWC/NDMO were accurate and clear.

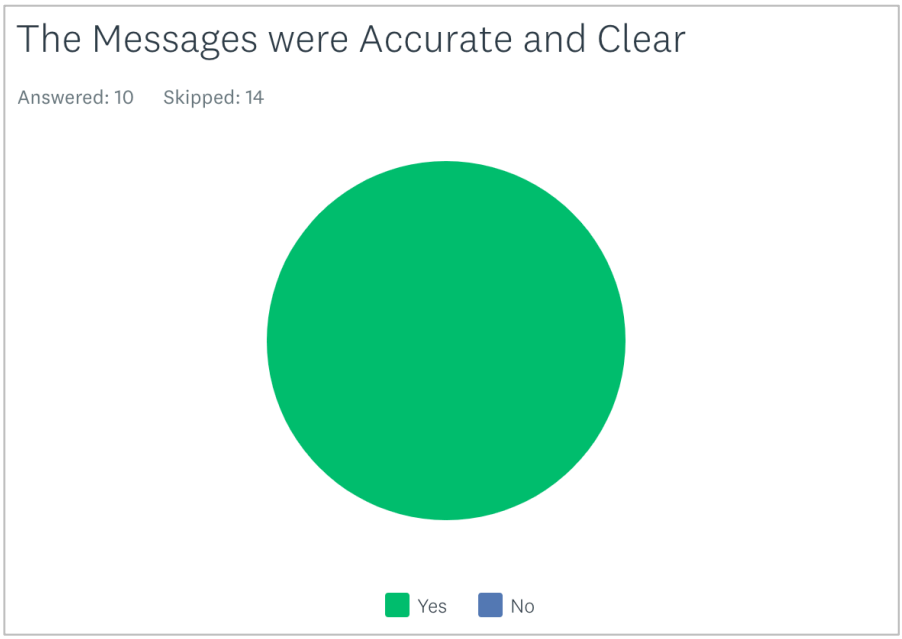



**Figure 8: Messages disseminated from the NTWC/NDMO were accurate and clear.**

### 2.7 Did the National Disaster Management Organisation (or equivalent) maintain communication with the National Tsunami Warning Centre throughout the event?

*Summary:*

Around 80% of respondents agreed that the NDMO maintained communication with the NTWC throughout the exercise. Two participating countries disagreed with this.

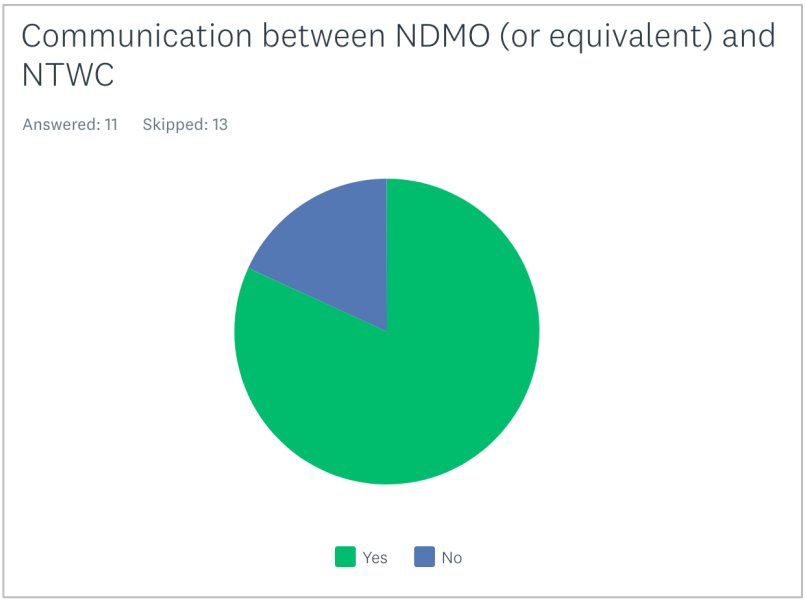



**Figure 9: The NDMO maintained communication with the NTWC throughout the event.**

*Comments*

- Within the framework of this exercise, communications were tested only between member states of GT-ATPS (Chile).
- There was no external participation during the exercise (Ecuador).
- Via VHF walkie talkie (Tuvalu).
- N/A - No dissemination (Malaysia).
- it was not involved the national disaster management organisation in the drill (El Salvador).
- No communication outside of TWFPs was conducted. Communication tests between Civil Defense (one of the main TWFP) and other organisations is conducted on a regular basis for other occasions or exercises. Civil Defense plays both the role of NDMO and NTWC (France N-CWF).

**2.8 If you answered yes to Q2.7, what was the nature of the communication between the National Disaster Management Organisation (or equivalent) with the National Tsunami Warning Centre throughout the event?**

The following comments were received from countries in this section:

- Via VHF walkie talkie (Tuvalu).

- Communication within standard operating procedures (FSRH, Russia) Operational interaction (exchange of messages and information) (FEERC, Russia).

- Communication between 2 independent agencies. NTWC is responsible for making and disseminating tsunami warning message, NDMO is responsible for implementation of mitigation actions (NMEFC) (China).

- A call is made to inform the national disaster management director about NTWC information of Tsunami that was sent (Vanuatu).

- Level of warning; Arrival time of waves along Fiji coastline; Estimated wave amplitude (Fiji).

- National tsunami forecast products and further explanation provided by CPPT were tested all along the exercise by phone, mail and fax (French Polynesia).

- Only telephone communication (Mexico).

- The nature of the communication was technical (Colombia).

- NA (France N-CWF).

**Objective 2a Comments**

The following comments were received from countries in this section:

- There were no problems with interaction with national organizations. (FEERC, Russia)

- Objective 2 was not tested during PacWave 2020 (Hong Kong, China).

- Vanuatu Tsunami Warning Centre(VTWC) did not followed the test message that PacWave20 sent on the 5th of Nov 2020, but during that day VTWC organize a tsunami drill on the island of Ifira and offshore areas just near the Port Vila. Therefore we disseminated our tsunami advisory on the 5th of November but at a different time as stated above on Q2.2. (Vanuatu).

- The national communication and cooperation within the country was well coordinated according to warning and response SOP (Fiji).

- No communication outside of TWFPs was conducted. Communication tests between Civil Defense (one of the main TWFP) and other organisations is conducted on a regular basis for other occasions or exercises (France N-CWF).

**Objective 2b:** ***To test national readiness within the country.***

*Objective 2b was answered by 17 respondents*

**2.9 The NTWC/NDMO has an activation and response process (standard operating procedures) in place for the receipt of tsunami warnings.**

*Summary:*

94% of respondents to this question agreed that activation and response procedures are in place.

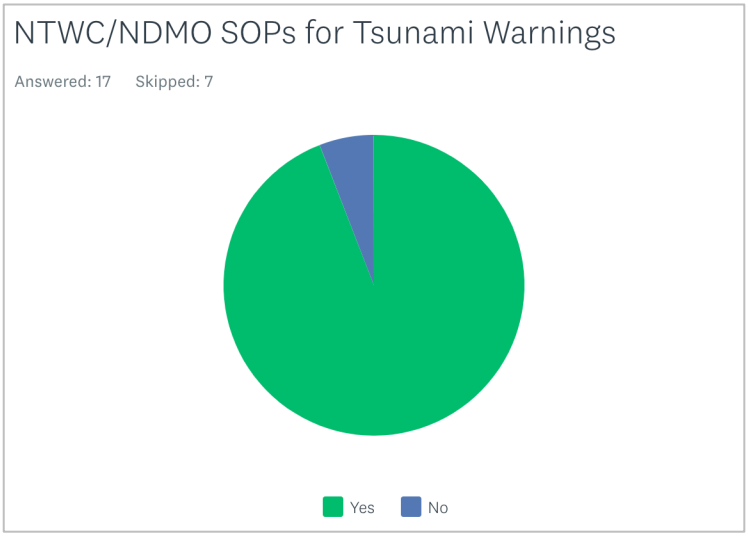



**Figure 10: The NTWC/NDMO has an activation and response process (standard operating procedures) in place for the receipt of tsunami warnings.**

## 2.10 The NTWC/NDMO knows its specific response role in the event of a tsunami.

*Summary:*

94% percent of respondents agreed that the NTWC/NDMO knows its response role in the event of a tsunami.

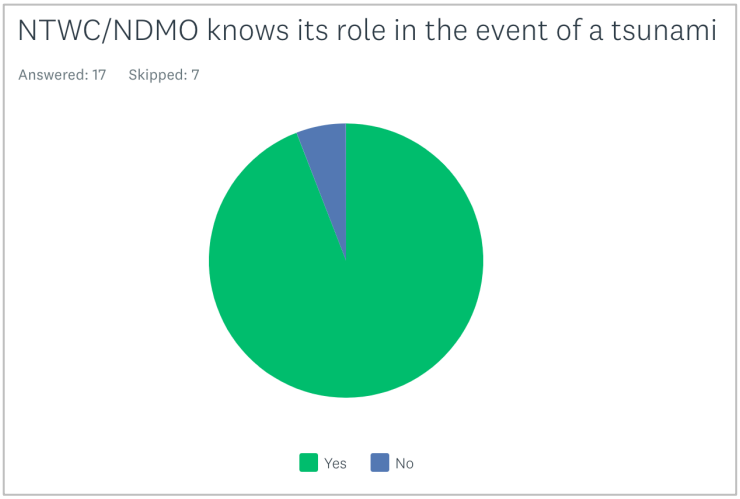



**Figure 11: The NTWC/NDMO knows its specific response role in the event of a tsunami.**

## 2.11 The NTWC/NDMO has, prior to the exercise, engaged in tsunami response planning.

*Summary:*

94% of respondents agreed that the NTWC/NDMO has engaged in prior tsunami response planning.

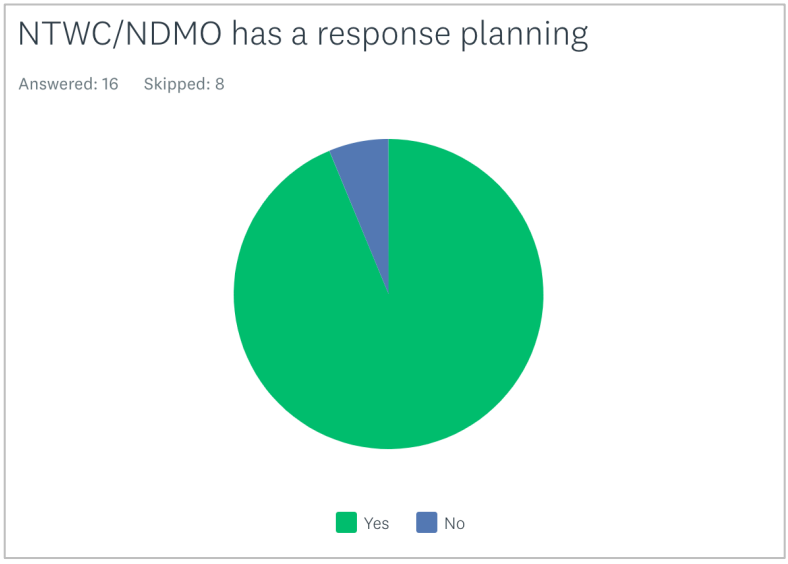



**Figure 12: The NTWC/NDMO has, prior to the exercise, engaged in tsunami response planning.**

### 2.12 The NTWC/NDMO has undertaken activities to increase its capacity and capability to support a national tsunami response (for example, training, exercise, etc.)

