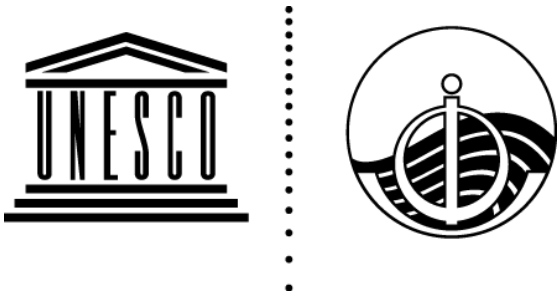
Intergovernmental Oceanographic Commission
Technical Series
139



EXERCISE PACIFIC WAVE 2018

A Pacific-wide Tsunami Warning and Enhanced Products Exercise

1 September–30 November 2018

Volume 1 Exercise Manual

UNESCO

Intergovernmental Oceanographic Commission
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IOC Technical Series, 139 (Volume 1)
Paris, April 2018
English only

For bibliographic purposes, this document should be cited as follows:

UNESCO/IOC. 2018. *Exercise Pacific Wave 2018. A Pacific-wide Tsunami Warning and Enhanced Products Exercise, September to November 2018. Volume 1: Exercise Manual.* IOC Technical Series No 139. Paris, UNESCO (English only)

Report prepared by: The Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System

Published in 2018
by United Nations Educational, Scientific
and Cultural Organization
7, Place de Fontenoy, 75352 Paris 07 SP

(IOC/2018/TS/139 Vol.1 Rev.2)

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1. BACKGROUND

The Intergovernmental Oceanographic Commission (IOC) of UNESCO established the International Coordination Group for the Tsunami Warning System in the Pacific (ICG/ITSU) in 1965 in response to the 1960 earthquake off the coast of Chile, which generated a tsunami killing 2,000 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 alerts, and advocate for comprehensive national programmes in hazard assessment, warning guidance, and preparedness (*ITSU Master Plan*, 2004 [IOC/INF-1124 Rev.]; *Medium-term Strategy: Pacific Tsunami Warning and Mitigation System* (PTWS MTS), 2014–2021 [IOC/2013/TS/108]; PTWS Implementation Plan 2013, (evolving document, version 4). In 2005, ITSU was re-established as the Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System (ICG/PTWS).

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 Pacific. Because of the Pacific's large size, several regional Tsunami Service Providers have been, or are being, established in order to improve the timeliness and threat assessment accuracy of especially regional events.

In response to Member State requests for additional regional information, Japan began operation of its Northwest Pacific Tsunami Advisory Center (NWPTAC) in March 2005, and in April 2006 expanded on an interim basis to the South China Sea. The NWPTAC, which serves as the TSP for the Northwest Pacific, 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. As of February 2018, the NWPTAC has issued the advisories for 232 events in total since it started the service in March 2005.

In 2013, Member States approved the proposal for the South China Sea Tsunami Warning and Mitigation System, and the establishment of the South China Sea Tsunami Advisory Center (SCSTAC) hosted by China. The SCSTAC services countries bordering the South China Sea, Sulu Sea, and Celebes Sea. The SCSTAC began issuing trial products in January 2018.

A Pacific-wide tsunami exercise is an effective tool for evaluating the readiness of PTWS countries and to identify 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 seven 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) and 2017 (IOC/2016/TS/131 Vol.1 and 2).

The exercises, using a multitude of Pacific scenarios and accompanied by tsunami message products from the Pacific Tsunami Warning Center, Japan Meteorological Agency's Northwest Pacific Tsunami Advisory Center, the US National Tsunami Warning Center (formerly West Coast and Alaska Tsunami Warning Center), and the South China Sea Tsunami Advisory Centre (SCSTAC) have been used to evaluate the effectiveness of the system and measure the readiness of countries to respond, as national tsunami warning centers and emergency response agencies and the public, to distant and local tsunamis. Exercise Pacific Wave 2011, 2013, and 2015 were additionally used to introduce and obtain feedback, test, and validate the PTWC new enhanced forecast 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 Enhanced Products are formally adopted. Exercise Pacific Wave 2017 was also used to support the development of the

SCSTAC products. Exercise Pacific Wave 2018 will be used to validate the NWPTAC enhanced products and test the new SCSTAC products.

At its 27th session, the Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System (ICG/PTWS-XXVII/3), held in Tahiti, France, from 28 to 31 March 2017, approved the conduct of Exercise Pacific Wave 2018 (PacWave18) from September to November 2018.

2. EXERCISE PURPOSE

Exercise Pacific Wave 2018 (PacWave18) intends to support the development of improved tsunami products and procedures, including the Enhanced Products of the Northwest Pacific Tsunami Advisory Center (NWPTAC) of the Japan Meteorological Agency (JMA) and the South China Sea Tsunami Advisory Centre (SCSTAC) of the China State Oceanic Administration (SOA).

The aim of PacWave18 is to test country preparedness arrangements, and operational procedures to respond and recover from a destructive tsunami, especially at the community level.

PacWave18 provides a valuable opportunity for Pacific countries to test the new products (where relevant), review their tsunami response procedures, test internal and external communication systems, and engage with communities through public education activities. Regular exercises are important for maintaining staff readiness in case of a real event. This is especially true for tsunamis, which are infrequent, but when they occur, require a rapid response. Every Pacific country is encouraged to participate.

3. EXERCISE OBJECTIVE

The overall objectives for Exercise Pacific Wave 2018 are to:

- Test communications from the PTWS PTWC, NWPTAC, and SCSTAC Tsunami Service Providers to Member States.
- Test national communication and cooperation, and readiness within the country.
- Test regional communication and cooperation between Member States.
- Test whether the PTWS PTWC, NWPTAC, and/or SCSTAC Tsunami Service Provider products are interpreted by Member States accurately and in a timely manner.
- Validate the format and content of NWPTAC Enhanced Products *(Only applicable to relevant countries)*.
- Evaluate the format and content of SCSTAC Enhanced Products *(Only applicable to relevant countries)*.

Each country may expand and/or customise its own objectives for the exercise.

4. NEW ENHANCED PRODUCTS

4.1 NORTHWEST PACIFIC TSUNAMI ADVISORY CENTER ENHANCED PRODUCTS

At the 26th session of the Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System (ICG/PTWS-XXVI), held in Honolulu, Hawaii, USA, from 22 to 24 April 2015, Member States agreed that the NWPTAC should proceed with the development

of its enhanced products for the North-West Pacific, with guidance and feedback to be received from the Task Team on Enhanced Products.

The enhanced products consist of an initial text message using information from a pre-established tsunami database, and are followed by text and graphical messages that include results from real-time simulations. The enhanced products include new forecast points, five categories of tsunami amplitude classification and three graphical products. The graphical products are sent solely to Tsunami Warning Focal Points of recipient countries. A draft Users' Guide based on the document *Operational users guide for the Pacific Tsunami Warning and Mitigation System (PTWS)* (IOC/2011/TS/87 Rev. (2nd ed.), mainly section 6) has been prepared and is available at the PacWave18 website as *Users Guide for the Northwest Pacific Tsunami Advisory Center Enhanced Products for the Pacific Tsunami Warning System*. PacWave16 and PacWave17 were used to support the development of the NWPTAC enhanced products. Exercise Pacific Wave 2018 will be used to validate the new NWPTAC enhanced products.

Through IOC Circular Letter 2702 (IOC/CL-2702) dated 13 December 2017, the Japan Meteorological Agency's NWPTAC commenced issuance of its experimental NWPTAC Enhanced Products on 20 December 2017, in parallel with its existing products. The full changeover date to the new products is expected six months to a year afterward.

4.2 SOUTH CHINA SEA TSUNAMI ADVISORY CENTER ENHANCED PRODUCTS

At the Twenty-seventh session of the ICG/PTWS (ICG/PTWS-XXVII) held in Tahiti, France, from 28 to 31 March 2017, Member States agreed to commence the trial operation of SCSTAC in late 2017, with a specific date to be decided by the Steering Committee of the ICG/PTWS (PTWS SC). The PTWS SC at its virtual meeting on 11 September 2017 accepted the proposal to start the trial issuance of SCSTAC products on 26 January 2018. The Technical Document entitled *Tsunami Advisory Products for the South China Sea Regional Tsunami Warning and Mitigation System* (October 2017) provides information on the SCSTAC products, geographical coverage, bulletins, forecast points and other technical aspects (http://www.scstac.org). PacWave17 was used to support the development of the SCSTAC enhanced products. Exercise Pacific Wave 2018 will be used to support the SCSTAC operation and products.

Through IOC Circular Letter 2706 (IOC/CL-2706) dated 5 January 2018, the SCSTAC will commence trial issuance of the SCSTAC Products on 26 January 2018. During the trial, comments or suggestions are welcome on the Technical Document or SCSTAC products through May 2018 for improving the products to be validated in PacWave18.

5. EXERCISE DATES

PacWave18 will be held within the period of 1 September to 30 November 2018. PacWave18 will simulate Pacific countries receiving Tsunami Threat messages containing wave amplitude forecasts. Member States may then use the information in their decision making to assess their national threat and to simulate creating and disseminating alerts. Countries are encouraged to engage communities at the local level and it is recommended to be at least a table-top exercise.

All products will be available prior to the exercise dates on the PacWave18 website (http://www.pacwave.info). Participating countries may choose to run their exercise at any time between 1 September and 30 November 2018, allowing flexibility to avoid conflict with other important national events.

5.1 PROVISIONAL TIMELINE AND MILESTONES

PROVISIONAL TIMELINE	
28 February 2018	Nomination of a National Contact for PacWave18
18 May 2018	Exercise Manual available on www.pacwave.info (including scenarios)
1 June 2018	Exercise Message and products available on www.pacwave.info
1 September – 30 November 2018	Exercise Pacific Wave 2018
21 December 2018	Countries to complete and submit evaluation survey online
ICG/PTWS-XXVIII, 2019	Draft PacWave18 Preliminary Results discussed at the ICG meeting
30 June 2019	Draft PacWave18 Preliminary Report available to Member States
31 August 2019	Final PacWave18 Summary Report uploaded to www.pacwave.info

Table 1. Provisional Timeline and milestones

6. EXERCISE SCENARIO

Each country will be responsible for designing its own national, provincial and/or local level exercise(s) in line with the international Exercise Pacific Wave exercise framework.

PacWave18 will include multiple scenarios to enable all Member States to select a distant, regional or local event that will impact their country. It is recommneded countries choose one scenario to exercise. Scenarios will include past historical events, including the 2009 Tonga Trench (Samoa Islands Region), 2010 Peru-Chile Trench (near the coast of Central Chile), 2011 Japan Trench (near the coast of Honshu), and 2013 South Solomon Trench (Santa Cruz Islands) tsunamis, and hypothesized scenarios for the Manila Trench, South Solomon Trench, and Tonga Trench (see Annex I for scenario details).

For exercise purposes, the date will be set to 5 November 2018. For historical events, the earthquake origin time will be the actual time it happened, and actual tsunami observations will be reported by the TSPs, and marigrams for stations observing the tsunami will also be available.

Note that a live communication test from the Tsunami Service Providers to Member States will be conducted at 0000 UTC on 5 November 2018.

The exercise will require the evaluation of PTWC and, as applicable, the NWPTAC and/or the SCSTAC enhanced products, issuance of appropriate country specific alerts by National Tsunami Warning Centres, and decision-making, including steps taken just prior to public notification. Member States are encouraged to engage with communities at the local level as part of the exercise.

Member States are also encouraged to engage in communication and coordination activities, such as through a joint exercise, with nearby jurisdictions and countries in the region. Examples might be the sharing of data, information, parameters, and/or analysis, and decision-making conference calls, and/or coordination of alert levels along borders.

7. TSUNAMI SERVICE PROVIDER COMMUNICATIONS TEST

To test communications from the Tsunami Service Providers to each Member State, one live message will be issued for PacWave18. The live test will occur at 0000 UTC on 5 November 2018. Member States should note when and how they receive the live communications test message and report back through the Post-Exercise Evaluation Survey.

8. TYPE OF EXERCISE

It is recommended that, if possible, Exercise Pacific Wave 2018 be carried out as a functional exercise with community engagement, or at a minimum, be carried out in a Table Top format (also referred to as a 'discussion exercise', or 'DISCEX').

Exercise Pacific Wave 2018 could be carried out in a drill format within communities or as a functional exercise. In a drill exercise, staff physically handle equipment or perform a specific procedure. The exercise usually has a time frame element and is used to test the procedures. An example of a drill exercise may involve activating an emergency operations centre or using alternative communications (such as radios).

A functional exercise may also be referred to as an 'operational' or a 'tactical' exercise. It takes place in an operational environment and requires participants to actually perform the functions of their roles. Participants interact within a simulated environment through an exercise control group who provide prewritten injects and respond to questions and tasks developing out of the exercise. Functional exercises normally involve multi-agency participation (real or simulated) and this type of exercise is used to practice multiple emergency functions, e.g. direction and control, resource management and communications. An example of a functional exercise is a multiple agency response to a tsunami threat, where evaluation of a coastal area is required. Messages and injects are provided by exercise control and are handled by participants in the way described in appropriate plans and procedures. Outcomes are generated that would be expected in a real situation.

Finally, functional exercises that include the practice evacuation of communities, or sectors of a community such as a school or other important facilities, are encouraged where possible. A school evacuation would test the procedures for receiving the warning and subsequent evacuation order, and the evacuation of school staff and school children to a designated tsunami safe area.

In a Table Top exercise, participants are presented with a situation or problem that they are required to discuss and for which they have to formulate the appropriate response or solution. Normally, the exercise requires no simulation other than the scenario and/or prewritten exercise injects. An exercise controller or moderator introduces a simulated scenario to participants and, as the exercise advances (in time), exercise problems and activities (injects) are further introduced. This type of exercise is used to practice problem solving and coordination of services with or without time pressures. There is no deployment or actual use of equipment or resources.

An example of a Tabletop Exercise may involve the key stakeholders, such as the National Tsunami Warning Centre and the National Disaster Management Office in one country, and/or

National Tsunami Warning Centres from neighboring countries, discussing their response to a tsunami threat in a particular area, where the only injects are the tsunami products from the relevant Tsunami Service Providers.

9. FURTHER GUIDANCE

9.1 PLANS AND PROCEDURES FOR TSUNAMI WARNING AND EMERGENCY MANAGEMENT GUIDELINE

The IOC Manual and Guides entitled *Plans and procedures for tsunami warning and emergency management* (IOC/2017/MG/76 Rev.) has been developed to provide *guidance for countries in strengthening tsunami warning and emergency response through the development of Plans and Standard Operating Procedures for their warning and emergency management authorities*. National authorities should have aligned and robust tsunami warning and response plans and procedures to ensure timely, actionable warnings and effective response by coastal communities.

The guideline is a product of collaboration between the four Intergovernmental Coordination Groups (ICGs) through the Working Group on Tsunamis and Other Hazards related to Sea-Level Warning and Mitigation Systems (TOWS-WG), and is a reference point for global consistency with regard to planning for and responding to tsunamis.

The content is based largely on training materials developed by the ICG/PTWS and the Intergovernmental Coordination Group for the Indian Ocean Tsunami Warning and Mitigation System (ICG/IOTWMS) and their respective Tsunami Information Centres, in particular the UNESCO-IOC-NOAA International Tsunami Information Centre (ITIC), based in Hawaii, USA, and was developed through training workshops conducted in countries of the Indian Ocean, Southeast Asia and South China Sea Region during 2008 to 2010, as part of the project entitled "Strengthening Tsunami Warning and Emergency Responses: Training Workshops on the Development of Standard Operating Procedures for Indian Ocean and Southeast Asian Countries". It includes contributions from international experts in the fields of tsunami science, early warning and mitigation, disaster management and community awareness.

9.2 HOW TO PLAN, CONDUCT AND EVALUATE TSUNAMI EXERCISES GUIDELINE

The IOC Manual and Guides *How to plan, conduct and evaluate UNESCO/IOC tsunami wave exercises* (IOC/2011/MG/58 Rev, English, Spanish) has been developed to aid countries in planning, conducting, and evaluating a tsunami exercise at a national and/or provincial level.

This guideline contains information on how to plan, conduct and evaluate tsunami wave exercises. It has been designed for use by IOC Member States who will participate in these exercises and has been divided into four easy stages to provide a range of practical advice and templates for in-country exercise developers to analyse the need for an exercise at the country, provincial or local level, design the exercise, conduct the exercise, and evaluate the exercise. A number of case studies have also been included to provide examples of various in-country tsunami exercises. The case study examples are not necessarily based on tsunami wave exercise scenarios, but they provide an insight into the planning and execution of national level tsunami exercises.

Both documents are also available at the PacWave18 website (http://www.pacwave.info).

9.3 INTERNATIONAL DAY FOR DISASTER REDUCTION AND WORLD TSUNAMI AWARENESS DAY

It will be useful to link your exercise, and especially any community activities with either the International Day for Disaster Reduction on 13 October 2018, or the World Tsunami Awareness Day on 5 November 2018. Note that a live communication test from the Tsunami Service Providers to Member States will be conducted at 0000 UTC on 5 November 2018.

10. ASSUMPTIONS

Each country will be responsible for determining what assumptions should be considered as part of its national, provincial, and/or local tsunami exercise.

11. EXERCISE PARTICIPATION

All Pacific countries are strongly encouraged to participate in the exercise. However, it is up to each country to decide what level of governmental participation they will undertake. At a minimum, to meet the objectives of PacWave18, it is recommended that the National Tsunami Warning Centre and the National Disaster Management Office participate.

Each country's lead agency and its PacWave18 National Contact will be responsible for:

- **During the initial phase of exercise planning**:
  - Determining their country's level of participation.
  - Planning their exercise through the country's Exercise Planning Team, including any regional or joint exercises.
- **During the exercise:**
  - Participating in the live communication test between the Tsunami Service Providers and Member States at 0000 UTC on 5 November 2018.
  - Responding as necessary to fulfil their all-of-government and national, provincial and/or local arrangement obligations.
  - Responding as necessary to fulfil regional commitments.
- **After the exercise:**
  - Encouraging the conduct of debriefs and evaluations by in-country agencies, and/or country-country evaluation.
  - Completing the PacWave18 Exercise Evaluation Form based on in-country feedback.

12. EXERCISE DOCUMENTATION

Exercise Pacific Wave 2018 planning, conduct, and evaluation should take into account the following documents:

- IOC Circular Letter, 2709: Pacific Tsunami Warning and Mitigation System (PTWS) Exercise Pacific Wave 2018 (PacWave18), during the period 1st September to 30 November 2018, issued 22 January 2018 (CL-2709)
- Exercise Pacific Wave 2018, A Pacific-wide Tsunami Warning and Enhanced Products Exercise, 1 September–30 November 2018. Exercise Manual, Volume 1, IOC Technical Series No 139. UNESCO/IOC 2018 (English)

- User's guide for the Pacific Tsunami Warning Center: enhanced products for the Pacific Tsunami Warning System. IOC Technical Series No 105, Revised edition. UNESCO/IOC 2014 (English; Spanish) (IOC/2013/TS/105 REV.3)
- Users Guide for the Northwest Pacific Tsunami Advisory Center Enhanced Products for the Pacific Tsunami Warning System. (English, draft December 2017)
- Tsunami Advisory Products for the South China Sea Regional Tsunami Warning and Mitigation System, Technical Document, October 2017
- Operational Users Guide for the Pacific Tsunami Warning and Mitigation System (PTWS), (IOC/2011/TS/87rev), rev August 2011 (English)

Resources on the development of tsunami Standard Operating Procedures, and the planning, conduct, and evaluation of exercises include the following:

- Plans and procedures for tsunami warning and emergency management. Paris, Intergovernmental Oceanographic Commission of UNESCO 2017. 72 pp. (IOC Manuals and Guides No. 76); English WC.(IOC/2017/MG/76 REV)
- How to plan, conduct and evaluate UNESCO/IOC tsunami wave exercises, IOC Manuals and Guides No 58, 2013 (English, Spanish) (IOC/2012/MG/58 REV)

All information related to Exercise Pacific Wave 2018 is available at the exercise website: http://www.pacwave.info

13. EXERCISE PRODUCTS

Countries may commence their PacWave18 exercise using the messages from the relevant Tsunami Service Provider (PTWC, NWPTAC and/or SCSTAC). All messages for each scenario are provided in the Master Schedule of Events List (MSEL, Annex II). Participating countries should select a relevant scenario and the most convenient date and time to conduct the Exercise within the 1 September–30 November 2018 time-period. For exercise purposes, the date noted in the MSEL is set to 5 November 2018.

Note that there will be **NO LIVE SCENARIO** dummy kick-off messages from the Tsunami Service Providers. Instead, there will be **ONE LIVE COMMUNICATION TEST** from the Tsunami Service Providers to Member States that will occur at 0000 UTC on 5 November 2018. Participating Member States should note the date, time, and method of receipt of the live communication test and report the finding in their Post-Exercise Evaluation Survey.