*Summary:*

All respondents agreed that regular capacity and capability building exercises are undertaken to support a national tsunami response. Topics identified were procedures, Communication tests, use of drills and exercises

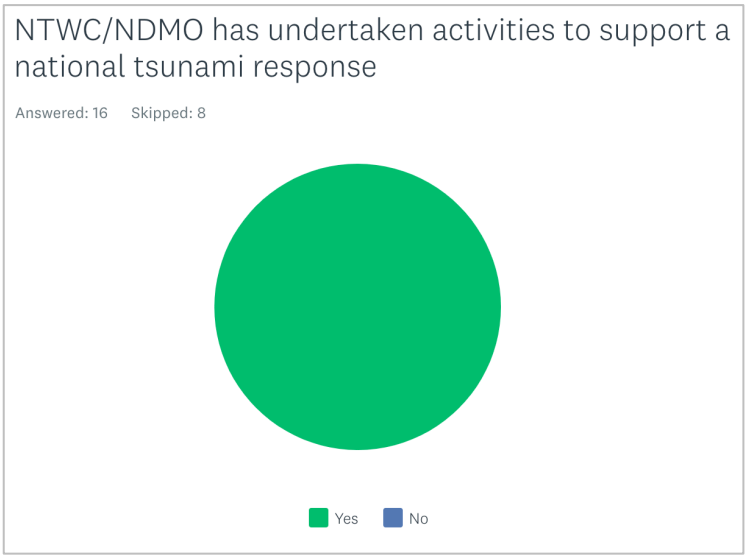



**Figure 12: The NTWC/NDMO has undertaken activities to increase its capacity and capability to support a national tsunami response**

*Countries detailed the following activities have taken place:*

- During 2020 NTWC (SHOA) and NDMO (ONEMI) carried out three exercises, involving close and far field events (Chile).

- Training for personnel of risk management agencies - Exercises – Drills (Ecuador).

- Refresh SOPs trainings (Tuvalu).
- Weekly communication tests, local trainings several times a year (FSRH) / Updating the rules of procedure (FEERC, Russia).
- communication test (HKO) - 2011,2017&2020 National Tsunami Exercise (NMEFC) (Hong Kong, China).
- Awareness campaign was done annually except this year (Malaysia).
- Tsunami drills with schools, universities, communities and agencies. Community and schools awareness program (Fiji).
- Training, exercise at each levels (emergency staff, public, schools) (French Polynesia).
- Courses and National Tsunami Exercises (Mexico).
- 1. Workshop "Tsunami Preparedness and Response". 2. Exercise of tsunami "communication exercise" (Colombia).
- Tsunami ready exercises (El Salvador).
- Exercises and Evacuation/hazard mapping (France N-CWF).

### 2.13 The NTWC/NDMO has an appropriate management structure identified and documented to support tsunami response.

*Summary:*

94% of respondents agreed that appropriate management structures had been identified and documented in their countries to support a tsunami response.

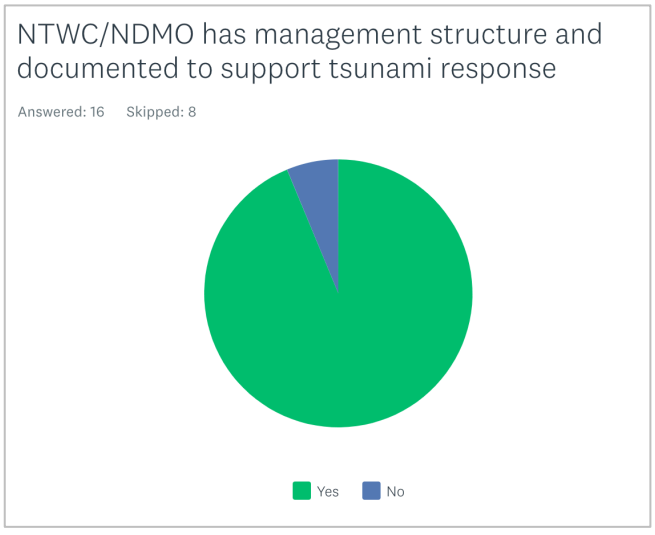



**Figure 14: The NTWC/NDMO has an appropriate management structure identified and documented to support tsunami response.**

### 2.14 The NTWC/NDMO has a tsunami mass coastal evacuation plan.

*Summary:*

60% of respondents indicated that their country has a tsunami mass coastal evacuation plan.

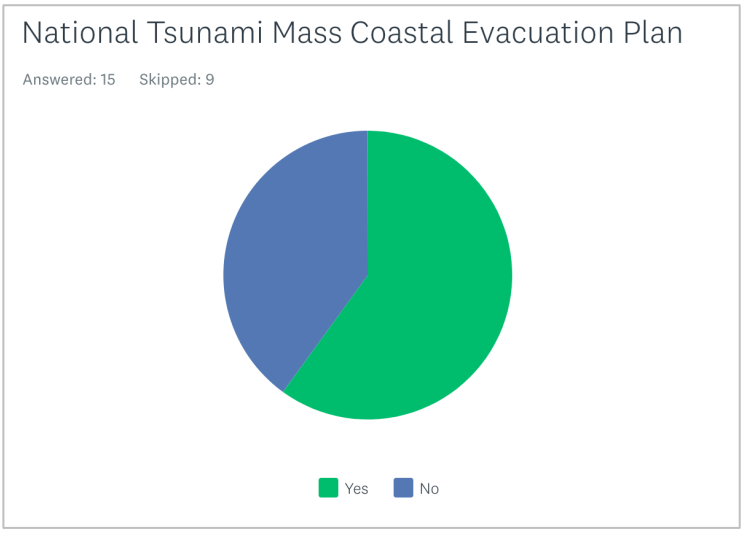



**Figure 15: The NTWC/NDMO has a national tsunami mass coastal evacuation plan.**

### 2.15 Arrangements to assemble the in-country disaster management group relevant to decision-making on tsunami warning and response were in place before the exercise.

*Summary:*

80% of respondents indicated that assembly arrangements were in place for their country's disaster management group. Three respondents indicated that these arrangements were not in place.

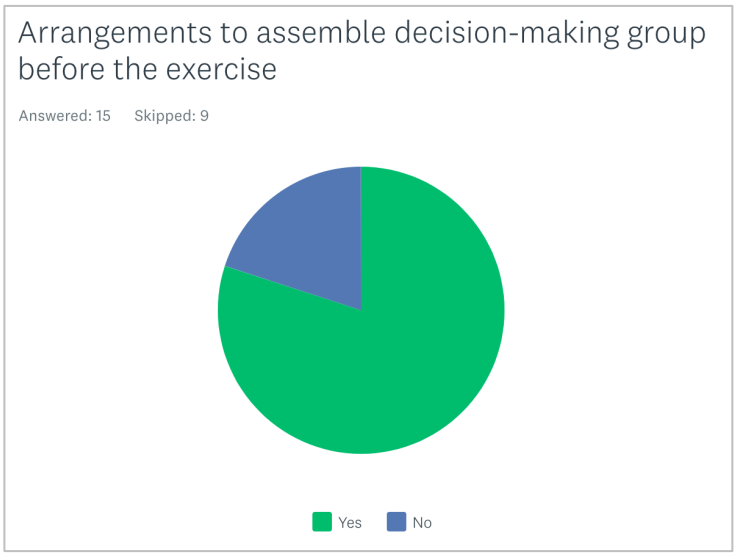



**Figure 16: Arrangements to assemble the in-country disaster management group relevant to decision-making on tsunami warning and response were in place before the exercise.**

### 2.16 A country tsunami emergency response plan (standard operating procedures) for tsunamis exists.

*Summary:*

80% of respondents indicated that they have a country tsunami emergency response plan in place for a distant tsunami, all respondents indicated that they have plans in place for a regional tsunami, and 73% of them indicated that have a plan in place for a local tsunami.

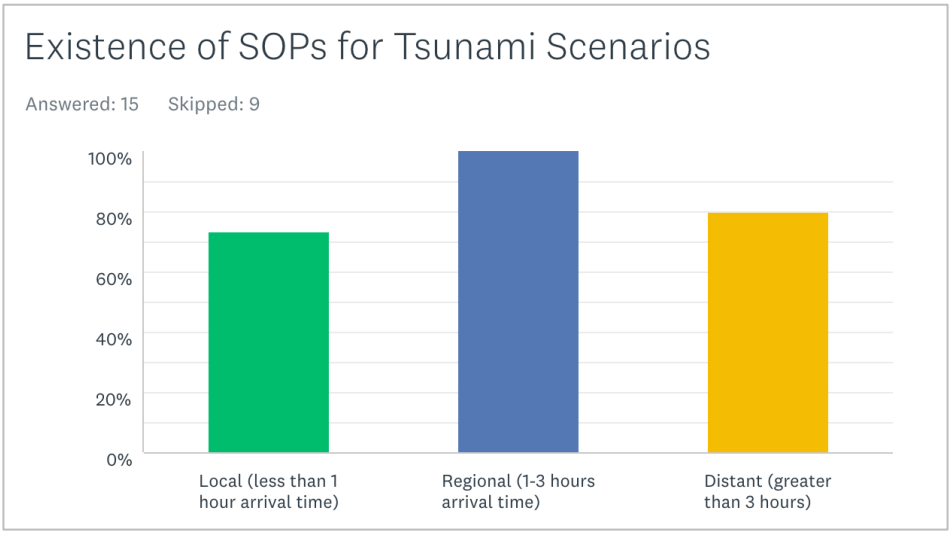



**Figure 17: A country tsunami emergency response plan (standard operating procedures) for tsunamis exists.**

## 2.17 The response plan includes processes to issue Safe-to-Return (All-Clear) notices?

*Summary:*

93% of respondents indicated that their tsunami emergency response plan includes processes to issue Safe-to-Return (All Clear) notices.

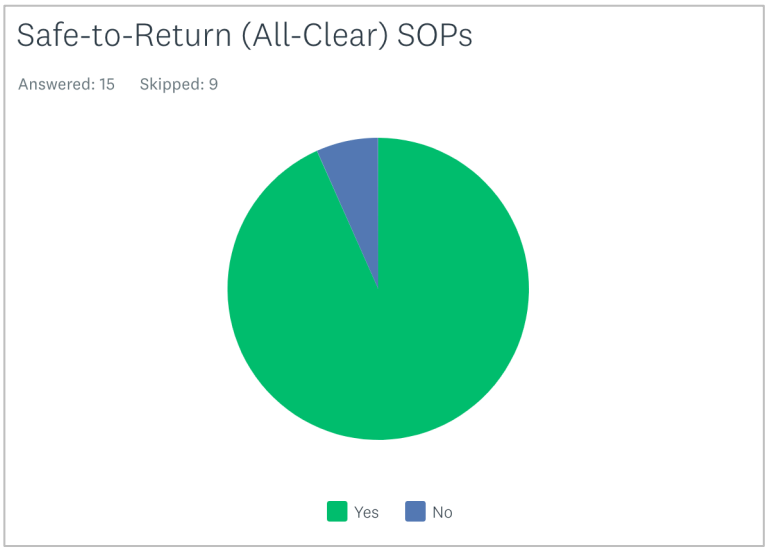



**Figure 18: The country tsunami emergency response plan includes processes to issue Safe-to-Return (All Clear) notices.**

## 2.18 Tsunami exercises are routinely conducted in-country.

*Summary:*

86% of respondents indicated that conduct exercises routinely. Two respondents do not conduct regular exercises.

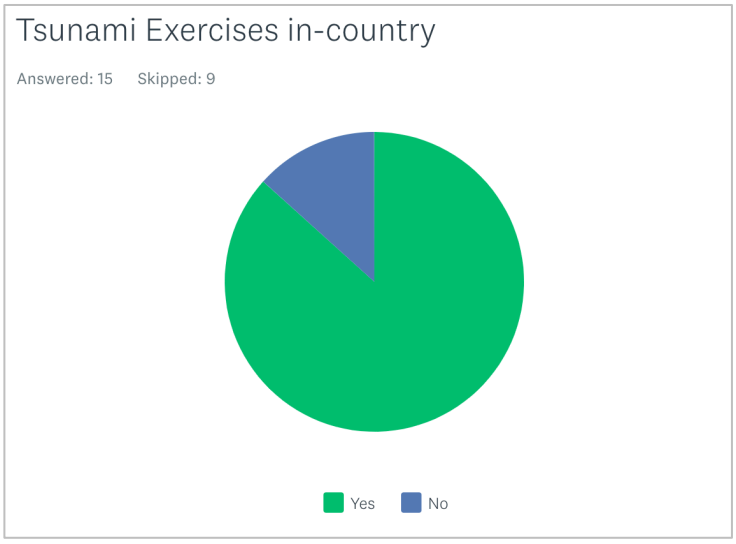



**Figure 19: Tsunami exercises are routinely conducted in-country.**

*Last Tsunami Exercises*

- September 3rd 2020, regional scenario with epicenter located in Tonga (Chile).
- National Earthquake Drill, 11 August 2021, local scenario (Costa Rica).
- Local and regional exercise in 2019 (FSRH, Russia) regional (FEERC, Russia).
- PacWave 18 based on a regional exercise scenario (Hong Kong, China).
- Luganville Tsunami Drill on the 18th on December 2020, scenario a local earthquake of 7.5 magnitude at a depth of 30km (Vanuatu).
- Tsunami Drill 2019 in Penang on 27 July 2019 (Malaysia).
- Full functional exercise using regional scenario (Fiji).
- National Earthquake and Tsunami Exercise Frequency: every other month Type of exercise: local, regional, distant (Japan).
- Present regional scenario : North Tonga magnitude Mw 9.2 Last exercise : Tonga earthquake magnitude Mw 8.8 (French Polynesia).
- two national tsunami exercises and one distant (Mexico).
- two national tsunami exercises and one distant (Colombia).
- Regional Scenario, Tonga Trench (France N-CWF).

### 2.19 Tsunami-related public education and awareness materials have been developed and disseminated?

*Summary:*

93% have developed and disseminated tsunami-related public education and awareness materials.

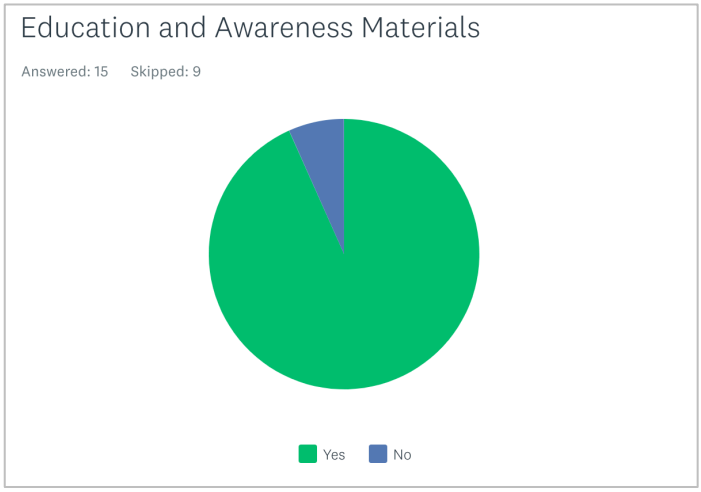



**Figure 20: Tsunami-related public education and awareness materials have been developed and disseminated.**

### 2.20 Tsunami-related curriculum programmes are in place for all levels (pre, primary, secondary, post-secondary) of education.

*Summary:*

Participant responses to this question were split, with only 33% countries indicating that tsunami curriculum programmes are in place for all levels of education, and 67% do not have this tsunami-related curriculum programmes.

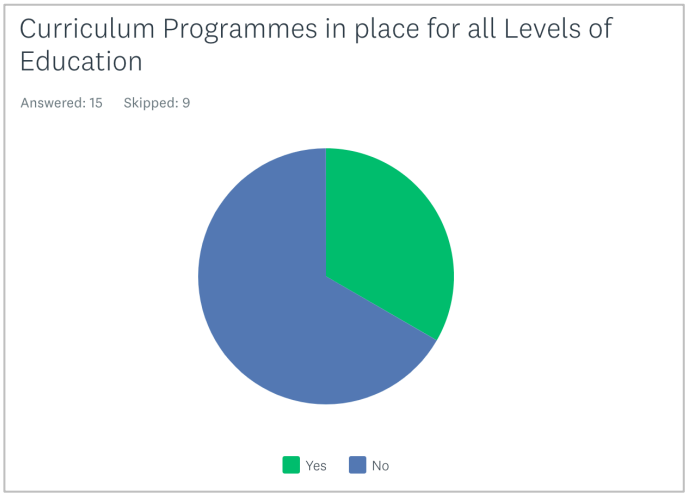



**Figure 21: Tsunami-related curriculum programmes are in place for all levels of education.**

*Comments*

- None (Costa Rica).

- All levels (Tuvalu).
- NMEFC (China) said Yes and HKO (China) said NO: General public through HKO website
- Community-level under National Disaster Management (NADMA) Malaysia (Malaysia).
- Primary, Secondary and Post Secondary (Fiji).
- Global programmes readable also by secondary level of education and post secondary (French Polynesia).
- Colombia have only awareness materials (Colombia).
- Not yet complete (France N-CWF).

### 2.21 All tsunami-vulnerable communities have tsunami evacuation maps, signage and assembly points for evacuation?

*Summary:*

Only 27% of participants indicated that tsunami evacuation routes and maps are available for all tsunami-vulnerable communities.

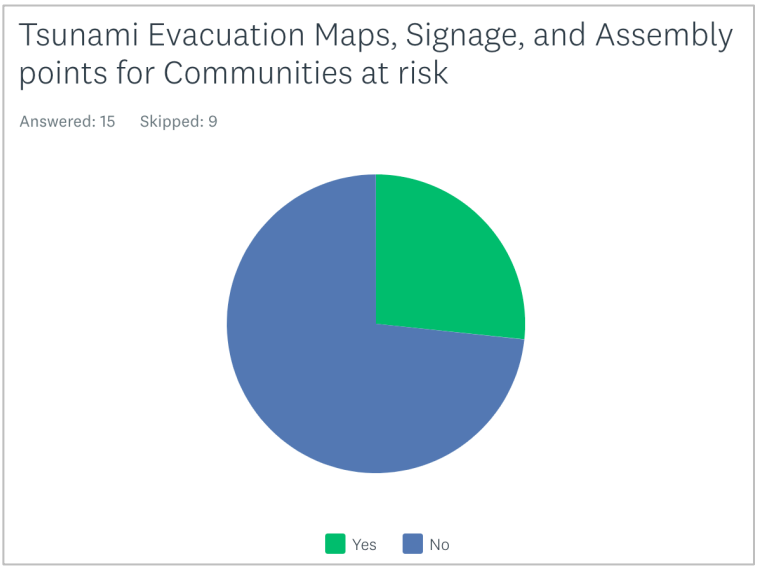



**Figure 22: Tsunami-vulnerable communities have tsunami evacuation maps, routes, evacuation signs and assembly points for evacuation areas.**

*Comments*

- 66 areas have Tsunami inundation maps that span across several communities, plans are to increase that number with 10 new maps for the period 2021-2022. Evacuation maps, signage and assembly points are undertaken by local governments and NDMO, covering most of the coast (Chile).

- 41 communities in the Pacific have tsunami evacuation maps, the list can be seen in https://www.sinamot.una.ac.cr/index.php/descargas/category/1-mapas-de-evacuacion-por-tsunami (Costa Rica).

- 19 communities with maps (20%), the gaps is 80% (Ecuador).

- None except main Government Building, Primary Schools, Secondary Schools have assembly zones (Tuvalu).

- In this densely populated city with many high rise buildings, announcement of vertical evacuation would be made (HKO, China). Tsunami inundation risk assessments have been completed for dozens of coastal cities or counties (NMEFC, China).

- Not all tsunami vulnerable communities in Vanuatu have tsunami evacuation maps and signage, only our two town areas that we have work on. We still have many more area to work with since most of the communities live near the coast (Vanuatu).

- In terms of percentage, we have approximately 0.5% communities covered (Fiji).

- Four municipalities in Tahiti and Bora Bora island have evacuation maps and signage, the others are preparing their evacuation plans (French Polynesia).

- Only one state has maps and tsunami signs (Mexico).

- 1. Guapi. 2. Tumaco. 3. Buenaventura. 4. Bahía Solano. 5. Juanchaco. 6. Curay. 7. Salahonda (Colombia).

- Only the coastal area of La Libertad have a map  It's necessary to work with the other coastal areas (El Salvador).

- Not yet (France N-CWF).

## 2.22 What type of exercise did you conduct?

*Summary:*

Most participants conducted either a table top or drills for PacWave20. Four countries carried out functional exercises and one participant undertook a full scale exercise.

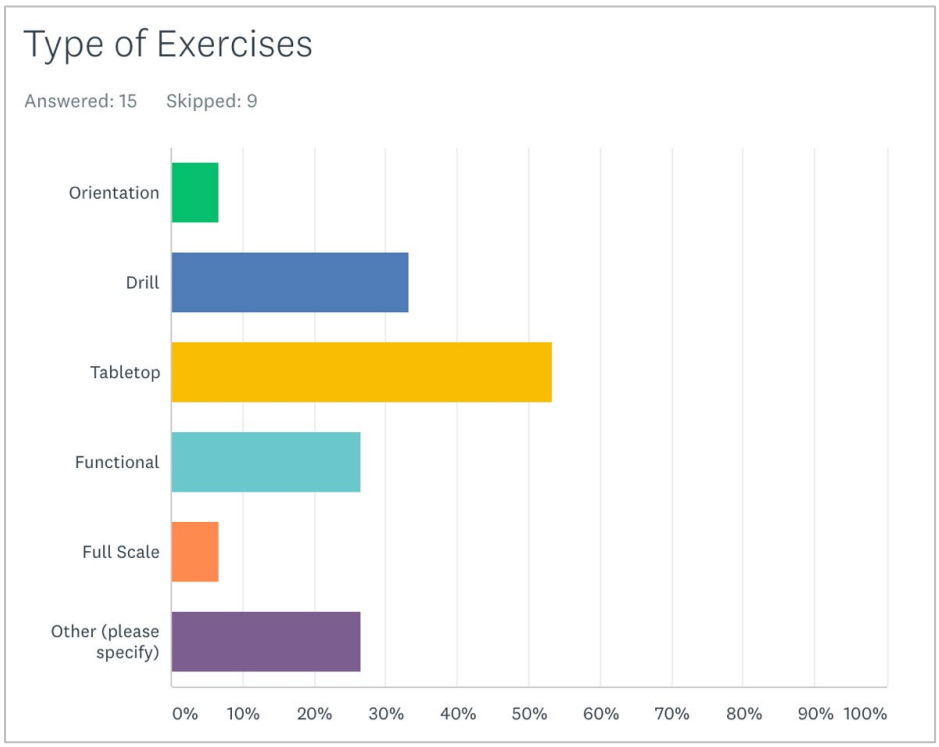



**Figure 23: Type of exercise conducted.**

*Comments*

- Communication test (Costa Rica).
- Communication test (Hong Kong, China).
- Awareness in schools and communities (Vanuatu).
- Internally (Malaysia).