Participating Member States may amend the exercise messages to suit their own timetable. The earthquake origin default date and time of the messages can be adjusted to coincide with your selected Exercise local date and time. Each Member State is also welcome to modify estimated arrival times or estimated wave amplitudes to suit their preference; for example, to have the arrival of tsunami sooner and with a larger amplitude. Subsequent message issuance date and times, and earthquake and tsunami arrival times should then also be adjusted accordingly.

All PTWC, NWPTAC, and SCSTAC products will be provided online at the PacWave18 website in advance to help countries plan and prepare. It is recommended to download from the PacWave18 website, the PTWC, NWPTAC, and SCSTAC products and messages for the appropriate scenario prior to the day of the exercise.

All documentation and correspondence relating to this exercise is to be clearly identified as **PacWave18** and **for exercise purposes only**.

14. EXERCISE DELIVERY/FORMAT

All messages and message issue times for the different scenarios (Annex I) are listed in the Master Schedule of Events List (MSEL, Annex II).

Distribution of the series of Tsunami Service Provider products for each scenario within each country (available beforehand on the exercise website) is the responsibility of each country.

Each PacWave18 National Contact and their Exercise Planning Team should decide whether the exercise scenario messages are made known to the other national, provincial and local agencies prior to the exercise.

Country Exercise Planning Teams may want to add their own national and/or local injects.

15. MASTER SCHEDULE OF EVENTS LIST (MSEL) – EXERCISE SCRIPT

The Master Schedule of Events List (MSEL) is a detailed sequence of events used by Exercise Control Team to ensure that the exercise runs smoothly.

The International Master Schedule of Events List (MSEL) giving the timeline for issuance of the Tsunami Service Provider products, and the product types are given in Annex II.

Each country's Exercise Control Team will be responsible for executing Master Schedule of Events List.

16. POST-EXERCISE EVALUATION

All exercises should have a learning focus. Learning is maximised when there is a continuous process of review to draw out the lessons identified. Review is the process of evaluating and validating the exercise. The exercise should also test an agency's Standard Operating Procedures (SOPs).

A review should evaluate the effectiveness of arrangements in place and identify if there are any corrective actions and gaps to fill. The hot and cold debriefs are then used to complete the Exercise Pacific Wave 2018 post-exercise evaluation form.

All participating countries are asked to provide feedback through the PacWave18 Evaluation Form (Annex III) **by 21 December 2018**. It is requested that each country compile evaluations from its jurisdictions and/or agencies, and submit only **ONE (1) PacWave18 evaluation per country**. Forms should be submitted online by visiting https://www.surveymonkey.com/ s/pacwave18_eval. This feedback will greatly assist in the evaluation of Exercise Pacific Wave 2018 and the finalisation of the NWPTAC and SCSTAC Enhanced Products.

16.1 DEBRIEFING

A post-exercise debrief is a critical review of the entire exercise. It identifies those areas that were handled well, those areas where issues were experienced, and recommendations for improvement.

The aim of organizational debriefing is for staff to communicate their experiences of the exercise so that lessons can be identified. Arrangements (plans, procedures, training etc.) can then be modified to reflect lessons identified along with best practice, and therefore improve the agency's ability to respond in future exercises/real events.

Each agency that participates in PacWave18 is expected to conduct its own debriefs after the exercise. This may take the form of a hot debrief (or hotwash) on the day of the exercise, with each participating agency conducting its own cold (formal) debrief within the week(s) following the exercise.

A formal exercise debrief inclusive of all participants in the respective countries will be required to facilitate a collective and official evaluation. The method (in person meeting, survey, teleconference, or other means) used to collect the data required is to be decided upon by the individual participant countries.

The feedback received from this structured debrief is then used to complete standard evaluation forms which are to be based on the overall exercise objectives, plus any additional evaluation forms or tools developed by each country.

A useful guide to debriefing is the one used by New Zealand Ministry of Civil Defence & Emergency Management (ISBN 0-478-25467-9). It can be found at:
https://www.civildefence.govt.nz/assets/Uploads/publications/is-06-05-organisational-debriefing.pdf

16.2 EXERCISE VALIDATION

The final stage of the exercise process is to determine whether or not the exercise has met its objectives. At the country level, a national exercise should compare the performance of the involved agencies during the exercise against the performance expected. After validation, countries and agencies may need to change or develop new plans, procedures, and training programmes. Exercise outcomes may be retested in future tsunami exercises, or new exercises written to meet newly identified needs.

16.3 EVALUATION CRITERIA

There will be two types of evaluation criteria. The first type will be international criteria based on the overall exercise objectives (Section 3). The key PacWave18 objectives are provided in Annex III. The second type will be criteria to be determined by each individual country to measure its own objectives.

In compiling the Exercise Pacific Wave 2018 Summary Report, the Exercise Task Team will require ONE (overall) evaluation form per participating country.

16.4 EVALUATORS

Countries may appoint Exercise Evaluators to observe and evaluate selected objectives during their exercise. Evaluators should be subject matter experts in the field they are evaluating, such as in warning centre operations, emergency response, or in specific agency areas of responsibility.

Appointing and assigning evaluators is the responsibility of each participating country.

16.5 EVALUATION TOOLS

The goal of exercise evaluation is to validate strengths and identify opportunities for improvement within the participating organizations. This is to be accomplished by collating supporting data; analysing the data to compare effectiveness against requirements; and determining what changes need to be made by participating organizations. At the international level, this would involve the ICG/PTWS as the Intergovernmental Coordinating Group supporting effective tsunami warning and decision making.

Evaluation of an exercise should focus on the adequacy of plans, policies, procedures, assessment capabilities, communication, resources and inter-agency/inter-jurisdictional relationships that support effective tsunami warning and decision-making at all levels of government. Participants that choose to include additional objectives, for example by exercising public warning and/or response plans, can expand the evaluation form accordingly. The evaluation of such additional objectives will be for the use of the particular participating agency only, and is not required for the PTWS Exercise Pacific Wave 2018 Summary Report.

The evaluation tool aims to inform and facilitate individual participant country evaluations as well as the Exercise Pacific Wave 2018 Summary Report.

All participanting countries are asked to complete the official PacWave18 Exercise Evaluation Form (Annex III) **by 21 December 2018**. Forms should be submitted online by visiting https://www.surveymonkey.com/s/pacwave18_eval.

16.6 EXERCISE PACIFIC WAVE 2018 SUMMARY REPORT

The Exercise Task Team will compile the Exercise Pacific Wave 2018 Summary Report based on the official Exercise Evaluation Forms received. The report will include the following:

- Exercise description
- Post-Exercise Evaluation Summary and Findings
- Identification of Best Practices or Strengths
- Identification of Areas for Improvement
- Recommendations on Plans of Action for Improvement

17. OBSERVERS

Exercise Pacific Wave 2018 may generate interest within the wider sector or local community. Visitors from other agencies (whether local or international) may be invited to observe various exercise activities. Media may also be invited to observe as a way of helping to increase tsunami awareness. Some media may also participate or be simulated, if they are part of the official warning and evacuation dissemination chain.

The invitation of internal or external agency personnel to observe the exercise is the responsibility of each participating country.

18. REAL EVENTS DURING EXERCISE PLAY

In the case of a real event occurring during the exercise, PTWC, JMA/NWPTAC and SCSTAC will issue their normal message products for the event. Such messages will be given full priority and a decision will be made by each international centre whether to continue or cease their participation in the exercise. Smaller earthquakes that only trigger a Tsunami Information Statement will not disrupt the exercise.

Nationally, each country may suspend or terminate the exercise for their own reasons.

19. RESOURCING

Although participating countries will have advance notice of the exercise and may elect to stand up a special dedicated shift to allow normal core business to continue uninterrupted, it

is requested that realistic resource levels be deployed in order to reflect some of the issues that are likely to be faced in a real event.

20. MEDIA ARRANGEMENTS

The UNESCO Division of Public Information / Sector for External Relations and Public Information will issue an international Media Advisory one week before the development of the Exercise Pacific Wave 2018 providing details of the exercise. ICG/PTWS Member States should consider issuing at least one press release to their respective country's media. Member States' press releases will give adequate alert to their country's population and give their local media time to conduct interviews and documentaries with participating exercise organisations in advance of the exercise.

Annex IV contains a sample press release that can be customised by Member States. The sample press release is provided in English. Samples in other languages can be found at the PacWave18 website (http://www.pacwave.info).

ANNEX I

SCENARIOS

EARTHQUAKE LOCATION	PAST EVENT	ORIGIN TIME (UTC)	LATITUDE (POSITIVE= NORTH)	LONGITUDE (POSITIVE = EAST)	DEPTH (KM)	MAGNITUDE
Tonga Trench (Samoa Islands Region) 29 September 2009	*	1748:10	-15.489	-172.095	18	8.1
Peru-Chile Trench (Near Coast of Central Chile) 27 February 2010	*	0634:11	-36.122	-72.898	23	8.8
Japan Trench (Near Coast of Honshu, Japan) 11 March 2011	*	0546:24	38.297	142.373	29	9.1
South Solomon Trench, (Santa Cruz Islands, Solomon Islands) 6 February 2013	*	0112:25	-10.799	165.114	24	8.0
South Solomon Trench (Santa Cruz Islands, Solomon Islands)		0112:25	-10.799	165.114	24	9.0
Manila Trench		0100:00	14.4	119.5	30	8.8
Tonga Trench		0200:00	-20.0	-173.4	20	9.0

Table 1. Scenarios

*Actual historical event

ANNEX II

INTERNATIONAL MASTER SCHEDULE OF EVENTS LIST

Scenario	2009 Tonga Trench (M 8.1)		2010 Peru Chile (M 8.8)		2011 Japan Trench (M 9.1)				2013 South Solomon Trench (M 8.0) and (M 9.0) *Note: -/TS indicates M9.0 only products*				Manila Trench (M 8.8)						Tonga Trench (M 9.0)	
Centre	PTWC		PTWC		PTWC		NWPTAC		PTWC		NWPTAC		PTWC		NWPTAC		SCSTAC		PTWC	
Date & Time (UTC)	#	TYP	#	TYP	#	TYP	#	TYP	#	TYP 8.0/9.0	#	TYP	#	TYP	#	TYP	#	TYP	#	TYP
05 Nov 0000																				
0010																				
0100													Quake							
0107													01	TI						
0110																	01	TFR		
0112										Quake										
0118									01	TI/TI										
0120															01	TI				
0125											01	TI/TI								
0135													02	TFR			02	TFH		
0142									02	TFR/TFR										
0150															02	TFR				
0200									03	TS/TFP			03	TFP			03	TS	Quake	
0202											02	TFR/TFR								
0206																			01	TI
0230													04	TFH					02	TFR
0300									04	TS/TS	03	TS/TS	05	TS	03	TS	04	TS	03	TFP
0400									05	TS/TS	04	TS/TS	06	TS			05	TS	04	TS
0500									06	TS/TS			07	TS	04	TS	06	TS	05	TS
0546					Quake															
0552					01	TI														
0600									07	TS/TS	05	TS/TS	08	TS	05	TS	07	TS	06	TS
0601							01	TI												
0616					02	TFR														
0630					03	TFP														
0634			Quake																	
0636							02	TFR												
0640			01	TI																
0700			02	TFR	04	TS	03	TS	08	TS/TS	06	TS/TS	09	TS					07	TS
0730			03	TFP																
0800			04	TS	05	TS	04	TS	09	TS/TS			10	TS	06	TS	08	TS	08	TS
0900			05	TS	06	TS			10	TS/TS	07	-/TS	11	TS	07	TS			09	TS

Scenario	2009 Tonga Trench (M 8.1)		2010 Peru Chile (M 8.8)		2011 Japan Trench (M 9.1)				2013 South Solomon Trench (M 8.0) and (M 9.0) *Note: -/TS indicates M9.0 only products*				Manila Trench (M 8.8)						Tonga Trench (M 9.0)	
Centre	PTWC		PTWC		PTWC		NWPTAC		PTWC		NWPTAC		PTWC		NWPTAC		SCSTAC		PTWC	
1000			06	TS	07	TS	05	TS	11	TL/TS			12	TS			09	TS	10	TS
1100			07	TS	08	TS	06	TS	12	- /TS			13	TS	08	TS			11	TS
1200			08	TS	09	TS			13	-/TS	08	-/TS	14	TS	09	TS	10	TS	12	TS
1300			09	TS	10	TS	07	TS	14	-/TS			15	TS					13	TS
1400			10	TS	11	TS	08	TS	15	-/TS			16	TS	10	TS	11	TS	14	TS
1500			11	TS	12	TS			16	-/TS	09	-/TS	17	TS	11	TS			15	TS
1600			12	TS	13	TS	09	TS	17	-/TS			18	TS			12	TS	16	TS
1700			13	TS	14	TS	10	TS	18	-/TS			19	TL	12	TS	13	TL	17	TS
1748	Quake																			
1752	01	TI																		
1800			14	TS	15	TS			19	-/TS	10	-/TS							18	TS
1815	02	TFR																		
1840	03	TFP																		
1900	04	TS	15	TS	16	TS			20	-/TL									19	TL
2000	05	TS	16	TS	17	TS														
2100	06	TS	17	TS	18	TS	11	TS												
2200	07	TS	18	TS	19	TS	12	TS												
2300	08	TS	19	TS	20	TS														
6 Nov 0000	09	TS	20	TS	21	TS														
0100	10	TS	21	TS	22	TS														
0200	11	TS	22	TS	23	TS														
0300	12	TS	23	TS	24	TS														
0400	13	TS	24	TS	25	TS														
0500	14	TS	25	TS	26	TL														
0600	15	TL	26	TL																

Table 2. International Master Schedule of Events List

Message Types:

TI = PTWC/NWPTAC Initial Text Message

TFR = PTWC/NWPTAC/SCSTAC text Message with a Forecast for the Region near the Earthquake

TFP = PTWC Products with a Pacific-wide Forecast

TFH = PTWC Products with a Forecast for Shallow Marginal Seas (High-Resolution Forecast Model Run)

TS = PTWC/NWPTAC/SCSTAC Text Message with Tsunami Observations

TL = PTWC/SCSTAC Last Message for this Event

Note 1) A live communication test from the Tsunami Service Providers to Member States will be conducted at 0000 UTC on 5 November 2018.

Note 2) Participating countries may shift the schedule to adapt it to their own timetable.

ANNEX III

POST-EXERCISE EVALUATION

Exercise evaluation forms are to be completed by each participating agency and forwarded to the country Exercise Pacific Wave 2018 National Contact, or the country Tsunami National Contact (TNC). **The PacWave18 National Contact will compile the country Evaluation Form and complete and submit this online no later than 21 December 2018**.

Note: **Only ONE (1) on-line evaluation form is to be completed per country.** The PacWave18 National Contact, TNC, or Tsunami Warning Focal Point (TWFP) should compile sub-jurisdiction evaluations into one country evaluation to submit.

The PacWave18 Evaluation Form can be found at:
https://www.surveymonkey.com/s/pacwave18_eval

Alternatively, the country evaluation forms can be submitted by email to the Exercise Pacific Wave 2018 Task Team Chairs:

- Laura Kong (email: laura.kong@noaa.gov, or
- Jo Guard (email: jo.guard@dpmc.govt.nz)

EXERCISE PACIFIC WAVE 2018 Instructions on how to Complete this Evaluation Form		
STEP	WHO COMPLETES THIS STEP?	DESCRIPTION
1	Each participating Agency/Country	Decide if your agency/country will include additional evaluation questions for each objective. Country/agency evaluation questions can be added at the **end** of each section. However, do NOT change the reference numbers to the questions.
2	Each participating Agency/Country	Print this form and mark your evaluation answers on it.
3	Each participating Agency/Country	• Answer each statement with either Y (Yes), N (No). • Comments should be used to explain/expand upon your Yes or No answer • Write your comments on the page following the evaluation questions. Note the question number in the left column and write your comments alongside.
4	Each participating Agency/Country	Send completed agency evaluation form to country PacWave18 National Contact so he/she can compile to complete Country PacWave18 Evaluation Form (this URL).
5	PacWave18 National Contact	PacWave18 National Contact should complete and submit the PacWave18 Evaluation Form by **21 December 2018.** (https://www.surveymonkey.com/s/pacwave18_eval). If there are problems or questions, please contact the PacWave18 Task Team co-Chairs: Laura Kong, laura.kong@noaa.gov; or Jo Guard, jo.guard@dpmc.govt.nz

Exercise Pacific Wave 2018 Evaluation Form **Contact Details**			
Agency:		**Country:**	
Contact Name:		**Contact Position:**	
Contact Phone:		**Contact Mobile:**	
Contact E-Mail:			

Country Exercise Scenario	
Scenario Used:	**Tick Scenario used during PacWave18:** ○ 2009 Tonga Trench (M 8.1)

Country Exercise Scenario	
	○ 2010 Peru-Chile Trench (M 8.8) ○ 2011 Japan Trench (M 9.1) ○ 2013 South Solomon Trench (M 8.0) ○ Manila Trench (M 8.8) ○ South Solomon Trench (M 9.0) ○ Tonga Trench (M 9.0)

Country Exercise Scenario	
Reason Scenario Chosen:	**Tick the primary reason:** ○ Exercise Local Tsunami – rapid response ○ Exercise Distant Tsunami – long response ○ Exercise Destructive Tsunami ○ Exercise Non-Destructive Tsunami ○ Exercise Real Event ○ Other (please specify)
OBJECTIVE 1 *Test communications from the PTWC, NWPTAC, and/or SCSTAC Tsunami Service Providers to Member States/Countries.*	

Ref No	Evaluation Statements/Questions	Yes	No	Comment	Not applicable
1.1	Did your country Tsunami Warning Focal Point receive the PTWS, NWPTAC, and/or SCSTAC information/threat message?	*Y*	*N*	*C*	*NA*
1.2	If yes, please state which Tsunami Service Provider you received the information/threat message from: • PTWC • NWPTAC • SCSTAC	*Y*	*N*	*C*	*NA*
1.3	If you received an information/threat message, when did you receive the message(s)? • PTWC	Please state the time in UTC:			

Ref No	Evaluation Statements/Questions	Yes	No	Comment	Not applicable
	• NWPTAC • SCSTAC				
1.4	How did you receive the message(s)? • GTS • AFTN • EMWIN • Fax • Email • CISN (Real-Time Earthquake Display) • Other (Please specify):			Please tick methods	

.

Ref No	**Objective 1 Comments** *(Insert extra rows as required)*

OBJECTIVE 2

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

➔ **Objective 2a**

*To test **national** communication and cooperation within the country*

Ref No	Evaluation Statements/Questions	Yes	No	Comment	Not applicable
2.1	The warning was disseminated to: • Emergency services • Other national government agencies • Science agencies/universities involved in assessment • Local government: provincial/regional level • Local government: city/district level. • Public Please list number of destinations in Comments	*Y*	*N*	*C*	*NA*
2.2	What time was warning sent to the agency or agencies or Public listed in Q2.1? Please note the date and time using 24-hour clock and UTC, e.g., 5 Nov, 14:35 UTC.	*Insert time in UTC*			
2.3	How did you send the warning to emergency, national, science, and local government agencies in Q2.1? Tick all that apply. • Landline Telephone • Satellite Telephone • Cell or Mobile Phone • Fax • Email • SMS • Radio (UHF, VHF, Amateur) • Chatty Beetle • TV • Website • Twitter	*Y*	*N*	*C*	*NA*

OBJECTIVE 2
*To test **national** communication and cooperation, and readiness within the country.*
➔ **Objective 2a**
*To test **national** communication and cooperation within the country*

Ref No	Evaluation Statements/Questions	Yes	No	Comment	Not applicable
	• Facebook • RSS • Other (Please specify)				
2.4	How did you send the warning to the Public? Tick all that apply. • Landline Telephone • Satellite Telephone • Cell or Mobile Phone • Fax • Email • SMS • Radio (UHF, VHF, Amateur) • Chatty Beetle • TV • Website • Twitter • Facebook • RSS • Sirens • Public Announcement Systems (voice speakers) • Emergency cell / mobile phone broadcast • Police • Door-to-door announcements • Electronic billboards • Other (Please specify)				

Y *N* *C* *NA*

OBJECTIVE 2

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

➔ **Objective 2a**

*To test **national** communication and cooperation within the country*

Ref No	Evaluation Statements/Questions	Yes	No	Comment	Not applicable
2.5	Based on feedback from agencies, were the communication methods timely and appropriate?	*Y*	*N*	*C*	*NA*
2.6	Based on feedback from agencies, were the message(s) disseminated from the NTWC/NDMO accurate and clear?	*Y*	*N*	*C*	*NA*
2.7	Did the national disaster management organisation (or equivalent) maintain communication with the National Tsunami Warning Centre throughout the event?	*Y*	*N*	*C*	*NA*
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?	*Note answer in the comment box*			

Ref No	**Objective 2a Comments *(insert extra rows as required)***

➔ **Objective 2b**

*To test **national** readiness within the country.*

Ref No	Evaluation Statements/Questions	Yes	No	Comment	Not applicable
2.9	The NTWC/NDMO has an activation and response process (standard operating procedures) in place for the receipt of tsunami warnings.	*Y*	*N*	*C*	*NA*
2.10	The NTWC/NDMO knows its specific response role in the event of a tsunami.	*Y*	*N*	*C*	*NA*

➔ **Objective 2b**

*To test **national** readiness within the country.*

Ref No	Evaluation Statements/Questions	Yes	No	Comment	Not applicable
2.11	The NTWC/NDMO has, prior to the exercise, engaged in tsunami response planning.	Y	N	C	NA
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.) – List activities in Comments.	Y	N	C	NA
2.13	The NTWC/NDMO has an appropriate management structure identified and documented to support tsunami response.	Y	N	C	NA
2.14	The NTWC/NDMO has a national tsunami mass coastal evacuation plan.	Y	N	C	NA
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.	Y	N	C	NA
2.16	A country tsunami emergency response plan (standard operating procedures) for tsunamis exists. Tick all that apply • Local (less than 1 hour arrival time) • Regional (1-3 hours arrival time) • Distant (greater than 3 hours)	Y	N	C	NA
2.17	The response plan includes processes to issue Safe-to-Return (All-Clear) notices	Y	N	C	NA
2.18	Tsunami exercises are routinely conducted in-country. Please list last exercise, and type of exercise scenario (local, regional, distant) in Comments.	Y	N	C	NA
2.19	Tsunami-related public education and awareness materials have been developed and disseminated	Y	N	C	NA
2.20	Tsunami-related curriculum programmes are in place for all levels (pre, primary, secondary, post-secondary) of education. If No, please list which levels have programmes in Comments.	Y	N	C	NA
2.21	All tsunami-vulnerable communities have tsunami evacuation maps, signage, and	Y	N	C	NA

➔ **Objective 2b**

*To test **national** readiness within the country.*

Ref No	Evaluation Statements/Questions	Yes	No	Comment	Not applicable
	assembly points for evacuation? If No, please list number of communities with maps and signage, gaps, and future plans to fill gaps in Comments.				
2.22	What type of exercise did you conduct? • Orientation • Drill • Tabletop • Functional • Full Scale • Other (Please specify)	*Y*	*N*	*C*	*NA*
2.23	Did you conduct community evacuation? If Yes, what type? • Schools • Businesses • Community • Other (Please specify)	*Y*	*N*	*C*	*NA*
2.24	If you answered yes to Q2.23, approximately how many people were evacuated in total?	Insert total			

Ref No	**Objective 2b Comments** *(insert extra rows as required)*

OBJECTIVE 3

*To test **regional** communication and cooperation.*

Ref No	Evaluation Statements/Questions	Yes	No	Comment	Not applicable
3.1	Did your country engage in communication and cooperation with other countries in the region for PacWave18? If yes, please list countries in Comments				
3.2	What types of cooperation were conducted? • Data sharing (seismic, sea level, etc.) • Event information sharing • Alert coordination (levels, dissemination) • Joint PacWave18 exercise • Other (Please specify)				
3.3	Did the National Tsunami Warning Center communicate with other countries during the event? If Yes, please list countries				
3.4	Did the National Disaster Management Agency communicate with other countries during the event? If Yes, please list countries				
3.5	Was national information shared with other countries during the event? If Yes, please list				
3.6	What type of national information did you share? Tick all that apply. • Seismic phase arrival times • Earthquake hypocentre and/or magnitude • Tsunami Alert Level (such as Warning, Cancellation, etc.) • Tsunami Forecast • Tsunami Observations • Tsunami Evacuation				

OBJECTIVE 3

*To test **regional** communication and cooperation.*

Ref No	Evaluation Statements/Questions	Yes	No	Comment	Not applicable
	• Tsunami Impact • Other (Please specify)				
3.7	How did you communicate the information? • Radio (UHF, VHF, Amateur) • Landline Telephone • Satellite Telephone • Cell or Mobile Phone • Fax • Email • SMS • Chatty Beetle • Other (Please specify)				

Ref No	**Objective 3 Comments** *(insert extra rows as required)*

OBJECTIVE 4

Test whether the PTWS PTWC/NWPTAC/SCSTAC Tsunami Service Provider (TSP) products are interpreted by Member States accurately and in a timely manner.

Ref No	Evaluation Statements/Questions	Yes	No	Comment	Not applicable
4.1	Information provided by the relevant Tsunami Service Provider (TSP) products was understood by the National Tsunami Warning Centre (NTWC)/National Disaster Management Office (NDMO).	*Y*	*N*	*C*	*NA*

OBJECTIVE 4

Test whether the PTWS PTWC/NWPTAC/SCSTAC Tsunami Service Provider (TSP) products are interpreted by Member States accurately and in a timely manner.

Ref No	Evaluation Statements/Questions	Yes	No	Comment	Not applicable
4.2	How did your country assess the tsunami threat during the exercise? Please tick as many as apply: • National tsunami experts • National tsunami coordination committee • National tsunami historical database • NCEI/WDS tsunami historical database (web) • TsuDig historical database GIS tool (NCEI/ITIC offline) • TsuCAT Tsunami Coastal Assessment Tool – pre-computed tsunami scenarios from NOAA Propagation Database (PMEL/ITIC offline) • National pre-computed tsunami scenarios • National tsunami forecasts • Tsunami Service Provider forecasts. List source of forecasts (PTWC, NWPTAC, SCSTAC, US NTWC) in Comments. • Communication with outside sources (such as ITIC, media, other) (Please specify)				
4.3	The information provided assisted with decision making, e.g., warning levels, earthquake parameters, estimated arrival times, forecast wave heights, etc.				
4.4	The information issued by our country national Tsunami Warning Focal Point was according to standard operating procedures.				
4.5	Do you require additional training on the use of the TSP products for national threat level decision-making. Tick TSP training requested • PTWC products • NWPTAC products				

OBJECTIVE 4

Test whether the PTWS PTWC/NWPTAC/SCSTAC Tsunami Service Provider (TSP) products are interpreted by Member States accurately and in a timely manner.

Ref No	Evaluation Statements/Questions	Yes	No	Comment	Not applicable
	• SCSTAC products	☐	☐	☐	☐

Ref No	Objective 4 Comments *(insert extra rows as required)*

OBJECTIVE 5

Validate the format and content of the Northwest Pacific Tsunami Advisory Center (NWPTAC) Enhanced Products (if applicable for your country).

Ref No	Evaluation Statements/Questions	Yes	No	Comment	Not applicable
5.1	Information provided in the Northwest Pacific Tsunami Advisory Center (NWPTAC) messages was understood by and useful to the National Tsunami Warning Centre (NTWC)/National Disaster Management Office (NDMO)	☐ *Y*	☐ *N*	☐ *C*	☐ *NA*
5.2	Threat information in NWPTAC products was understood and useful. Please comment as necessary. • Text products • Graphical products	☐ *Y*	☐ *N*	☐ *C*	☐ *NA*
5.3	Components of the NWPTAC product suite were understood and useful. Please comment as necessary on product clarity or confusion.	☐ *Y*	☐ *N*	☐ *C*	☐ *NA*
5.4	The information provided assisted with decision making, e.g. warning levels, earthquake parameters, estimated arrival times, forecast wave heights, etc.	☐ *Y*	☐ *N*	☐ *C*	☐ *NA*

Ref No	**Objective 5 Comments** *(insert extra rows as required)*

OBJECTIVE 6

Evaluate the format and content of the South China Sea Tsunami Advisory Centre (SCSTAC) Enhanced Products (if applicable for your country).

Ref No	Evaluation Statements/Questions	Yes	No	Comment	Not applicable
6.1	Information provided in the South China Sea Tsunami Advisory Centre (SCSTAC) messages was understood by and useful to the National Tsunami Warning Centre (NTWC)/National Disaster Management Office (NDMO)	*Y*	*N*	*C*	*NA*
6.2	Threat information in SCSTAC products was understood and useful. Please comment as necessary. • Text products • Graphical products	*Y*	*N*	*C*	*NA*
6.3	Components of the SCSTAC product suite were understood and useful. Please comment as necessary on product clarity or confusion.	*Y*	*N*	*C*	*NA*
6.4	The information provided assisted with decision making, e.g. warning levels, earthquake parameters, estimated arrival times, forecast wave heights, etc.	*Y*	*N*	*C*	*NA*

Ref No	**Objective 6 Comments** *(insert extra rows as required)*

GENERAL EXERCISE OBSERVATIONS

Provide feedback on the planning and conduct of PacWave18

Please also provide information on your country's exercise.

- Include electronic links to Media Coverage in Comments section.
- Send summaries, photos and videos directly to the PTWS Technical Secretary (Bernardo Aliaga, b.aliaga@unesco.org) and PacWave18 Chairs (Laura Kong, laura.kong@noaa.gov, Jo Guard, jo.guard@dpmc.govt.nz)

Evaluation Statements / Questions. Indicate Yes or No	**Yes**	**No**
Overall assessment		
Country stakeholder agencies have a better understanding of the goals, responsibilities 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 (Please provide electronic links if applicable in Comments).		
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	Estimated number	
Exercise planning (please make comments on the following page to all of the statements below)		
Overall, the exercise planning, conduct, format and style were satisfactory.		
Exercise planning at the international level went well.		
Exercise planning at the national level went well.		
Exercise planning at the provincial/local level went well.		
The PacWave18 exercise website pages were useful.		
This evaluation form was easy to use.		
PacWave18 Exercise Manual provided an appropriate level of detail.		
IOC Manual & Guides 76: Plans and Procedures for Tsunami Warning and Emergency Management was useful.		
IOC Manual & Guides 58: How to Plan, Conduct, and Evaluate IOC Tsunami Wave Exercises was useful.		

Please provide a general statement on your Exercise Pacific Wave 2018 experience.

Exercise Planning

Please provide a general statement about **what went well**.
Insert comments

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

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

Exercise Conduct

Please provide a general statement about **what went well**.
Insert comments

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

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

Exercise Debrief or Evaluation

Please provide a general statement about **what went well**.
Insert comments

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

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

ANNEX IV

SAMPLE PRESS RELEASE

TEMPLATE FOR NEWS RELEASE

USE AGENCY MASTHEAD

Contact: (insert name)
(insert phone number)
(insert email address)

FOR IMMEDIATE RELEASE
(insert date)

EIGHTH PACIFIC TSUNAMI DRILL SET FOR SEPTEMBER TO NOVEMBER 2018

(Insert country name) will join over [insert number] countries around the Pacific Rim as a participant in a mock tsunami scenario during September to November 2018. The purpose of this Pacific-wide exercise is to exercise country tsunami decision-making procedures and communication systems and processes. It will also provide an opportunity for those countries that receive products from the Northwest Pacific Tsunami Advisory Center (NWPTAC) in Japan and the South China Sea Tsunami Advisory Center (SCSTAC) in China to assess new experimental enhanced forecast products, including tsunami wave forecasts that enable each country to better assess its own tsunami threat. Additionally, the Pacific will conduct a live communication test from its Tsunami Service Providers (PTWC, NWPTAC, SCSTAC) to countries on 5 November 2018, World Tsunami Awareness Day.

"The events of the 2009 Samoa Islands Region, 2010 Chile, 2011 Japan, and the February 2013 Solomon Islands tsunamis have increased our need to be more prepared for such events," said (insert name of appropriate official). "This important exercise will validate the enhanced products for future official use by countries of the Pacific Tsunami Warning and Mitigation System.

The exercise, titled Exercise Pacific Wave 2018 (PacWave18), will simulate Pacific countries being put into a Tsunami Warning situation requiring government decision-making (and community action [insert what is to be done in your country]. It is the eighth such exercise with the first having been carried out in May 2006, and subsequent exercises held in October 2008, November 2011, May 2013, February 2015, February 2016 and February 2017.

Participating countries will select from seven different Pacific scenarios based on real events and conduct at least a Tabletop Exercise within the period of September to November. Destructive Pacific-wide tsunamis will be simulated through tsunami information messages from the Pacific Tsunami Warning Center in Hawaii, NWPTAC in Japan, and the SCSTAC in China, and then reviewed by focal points designated by each country that are responsible for their country's tsunami response.

Insert paragraph tailored for specific country. Could identify participating agencies and specific plans. Could describe current early warning program, past evacuation drills (if any), ongoing mitigation and public education programs, etc. Could describe tsunami threat, history of tsunami hazards, if any.

The exercise is sponsored by UNESCO's Intergovernmental Oceanographic Commission through its Intergovernmental Coordination Group of the Pacific Tsunami Warning and Mitigation System (ICG/PTWS).###

On the Web:

Exercise Pacific Wave 2018 information site: http://www.pacwave.info

Media Resources:
http://itic.ioc-unesco.org/index.php?option=com_content&view=category&layout=blog&id=1150&Itemid=1150

Pacific Tsunami Warning and Mitigation System:
http://www.ioc-tsunami.org/index.php?option=com_content&view=article&id=11&Itemid=12&lang=en

Pacific Tsunami Warning Center: http://www.tsunami.gov

Northwest Pacific Tsunami Advisory Center:
http://www.data.jma.go.jp/svd/eqev/data/nwptac/index.html

US National Tsunami Warning Center: http://www.tsunami.gov

South China Sea Tsunami Advisory Center: http://www.scstac.org

[Insert country URLs]

ANNEX V

LIST OF ACRONYMS

CL	Circular letter
DISCEX	Discussion Exercise' or Tabletop Exercise
ICG	Intergovernmental Coordination Groups
ICG/IOTWMS	Intergovernmental Coordination Group for the Indian Ocean Tsunami Warning and Mitigation System
ICG/ITSU	International Coordination Group for the Tsunami Warning System in the Pacific
ICG/PTWS	Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System (formerly ITSU)
IOC	Intergovernmental Oceanographic Commission (of UNESCO)
ITIC	International Tsunami Information Center (UNESCO/IOC–NOAA)
JMA	Japan Meteorological Agency
MSEL	Master Schedule of Events List
MTS	Medium-term strategy:
NDMO	National Disaster Management Office
NOAA	National Oceanic & Atmospheric Administration (USA)
NTWC	National Tsunami Warning Centre
NWPTA	Northwest Pacific Tsunami Advisory
NWPTAC	Northwest Pacific Tsunami Advisory Center (Japan)
PTWC	Pacific Tsunami Warning Center (USA)
SCSTAC	South China Sea Tsunami Advisory Center (China)
SOA	China State Oceanic Administration
SOP	Standard Operating Procedures
TOWS-WG	Working Group on Tsunamis and Other Hazards related to Sea-Level Warning and Mitigation Systems
TT	Task Team
TNC	Tsunami National Contact
TWFP	Tsunami Warning Focal Point
UNESCO	United Nations Educational, Scientific & Cultural Organization
US NTWC	US National Tsunami Warning Center (USA)
WG	Working Group

IOC Technical Series

No.	Title	Languages
1	Manual on International Oceanographic Data Exchange. 1965	(out of stock)
2	Intergovernmental Oceanographic Commission (Five years of work). 1966	(out of stock)
3	Radio Communication Requirements of Oceanography. 1967	(out of stock)
4	Manual on International Oceanographic Data Exchange - Second revised edition. 1967	(out of stock)
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EXERCISE PACIFIC WAVE 18

A Pacific-wide Tsunami Warning and Enhanced Products Exercise

1 September–30 November 2018

Volume 2 Summary Report

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EXERCISE PACIFIC WAVE 18

A Pacific-wide Tsunami Warning and Enhanced Products Exercise

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Volume 2 Summary Report

UNESCO 2019

IOC Technical Series, 139 (Volume 2)
Honolulu and Paris 2019
English only

For bibliographic purposes, this document should be cited as follows:

UNESCO/IOC. 2019. *Exercise Pacific Wave 18. A Pacific-wide Tsunami Warning and Enhanced Products Exercise, 1 September-30 November 2018.*Volume 2*.* Paris*,* UNESCO. (IOC Technical Series No 139 Vol.2)

Report prepared by: The Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System (ICG/PTWS)
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International Tsunami Information Center (ITIC)
New Zealand Ministry of Civil Defence & Emergency Management

Published in 2019
by United Nations Educational, Scientific
and Cultural Organization
7, Place de Fontenoy, 75352 Paris 07 SP

(IOC/2018/TS/139 Vol.2)

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1. EXECUTIVE SUMMARY

Most of the world's earthquakes and tsunamis occur in the Pacific Ocean and its marginal seas. Over history, 70% of the world's fatal tsunamis have occurred in this basin. 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.

Exercise Pacific Wave 2018 (PacWave18) is the eighth Pacific-wide drill in a regular schedule of Pacific exercises. PacWave18 provided a valuable opportunity for Pacific countries to test the new products (where relevant), review their tsunami response procedures, test internal and external communication systems, and engage with communities through public education activities. Regular exercises are important for maintaining staff readiness in case of a real event. This is especially true for tsunamis, which are infrequent, but when they occur, require a rapid response.

A total of 26 countries (including 3 sub-national entities) participated in the exercise. The strong majority of responding countries expressed a positive view of the planning and conduct of PacWave18. Exercise objectives were exercised, evaluated and reported, thus enabling PTWS lessons to be identified and a number of recommendations have been made to improve readiness and response to a damaging tsunami. PacWave18 provided valuable feedback from countries on the Enhanced Products of the Northwest Pacific Tsunami Advisory Center (NWPTAC) of the Japan Meteorological Agency (JMA) and the South China Sea Tsunami Advisory Center (SCSTAC) of the China State Oceanic Administration (SOA).

The findings from PacWave18 are as follows:

- The majority of respondents indicated that the initial message was received in a timely manner from the Tsunami Service Providers. The majority of countries received the message by email and/or by fax.

- The majority of respondents agreed that the format and content of the Pacific tsunami Warning Center (PTWC), NWPTAC, and SCSTAC Tsunami Service Provider (TSP) products were clear and easy to understand. Some suggestions for improvements were made.

- The majority of respondents indicated the National Tsunami Warning Centres (NTWCs) and National Disaster Management Offices (NDMOs) understand the content of the TSP products.

- All respondents indicated that the NTWC/NDMO knows its specific response role in the event of a tsunami and the majority of respondents agreed that the NTWC/NDMO has an activation and response process in place for when tsunami warnings are received.

- The majority of respondents used Tsunami Service Provider forecasts and national tsunami resources (pre-computed scenarios, experts, and forecasts) to assess their tsunami threat. Most of the respondents had arrangements in place to assemble these experts before the exercise.

- A number of Member States indicated that they would like further training on the use of Tsunami Service Provider products for national threat level decision making.

- Half of respondents indicated that tsunami-related curriculum programmes are in place at all levels of education. The comments revealed that many respondents did have some programmes in place, though not for all educational levels.

- Only a small number of respondents indicated that all tsunami-vulnerable communities have tsunami evacuation maps, signage and assembly points for evacuation, however, the comments revealed that many communities have some of elements in place, and that countries have plans in place to undertake these activities for more communities.

- Few respondents engaged in communication and cooperation with other countries in the region for PacWave18.

- Of the 26 participating countries and sub national entities, few actually used a real event scenario (despite the recommendation made by the Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System (ICG/PTWS) at its 27th meeting in Tahiti in 2017 to use real event scenarios to support finding gaps using past events records).

- Overall, respondents indicated that stakeholder agencies now have a better understanding of their goals, responsibilities and roles in tsunami emergencies.

- The majority of respondents indicated that exercise planning, conduct, format and style were satisfactory and that exercise planning at the national level went well. There is some room for improvement in exercise planning at both the international level, and at the provincial/local levels.

- The majority of respondents indicated the PacWave18 website pages were useful and the evaluation form was easy to use. The PacWave18 Exercise Manual (IOC/2018/TS/139 Vol.1 Rev.2) and the document *How to plan, conduct and evaluate UNESCO/IOC tsunami wave exercises* (IOC/2012/MG/58 Rev.) were all found to be useful by the majority of exercise participants.

- The majority of participating countries agreed that NWPTAC messages were understood and useful (including the graphical products), and that these assisted with decision making.

- Participating countries agreed and sub-national entities that SCSTAC messages were understood and useful (including the graphical products), and that these assisted with decision making.