## 2.23 Did you conduct community evacuation? 37. What type?

*Summary:*

Only 13% of respondents undertook community evacuation as part of their exercise. The most common reason for this low participation was the global situation and restrictions due to COVID-19.

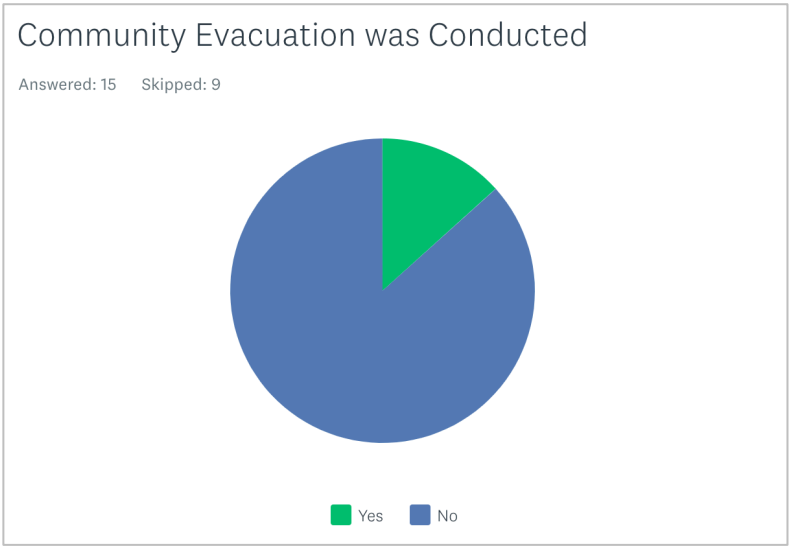



**Figure 24: Community evacuation conducted.**

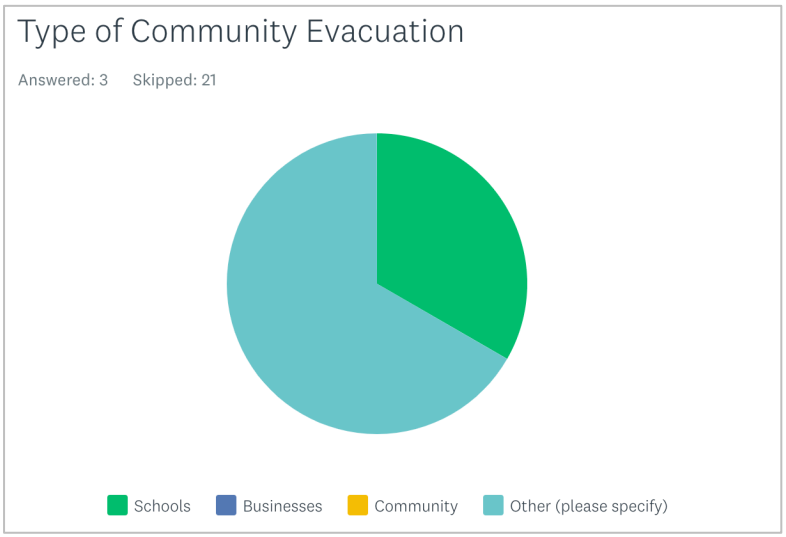



**Figure 25: Type of community evacuation.**

*Comments*

- Communities, schools, and businesses (Vanuatu).
- Schools (Fiji).
- Secondary school evacuation was cancelled because of COVID-19 (French Polynesia).

## 2.24 If you answered yes to Q2.23, approximately how many people were evacuated in total.

- Approximately 500 people evacuated in one of our drill (Vanuatu).
- 200 people (Fiji)

**OBJECTIVE 2b Comments.**

The following comments were received from countries in this section:

- No significant shortcomings have been identified (FEERC, Russia).
- Due to the pandemic, any activities that gather crowds are restricted (Malaysia).
- The national readiness within the country was tested. (Fiji).

## Objective 3: *To test regional communication and cooperation.*

Objective 3 was answered by 13 respondents

### 3.1 Did your country engage in communication and cooperation with other countries in the region for PacWave20?

*Summary:*

Few countries (4) engaged in communication and cooperation with other countries in the region for PacWave20.

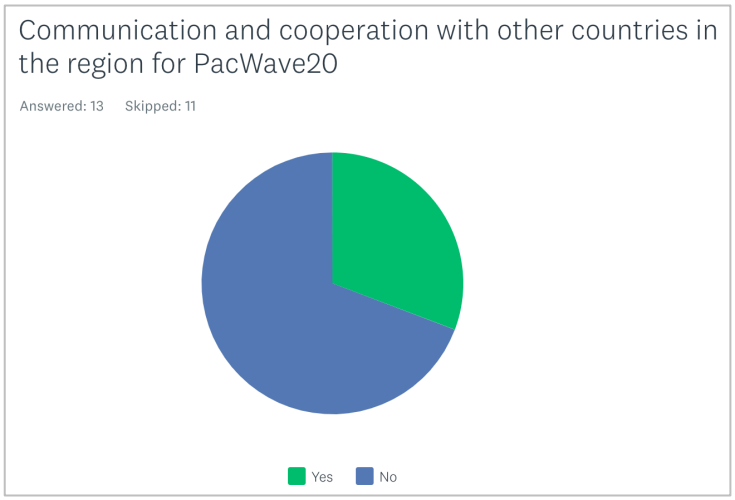



**Figure 36: Engagement in communication and cooperation with other countries in the region for PacWave20.**

*Comments*

- Chile, Perú, Ecuador and Colombia were involved in this exercise (Chile).
- Colombia, Peru y Chile (Ecuador).
- Brunei, Cambodia, Indonesia, Malaysia, Philippines, Singapore, Thailand, Vietnam (China).
- Ecuador, Chile and Peru (Colombia).

### 3.2 What types of cooperation were conducted?

*Summary:*

Of these participants who undertook regional communication and cooperation, the main activities were data sharing, event information sharing and joint PacWave20 exercise.

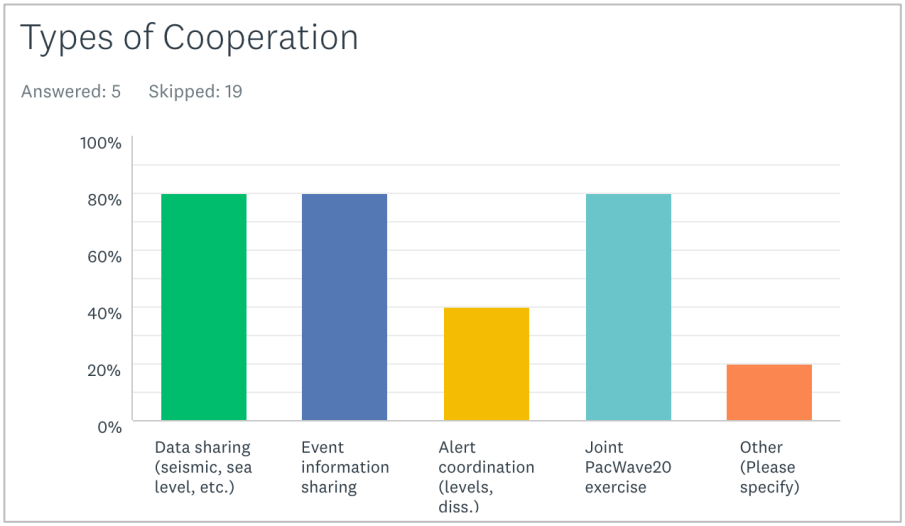



**Figure 27: Types of cooperation conducted.**

*Comments*

- New Caledonia is hosting the main ORSNET server (France N-CWF).

### 3.3 Did the National Tsunami Warning Centre communicate with other counties during the event?

*Summary:*

The majority of participants indicated that the National Tsunami Warning Centre did not communicate with other countries during the event (77%).

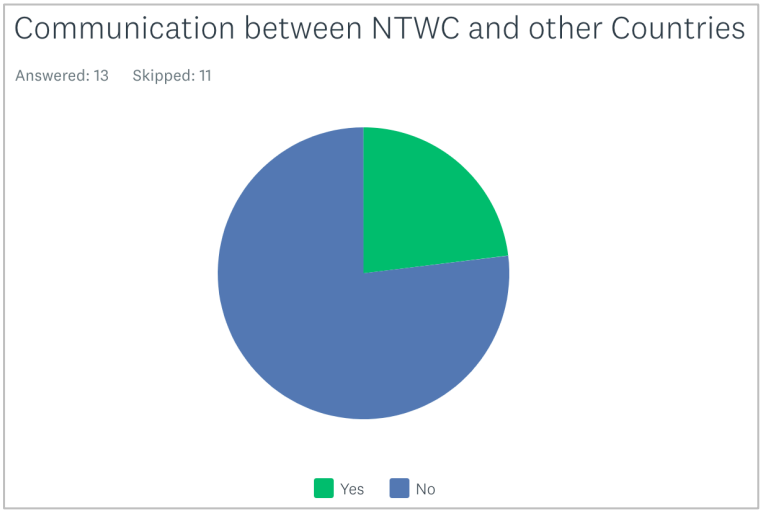



**Figure 28: Communication of the NTWC with other countries during the exercise.**

*Comments*

- Brunei, Cambodia, Indonesia, Malaysia, Philippines, Singapore, Thailand, Vietnam (China).
- Ecuador (INOCAR), Chile (SHOA) and Peru (DHN) (Colombia).

### 3.4 Did the National Disaster Management Agency communicate with other countries during the event?

*Summary:*

No participants indicated that the NDMO communicated with other countries during the event.