2. INTRODUCTION

2.1 HISTORICAL TSUNAMIS

Over the last 3 600 years, there have been 252 fatal tsunamis and more than 540,000 deaths. The worst catastrophe in history took place the 26 December 2004 in Sumatra, Indonesia, when a tsunami killed 228,000 people in 14 Indian Ocean countries and caused US$10 billion in damages. The Pacific Ocean and its marginal seas, however, are where 70% of the world's tsunamis occur. For tsunamis in the Pacific, 31% have occurred in Japan, 21% in South Pacific Islands, 10% in North and Central America, 10% in South America, 7% each in Russian Federation, Asia, and Indonesia (Pacific Coast and marginal seas), 6% in Alaska, and 1% in Hawaii; 99% of the deaths were caused by local tsunamis. Since 81% of the tsunamis are generated by shallow great earthquakes, shaking and damage from the earthquake is the first hazard to address before the tsunami arrives.

Between 1980 and 2018 there were 37 local or regional tsunamis that resulted in nearly 254,639 deaths and billions of dollars in property damage; the source of 25 of these was located in the Pacific and adjacent seas. Over the past ten years (2009–2018), there has been

13 deadly tsunamis, with six of the seven occurring in the Pacific and causing casualties locally where the first waves arrived within a few to 30 minutes.

On 29 September 2009, Samoa, American Samoa, and Tonga were hit by a deadly tsunami that was the largest since the 1998 Sissano, Papua New Guinea, event. Altogether, 192 lives were lost locally. This was followed, five months later by the 27 February 2010 Chile tsunami where 156 lives were lost. And one year later, the Pacific and the world watched the 11 March 2011 Japan tsunami devastate the Honshu coastlines within 30 minutes claiming 18,434 lives. On 6 February 2013, a local tsunami was generated by a powerful 8.0-magnitude earthquake that struck near the town of Lata, on Santa Cruz in Temotu, the eastern-most province in the Solomon Islands, killing 10 people and damaging or destroying five villages. On 15 September 2015, a magnitude 8.5 earthquake triggered a tsunami, inundating the region nearby its epicentre, Coquimbo, Chile, and killing eight people.

On 28 September 2019, a tsunami triggered by strike-slip earthquake faulting and ensuing small landslides hit Donggala, Palu City, and Sigi along Makassar Strait between the Java and Celebes Seas in Indonesia killing 2,081 persons with 1,039 missing or presumed buried by extreme liquefaction caused the earthquake shaking. And finally, on 22 December 2018, a tsunami followed an eruption and partial collapse of the Anak Krakatau volcano in the Sunda Straits, killed at least 426 people on the adjacent shores between the Indian Ocean and Java Sea.

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) in 1965 in response to the 1960 magnitude 9.5 earthquake off the coast of Chile that generated a tsunami killing 2,000 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 warnings, and advocate for comprehensive national programmes in hazard assessment, warning guidance, and preparedness (*ITSU Master Plan*, *2004* [IOC/INF.1124], *PTWS Medium-Term Strategy 2014–2021* [IOC/2013/TS/108], *PTWS Implementation Plan 2013, v. 4* [IOC/2010/TS/86]). In 2005, ITSU was re-established as the Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System (ICG/PTWS).

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 Pacific. Because of the Pacific's large size, several regional Tsunami Service Providers have been, or are being, established in order to improve the timeliness and threat assessment accuracy of especially regional events.

In response to Member State requests for additional regional information, Japan began operation of its Northwest Pacific Tsunami Advisory Center (NWPTAC) in March 2005, and in April 2006 expanded on an interim basis to the South China Sea in cooperation with the PTWC. In 2015 following the October 2014 changeover of PTWC to its Enhanced Products, the NWPTAC commenced the development of its Enhanced Products, and these were evaluated during Exercise Pacific Wave 2016 (IOC/2015/TS/126 Vol.1 and 2) and 2017 (IOC/2016/TS/131 Vol.1 and 2) by NWPTAC customers. On 20 December 2017, the NWPTAC began issuing its experimental products in parallel with its existing products. After one year of shadow operations, including Exercise Pacific Wave 2018, JMA switched to its Enhanced Products on 28 February 2019. Coverage was also extended to 170 degree E and coverage of Papua New Guinea and the Solomon Islands in the South. As of February 2019, the NWPTAC has issued advisories for 248 events since it started the service in March 2005, and 17 events since it began issuing Enhanced Products in December 2017.

In 2013, Member States approved the proposal for the South China Sea Tsunami Warning and Mitigation System, and the establishment of the South China Sea Tsunami Advisory Center (SCSTAC) hosted by China. The SCSTAC services countries bordering the South China Sea, Sulu Sea, and Celebes Sea. The SCSTAC began issuing trial products on 26 January 2018.

2.3 INTERNATIONAL TSUNAMI EXERCISES

A Pacific-wide tsunami exercise is an effective tool for evaluating the readiness of PTWS countries and to identify 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 Teams with strong contributions from the International Tsunami Information Center (ITIC), the Pacific Tsunami Warning Center (PTWC), and the Japan Meteorological Agency (JMA). Altogether there have been eight IOC-coordinated international exercises, Exercise Pacific Wave 2006, 2008, 2011, 2013, 2015, 2016, 2017 and 2018.

The exercises, using a number of Pacific scenarios and accompanied by tsunami message products from the Pacific Tsunami Warning Center, Japan Northwest Pacific Tsunami Advisory Center, the US National Tsunami Warning Center (formerly West Coast and Alaska Tsunami Warning Center), and the South China Sea Tsunami Advisory Center (SCSTAC) have been used to evaluate the effectiveness of the System and measure the readiness of countries to respond as national tsunami warning centres and emergency response agencies, and the public, to distant and local tsunamis.

Exercise Pacific Wave 2011, 2013, and 2015 were additionally used to introduce and obtain feedback, test, and validate the PTWC new 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 Enhanced Products are 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.

3. EXERCISE PACIFIC WAVE 2018

3.1 OVERVIEW

At its 27th session, the Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System (ICG/PTWS-XXVII, Tahiti, France 28–31 March 2017) approved the conduct of Exercise Pacific Wave 2018 (PacWave18) during the last quarter of 2018.

The exercise intended to encourage country and regional readiness for the next tsunami, and support the development of improved regional tsunami products and procedures, including new products from the Northwest Pacific Tsunami Advisory Center (NWPTAC) of the Japan Meteorological Agency (JMA), and the South China Sea Tsunami Advisory Center (SCSTAC) of the China's Ministry of Natural Resources (MNR).

PacWave18 was overseen by the 'Task Team on PacWave Exercises'. Detailed PacWave18 information was made available at the exercise web site http://www.pacwave.info.

3.2 COUNTRY PARTICIPATION

A total of 26 countries (including 3 sub-national entities) participated in Exercise Pacific Wave 2018 (PacWave18). A summary compiling the exercise evaluation responses is provided at Annex III. Pacific countries and sub-national jurisdictions that participated and submitted post-exercise evaluation forms were:

• Australia	• Brunei Darussalam
• Chile	• China
• China (Hong Kong)	• Colombia
• Costa Rica	• Ecuador
• El Salvador	• Fiji
• France (New Caledonia, Wallis and Futuna)	• France (French Polynesia)
• Malaysia	• Mexico
• New Zealand	• Nicaragua
• Panama	• Peru
• Philippines	• Russian Federation
• Samoa	• Singapore
• Solomon Islands	• Thailand
• Viet Nam	• Tonga

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

4. CONCEPT OF THE EXERCISE

4.1 PURPOSE

The purpose (aim) of Exercise PacWave18 was to test country preparedness arrangements, and operational procedures to respond and recover from a destructive tsunami, especially at the community level.

The exercise provided an opportunity for Pacific countries to test the new products (where relevant), review their tsunami response procedures, test internal and external communication systems, and engage with communities through public education activities. Regular exercises are important for maintaining staff readiness in case of a real event. This is especially true for tsunamis, which are infrequent, but when they occur, require a rapid response. Every Pacific country was encouraged to participate.

4.2 OBJECTIVES

The overall objectives for Exercise PacWave18 were to:

- Test communications from the PTWC, NWPTAC, and SCSTAC Tsunami Service Providers to Member States.
- Test national communication and cooperation, and readiness within the country.
- Test regional communication and cooperation between Member States.
- Test whether the PTWC, NWPTAC, and/or SCSTAC Tsunami Service Provider products are interpreted by Member States accurately and in a timely manner.

- Validate the format and content of NWPTAC Enhanced Products *(only applicable to relevant countries).*

- Evaluate the format and content of the SCSTAC Enhanced Products *(Only applicable to relevant countries).*

Each country was given the opportunity to expand and/or customise its own objectives for the exercise.

4.3 EXERCISE CONCEPT

For PacWave18, participating countries selected a relevant scenario and its most convenient date and time to conduct the exercise within the 1 September–30 November 2018 time period. Participating countries were able to amend the exercise messages to suit their own timetable.

All international products were provided online at the Exercise PacWave18 website (http://www.pacwave.info) in advance to help countries plan and prepare.

All documentation and correspondence relating to this exercise was to be clearly identified as **Exercise Pacific Wave 18** and **For Exercise Purposes Only**.

Each country was also welcomed to modify estimated arrival times or estimated wave amplitudes to suit their preference; for example, to have the arrival of tsunami sooner and with a larger amplitude.

4.4 COMMUNICATIONS TEST

In order to test communications from the Tsunami Service Providers to each Member State, one live message was issued for PacWave18. The live test occurred at 0000 UTC on 5 November 2018. 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.

4.5 EXERCISE DATE

Exercise PacWave18 was held within the period of 1 September–30 November 2018. Participating countries could choose to run their exercise any time during this period, allowing flexibility to avoid conflict with other important national events.

PacWave18 simulated Pacific countries receiving Tsunami Threat messages containing wave amplitude forecasts. Member States could then use the information in their decision making to assess their national threat and to simulate creating and disseminating alerts. Countries were encouraged to engage communities at the local level and it was recommended to be conducted at least as a table-top exercise.

All products were available prior to the exercise dates on the PacWave18 website (http://www.pacwave.info).

4.6 SCENARIOS

PacWave18 included seven scenarios to enable all Member States to select a distant, regional or local event that would impact their country. Countries were asked to choose only one scenario to exercise. Exercise scenarios included past historical events: the 2009 Tonga Trench (Samoa Islands Region), 2010 Peru-Chile Trench (near the coast of central Chile), 2011 Japan Trench (near the coast of Honshu), and 2013 South Solomon Trench (Santa Cruz

Islands) tsunamis, and hypothesized scenarios for the Manila Trench, South Solomon Trench, and Tonga Trench.

The date used for all scenario documentation in PacWave18 was 5 November 2018 to coincide with World Tsunami Awareness Day. For historical events, the earthquake origin time was the actual time the earthquake occurred, and actual tsunami observations that were reported by the TSPs, with marigrams for stations observing the tsunami also created.

The exercise required the evaluation of PTWC and, as applicable, the NWPTAC and/or the SCSTAC enhanced products, issuance of appropriate country specific alerts by National Tsunami Warning Centres, and decision-making, including steps taken just prior to public notification. Member States were encouraged to engage with communities at the local level as part of the exercise.

Member States were also encouraged to engage in communication and coordination activities, such as through a joint exercise, with nearby jurisdictions and countries in the region.

4.7 EXERCISE TYPE

It was recommended that, if possible, Exercise PacWave18 be carried out as a functional exercise with community engagement, or at a minimum, be carried out in a table-top format (also referred to as a 'discussion exercise', or 'DISCEX').

4.8 EXERCISE DOCUMENTATION

It was recommended to participating agencies that they take into account the following Exercise PacWave18 documents when planning, conducting, and evaluating the exercise:

- IOC Circular Letter, 2709: Pacific Tsunami Warning and Mitigation System (PTWS) Exercise Pacific Wave 2018 (PacWave18), during the period 1st September to 30 November 2018, issued 22 January 2018 (CL-2709)

- Exercise Pacific Wave 2018, A Pacific-wide Tsunami Warning and Enhanced Products Exercise, 1 September-30 November 2018. Exercise Manual, Volume 1. UNESCO/IOC, IOC Technical Series No 139. (English)

- User's Guide for the Pacific Tsunami Warning Center enhanced products for the Pacific Tsunami Warning System. UNESCO/IOC, IOC Technical Series No 105, Revised edition, 2014. (English, Spanish)

- Users' Guide for the Northwest Pacific Tsunami Advisory Center Enhanced Products for the Pacific Tsunami Warning System. UNESCO/IOC, IOC Technical Series No 142, 2019. (English)

- Tsunami Advisory Products for the South China Sea Regional Tsunami Warning and Mitigation System, Technical Document, October 2017

- Operational Users Guide for the Pacific Tsunami Warning and Mitigation System (PTWS), (IOC/2011/TS/87rev), rev August 2011 (English).

All information related to Exercise PacWave18 is available at the exercise website: http://www.pacwave.info .

5. EVALUATION

5.1 EVALUATORS

Participating countries were required to appoint their own exercise evaluators to observe and evaluate selected objectives during their exercise. It was recommended that evaluators be subject matter experts in the field they are evaluating, such as in warning centre operations, emergency response, or in specific agency areas of responsibility.

5.2 OBSERVERS

The invitation of internal or external agency personnel to view the exercise was the responsibility of each participating country.

5.3 EVALUATION TOOLS

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 by participating countries. At the international level, this involves the ICG/PTWS as the Intergovernmental Coordinating Group supporting effective tsunami warning and decision making.

Evaluation of Exercise PacWave18 focused on the adequacy of plans, policies, procedures, assessment capabilities, communication, resources and inter-agency/inter-jurisdictional relationships that support effective tsunami warning and decision-making at all levels of government. The evaluation tool aimed to inform and facilitate individual participant country evaluations as well as the Exercise PacWave18 Summary Report.

All participating countries were asked to complete the official Exercise PacWave18 Evaluation Form **(Annex II) by 21 December 2018**. Forms were submitted online by visiting https://www.surveymonkey.com/s/pacwave18_eval.

6. POST-EXERCISE EVALUATION FINDINGS

A total of 26 countries (including 3 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 III. The strong majority of responding countries expressed a positive view of the planning and conduct of PacWave18. Exercise 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. PacWave18 reinforced the integration of TSP products in participant country decision-making processes, and in their Standard Operating Procedures (SOPs).

Countries continue to find TSP forecast products timely, clear and useful. Countries generally understood the products and viewed them as adding important advice to guide them in providing more accurate national warnings. For many respondents, the TSP forecast advice is a key part of their decision-making processes.

Although all countries have now implemented the TSP products into their national processes and procedures, there is still an ongoing need for continued training and exercising as countries technological abilities are developed and new staff is introduced.

The findings from PacWave18 are as follows:

- The majority of respondents indicated that the initial message was received in a timely manner from the Tsunami Service Providers. The majority of countries received the message by email and/or by fax.
- The majority of respondents agreed that the format and content of the PTWC, NWPTAC, and SCSTAC Tsunami Service Provider (TSP) products were clear and easy to understand. Some suggestions for improvements were made.
- The majority of respondents indicated the National Tsunami Warning Centres (NTWCs) and National Disaster Management Offices (NDMOs) understand the content of the TSP products.
- All respondents indicated that the NTWC/NDMO knows its specific response role in the event of a tsunami and the majority of respondents agreed that the NTWC/NDMO has an activation and response process in place for when tsunami warnings are received.
- The majority of respondents used Tsunami Service Provider forecasts and national tsunami resources (pre-computed scenarios, experts, and forecasts) to assess their tsunami threat. Most of the respondents had arrangements in place to assemble these experts before the exercise.
- A number of Member States indicated that they would like further training on the use of Tsunami Service Provider products for national threat level decision making.
- Half of respondents indicated that tsunami-related curriculum programmes are in place at all levels of education. The comments revealed that many respondents did have some programmes in place, though not for all educational levels.
- Only a small number of respondents indicated that all tsunami-vulnerable communities have tsunami evacuation maps, signage and assembly points for evacuation; however, the comments revealed that many communities have some of elements in place, and that countries have plans in place to undertake these activities for more communities.
- Few respondents engaged in communication and cooperation with other countries in the region for PacWave18.
- Of the 26 participating countries and sub national entities, few actually used a real event scenario (despite the recommendation made by the ICG/PTWS at its 27th meeting in Tahiti in 2017 to use real event scenarios to support finding gaps using past events records).
- Overall, respondents indicated that stakeholder agencies now have a better understanding of their goals, responsibilities and roles in tsunami emergencies.
- The majority of respondents indicated that exercise planning, conduct, format and style were satisfactory and that exercise planning at the national level went well. There is some room for improvement in exercise planning at both the international level, and at the provincial/local levels.
- The majority of respondents indicated the PacWave18 website pages were useful and the evaluation form was easy to use. The PacWave18 Exercise Manual and the IOC Manual and Guides 58 were all found to be useful by the majority of exercise participants.

PTWC, NWPTAC and SCSTAC message dissemination summaries can be found in the International Master List of Events table available in Annex I.

Findings for the Northwest Pacific Tsunami Advisory Center (NPTWC)

Countries covered by the NWPTAC:

Brunei Darussalam	Russian Federation
China (including Hong Kong)	Samoa
France (French Polynesia)	Singapore
Indonesia	Solomon Islands
Malaysia	Republic of Korea
Papua New Guinea	Viet Nam

- Ten countries that receive NWPTAC products participated in Exercise PacWave18. Nine received products from NWTPAC.
- The majority of participating countries agreed that NWPTAC messages were understood and useful (including the graphical products), and that these assisted with decision making.

Findings for the South China Sea Tsunami Advisory Center (SCSTAC)

Countries covered by the SCSTAC:

Brunei Darussalam	Philippines
Cambodia	Singapore
China: Hong Kong	Thailand
Indonesia	Viet Nam
Malaysia	

Exercise Pacific Wave 2018 was successfully conducted in the South China Sea (SCS). Seven countries and one sub national entity participated; two countries did not. The communication and enhanced products were tested during the exercise.

Findings for communication methods for disseminating messages:

- Not all participating countries and sub national entities were able to receive the products by every SCSTAC communication method. There are still some issues with some communication channels from SCSTAC to SCS countries and sub national entities. GTS is absent and needs to be online in future. Therefore, routine communication test is very necessary in order to confirm that Member States can receive information in a timely manner.
    - All participating countries and sub national entities received products from SCSTAC with the exception of the Philippines. However, Philippines did receive PTWC products.
    - Not all participating countries and sub national entities were able to receive the products by fax and email. Malaysia only received via email, and Singapore only through fax.

- SCSTAC sent products to 23 fax numbers in total, with 10 successes and 13 failures. Each Member State received products via this method except Cambodia, Indonesia, Philippines and Viet Nam.

- SCSTAC sent products to 35 email addresses in total, with 28 successes and 7 failures. Each Member State received products via this method except Cambodia.

Findings for the understanding of the SCSTAC enhanced products:

- Participating countries agreed that SCSTAC messages were understood and useful (including the graphical products), and that these assisted with decision making.

- It is important to continue tsunami disaster awareness and public education so that communities and the media understand the right action to take in a tsunami.