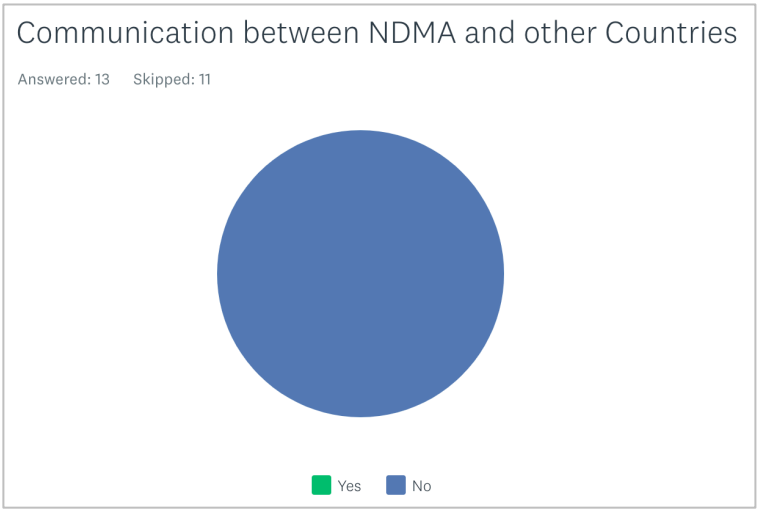



**Figure 29: Communication of the NDMO with other countries during the exercise.**

### 3.5 Was national information shared with other countries during the event?

*Summary:*

77% of respondents indicated no national information was shared with other countries during the exercise.

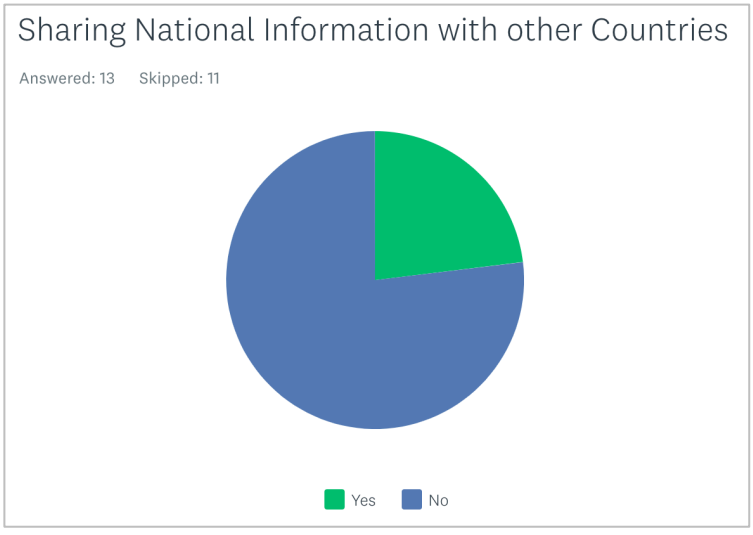



**Figure 30:** Sharing of national information with other countries.

*Comments*

- Brunei, Cambodia, Indonesia, Malaysia, Philippines, Singapore, Thailand, Vietnam (China).
- Ecuador (INOCAR), Chile (SHOA) and Peru (DHN) (Colombia).

### 3.6 What type of national information did you share?

*Summary:*

Of those participants who shared national information, the only type of information not shared were tsunami evacuation and tsunami impact.

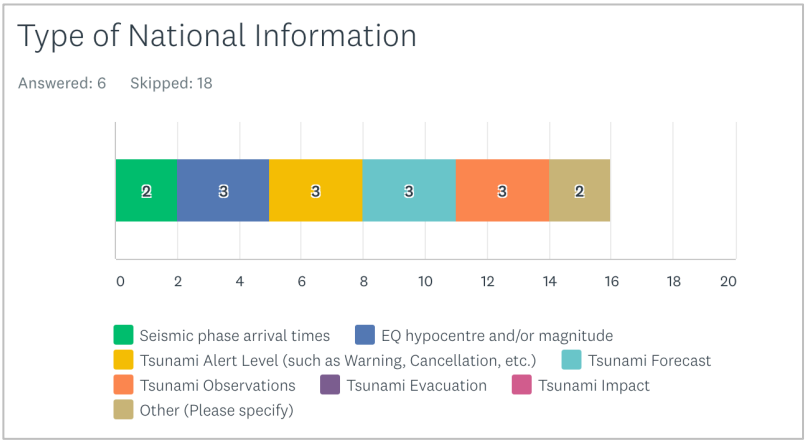



**Figure 41: Types of national information shared.**

### 3.7 How did you communicate the information?

*Summary:*

Email was the primary method of communication with other countries.

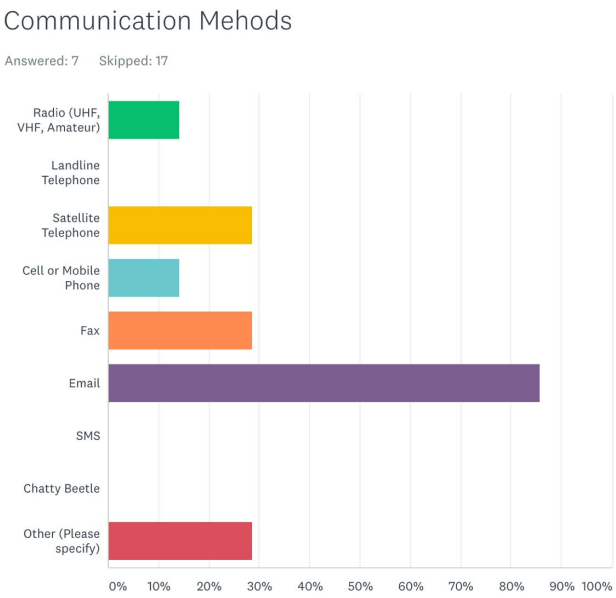



**Figure 32: Methods of communication.**

**OBJECTIVE 3 Comments.**

The following comments were received from countries in this section:

- Tsunami Threat Assessments are not coordinated at regional level for the South East Pacific, each country is responsible for issuing alerts for their coast regardless of the threat level determined by another country with a common frontier (Chile).

- The Russian Federation didn't interact with other countries during the Pacific Wave 2020. (FEERC, Russia).

- Objective 3 was not tested during PacWave 2020 (Hong Kong, China).

## Objective 4: *To Evaluate the format and content of the Central America Tsunami Advisory Centre (CATAC) Products (ifapplicable for your country).*

**4.1 Information provided in the Central America Tsunami Advisory Center (CATAC) messages was understood by and useful to the National Tsunami Warning Centre (NTWC)/National Disaster Management Office (NDMO). La información proporcionada en los mensajes del Centro de Asesoramiento sobre Tsunamis de América Central (CATAC) fue comprendida por el Centro Nacional de Alerta contra los Tsunamis (NTWC)/Oficina Nacional de Gestión de Desastres (NDMO) y resultó útil para ellos.**

*Summary:*

Three CA countries indicated that the information provided by CATAC was understood by the NTWC/NDMO.

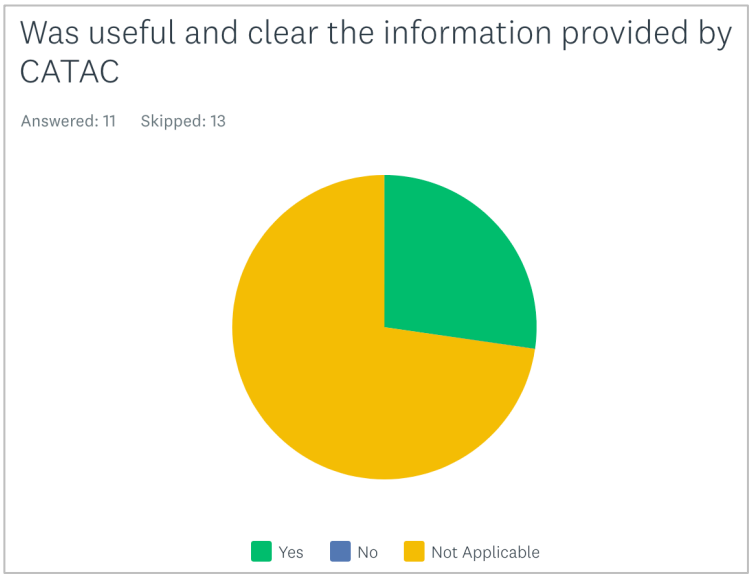



**Figure 33: Information provided by the relevant TSP was understood and useful.**

**4.2 Threat information in CATAC products was understood and useful. La información sobre las amenazas en los productos de la CATAC era entendida y útil. Por favor, comente lo que sea necesario.**

*Summary:*

100% of respondents indicated that the text and graphical products from CATAC were understood and useful.

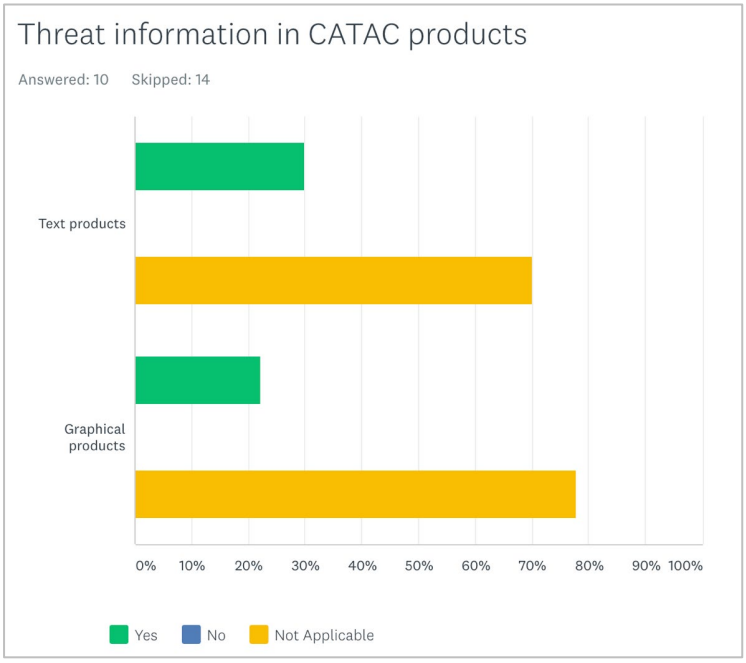



**Figure 34: Threat information in TSP products was understood and useful.**

**4.3 Components of the CATAC product suite were understood and useful. Los componentes del conjunto de productos de la CATAC se comprendían y eran útiles. Por favor, comente según sea necesario sobre la claridad o confusión del producto.**

*Summary:*

Two CA respondents (22%) agreed that components of the CATAC product suite were understood and useful.