ANNEX I

INTERNATIONAL MASTER SCHEDULE OF EVENTS LISTS

Scenario	2009 Tonga Trench (M 8.1)		2010 Peru Chile (M 8.8)		2011 Japan Trench (M 9.1)				2013 South Solomon Trench (M 8.0) and (M 9.0) *Note: -/TS indicates M9.0 only products*				Manila Trench (M 8.8)						Tonga Trench (M 9.0)	
Centre	PTWC		PTWC		PTWC		NWPTAC		PTWC		NWPTAC		PTWC		NWPTAC		SCSTAC		PTWC	
Date & Time (UTC)	#	TYP	#	TYP	#	TYP	#	TYP	#	TYP 8.0/9.0	#	TYP	#	TYP	#	TYP	#	TYP	#	TYP
05 Nov 0000																				
0010																				
0100																	Quake			
0107													01	TI						
0110																	01	TFR		
0112										Quake										
0118									01	TI/TI										
0120															01	TI				
0125											01	TI/TI								
0135													02	TFR			02	TFH		
0142									02	TFR/TFR										
0150															02	TFR				
0200									03	TS/TFP			03	TFP			03	TS	Quake	
0202											02	TFR/TFR								
0206																			01	TI
0230													04	TFH					02	TFR
0300									04	TS/TS	03	TS/TS	05	TS	03	TS	04	TS	03	TFP
0400									05	TS/TS	04	TS/TS	06	TS			05	TS	04	TS
0500									06	TS/TS			07	TS	04	TS	06	TS	05	TS
0546					Quake															
0552					01	TI														
0600									07	TS/TS	05	TS/TS	08	TS	05	TS	07	TS	06	TS
0601							01	TI												
0616					02	TFR														
0630					03	TFP														
0634			Quake																	
0636							02	TFR												
0640			01	TI																
0700			02	TFR	04	TS	03	TS	08	TS/TS	06	TS/TS	09	TS					07	TS
0730			03	TFP																
0800			04	TS	05	TS	04	TS	09	TS/TS			10	TS	06	TS	08	TS	08	TS
0900			05	TS	06	TS			10	TS/TS	07	-/TS	11	TS	07	TS			09	TS
1000			06	TS	07	TS	05	TS	11	TL/TS			12	TS			09	TS	10	TS
1100			07	TS	08	TS	06	TS	12	- /TS			13	TS	08	TS			11	TS
1200			08	TS	09	TS			13	-/TS	08	-/TS	14	TS	09	TS	10	TS	12	TS
1300			09	TS	10	TS	07	TS	14	-/TS			15	TS					13	TS
1400			10	TS	11	TS	08	TS	15	-/TS			16	TS	10	TS	11	TS	14	TS
1500			11	TS	12	TS			16	-/TS	09	-/TS	17	TS	11	TS			15	TS
1600			12	TS	13	TS	09	TS	17	-/TS			18	TS			12	TS	16	TS
1700			13	TS	14	TS	10	TS	18	-/TS			19	TL	12	TS	13	TL	17	TS
1748	Quake																			
1752	01	TI																		
1800			14	TS	15	TS			19	-/TS	10	-/TS							18	TS
1815	02	TFR																		
1840	03	TFP																		

Scenario	2009 Tonga Trench (M 8.1)		2010 Peru Chile (M 8.8)		2011 Japan Trench (M 9.1)				2013 South Solomon Trench (M 8.0) and (M 9.0) *Note: -/TS indicates M9.0 only products*				Manila Trench (M 8.8)						Tonga Trench (M 9.0)	
Centre	PTWC		PTWC		PTWC		NWPTAC		PTWC		NWPTAC		PTWC		NWPTAC		SCSTAC		PTWC	
1900	04	TS	15	TS	16	TS			20	-/TL									19	TL
2000	05	TS	16	TS	17	TS														
2100	06	TS	17	TS	18	TS	11	TS												
2200	07	TS	18	TS	19	TS	12	TS												
2300	08	TS	19	TS	20	TS														
6 Nov 0000	09	TS	20	TS	21	TS														
0100	10	TS	21	TS	22	TS														
0200	11	TS	22	TS	23	TS														
0300	12	TS	23	TS	24	TS														
0400	13	TS	24	TS	25	TS														
0500	14	TS	25	TS	26	TL														
0600	15	TL	26	TL																

Message Types:

TI = PTWC/NWPTAC Initial Text Message

TFR = PTWC/NWPTAC/SCSTAC Text Message with a Forecast for the Region near the Earthquake

TFP = PTWC Products with a Pacific-wide Forecast

TFH = PTWC Products with a Forecast for Shallow Marginal Seas (High-Resolution Forecast Model Run)

TS = PTWC/NWPTAC/SCSTAC Text Message with Tsunami Observations

TL = PTWC/SCSTAC Last Message for this Event

Note 1) A live communication test from the Tsunami Service Providers to Member States will be conducted at 0000 UTC on 5 November 2018.

Note 2) Participating countries may shift the schedule to adapt it to their own timetable.

ANNEX II

EXERCISE PACIFIC WAVE 2018 EVALUATION FORM

INSTRUCTIONS

EXERCISE PACIFIC WAVE 2018 Instructions on how to Complete this Evaluation Form		
STEP	WHO COMPLETES THIS STEP?	DESCRIPTION
1	Each participating Agency/Country	Decide if your agency/country will include additional evaluation questions for each objective. Country/agency evaluation questions can be added at the **end** of each section. However, do NOT change the reference numbers to the questions.
2	Each participating Agency/Country	Print this form and mark your evaluation answers on it.
3	Each participating Agency/Country	• Answer each statement with either Y (Yes), N (No). • Comments should be used to explain/expand upon your Yes or No answer • Write your comments on the page following the evaluation questions. Note the question number in the left column and write your comments alongside.
4	Each participating Agency/Country	Send completed agency evaluation form to country PacWave18 National Contact so he/she can compile to complete Country PacWave18 Evaluation Form (this URL).
5	PacWave18 National Contact	PacWave18 National Contact should complete and submit the PacWave18 Evaluation Form by **21 December 2018.** (https://www.surveymonkey.com/s/pacwave18_eval). If there are problems or questions, please contact the PacWave18 Task Team co-Chairs: Laura Kong, laura.kong@noaa.gov; or Jo Guard, jo.guard@dpmc.govt.nz

EXERCISE PACIFIC WAVE 2018 EVALUATION FORM

Exercise Pacific Wave 2018 Evaluation Form Contact Details			
Agency:		**Country:**	
Contact Name:		**Contact Position:**	
Contact Phone:		**Contact Mobile:**	
Contact E-Mail:			

Country Exercise Scenario	
Scenario Used:	**Tick Scenario used during PacWave18:** ○ 2009 Tonga Trench (M 8.1) ○ 2010 Peru-Chile Trench (M 8.8) ○ 2011 Japan Trench (M 9.1) ○ 2013 South Solomon Trench (M 8.0) ○ Manila Trench (M 8.8) ○ South Solomon Trench (M 9.0) ○ Tonga Trench (M 9.0)

Country Exercise Scenario	
Reason Scenario Chosen:	**Tick the primary reason:** ○ Exercise Local Tsunami – rapid response ○ Exercise Distant Tsunami – long response ○ Exercise Destructive Tsunami ○ Exercise Non-Destructive Tsunami ○ Exercise Real Event ○ Other (please specify)

OBJECTIVE 1

Test communications from the PTWC, NWPTAC, and/or SCSTAC Tsunami Service Providers to Member States/Countries.

Ref No	Evaluation Statements/Questions	Yes	No	Comment	Not applicable
1.1	Did your country Tsunami Warning Focal Point receive the PTWS, NWPTAC, and/or SCSTAC information/threat message?				
1.2	If yes, please state which Tsunami Service Provider you received the information/threat message from: • PTWC • NWPTAC • SCSTAC				
1.3	If you received an information/threat message, when did you receive the message(s)? • PTWC • NWPTAC • SCSTAC	Please state the time in UTC:			
1.4	How did you receive the message(s)? • GTS • AFTN • EMWIN • Fax • Email • CISN (Real-Time Earthquake Display) • Other (Please specify):	Please tick methods			

Ref No	**Objective 1 Comments** *(Insert extra rows as required)*

OBJECTIVE 2
*To test **national** communication and cooperation, and readiness within the country.*
➔ **Objective 2a**
*To test **national** communication and cooperation within the country*

Ref No	Evaluation Statements/Questions	Yes	No	Comment	Not applicable
2.1	The warning was disseminated to: • Emergency services • Other national government agencies • Science agencies/universities involved in assessment • Local government: provincial/regional level • Local government: city/district level. • Public Please list number of destinations in Comments	*Y*	*N*	*C*	*NA*
2.2	What time was warning sent to the agency or agencies or Public listed in Q2.1? Please note the date and time using 24-hour clock and UTC, e.g., 5 Nov, 14:35 UTC.	*Insert time in UTC*			
2.3	How did you send the warning to emergency, national, science, and local government agencies in Q2.1? Tick all that apply. • Landline Telephone • Satellite Telephone • Cell or Mobile Phone • Fax • Email • SMS • Radio (UHF, VHF, Amateur) • Chatty Beetle • TV • Website • Twitter	*Y*	*N*	*C*	*NA*

OBJECTIVE 2 *To test **national** communication and cooperation, and readiness within the country.*
➔ **Objective 2a** *To test **national** communication and cooperation within the country*

Ref No	Evaluation Statements/Questions	Yes		No		Comment		Not applicable	
	• Facebook • RSS • Other (Please specify)								
2.4	How did you send the warning to the Public? Tick all that apply. • Landline Telephone • Satellite Telephone • Cell or Mobile Phone • Fax • Email • SMS • Radio (UHF, VHF, Amateur) • Chatty Beetle • TV • Website • Twitter • Facebook • RSS • Sirens • Public Announcement Systems (voice speakers) • Emergency cell / mobile phone broadcast • Police • Door-to-door announcements • Electronic billboards • Other (Please specify)		*Y*		*N*		*C*		*NA*

OBJECTIVE 2

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

➔ **Objective 2a**

*To test **national** communication and cooperation within the country*

Ref No	Evaluation Statements/Questions	Yes	No	Comment	Not applicable
2.5	Based on feedback from agencies, were the communication methods timely and appropriate?	Y	N	C	NA
2.6	Based on feedback from agencies, were the message(s) disseminated from the NTWC/NDMO accurate and clear?	Y	N	C	NA
2.7	Did the national disaster management organisation (or equivalent) maintain communication with the National Tsunami Warning Centre throughout the event?	Y	N	C	NA
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?	*Note answer in the comment box*			

Ref No	**Objective 2a Comments *(insert extra rows as required)***

➔ **Objective 2b**

*To test **national** readiness within the country.*

Ref No	Evaluation Statements/Questions	Yes	No	Comment	Not applicable
2.9	The NTWC/NDMO has an activation and response process (standard operating procedures) in place for the receipt of tsunami warnings.	Y	N	C	NA
2.10	The NTWC/NDMO knows its specific response role in the event of a tsunami.	Y	N	C	NA
2.11	The NTWC/NDMO has, prior to the exercise, engaged in tsunami response planning.	Y	N	C	NA

➔ **Objective 2b**

*To test **national** readiness within the country.*

Ref No	Evaluation Statements/Questions	Yes	No	Comment	Not applicable
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.) – List activities in Comments.				
2.13	The NTWC/NDMO has an appropriate management structure identified and documented to support tsunami response.				
2.14	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.				
2.16	A country tsunami emergency response plan (standard operating procedures) for tsunamis exists. Tick all that apply • Local (less than 1 hour arrival time) • Regional (1-3 hours arrival time) • Distant (greater than 3 hours)				
2.17	The response plan includes processes to issue Safe-to-Return (All-Clear) notices				
2.18	Tsunami exercises are routinely conducted in-country. Please list last exercise, and type of exercise scenario (local, regional, distant) in Comments.				
2.19	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. If No, please list which levels have programmes in Comments.				
2.21	All tsunami-vulnerable communities have tsunami evacuation maps, signage, and assembly points for evacuation? If No, please list number of communities				

➔ **Objective 2b**

*To test **national** readiness within the country.*

Ref No	Evaluation Statements/Questions	Yes	No	Comment	Not applicable
	with maps and signage, gaps, and future plans to fill gaps in Comments.				
2.22	What type of exercise did you conduct? • Orientation • Drill • Tabletop • Functional • Full Scale • Other (Please specify)	*Y*	*N*	*C*	*NA*
2.23	Did you conduct community evacuation? If Yes, what type? • Schools • Businesses • Community • Other (Please specify)	*Y*	*N*	*C*	*NA*
2.24	If you answered yes to Q2.23, approximately how many people were evacuated in total?	Insert total			

Ref No	**Objective 2b Comments** *(insert extra rows as required)*

OBJECTIVE 3

*To test **regional** communication and cooperation.*

Ref No	Evaluation Statements/Questions	Yes	No	Comment	Not applicable
3.1	Did your country engage in communication and cooperation with other countries in the region for PacWave18? If yes, please list countries in Comments		*Y*		*N*		*C*		*NA*
3.2	What types of cooperation were conducted? • Data sharing (seismic, sea level, etc.) • Event information sharing • Alert coordination (levels, dissemination) • Joint PacWave18 exercise • Other (Please specify)		*Y*		*N*		*C*		*NA*
3.3	Did the National Tsunami Warning Center communicate with other countries during the event? If Yes, please list countries		*Y*		*N*		*C*		*NA*
3.4	Did the National Disaster Management Agency communicate with other countries during the event? If Yes, please list countries		*Y*		*N*		*C*		*NA*
3.5	Was national information shared with other countries during the event? If Yes, please list		*Y*		*N*		*C*		*NA*
3.6	What type of national information did you share? Tick all that apply. • Seismic phase arrival times • Earthquake hypocentre and/or magnitude • Tsunami Alert Level (such as Warning, Cancellation, etc.) • Tsunami Forecast • Tsunami Observations • Tsunami Evacuation • Tsunami Impact • Other (Please specify)								
3.7	How did you communicate the information? • Radio (UHF, VHF, Amateur)								

OBJECTIVE 3

*To test **regional** communication and cooperation.*

Ref No	Evaluation Statements/Questions	Yes	No	Comment	Not applicable
	• Landline Telephone • Satellite Telephone • Cell or Mobile Phone • Fax • Email • SMS • Chatty Beetle • Other (Please specify)				

Ref No	Objective 3 Comments *(insert extra rows as required)*

OBJECTIVE 4

Test whether the PTWS PTWC/NWPTAC/SCSTAC Tsunami Service Provider (TSP) products are interpreted by Member States accurately and in a timely manner.

Ref No	Evaluation Statements/Questions	Yes	No	Comment	Not applicable
4.1	Information provided by the relevant Tsunami Service Provider (TSP) products was understood by the National Tsunami Warning Centre (NTWC)/National Disaster Management Office (NDMO).	*Y*	*N*	*C*	*NA*

OBJECTIVE 4

Test whether the PTWS PTWC/NWPTAC/SCSTAC Tsunami Service Provider (TSP) products are interpreted by Member States accurately and in a timely manner.

Ref No	Evaluation Statements/Questions	Yes	No	Comment	Not applicable
4.2	How did your country assess the tsunami threat during the exercise? Please tick as many as apply: • National tsunami experts • National tsunami coordination committee • National tsunami historical database • NCEI/WDS tsunami historical database (web) • TsuDig historical database GIS tool (NCEI/ITIC offline) • TsuCAT Tsunami Coastal Assessment Tool – pre-computed tsunami scenarios from NOAA Propagation Database (PMEL/ITIC offline) • National pre-computed tsunami scenarios • National tsunami forecasts • Tsunami Service Provider forecasts. List source of forecasts (PTWC, NWPTAC, SCSTAC, US NTWC) in Comments. • Communication with outside sources (such as ITIC, media, other) (Please specify)		*Y*		*N*		*C*		*NA*
4.3	The information provided assisted with decision making, e.g., warning levels, earthquake parameters, estimated arrival times, forecast wave heights, etc.		*Y*		*N*		*C*		*NA*
4.4	The information issued by our country national Tsunami Warning Focal Point was according to standard operating procedures.		*Y*		*N*		*C*		*NA*
4.5	Do you require additional training on the use of the TSP products for national threat level decision-making. Tick TSP training requested • PTWC products • NWPTAC products		*Y*		*N*		*C*		*NA*

OBJECTIVE 4

Test whether the PTWS PTWC/NWPTAC/SCSTAC Tsunami Service Provider (TSP) products are interpreted by Member States accurately and in a timely manner.

Ref No	Evaluation Statements/Questions	Yes	No	Comment	Not applicable
	• SCSTAC products				

Ref No	Objective 4 Comments *(insert extra rows as required)*

OBJECTIVE 5

Validate the format and content of the Northwest Pacific Tsunami Advisory Center (NWPTAC) Enhanced Products (if applicable for your country).

Ref No	Evaluation Statements/Questions	Yes	No	Comment	Not applicable
5.1	Information provided in the Northwest Pacific Tsunami Advisory Center (NWPTAC) messages was understood by and useful to the National Tsunami Warning Centre (NTWC)/National Disaster Management Office (NDMO)	*Y*	*N*	*C*	*NA*
5.2	Threat information in NWPTAC products was understood and useful. Please comment as necessary. • Text products • Graphical products	*Y*	*N*	*C*	*NA*
5.3	Components of the NWPTAC product suite were understood and useful. Please comment as necessary on product clarity or confusion.	*Y*	*N*	*C*	*NA*
5.4	The information provided assisted with decision making, e.g. warning levels, earthquake parameters, estimated arrival times, forecast wave heights, etc.	*Y*	*N*	*C*	*NA*

Ref No	**Objective 5 Comments** *(insert extra rows as required)*

OBJECTIVE 6

Evaluate the format and content of the South China Sea Tsunami Advisory Centre (SCSTAC) Enhanced Products (if applicable for your country).

Ref No	Evaluation Statements/Questions	Yes	No	Comment	Not applicable
6.1	Information provided in the South China Sea Tsunami Advisory Centre (SCSTAC) messages was understood by and useful to the National Tsunami Warning Centre (NTWC)/National Disaster Management Office (NDMO)	*Y*	*N*	*C*	*NA*
6.2	Threat information in SCSTAC products was understood and useful. Please comment as necessary. • Text products • Graphical products	*Y*	*N*	*C*	*NA*
6.3	Components of the SCSTAC product suite were understood and useful. Please comment as necessary on product clarity or confusion.	*Y*	*N*	*C*	*NA*
6.4	The information provided assisted with decision making, e.g. warning levels, earthquake parameters, estimated arrival times, forecast wave heights, etc.	*Y*	*N*	*C*	*NA*

Ref No	**Objective 6 Comments** *(insert extra rows as required)*

GENERAL EXERCISE OBSERVATIONS

Provide feedback on the planning and conduct of PacWave18

Please also provide information on your country's exercise.

- Include electronic links to Media Coverage in Comments section.
- Send summaries, photos and videos directly to the PTWS Technical Secretary (Bernardo Aliaga, b.aliaga@unesco.org) and PacWave18 Chairs (Laura Kong, laura.kong@noaa.gov, Jo Guard, jo.guard@dpmc.govt.nz)

Evaluation Statements / Questions. Indicate Yes or No	**Yes**	**No**
Overall assessment		
Country stakeholder agencies have a better understanding of the goals, responsibilities 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 (Please provide electronic links if applicable in Comments).		
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	Estimated number	
Exercise planning (please make comments on the following page to all of the statements below)		
Overall, the exercise planning, conduct, format and style were satisfactory.		
Exercise planning at the international level went well.		
Exercise planning at the national level went well.		
Exercise planning at the provincial/local level went well.		
The PacWave18 exercise website pages were useful.		
This evaluation form was easy to use.		
PacWave18 Exercise Manual provided an appropriate level of detail.		
IOC Manual & Guides 76: Plans and Procedures for Tsunami Warning and Emergency Management was useful.		
IOC Manual & Guides 58: How to Plan, Conduct, and Evaluate IOC Tsunami Wave Exercises was useful.		

Please provide a general statement on your Exercise Pacific Wave 2018 experience.

Exercise Planning

Please provide a general statement about **what went well**.
Insert comments

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

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

Exercise Conduct

Please provide a general statement about **what went well**.
Insert comments

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

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

Exercise Debrief or Evaluation

Please provide a general statement about **what went well**.
Insert comments

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

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

ANNEX III

POST-EXERCISE EVALUATION COMPILATION

This Annex contains a compilation of the responses provided by countries to the Exercise PacWave18 post-exercise evaluation form. Altogether, 26 countries submitted evaluation forms between November 2018 and March 2019.

Surveys were completed online through the Survey Monkey online survey and questionnaire tool, or submitted by transmission of the completed survey file to the PacWave18 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 survey was available in English only at https://www.surveymonkey.co/s/pacwave18_eval. The survey was divided into three sections according to the PacWave18 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.

1. Overall Country and Agency Participation

	Country	**Agency**
1	Australia	Australian Bureau of Meteorology
2	Brunei Darussalam	Brunei Darussalam Meteorological Department / National Seismic Centre
3	Chile	Hydrographic and Oceanographic Service of the Chilean Navy
4	China	National Marine Environmental Forecasting Center (NMEFC)
5	China - Hong Kong	Hong Kong Observatory
6	Colombia	Dirección General Marítima
7	Costa Rica	SINAMOT (Sistema Nacional de Monitoreo de Tsunamis de Costa Rica)
8	Ecuador	Instituto Oceanográfico de la Armada del Ecuador
9	El Salvador	Ministry of Environment and Natural Resources
10	Fiji	Lands and Mineral Resources Department (MRD)
11	France (New Caledonia, Wallis and Futuna)	Research Institute Development (IRD)
12	France (French Polynesia)	CEA/LDG/CPPT
13	Malaysia	Malaysian Meteorological Department
14	Mexico	Centro de Alerta de Tsunamis
15	New Zealand	Ministry of Civil Defence & Emergency Management
16	Nicaragua	Nicaraguan Territorial Studies Institute (INETER)
17	Panama	Autoridad Marítima de Panamá

18	Peru	Directorate of Hydrography and Navigation (DHN)
19	Philippines	Philippine Institute of Volcanology and Seismology
20	Russian Federation	Kamchatka Tsunami Warning Center, Federal Service of Russia for Hydrometeorology and Environmental Monitoring
21	Samoa	Ministry of Natural Resources and Environment
22	Singapore	Meteorological Service Singapore
23	Solomon Islands	Solomon Islands Meteorological Services and National Disaster Management Office
24	Thailand	National Disaster Warning Center
25	Tonga	Tonga Meteorological Service
26	Viet Nam	Earthquake Information and Tsunami Warning Center, Institute of Geophysics

2. South China Sea Participation

All South China Sea countries were encouraged to participate in Exercise PacWave18 in the South China Sea region. Seven countries and sub national entities participated.

Country	**Agency**
Brunei Darussalam	Brunei Darussalam Meteorological Department / National Seismic Centre
China	National Marine Environmental Forecasting Center(NMEFC)
China (Hong Kong)	Hong Kong Observatory
Malaysia	Malaysia Meteorological Department
Philippines	Philippine Institute of Volcanology and Seismology
Singapore	Meteorological Service Singapore
Thailand	National Disaster Warning Center
Viet Nam	National Disaster Warning Center, Institute of Geophysics

3. Country Exercise Scenario: Select scenario used during PacWave18:

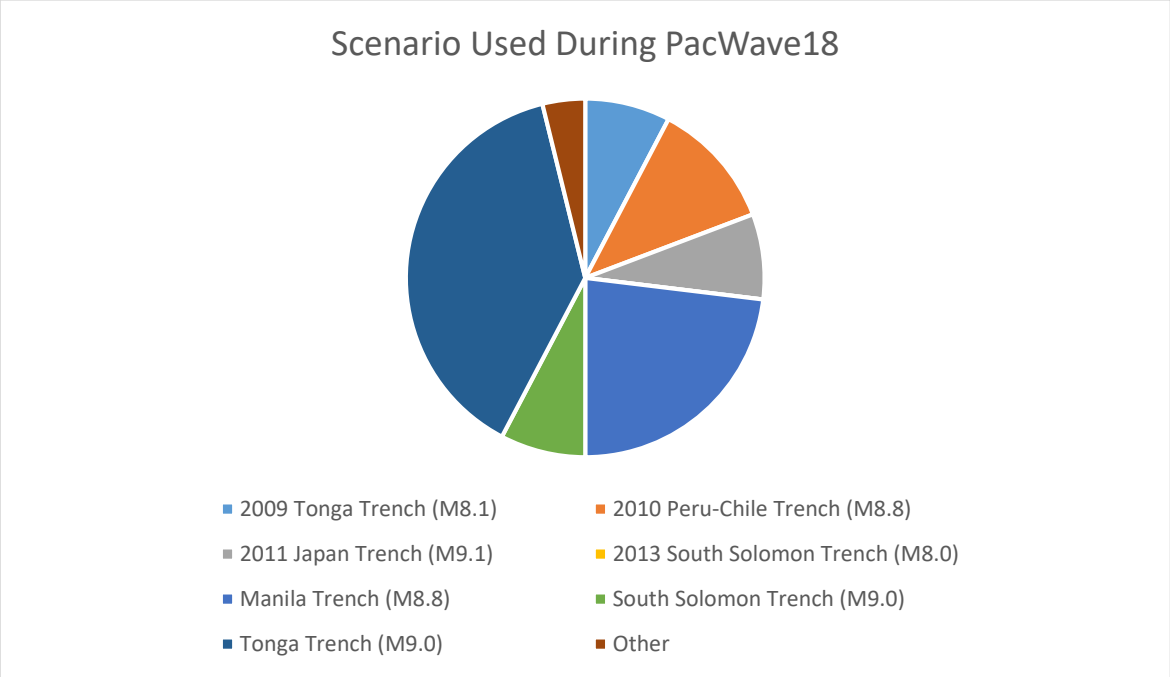
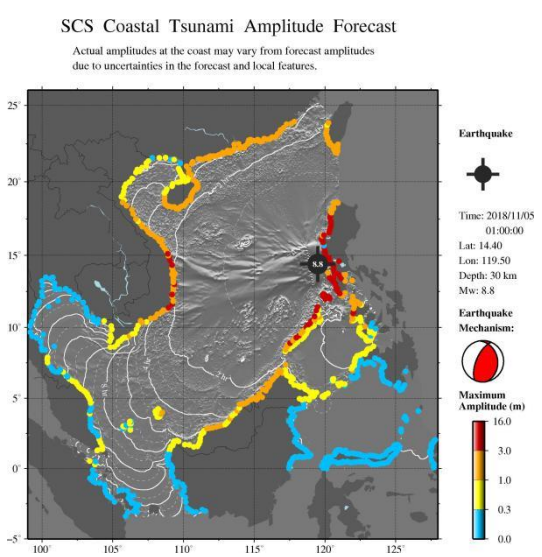


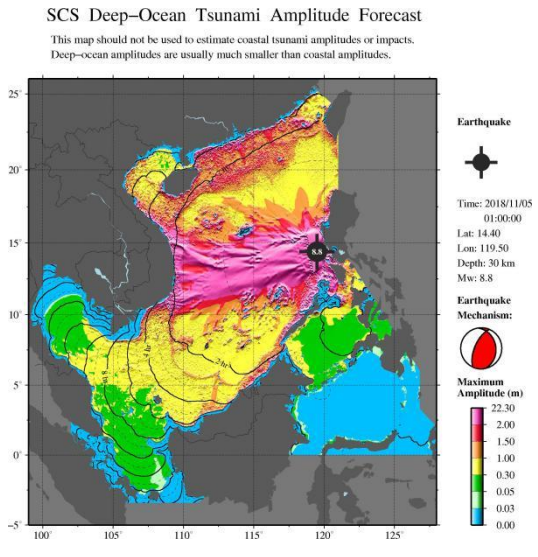
Figure 1. Scenario used during PacWave18

The majority of countries selected either the Tonga Trench (M9.0) (39% of participants) or the Manila Trench (M8.8) (23% of participants) scenarios for PacWave18.

South China Sea scenario

In the South China Sea region, a Manila Trench Mw8.8 scenario was used. The South China Sea Tsunami Advisory Center (SCSTAC) prepared 13 bulletins, which were uploaded to http://www.pacwave.info prior to PacWave18. These included enhanced products:





4. Country Exercise Scenario: Reason scenario chosen:

Most of the countries that participated in PacWave18 chose a scenario to either exercise their rapid response arrangements for a local tsunami, or the long response arrangement for a distant tsunami. Only one country indicated they chose their scenario specifically to exercise a past real event (although several others did select a real event, the majority of countries selected a past exercise scenario). One country chose to use a scenario that was not part of the suite of PacWave18 options.

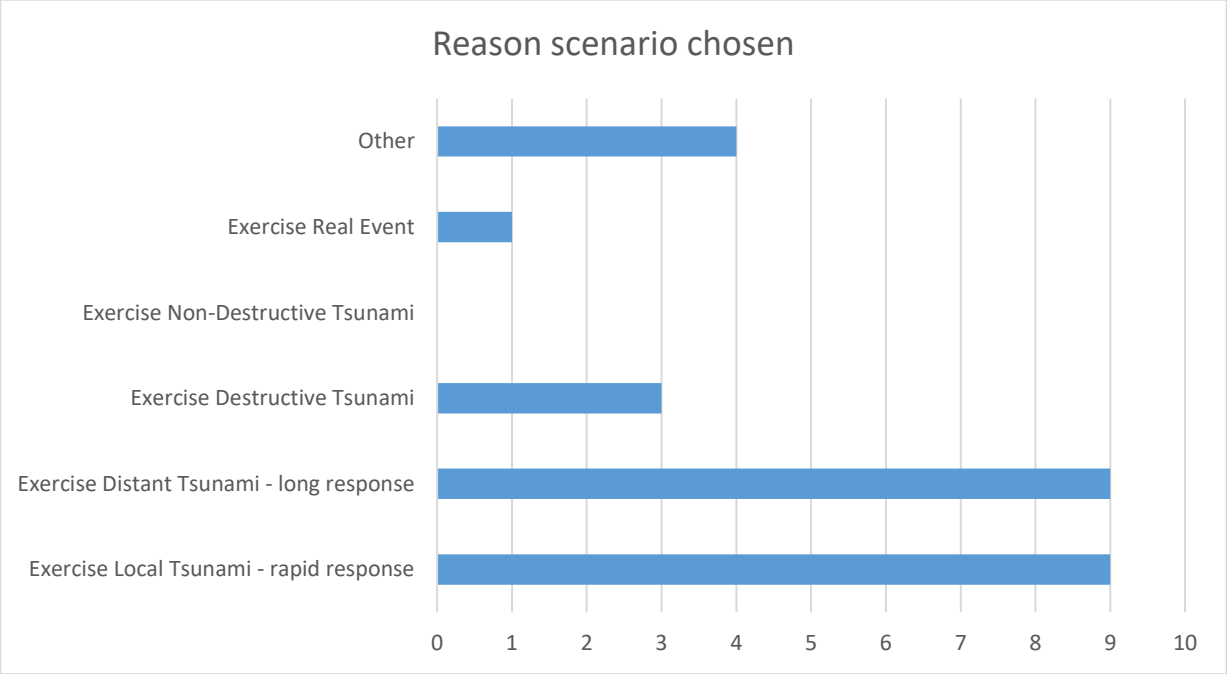


Figure 2. Reason scenario chosen

Comments

- Both local/regional – rapid response and post disaster recovery (France – New Caledonia).
- That scenario is the nearest to the country and might impact from distant tsunami (Thailand).
- It was the closest scenario to our country (Nicaragua).
- For exercise held on November 23, messages were previously downloaded and forwarded from secondary email account to all the organizations involved in the exercise (Chile).
- Not applicable. Due to logistic concern, the scenario was changed to Minhassa Trench 8.5M (Malaysia).

Objective 1: To test communications from the PTWC, NWPTAC, and/or SCSTAC Tsunami Service Providers to Member States/Countries.

5. Did your country Tsunami Warning Focal Point receive the PTWS, NWPTAC, and/or SCSTAC information/threat message?

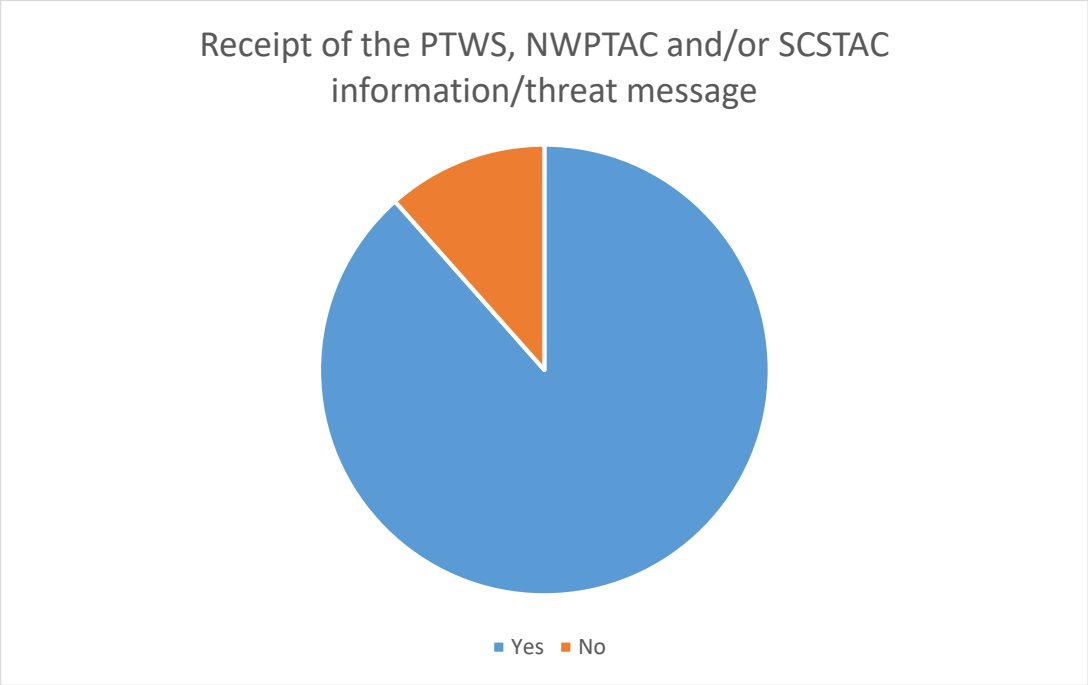


Figure 3. Receipt of initial information/threat message (text product).

The majority of respondents to this question indicated that the initial message was received. Three respondents indicated that the message was not received.

Comments:

- The exercise was conducted the 23 and 24 October and dummy message was sent 5 November (Colombia).
- The exercise was made only for Panama's July 13, 2018 in the community of Puerto Armuelles (Panama).
- We conducted a national exercise without formal messaging or information received. It was based entirely on ground shaking to get people to know where to evacuate to in 15 minutes during a local tsunami event).

The majority of respondents received the information/threat message from PTWC.

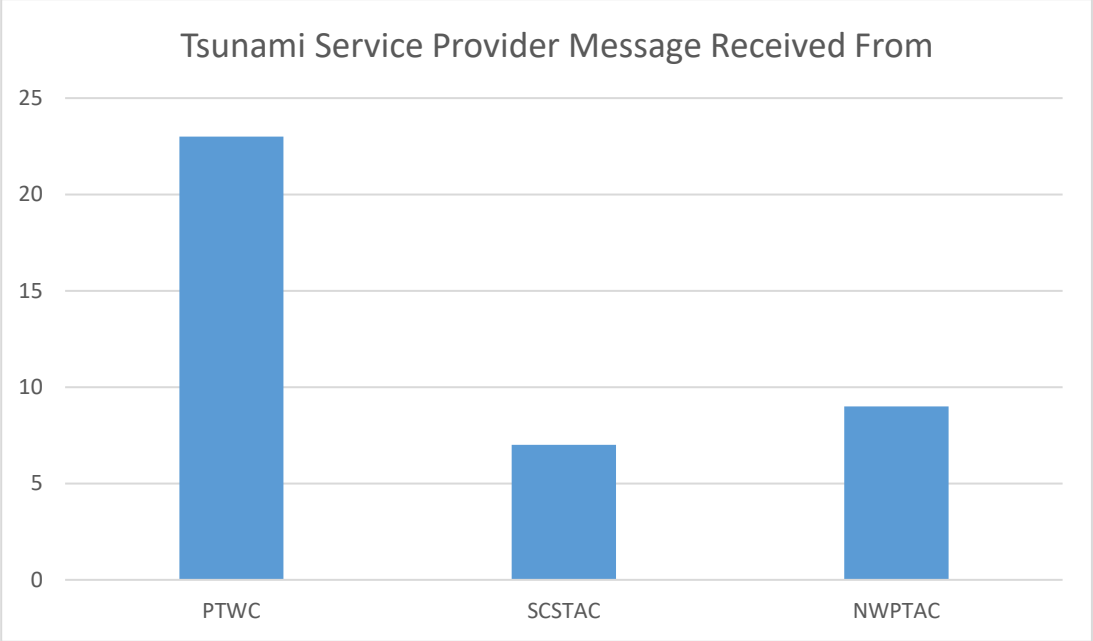


Figure 4. Where the initial tsunami message was received from

Comments:

- SHOA (Chile) was doing the functions of PTWC as TSP (Peru).
- We use Tonga trench 9.0 scenarios. The TNC simulate the exercise using tailored PTWC messages provided (after adjusting time and date within the message to fit with our exercise) (France – New Caledonia).
- Received by email and fax (El Salvador).
- For this exercise our country Tsunami Warning Focal Point receive the PTWS, Warnings were upload online (Solomon Islands).

For those that received the message, it was received in a timely manner. There was some discrepancy in the times the messages were received due the long period over which the exercise was conducted and countries changing the times of the exercises to suit their circumstances. Not all countries who completed the evaluation indicated when the dummy message was received.

South China Sea region

All participating countries and sub national entities except the Philippines could receive bulletins from SCSTAC, while the Philippines could receive PTWC bulletins. SCSTAC disseminated bulletins by fax and email. Not all participating countries and sub national entities could receive both methods. Malaysia only received email, with Singapore only receiving via fax.

It shows that there are still some issues with the communication channels from SCSTAC to SCS countries and sub national entities. GTS should be online in future.

Received time of dummy message sent the 5 November 2018

Country	Received Time
Russia	5 November 00:02 UTC (PTWC) 5 November 00:00 UTC (NWPTAC)
Singapore	0002 UTC (PTWC) 0001 UTC (NWPTAC) 0003 UTC (SCSTAC)
Nicaragua	0000 UTC 5 November (PTWC)
French Polynesia (France)	00:01 UTC (PTWC) 00:06 UTC NWPTAC
Thailand	00:01 UTC (PTWC) 00:06 UTC (NWPTAC) 00:00 UTC (SCSTAC)
Australia	00:00 UTC (PTWC) 00:00 UTC (NWPTAC)
New Zealand	00:01 UTC (PTWC)
Fiji	22:03 UTC (PTWC)
El Salvador	00:03 UTC (PTWC)
New Caledonia (France)	21:06 UTC (PTWC)
Brunei Darussalam	00:01 UTC (PTWC) 00:06 UTC (NWPTAC) 01:00 UTC (SCSTAC)
Peru	02:06 UTC (PTWC)
Costa Rica	00:00 UTC (PTWC)
Viet Nam	00:00 UTC (PTWC) 00:00 UTC (NWPTAC) 00:00 UTC (SCSTAC)
Samoa	9 Oct 2018 1900 UTC
Hong Kong (China)	00:01 UTC (PTWC) 00:06 UTC (NWPTAC) 23:59 UTC (SCSTAC)
Ecuador	02:00 UTC (PTWC)
Mexico	02:06 UTC (PTWC)
Chile	00:01 UTC (PTWC)
Malaysia	00:01 UTC (PTWC) 00:06 UTC (NWPTAC)
Philippines	0225 UTC (PTWC)
Panama	08:00 UTC (PTWC)
China	01:02 UTC (PTWC) 01:03 UTC (NWPTAC) 01:02 UTC (SCSTAC)

6. How did you receive the PTWC text message? Please tick all methods that apply.

The majority of countries indicated that they received the message by email (84%). Fax was the next most common form of receipt (52%). Other methods of receipt include GTS and AFTN.

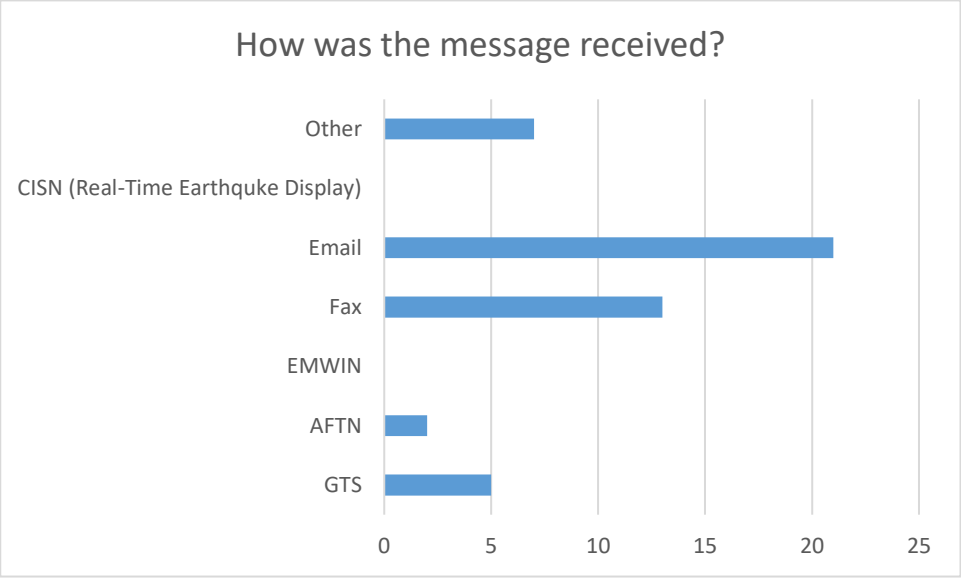


Figure 5. Methods of receiving the PTWC text message
(more than one option could be chosen).

Comments

- Early warning earthquake detection SMS from ORSNET/IRD are used in these territories to provide “heads up” warning before PTWC messages (France – New Caledonia).
- Regional web platform (SRATPS) (Peru).
- Dummy utilizing information in manual (Samoa).
- Skype, WhatsApp (Ecuador).
- It was received by phone (Panama).