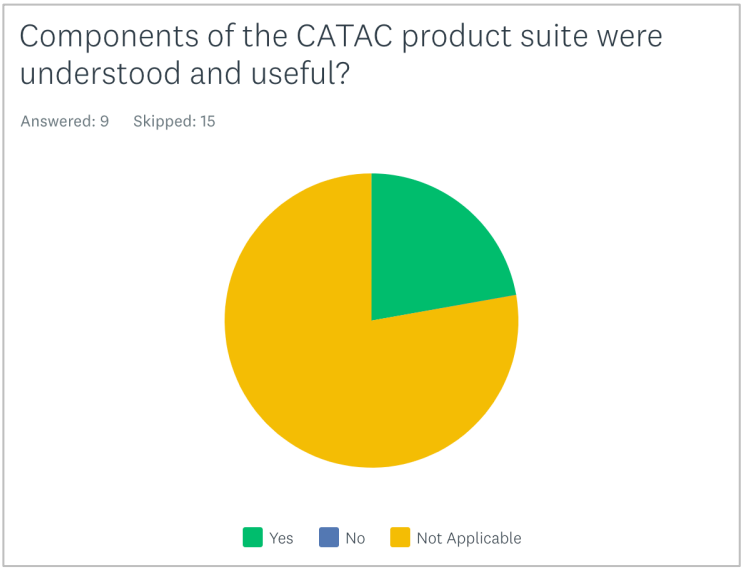



**Figure 35: Components of the TSP product suite were understood and useful.**

**4.4 The information provided assisted with decision making? (e.g. warning levels, earthquake parameters, estimated arrival times, forecast wave heights, etc.)**

**La información proporcionada ayudó en la toma de decisiones, por ejemplo, niveles de alerta, parámetros de terremotos, tiempos estimados de llegada, previsión de alturas de olas, etc.**

*Summary:*

**Three CA respondents agreed with that the information provided assisted with decision making**

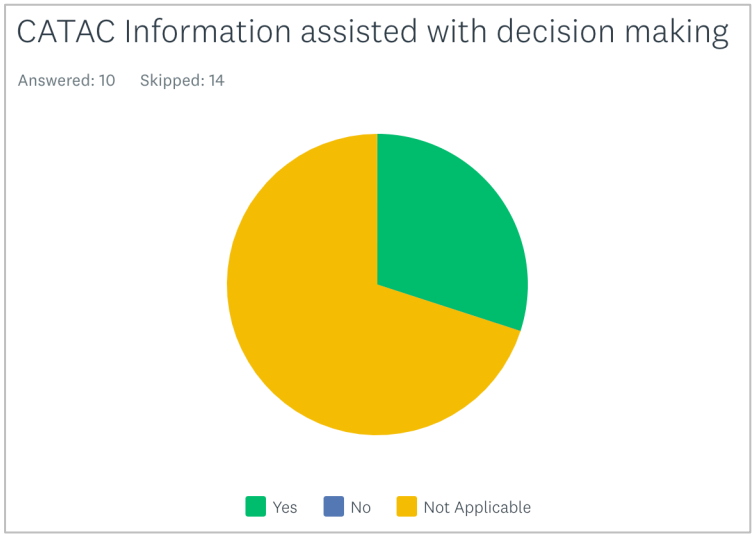



**Figure 36: The information provided assisted with decision making.**

The following information highlights responses from countries:

- The parameters of the earthquakes emitted by CATAC are considered, however a validation is always carried out (El Salvador).

**Objective 4 Comments.**

There was no interaction with CATAC. (FEERC, Russia).

## GENERAL EXERCISE OBSERVATIONS

### 1 Overall assessment.

This section gave respondents the opportunity to provide overall comment on the exercise and how it contributed to the development of tsunami response in each country.

*Summary:*
Over 65% of country respondents affirmed that

1) local stakeholders understand better their goals, responsibilities and roles in case of tsunami emergencies,
2) coastal communities are aware of their tsunami risk and are better prepared for tsunami events and
3) the exercise provide an opportunity to improve if gaps in capability and capacity are identified.

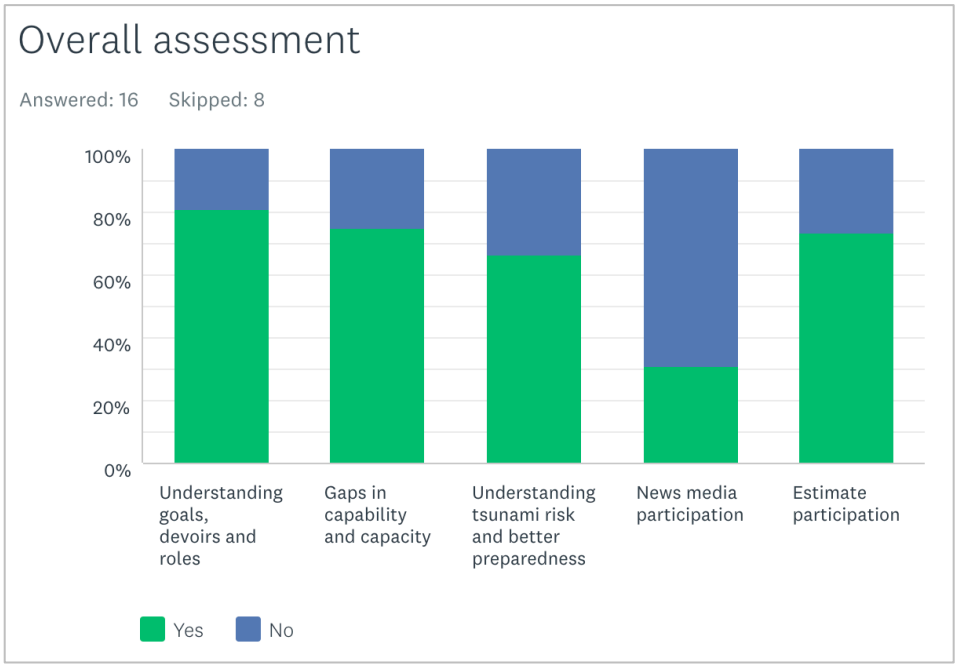



**Figure 37: Country stakeholder agencies have a better understanding of the goals, responsibilities (devoirs) and roles in tsunami emergencies; Gaps in capability and capacity have been identified; Community have a better understanding of their tsunami risk and are better prepared for tsunami events; News media participated and covered the exercise; and Estimated people participating in the exercise within the country/territory.**

.

*How many people do you estimate participated in the exercise within your country/territory? Include both government and non-government agencies and public, if applicable.*

- Around 20 people from SHOA and 10 from ONEMI participated in this exercise (Chile).
- There was NO participation of the population (Ecuador).
- 20-30 people (Tuvalu).
- 15 (FEERC, Russia).

- news media links: http://www.nmefc.cn/nr/cont.aspx?  itemid=2&id=7346 about 50 people participated in the  exercise (China).

- Not applicable as only communication is done (Malaysia).

- https://www.facebook.com/MinLMR/posts/3529287853760866
  https://www.facebook.com/MinLMR/posts/3529160087106976
  https://www.facebook.com/MinLMR/posts/3529154480440870
  https://www.facebook.com/watch/?v=929941267538257 (Fiji)

- As I stated earlier, Australia only participated in the TSP-NTWC communication test, thus there is no other planning and preparation for the exercise in the country.  Hence I can't answer meaningfully any of the questions above (Australia).

- About 20 (Cook Islands).

- We only did Objective number 1, so we haven't included the community/ stakeholder in this exercise (Philippines).

- All NDMO staff participated in the exercise, and the Chief of Staff to the High Commissioner was present (French Polynesia).

- 252 people (Mexico).

- In Colombia 181 people participated in the exercise. The exercise didn´t involve the community (Colombia).

- Just government people participated in the exercise because the emergency for the hurricane and the COVID-19 situation (El Salvador).

## 2 Exercise planning.

This section gave respondents the opportunity to provide overall comment on the planning of the exercise and their preparation for it.

- Overall respondents indicated that exercise planning, conduct, format and style were very satisfactory (94%).  Exercise planning at the international level went better (85%) than the planning at national (81%) or provincial/local level (71%).
- 100% of respondents indicated that the PacWave20 Exercise Manual provided an appropriate level of detail, also the IOC Manual & Guides 58 (How to Plan, Conduct, and Evaluate IOC Tsunami Wave Exercises) and 76 (Plans and Procedures for Tsunami Warning and Emergency Management) were useful.
- The IOC Manual & Guides 82: Preparing for Community Tsunami Evacuations: from inundation to evacuation maps, response plans and exercises was considered useful for 92% of the participants.
- 13 respondents chose the PacWave20 exercise website pages as useful
- 14 thought the evaluation form was easy to use.
- 53% of the participants (9 countries) used TsuCAT for exercise planning or hazard assessment during the PacWave20.


**Figure 38: Countries evaluate different components of the exercise planning.**

Exercise Planning was difficult for some countries due to the Pandemic. Exercise documents were useful and detailed.

*Comments*

- The information provided to carry out the PACWAVE20 was very useful and allows the best organization for the regional exercise (Ecuador).
- This evaluation form was easy to use (Russia).
- All of these things mention above like; PacWave20 website pages, Exercise Manual, Plans and Procedures for Tsunami Warning and Emergency Management etc... was very useful but we just needed to check it often and also used it to help with our planning and exercise etc. (Vanuatu).
- The above documents were very useful in conducting of Tsunami Drills and as well as the PACWAVE20 with relevant process and procedures that are in place within the country. Even though we have the COVID19 restriction but we were able to carry out PACWAVE20 (Fiji).
- Hard to assess most questions due to virtually no planning and participation from Australia as a whole. With COVID playing havoc across the ocean basin, I can understand the reasons for the significant reduction in the exercise scope and the very late publication of the exercise manual by the Task Team. So on balance, reducing the exercise to comms test is appropriate for this special year. I rated NO to the evaluation form because the survey questions did not allow for skipping over objectives, even though many countries probably only participated in the comms test. For similar reason, I found it difficult to answer those exercise planning and execution questions (Australia).
- Most of these manual identified appropriate cases that suited the Cook Islands, thus making it easier to plan (Cook Islands).

- The manuals and all the instructions for the PacWave2020 were very detailed. But since we are working in skeletal force right now due to the Pandemic, we failed to have table top exercises. On the other hand, we were able to request TsuCat on ITIC, since it is not yet part of our system. Now it is now accessible in our data receiving center. Thank you very much for sending it! (Philippines).

- The PacWave20 exercise website pages wasn´t used because the exercise was conducted on 22th October. The IOC Manual & Guides 82 wasn´t used because the exercise didn´t involve community (Colombia).

- The manual provided by CATAC was very helpful. Only the first scheduled message was received, for future exercises, all the messages shown in the document could be sent (El Salvador).

## EXERCISE PACIFIC WAVE 2020 EXPERIENCE

## EXERCISE PLANNING

### 1 Please provide a general statement about what went well.

*Summary:*

Overall, participants considered the exercise went well, with particular highlights being the choice of scenarios available, and the opportunity to work through and test tsunami response procedures.

*Comments*

- Communication and coordination to plan the exercise (Chile).

- The coordination between National Tsunami Center of Regional countries was very good (Ecuador).

- No comment (FEERC, Russia).

- What was plan, was all carried out (Vanuatu).

- Not applicable (Malaysia).

- Planning, Tsucat generated Scenario and messages, Master Scenario event list, Exercise Coordination briefing, evacuation drill and evaluation. Also a good participation of local emergency response agencies (Fiji).

- Timeliness of the warning that went out promptly (Cook Islands).

- The exercise planning has been carefully prepared (French Polynesia).

- The message was sent via email and it was received on time (Mexico).

- The national and regional articulation in the conduct of the exercise was well (Colombia).

- Planning was done in advance, using the CATAC guide documents.
  It was determined that the exercise would be internal due to the climatic situation and the covid-19 pandemic (El Salvador).

## 2 Please provide a general statement about what did not go well.

*Summary:*

This main area that did not go well during the exercise planning process was close timing with IOWave18 and encouraging community participation.

*Comments*

- N/A (Ecuador).
- Little time to prepare (FEERC, Russia).
- Timing of carrying out some activities was not on time as schedule (Vanuatu).
- Not applicable (Malaysia).
- Technical challenges with our drone live feed; Poor Internet connectivity due to low bandwidth (Fiji).
- Still need a communication mode for mass dispatching of information (Cook Islands).
- Some agencies received the message late (Mexico).
- Since it was an event of distant origin and with the participation of the countries of the Southeast Pacific, the organization of the times for sending messages was a bit complicated (Colombia).
- The technicians in charge of the exercise did not review the information with enough time (El Salvador).