7. You may add additional individual agency evaluation statements regarding OBJECTIVE 1 in the section below.

The following comments were received from countries in this section:

- Singapore: SCS bulletin not received at:
  - Fax number +65 65422915
  - GTS: WSSS
  - Email: MSS_CFO_Fcsters@nea.gov.sg and NEA-MSD_TechOps@nea.gov.sg
- Singapore: PTWC bulletin not received at:

- Fax number: +65 65422915 and +65 65425026
- Email: MSS_CFO_Fcsters@nea.gov.sg and NEA-MSD_TechOps@nea.gov.sg

- The message was received correctly according to the exercise (Nicaragua).
- For GTS we have received only from PTWC (Thailand).
- Only the PWTC message was received via AFTN (Australia).
- Test message was received in a timely manner (New Zealand).
- The threat message was received from PTWC in a timely manner via email and it was found to be very informative for the NTWC decision-making (Fiji).
- Both SMS and email arrived correctly and in time (France – New Caledonia).
  - Brunei Darussalam: **PTWC** bulletin not received at:

    Fax number: (+673) 2380542 / (+673) 2380387 / (+673) 2382671

    Email: dcc@ndmc.gov.bn, rinaurhafizah.rani@ndmc.gov.bn, adib.matali@ndmc.gov.nb, aiman.jaya@pwd.gov.bn
  - Brunei Darussalam: **NWPTAC** bulletin not received at:

    Fax number: (+673) 2380542 / (+673) 2380387 / (+673) 2382671

    GTS: PHEB

    Email: dcc@ndmc.gov.bn, rinaurhafizah.rani@ndmc.gov.bn, adib.matali@ndmc.gov.nb, aiman.jaya@pwd.gov.bn
  - Brunei Darussalam: **SCSTAC** bulletin not received at:

    Fax number: (+673) 2380542 / (+673) 2380387 / (+673) 2382671

    GTS: PHEB

    Email: dcc@ndmc.gov.bn, rinaurhafizah.rani@ndmc.gov.bn, adib.matali@ndmc.gov.nb, aiman.jaya@pwd.gov.bn
- To test all Standard Operating Procedures (SOPs) for Tsunami Warning, Dissemination and Operations (Samoa).
- Email came first, followed by GTS and then fax (Hong Kong, China).
- Our exercise was regional (Chile, Peru, Colombia and Ecuador). The products were provided for SHOA Chile. The objective 1 was accomplished, we had some problems in communications delaying our response time (Ecuador).
- All the information/threat message used for this exercise were accessed online. The exercise was conducted according to our own timings (Solomon Islands).

- Communications test from PTWC was received November 5th at 0001 by email and 0004 UTC by fax (Chile).
- The test communications from the PTWC, NWPTAC, and/or SCSTAC Tsunami Service Providers were received accordingly and in time (Malaysia).
- Only PTWC product is available for the Peru-Chile trench M8.8 scenario (Philippines).
- The objective was to test the capacity of response to tremors and tsunami, for students of the schools present in the community and the population (Panama).

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

8. Where was the warning disseminated to? Please list the number of destinations.

The majority of participants in the exercise disseminated the warning message to emergency services (69%) and other national government agencies (69%). Only 31% provided the warning message with 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 (54%), and local government – city/district level (42%).

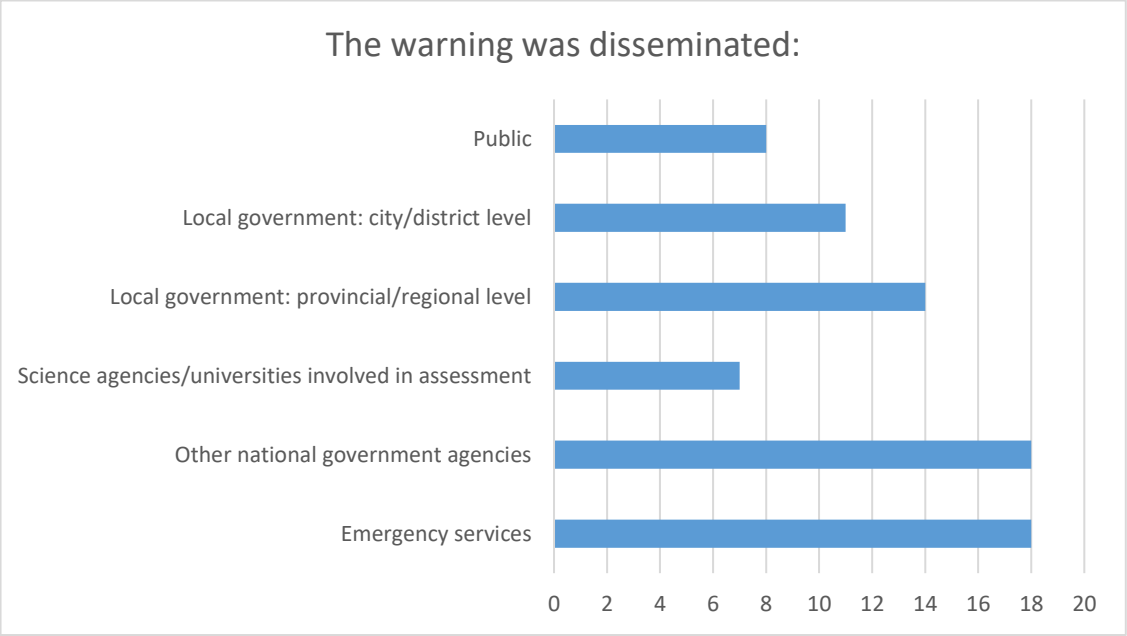


Figure 6. Where the warning was disseminated to.

Destinations

- 28 (Russia).
- 14 government agencies (including the emergency response agency) (Singapore).
- The exercise was tabletop and was carried out within the institution (Nicaragua).
- Only Civil authorities were involved in the PacWave 2018 exercise. Public not involved in PacWave 2018 (French Polynesia).

- Australian Government Crisis Coordination Centre, Australian Maritime Safety Authority, Australian Antarctic Division, Australian Defence Force, New South Wales State Emergency Service, Queensland Fire and Emergency Services, Surf Lifesaving New South Wales, Surf Life Saving Queensland, Surf Lifesaving Tasmania, Tasmania State Emergency Service, Victoria State Emergency Service, Emergency Management Norfolk Island (Australia).

- Approximately 20 (Colombia).

- Warning was not actually disseminated as part of the exercise but would be distributed to 145 organisations on the National Warning System list plus 55 on the Media Groups list. However, separate National Warning System and Emergency Mobile Alert tests were carried out as part of the wider New Zealand Exercise Pacific Wave activities and these test messages were successfully disseminated to all the destinations above (New Zealand).

- 24 agencies (Fiji).

- 2 community leaders (El Salvador).

- Local NDMO already have a list of agencies/group to contact in emergencies (France – New Caledonia).

- National Disaster Management Centre (NDMC) (Brunei Darussalam).

- 4 municipal emergency committees, but this was not the same day as the international communication test (Costa Rica).

- 2 (Viet Nam).

- As per phone numbers provided of key officials of key stakeholders above (Samoa).

- 5 warning bulletins disseminated to 27 destinations (Hong Kong, China).

- Servicio Nacional de Gestión de Riesgos y Emergencias del Ecuador (SNGRE) (Ecuador).

- Estimated number of destinations 120 (Solomon Islands).

- National Emergency Management Agency, National Seismological Center (Chile).

- The warning was not disseminated to the public or to the agencies (Malaysia).

- Ministry of educacion, Universidades, police department, fire brigade, and other state agencies (Panama).

- Director of MET Office and Director of the Emergency Management Office ran the national exercise from the National Radio Station. The exercise was to mimic a massive local earthquake with violent ground shaking to evacuate people to evacuation points within 15 minutes of earthquake due to likely tsunami hazard. All was done from the national radio by the Director of the Warning Center and the Director of the Emergency Management Office. The entire exercise took 20 minutes (Tonga).

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

Due to the large time period allowed for PacWave18 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	30 October 00:10 UTC
Singapore	5 November 01:21 UTC
Nicaragua	29 November 14:40 UTC
French Polynesia (France)	30 November 18:36 UTC
Australia	11 September 00:09 UTC
Colombia	24 October 02:12 UTC
New Zealand	4 November 21:13 UTC
Fiji	30 October 22:05 UTC
El Salvador	16:00 UTC
New Caledonia (France)	21:10 UTC
Brunei Darussalam	27 November 01:20 UTC
Peru	24 October 02:10 UTC
Viet Nam	5 November 00:03 UTC
Samoa	9 October 19:02 UTC
Hong Kong (China)	5 November 01:35 UTC
Ecuador	24 October 02:00 UTC
Solomon Islands	28 November 00:55 UTC
Mexico	6 November 13:12 UTC
Chile	24 November 02:00 UTC
Panama	13 July 08:30 local time
China	5 November 01:10 UTC
Tonga	8 November 23:30 UTC

Comments:

- Australia chose to exercise on 11 September 2018 at 00:00 UTC. The first National Watch bulletin was issued to participating agencies at 11 September 00:09:11 UTC. The test communication messages from PTWC and NWPTAC were not on-forwarded (Australia).

- 24 Oct 02:12 UTC NTWC sent to the DMO watch message; 24 Oct 02:18 sent to the agencies the message; 24 Oct 03:30 UTC NTWC sent to the DMO warning message; 03:35 UTC DMO sent to the agencies warning message (Colombia).

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

The majority of participants in the exercise disseminated the warning message to emergency, national, science, and local government agencies by email (69%) or by cell or mobile phone (46%). Other methods of dissemination included fax (35%), SMS (31%) and landline telephone (31%).

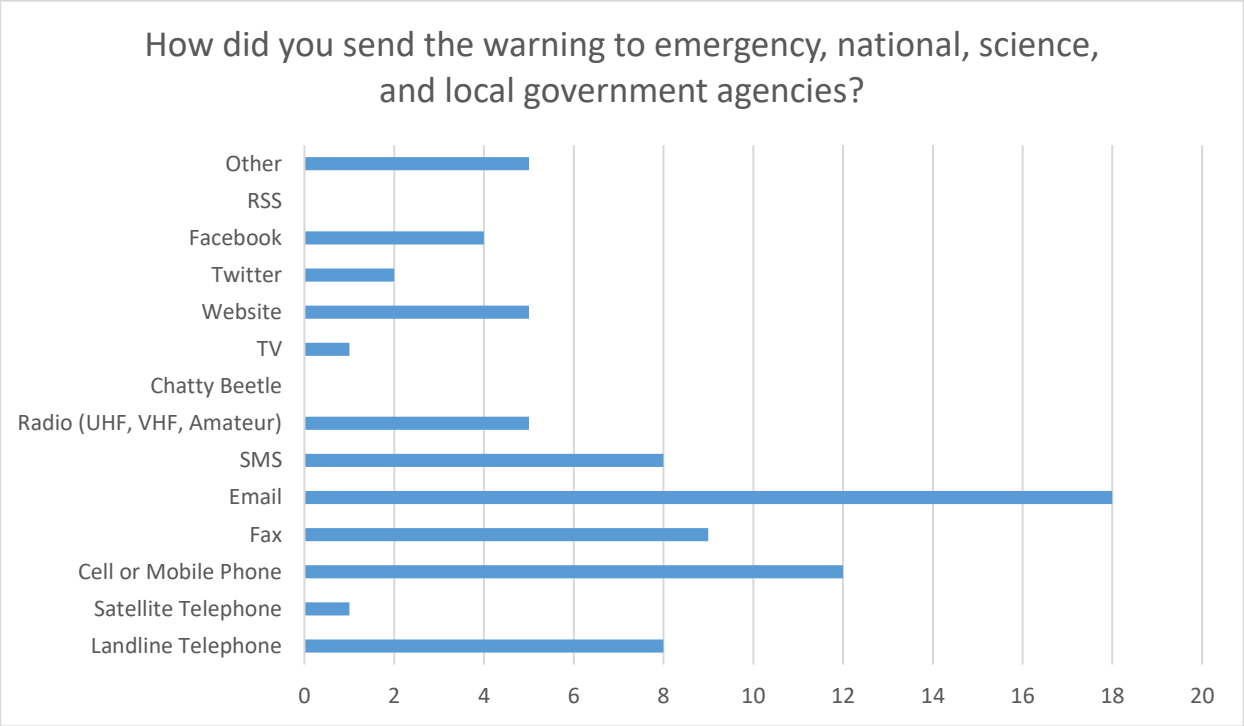


Figure 7. How the warning was disseminated to emergency, national, science and local government agencies.

Comments

- Warning was not actually distributed as part of the exercise, but was sent by these means in our simulated warning system training environment. Separate tests were carried out on these systems (see further comment above) (New Zealand).
- Private optical fiber (Viet Nam).
- Government Internal Network (Hong Kong, China).
- Skype and WhatsApp (Ecuador).
- Satellite telephone only as a back-up. Landline communication used only to confirm fax and email reception (Chile).
- National Radio (AM Frequency) (Tonga).

11. How did you send the warning to the public?

Compared with how the warning message was disseminated to agencies, a wider variety of methods were used to disseminate the warning to the public. The most popular methods were sirens (27%), radio (27%), cell or mobile phone (23%), and Facebook (23%). A number of the

participants who responded with 'other' to this question indicated that the warning was not disseminated to the public as part of their exercise.

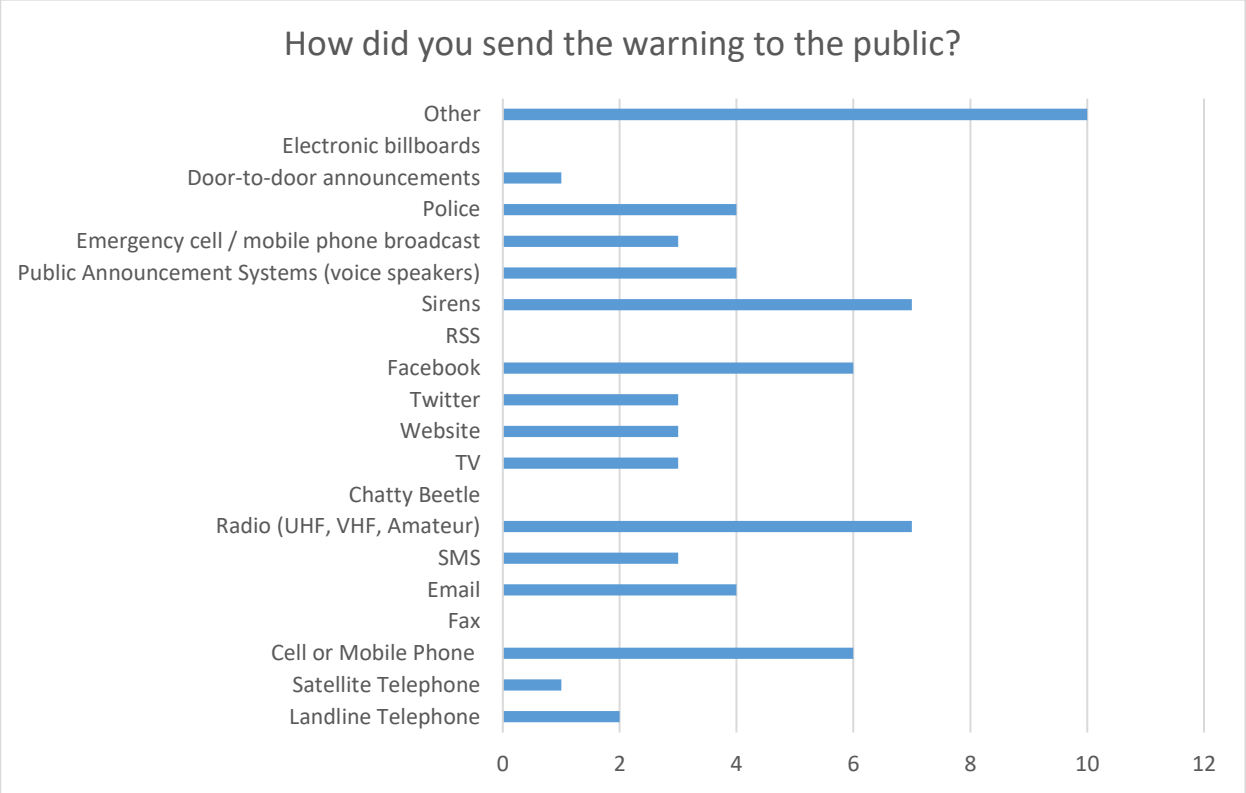


Figure 8. How the warning was sent to the public.

Comments

- Dissemination to the public was not exercised (Singapore).
- The warning wasn't sent to the public (Nicaragua).
- Public not involved in PacWave 2018 (French Polynesia, France).
- The public was not involved in this exercise (Australia).
- Warning was not actually distributed as part of the exercise, but was sent by these means in our simulated warning system training environment. Separate tests were carried out on these systems (see further comment above) (New Zealand).
- Whistle (El Salvador).
- None – issued by NDMC (Brunei Darussalam).
- Our exercise was not for the public. We used internal website (Ecuador).
- Media (print and broadcast) (Solomon Islands).
- This exercise was limited to NTWC/NDMO only, not involving the public (Chile).
- National Radio (AM Frequency) (Tonga).

South China Sea Region

Five of the eight participating countries and sub national entities conducted interior exercises and tested communications. Fax is the primary communication method, followed by email.

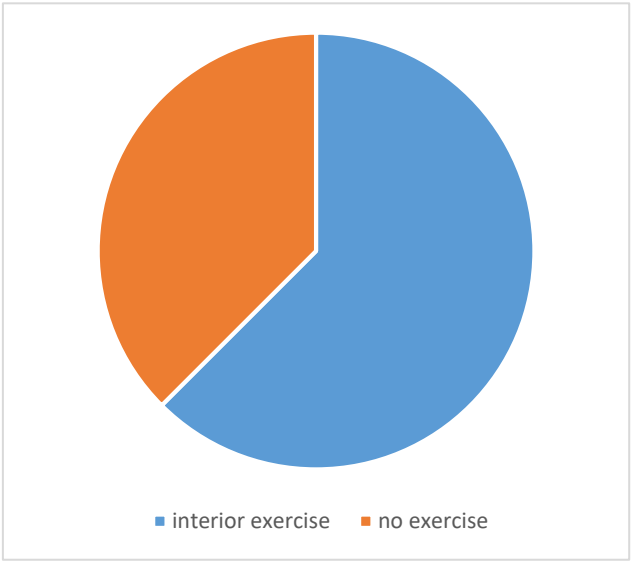


Figure 9. Communication methods for the South China Sea Region.

12. Based on feedback from agencies, were the communication methods timely and appropriate?

The majority of exercise participants (88%) considered that the communication methods used during the exercise were timely and appropriate.

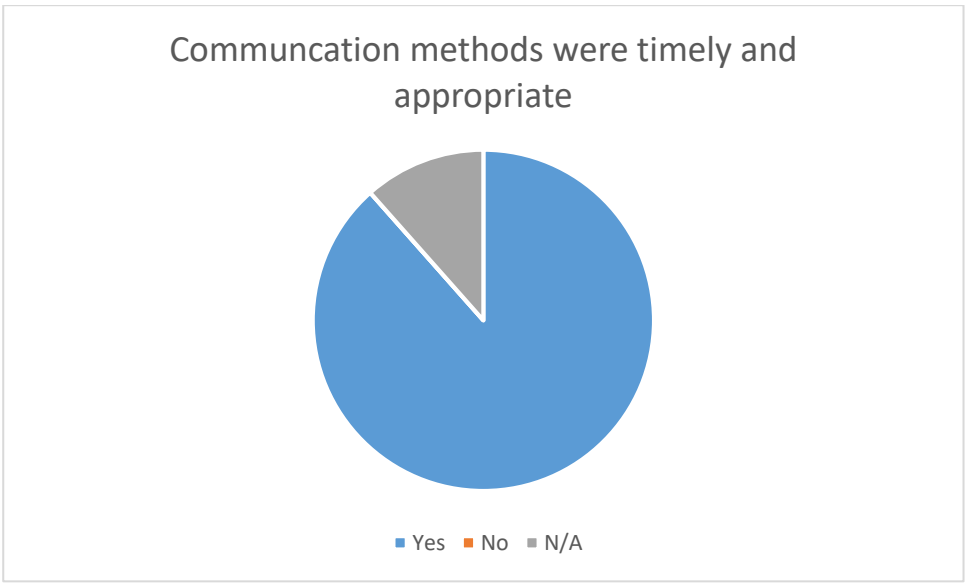


Figure 10. Communication methods were timely and appropriate.

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

The majority of exercise participants (92%) considered that the messages disseminated from the NTWC/NDMO were accurate and clear.

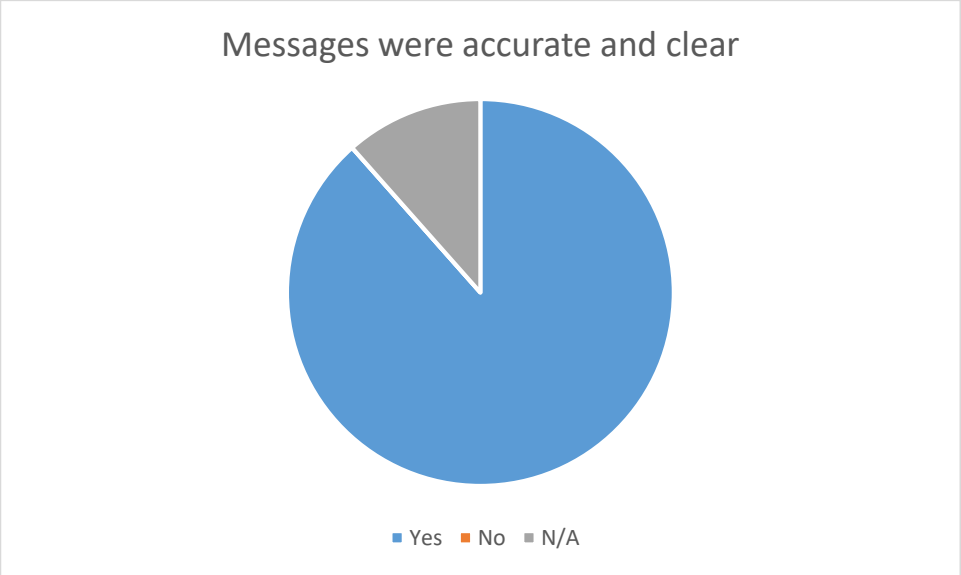


Figure 11. Messages disseminated from the NTWC/NDMO were accurate and clear.