## 3 Please provide a general statement about what could be improved.

*Summary:*

Areas identified that could be improved are more proactive engagement with stakeholders earlier on in the planning process and starting the planning process earlier.

*Comments*

- Scenarios could include gaps or malfunctions affecting one or more communication systems during the first stages of the emergency (Chile).
- The preparation of the CMO staff (Ecuador).
- Start preparation for the exercise 6 months in advance. (FEERC, Russia).
- Needed to work on time (Vanuatu).
- Not applicable (Malaysia).
- Proper advance Planning; Exercise manual; Early announcement of PACWAVE exercise; Proper collation data (Fiji).

- Plan for a different time of the year so as to capture more audience (Cook Islands).
- Use other means to send the message (Mexico).
- It is suggested that the manual be published earlier (Colombia).
- The information that will be sent should be clarified in the previous meetings (El Salvador).

**EXERCISE CONDUCT**

**1 Please provide a general statement about what went well.**

*Summary:*

Areas that went well during the exercise included the enthusiasm of participants, the opportunity to practice using SOPs, and the opportunity to test procedures and communication methods.

*Comments*

- Communication and coordination to support other countries (Chile).
- In general, the CMO staff manages the times and the handling of the situation very well. The time for each activity was well (Ecuador).
- Exercise was carried out satisfactorily at all levels. There was no significant remarks and lacks during the Exercise Pacific Wave 2020. (FSRH, Russia). All (FEERC, Russia).
- Overall, the exercise was satisfactory (China).
- Many people participated in the exercise. Other NGO's like Vanuatu Red Cross Society were there to help in the coordination of the exercise, even during awareness as well (Vanuatu).
- Not applicable (Malaysia)
- The PACWAVE2020 was executed well from the launching of the WTAD2020 until the completion of the evacuation drill exercise (Fiji).
- Notification was received and sent promptly (Cook Islands).
- We received the comm test/ dummy messages in our email in a very short time (Philippines).
- All warning messages were sent in time and contained all the information needed to assess the tsunami risk (French Polynesia).
- The exercise was only to communicate the message (Mexico).
- In general the exercise was well, the messages sent on time and the procedures were applied (Colombia).
- The technicians to perform the exercise were attentive and motivated about the practice. The bosses explain the importance of this kind of exercises and created the space for its realization (El Salvador).

## 2 Please provide a general statement about what did not go well.

*Summary:*

Message communication (confusion on messages or delivery) and non-interest or lack of participation were identified as what did not go well.

*Comments*

- Due to COVID-19 restrictions, the community was not involved in this exercise (Chile).
- The communication (Ecuador).
- No comment (FEERC, Russia).
- The fax dissemination time to some local governmental agencies was too long (China).
- Some people just took the exercise for granted (Vanuatu).
- Not applicable (Malaysia).
- There is a need of proper planning and the early announcement of the PACWAVE2020 exercise to allow ample time for preparation (Fiji).
- SMS to local audiences (Cook Islands).
- One of our communication channels (telefax) fails to receive any of them because of the changes in its number. It is better to have multiple channels (Philippines).
- The exercise was only to communicate the message (Mexico).
- The exercise was conducted satisfactorily according to the planned guide (Colombia).
- Little interest of the other areas of the observatory to participate (El Salvador).

## 3 Please provide a general statement about what could be improved.

*Summary:*

Improvements within each country were listed, such as in preparation, communication and contact information, and stakeholder participation (including local).

*Comments*

- Technical definition and format of text messages including Tsunami amplitudes must be clarified. PTWC text messages still use “Wave height” instead of Tsunami amplitudes (Chile).
- The preparation of the CMO staff (Ecuador).
- No comment (FEERC, Russia).
- Improve the fax line so that the message could be received timely (China).
- Need to involve and influence many people as possible so many people could also participate (Vanuatu).

- Not applicable (Malaysia).
- Proper Planning (Fiji).
- Media coverage (Cook Islands).
- I hope we can have a system in which we can update our contacts - person, numbers, emails. It could be every quarter or per year (Philippines).
- The exercise was only to communicate the message (Mexico).
- For futures exercises, participation at the local and community level can be improved (Colombia).
- Inform other managers and director about the exercise increase and its importance
  Join the civil protection agency to discuss aspects of the national tsunami contingency plan
  Improve the gaps and deficiencies observed during exercise (El Salvador).

**EXERCISE DEBRIEF OR EVALUATION**

**1 Please provide a general statement about what went well.**

*Summary:*

Aspects of the exercise evaluation that went well included ease of use of the evaluation form and identifying improvements to processes.

Exercises useful for introducing new staff to procedures and for practicing (such as use of communication equipment)

Specific tools used in exercise were
- Communications
  - Web-based chat portal in addition to regular communications
  - Social media - Viber and WhatsApp
- TsuCAT

*Comments*

- Web based chat portal, was a useful addition to the regular communication channels, since several countries could exchange information at the same time (Chile).
- It is applicable (Ecuador).
- No comment (FEERC, Russia).
- Was well done after the exercise (Vanuatu).
- Not applicable (Malaysia).
- (Fiji)
  - Information flow and acknowledgement of messages was applauded by the officials manning the EOC. Most of the officials mentioned that it was the first time for them to

know about how information is usually disseminated and they had learnt a lot and appreciated the way it was coordinated.
    - The handling of people with special needs was done well as there were plans in place to evacuate them first and supervise them at the assembly area. The evacuation exercise ensured that no one was left behind.
        - Teamwork and professionalism was shown throughout the exercise. Everyone looked out for each other and ensured that the evacuation was conducted in an organised manner.
    - Usage of communications equipment and constant provision of updates eased operations at the EOC.
    - Timing of execution of activities went well. The exercise was conducted within the allocated timeframe and everything was executed accordingly.
        - Overwhelming support and coordination by the stakeholders ensured that the exercise was conducted in a professional and timely manner. Traffic control assisted in the emergency cases to be transported swiftly to the hospital.
    - Demarcation of roles and responsibilities ensured the smooth execution of the exercise.
    - Provision of equipment (E.g. hailer and high visibility jackets) to assist the evacuees and responders during the exercise.
    - Use of other social media platforms (Viber and WhatsApp) as means of communicating between stakeholders during the exercise (Fiji).

- Agencies were communicating among themselves of the exercise (Cook Islands).

- We found out about TsuCat through this PacWave and how it can be helpful for us. Now we successfully have it (Philippines).

- Newly arrived NDMO staff were able to practice reading and understanding warning messages (French Polynesia).

- The sending of the message was successful, as well as the telephone communication (Mexico).

- The question are clear and accurate (Colombia).

- The first CATAC message was received as planned.
  Internal protocols were implemented as part of the exercise
  A discussion was held between seismology personnel after the drill (El Salvador).

**2 Please provide a general statement about what did not go well.**

*Summary:*

Answer type coded wrong for entering how many participants – should have field to write and not select yes or no

*Comments*

- It is so large (Ecuador).

- No comment (FEERC, Russia).

- Some evacuation area were not save of people with difficulties and was not continually clean. Siren was too short (Vanuatu).

- Not applicable (Malaysia).

- (Fiji)
  - Acknowledgement of messages being received by on-site personnel needs to be improved. There were at times during the exercise that the Operations Team needed confirmation on messages being received and actions that were taken.
  - The designing of the USP Labasa Tsunami Response and Evacuation Plan must involve all stakeholders and regular exercises need to be conducted so that the stakeholders are aware of their roles and responsibilities.
  - Communication modes can be improved. There was a call for the communications call signs to be presented in a diagrammatic form for easier understanding. The communications scenario should also be part of the TTX.
  - Live feed from the drone operators was a setback due to connectivity issues. The evacuation exercise could not be monitored from the Operations Room.
  - The evacuation exercise needs to be more realistic and practical. The students and officials of the two campuses were well informed beforehand of the time of the exercise and were eagerly waiting for the hour rather than being caught off guard. Most of the students who were informed of the evacuation drill days before did not turn up during the drill day.
  - Headcount of evacuees could have been done better. Only the total number of evacuees was presented and there was no other disaggregated information.
  - The exercise highlighted areas of concern that can be considered when revisiting or formulating tsunami response and evacuation plans. The two campuses had the Labasa Primary School grounds as their safe haven but the routes to the haven was through high risk areas. Alternate routes and safe areas were presented which were more preferable, shorter and safer (Fiji).

- Smaller communities fell behind with receiving information (Cook Islands).

- Some agencies didn't receive the message or received it late (Mexico).

- The question “How many people do you estimate participated in the exercise within your country territory? should have a field to write and not select yes or no (Colombia).

- CATAC's message was received 2 minutes later than expected what affected the hours of information emission (only at the institutional level in Microsoft team) (El Salvador).

**3 Please provide a general statement about what could be improved.**

*Summary:*

The evaluation process could be improved by improving the usability of the online evaluation form (fewer questions) and receiving a copy of the completed evaluation form.

Other improvements:
- Improve tsunami reporting formats, increase sea level data sharing
- Provide guidelines for virtual exercises
- Additional forecast points for French Polynesia

*Comments*

- Improve Tsunami reporting formats and increase data sharing for sea level stations (Chile).

- Reduce the number of questions (Ecuador).

- No comment (FEERC, Russia).

- Community leads could work on continually cleaning the tsunami save areas or evacuation areas. So we did on the siren for 2 minutes for our recent exercise (Vanuatu).

- Guidelines for virtual exercise (Malaysia).

- (Fiji)
  i. Tsunami evacuation exercises needs to be continued due to positive feedbacks and recommendations from stakeholders and also to build resilient communities.
  ii. Tsunami Early Warning Systems – the systems need to be expanded into other urban areas and vulnerable hotspots to ensure that the communities concerned are familiarized with the sounds and its purpose. Vulnerable communities can be provided with lead time to prepare and execute their response and evacuation plans when the time arises.
  iii. Local municipalities in tsunami hazard areas must ensure that there are response and evacuation plans in place that the people can adhere to in times of tsunami events. The response plan that was used by the USP Labasa Campus during the evacuation exercise only involved the students and officials and did not take into account other personnel that were in the vicinity during the time to evacuate.
  iv. National Response Agencies should also have Tsunami Response Plans in place to safeguard the safety of all personals while in responding to a Tsunami threat. Regular Tsunami Response Exercise is critical to familiarize operation personals with their roles and responsibilities

- All good (Cook Islands).

- Some forecast points could be added to the current list, particularly for alternate aerodromes in case of flooding of international airport (French Polynesia).

- Other means to send the message (Mexico).

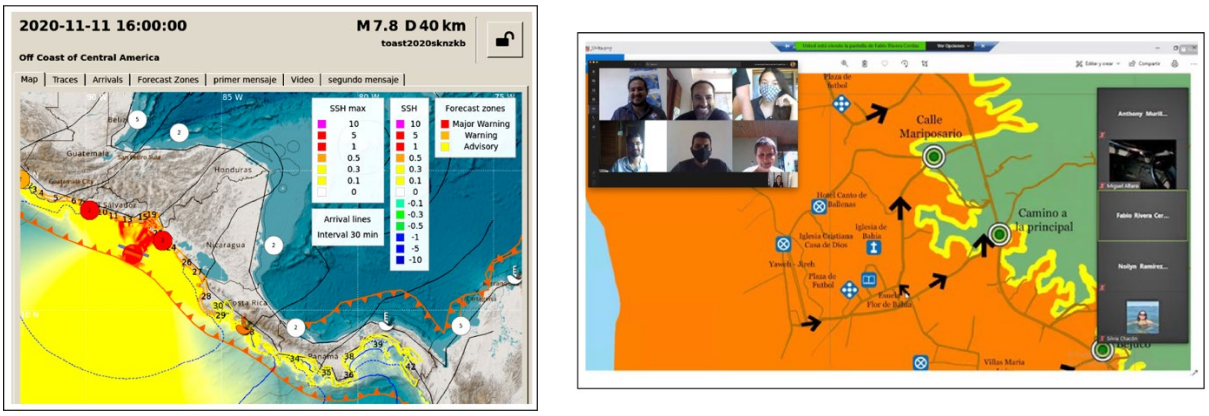
- An option to receive a copy of the answers at the end of the evaluation would be suggested (Colombia).

- In the future all messages can be sent from CATAC and the times could be more realistic, considering the delay in receiving the initial mail received (El Salvador).

## ANNEX III. CATAC REGIONAL EXERCISE

## CATAC REGIONAL TSUNAMI EXERCISE, 11 NOV 2020

In Central America, the Central America Tsunami Advisory Center (CATAC) conducted its second regional exercise with the NTWCs. The exercise simulated a “slow” earthquake off the Gulf of Fonseca in the Pacific Ocean that impacted El Salvador, Nicaragua, and Costa Rica, as well as Mexico and Ecuador. The scenario was similar to the deadly tsunami of 1 September 1992 on the Pacific coast of Nicaragua and the dangerous tsunami of 26 August 2012 in El Salvador and Nicaragua. In both cases, the lack of strong shaking led people living in coastal areas to mistakenly believe that the risk of tsunamis was low. During the simulation, Costa Rica issued a warning to the beachside community of Bahia at Osa, Puntarenas, who followed their tsunami preparedness and response plan and evacuated.




*Left: PacWave20 CATAC regional exercise scenario. Right: Costa Rica NTWC staff (right) virtually simulated tsunami evacuation for Bahia at Osa, Puntarenas.*
*Credits INETER, S. Chacón-Barrantes*

### Summary

On November 11, 2020, starting from the second regional tsunami drill for Central America (Guatemala, El Salvador, Honduras, Nicaragua, Costa Rica, Panama) will be held, which was prepared by the Central America Tsunami Advisory Center (CATAC).
In the last 10 years, tsunami preparedness in Central America is improving a lot. Seismic monitoring institutions have significantly increased the number of stations, improved the quality of equipment, and also used more sophisticated methods for earthquake processing; the monitoring and alert centers exchange their information in real time. However, certain situations that require good preparation are possible.
This exercise will simulate a strong tsunami caused by a magnitude 7.8 Mw earthquake off the Gulf of Fonseca in the Pacific Ocean of Central America. It is assumed the breaking of a huge fault along the subduction zone of the Cocos and Caribe tectonic plates and that due to certain geological conditions the movement occurs more slowly than normal. This would result in a so-called "slow" earthquake that is characterized by generating little seismic but large tsunamis.
The disastrous tsunami, on September 1, 1992, on the Pacific coast of Nicaragua, and the dangerous tsunami, on August 26, 2012, in El Salvador and Nicaragua had this deceptive characteristic. Due to the lack of strong shaking, people on the beaches do not obtain the natural alert about a possible tsunami. Also seismic networks tend to initially underestimate the danger because traditional seismic processing methods give too low magnitudes for these earthquakes and therefore the initial tsunami prediction also fails.

CATAC uses - like the PTWC, other regional centers and some national tsunami warning centers - special methods to quickly determine the correct magnitude for “slow” earthquakes. In case of slow earthquakes, the initial magnitudes that the CATAC publishes will be too low but they increase in one or two steps until reaching the correct value in the following messages. Civil protection institutions and the population in Central America need to understand the possibility of slow earthquakes and not question the predictions of a tsunami just because no strong shaking was felt.
In the Tsunami-CA-20 drill, the first message that CATAC will send to the countries automatically a few seconds after the earthquake is detected stipulates a magnitude of only 5.3. About three minutes after the beginning of the earthquake, the CATAC will send a correction in which the magnitude rises to 6.8 and finally, about 5 minutes after the earthquake, the final magnitude of 7.8 obtained with the Tsunami Tensor Moment method is sent. The earthquake data and the prediction of the arrival times of the tsunami waves and the maximum amplitudes for the different segments of the coast will be provided. About 45 minutes after the earthquake, the data recorded by the tide gauges in the region will be provided. This will be the last message of the drill.

On the afternoon of November 11, 2020, after the drill, CATAC will conduct a first evaluation of the drill through a virtual meeting together with the institutions participating in the drill.

**Background**

On August 19, 2019, the first regional tsunami drill for Central America (Guatemala, El Salvador, Honduras, Nicaragua, Costa Rica, Panama) was conducted, using information prepared by the Central America Tsunami Advisory Center (CATAC) , see CATAC (2019). This demonstrated that Central America had acquired the ability to characterize tsunami-generating earthquakes in real time and to forecast the parameters of the tsunamis and the possible impact on the different countries of the region.

Since 2016, INETER had developed with the support of Japan the Tsunami Advisory Center for Central America (CATAC) based on the national tsunami warning center in Nicaragua, Furukawa et al. (2018). As of 2019, CATAC has the ability to emit tsunami products based on the earthquake seismological assessment and the numerical tsunami prediction.

The design of the 2019 exercise, like the 2020 one prepared with this document, reflects the experience of a tsunami processed by an advisory center located in the affected region. The seismologist on duty may feel the shaking caused by the generating tsunami earthquake while monitoring the automated system and processing the seismic data. The first results are sent to recipients in Central American countries before the rupture that caused the earthquake has ended. This brings with it the need to update and correct the first results at the time of having more complete information on the situation. Participants in the exercise must understand these dynamics. An important objective of this exercise is to discuss, before and after the exercise, with the participants from the Central American institutions, how in the future the CATAC information can be provided in a way that facilitates this awareness of the changing situation in real time. .

**Motivation justification**
This regional tsunami exercise is being conducted to aid tsunami preparedness efforts in the Central American region. Recent experiences in other parts of the world, such as the Indian Ocean (2004), Samoa (2009), Haiti (2010), Chile (2010, 2014, 2015) and Japan (2011), attest to the importance of proper planning of the tsunami response.

Central America lies between two oceans, the Pacific and the Atlantic across the Caribbean Sea. The tsunami catalog based on historical references for Central America lists more than 50 tsunamis (Molina, 1997; Figure 1). A couple of tsunamis on both coasts have caused damage

and victims at the end of the 20th century: 1991 in Costa Rica-Panama and 1992 in Nicaragua. At least two "tsunami earthquakes" have affected the Pacific coasts of Central America: 1) 1992 in Nicaragua with waves (runup) of up to 10 meters, more than 170 deaths (Kikuchi and Kanamori, 1995); 2) 2012 in El Salvador and Nicaragua, with wave heights of about 4 to 5 meters (Tenorio and Strauch, 2012; Borrero et al., 2014).

Since the most recent destructive tsunami, in 1992 in Nicaragua, there has been a population growth in Central America and an increased influx of tourists along the Pacific and Caribbean coasts, increasing the region's vulnerability to tsunamis. In addition to tsunamis, the region also has a long history of destructive earthquakes. The question is not whether another major tsunami will occur, but when it does: will the region be prepared for the impact?

In the last 10 years, tsunami preparedness in Central America is improving a lot. Seismic monitoring institutions have significantly increased the number of stations, improved the quality of equipment, and also used more sophisticated methods for earthquake processing; the monitoring and alert centers exchange their information in real time. The number of tide gauges in the region increased, with more progress in Honduras and Nicaragua. El Salvador, Nicaragua, and Costa Rica already have national tsunami warning systems.

## ANNEX IV. SEP REGIONAL EXERCISE

**REGIONAL EXERCISE**
**PACWAVE20**
**GT-ATPS / SEP-WG**

**(to insert in final)**

**File:**
**REPORT PAC WAVE 2020 PTWS_ENG.PDF**

## ANNEX V. FIJI NATIONAL EXERCISE

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**(to insert in final)**

**File:**
**EPC REPORT - LABASA USP DRILL[47349].PDF**

# EMERGENCY PLANNING & COORDINATION (EPC) UNIT REPORT


**Tsunami Evacuation Drill for USP Labasa Campus & TAFE Campus**

National Disaster Management Office
10th December 2020

## ANNEX VI. TUVALU NATIONAL EXERCISE

**(to insert in final)**

**File:**
**TSUNAMI DRILL SIMULATION FETUVALU Narrative Report FINAL[28471].pdf**

From the People of Japan

# TSUNAMI DRILL SIMULATION FETUVALU SECONDARY SCHOOL NARRATIVE REPORT

in vulnerable communities in 'I'

Prepared by the Department of Disaster Management

Date: 20th November 2020

## ANNEX VII. LIST OF ACRONYMS

| | |
|---|---|
| **CATAC** | Central America Tsunami Advisory Centre |
| **ICG** | Intergovernmental Coordination Groups |
| **ICG/CARIBE-EWS** | Intergovernmental Coordination Group for the Tsunami and other Coastal Hazards Warning System for the Caribbean and Adjacent Regions |
| **ICG/ITSU** | International Coordination Group for the Tsunami Warning System in the Pacific (now renamed ICG/PTWS) |
| **ICG/PTWS** | Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System (formerly ITSU) |
| **INETER** | Instituto Nicaragüense de Estudios Territoriales |
| **IOC** | Intergovernmental Oceanographic Commission (of UNESCO) |
| **ITIC** | International Tsunami Information Center (UNESCO/IOC–NOAA) |
| **JMA** | Japan Meteorological Agency |
| **MTS** | Medium-term Strategy |
| **NDMO** | National Disaster Management Office |
| **NOAA** | National Oceanic & Atmospheric Administration (USA) |
| **NTWC** | National Tsunami Warning Centre |
| **NWPTAC** | Northwest Pacific Tsunami Advisory Center (Japan) |
| **PacWave20** | Exercise Pacific Wave 2020 |
| **PMEL** | Pacific Marine Environmental Laboratory |
| **PTWC** | Pacific Tsunami Warning Center (USA) |
| **SOP** | Standard Operating Procedures |
| **TNC** | Tsunami National Contact |
| **TSP** | Tsunami Service Provider |
| **TsuCAT** | Tsunami Coastal Assessment Tool |
| **TWFP** | Tsunami Warning Focal Point |
| **UNESCO** | United Nations Educational, Scientific & Cultural Organization |
| **SCSTAC** | South China Sea Tsunami Advisory Center (China) |
| **WG** | Working Group |
| **WG-CA** | Working Group on the Central American Pacific Coast Tsunami Warning and Mitigation System |
| **WG-SE** | Working Group on the Southeast Pacific Tsunami Warning and Mitigation System |
| **WG-TOWS** | Working Group on Tsunamis and Other Hazards related to Sea- Level Warning and Mitigation Systems |