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

The majority of exercise participants agreed that the NDMO maintained communication with the NTWC throughout the exercise. Only one participating country disagreed with this.

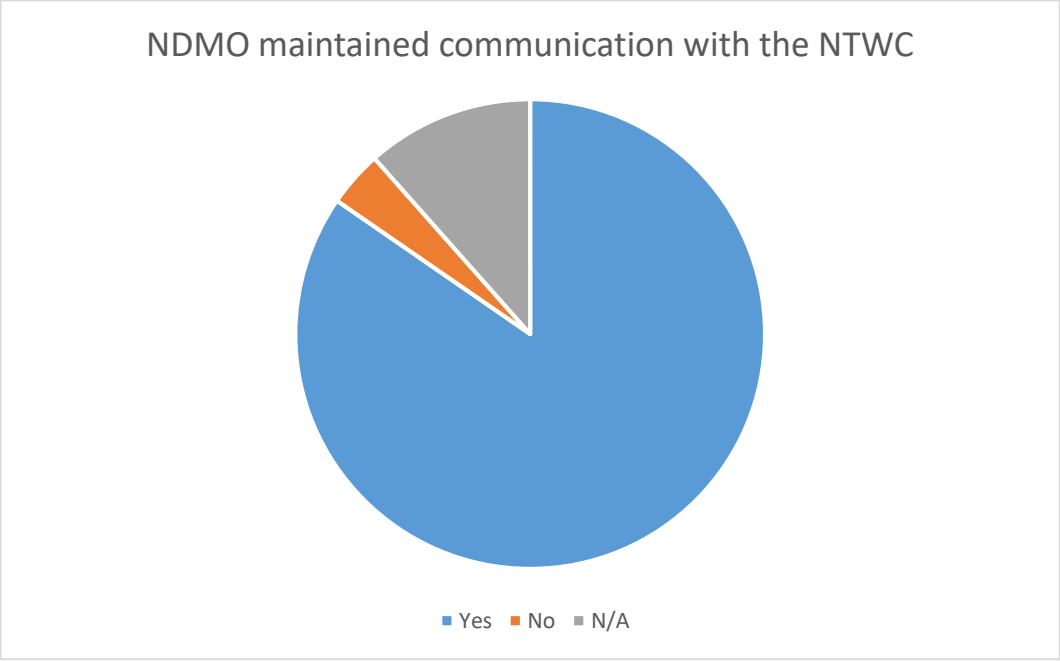


Figure 12. The NDMO maintained communication with the NTWC throughout the event.

Comments

- Communication lines were open so that the agencies participating in the exercise could contact the NTWC. However, there were no communications during this exercise (Singapore).
- Liaison occurred by teleconference (Australia).
- In New Zealand, the NTWC and the NDMO are the same organisation (New Zealand).
- NTWC was together with New Caledonia NDMO, Communication was both about wave arrival planning and post-disaster recovery needs (New Caledonia, France).
- Done through the NEOC arrangement and SOP and the Tsunami draft sub-plan (Solomon Islands).
- Communication protocols with NDMO considers VHF, Email, fax, landline, fax and satellite phone (Chile).

15. If yes, 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:

- National tsunami forecast products and further explanation provide by CPPT were tested all along the exercise (French Polynesia, France).
- The NTWC provided briefings to the NDMO as required. Note that the NDMO is not the primary emergency response agency in Australia. Instead, this is the responsibility of the regional authorities (Australia).
- Confirm the reception of the messages (Colombia).
- Email and Mobile Application (geobingAn) and cellular mobile phone (Fiji).
- The evolution of the exercise was reported by twitter (messages and photos) (El Salvador).
- Brief and prompt (Brunei Darussalam).
- We communicated by radio VHF, fax, cell phone, email (Peru).
- To obtain more information on what to expect (Costa Rica).
- We have a private optical fibre system to disseminate the information between NDMO and NTWC (Viet Nam).
- Wireless to confirm dissemination, SMS mobile phone to confirm receipt of message and trigger evacuation, or cancellation (Samoa).
- Technical advice, particularly on the tsunami forecasts and situation reports (Hong Kong, China).

- Social networks (Ecuador).

- Frequent communication via emails, briefings and phone calls were made between the National Disaster Management Office and Solomon Islands Meteorological Service (Solomon Islands).

- Give receiving recent information about tsunami (Mexico).

- Both agencies kept permanent communication through email, phone and VHF (Chile).

- That had occurred an event near in Peru and that also on the coasts of Puerto Armuelles Panama had occurred a strong earthquake (Panama).

- Both exercise controllers were at the National Radio station starting out the exercise. Warning Centre and NDMO were in the same room (Tonga).

16. Additional Objective 2a comments

The following comments were received from countries in this section:

- In our exercise, messages were not disseminated to other agencies or the public, they were simulated in our national warning system training environment only. The assessment is that these were timely, accurate and clear is based on previous examples of disseminating these messages during real events and tests. Separate tests of the National Warning System and the Emergency Mobile Alert System were carried out in association with PacWave. These systems disseminate warning messages to the public, emergency services, local government, science agencies, and other government agencies (New Zealand).

- Some of the buildings are soundproof and occupants can barely hear the siren. National Communications system tested and a lot of cooperation was evident as per National Tsunami Response Plan 2017 during the PacWave18 exercise (Fiji).

- All agencies were cooperating (Brunei Darussalam).

- To test early warning systems in accordance with standard operating procedures. Villages demonstrate an understanding of basic safety procedures during tsunami evacuation (Samoa).

- All messages were communicated to government bureaux and departments in a timely manner (Hong Kong, China).

- We had problems with communications at the national and regional level, however, it was solved (Ecuador).

- All communication methods tested based on the NEOC arrangement, NEOC SOP and tsunami draft plan worked well (Solomon Islands).

- Exercise was successful, showing excellent coordination and understanding of each other's roles and responsibilities (Chile).

- PacWave18 was conducted within PHIVOLCS only (Philippines).

- Check communications and rapid response for the evacuation (Panama).

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

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

All responses to this question (100%) agreed that activation and response procedures are in place.

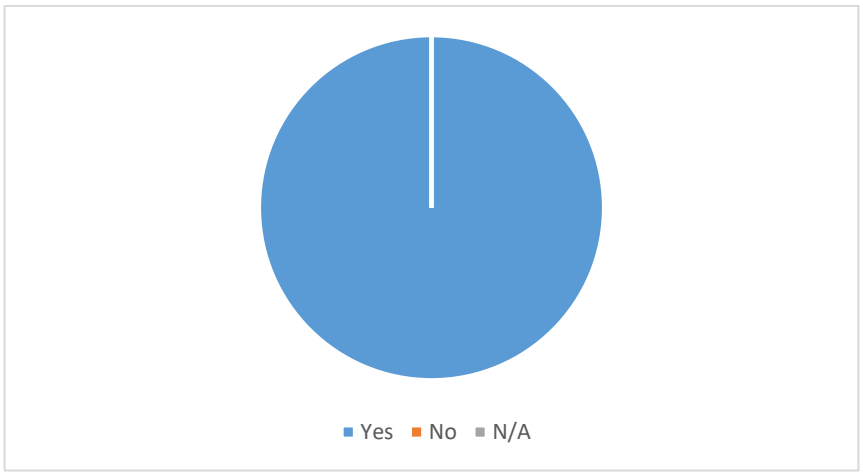


Figure 13. The NTWC/NDMO has an activation and response process (standard operating procedures) in place for the receipt of tsunami warnings.

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

All respondents (100%) agreed that the NTWC/NDMO knows its response role in the event of a tsunami.

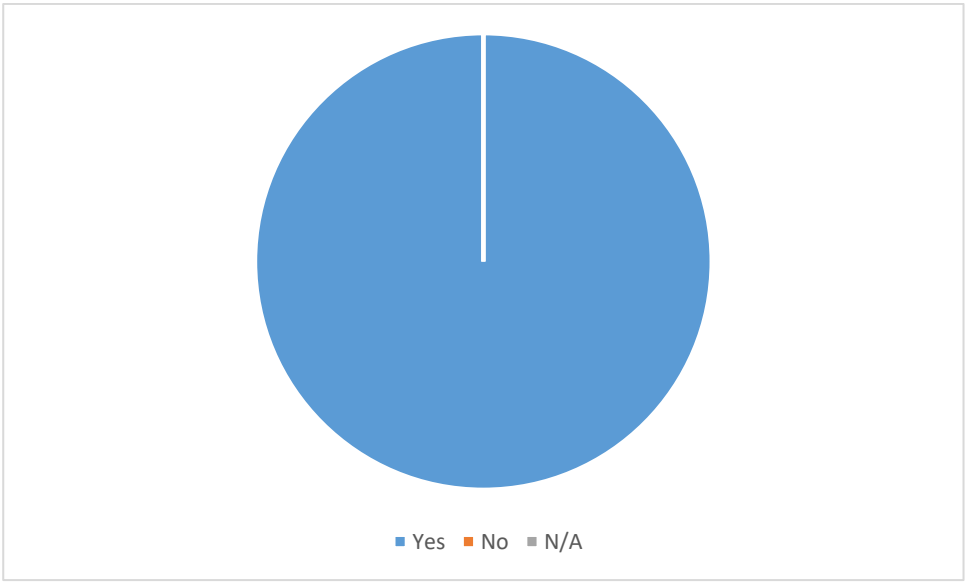


Figure 14. The NTWC/NDMO knows its specific response role in the event of a tsunami.

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

All respondents (100%) agreed that the NTWC/NDMO has engaged in prior tsunami response planning.

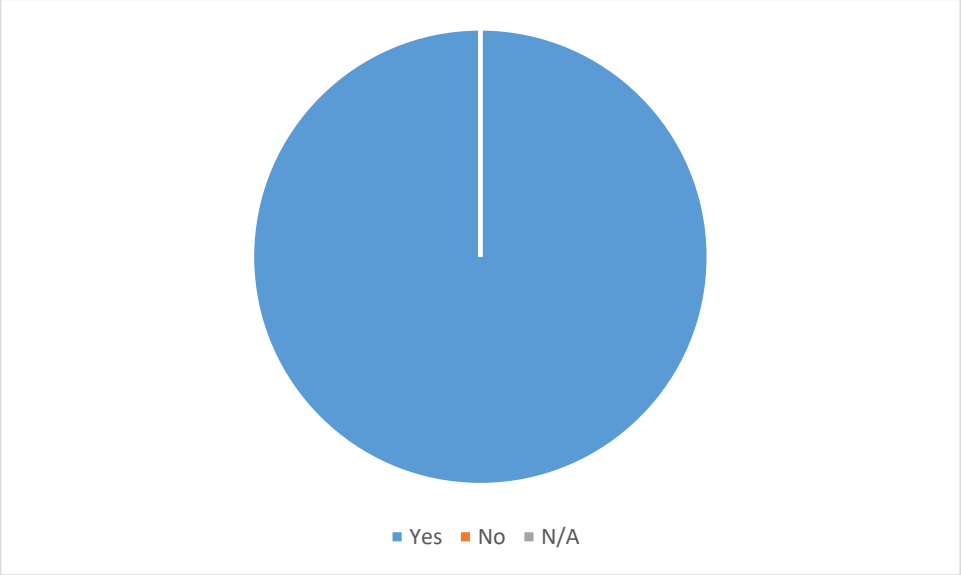


Figure 15. The NTWC/NDMO has, prior to the exercise, engaged in tsunami response planning.

20. The NTWC/NDMO regularly undertakes activities to increase its capacity and capability to support a national tsunami response (for example, training, exercise, etc.)

100% of respondents (26) agreed that regular capacity and capability building exercises are undertaken to support a national tsunami response.

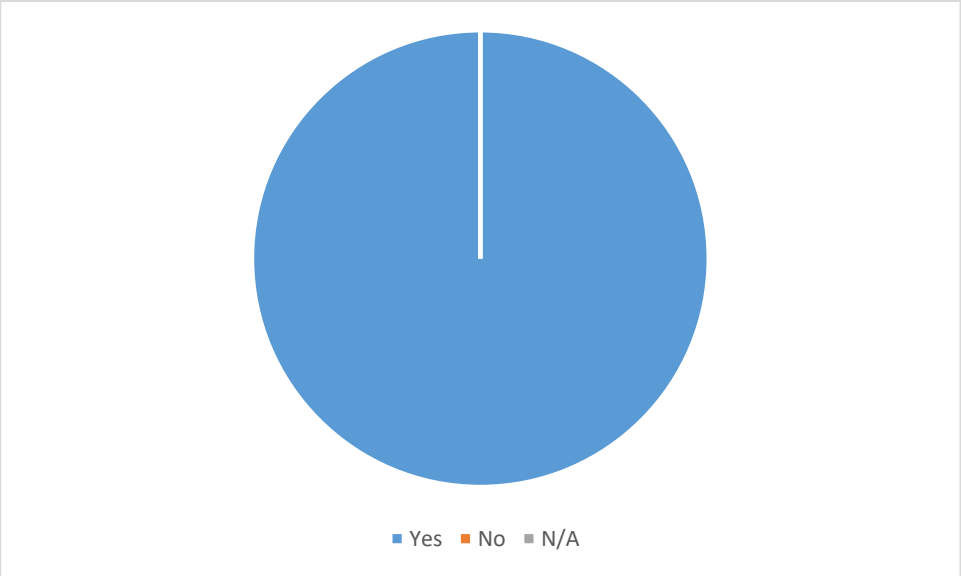


Figure 16. The NTWC/NDMO has undertaken activities to increase its capacity and capability to support a national tsunami response

Countries detailed the following activities have taken place:

- Training (Russia).
- Maintenance and upgrade of detection and monitoring system, and continuous training of staff to operate system (Singapore).
- Training, exercises, drills (Nicaragua).

- Training, exercise at each level (emergency staff, public, schools) (French Polynesia, France).
- Upgraded tsunami Decision Support Tool software. Staff competency training. Participation in IOWave and PacWave exercises (Australia).
- MCDEM undertake regular internal training and exercising, as well as regular engagement with GNS Science who provide threat advice in the event of a tsunami, New Zealand ran a major tsunami exercise with involvement down to community level and over 100 organisations participating in 2016. As part of the National Exercise Programme, a tsunami exercise was also held in 2010 for a distant scenario (New Zealand).
- Tsunami drill with 5 schools. Tsunami drill with 7 government agencies. Table top exercise. Earthquake and tsunami awareness activities (Fiji).
- At least five internal exercise have been carried out during 2018 (El Salvador).
- Creation of evacuation routes for schools, outreach with the population (New Caledonia, France).
- Training, exercise, workshops (Peru).
- Exercises (Costa Rica).
- Training and exercise (Viet Nam).
- Villages demonstrate an understanding of basic safety procedures during tsunami evacuation. To assess the effectiveness of Village Response Teams. To test if existing resources in country is sufficient enough to execute response roles and functions (Samoa).
- Briefings and exercise (Hong Kong, China).
- We elaborated a regional and national protocol according to the SOPs of the PTWS (Ecuador).
- Safe School tsunami drill (Solomon Islands).
- Training, exercise, drills (Mexico).
- Tsunami evacuation exercises and drills performed at communal level (Chile).
- Awareness campaign/tsunami drill (Malaysia).
- Quarterly exercises (Philippines).
- Prior to the school training. Firefighters, police, state agencies and the community through talks (Panama).
- Training of schools and government agencies as well as coastal communities (Tonga).

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

Ninety-two (92) percent of respondents agreed that appropriate management structures had been identified and documented in their countries to support a tsunami response.

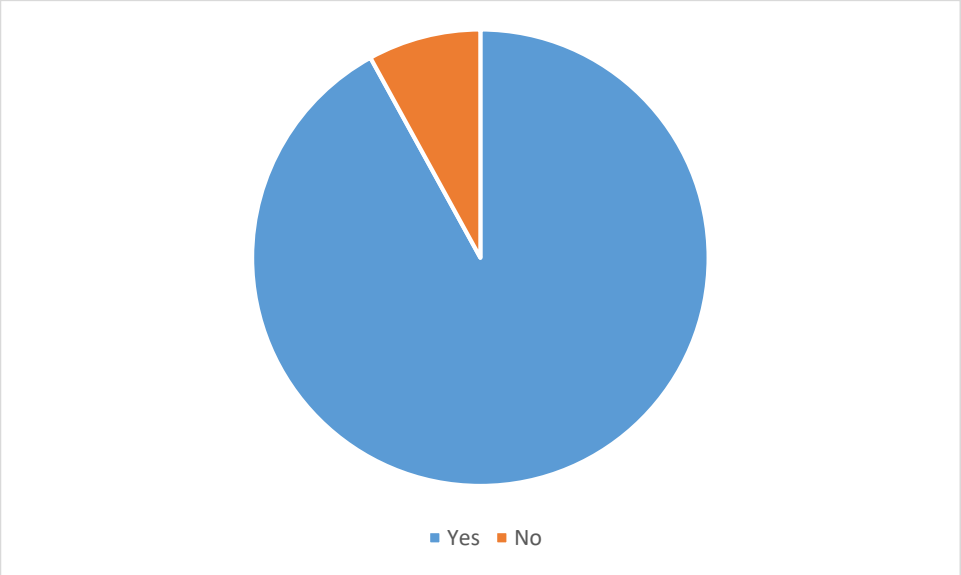


Figure 17. The NTWC/NDMO has an appropriate management structure identified and documented to support tsunami response.

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

Fifty (50) percent (13) of respondents indicated that their country has a tsunami mass coastal evacuation plan.

Figure 18. The NTWC/NDMO has a national tsunami mass coastal evacuation plan.

South China Sea Region

All participating countries and sub national entities' NTWC/NDMO are responsible for, and have capability to respond to a tsunami. Half of the respondents indicated they have a community evacuation plan. The national tsunami exercises are planned and routinely conducted in four SCS countries.

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

Eighty-five (85) percent (22) of respondents indicated that assembly arrangements were in place for their country's disaster management group. Fifteen (15) percent (4) of respondents indicated that these arrangements are not in place.

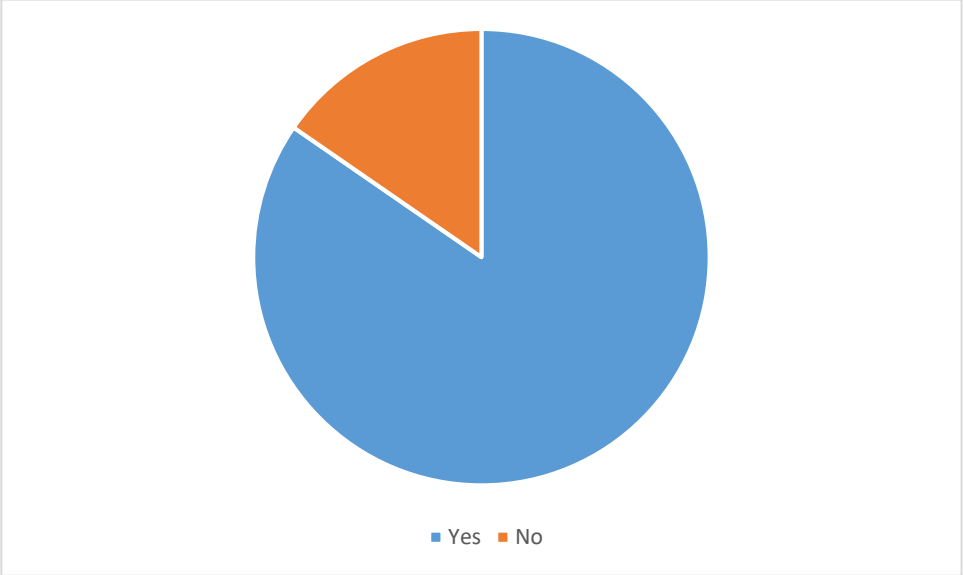


Figure 19. Arrangements to assemble the in-country disaster management group relevant to decision-making on tsunami warning and response were in place before the exercise.

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

Eighty-five (85) per cent (22) of respondents indicated that they have a country tsunami emergency response plan in place for a distant tsunami, 81% (21) of respondents indicated that they have plans in place for a regional tsunami, and 73% (19) indicated that they have a plan in place for a local tsunami.

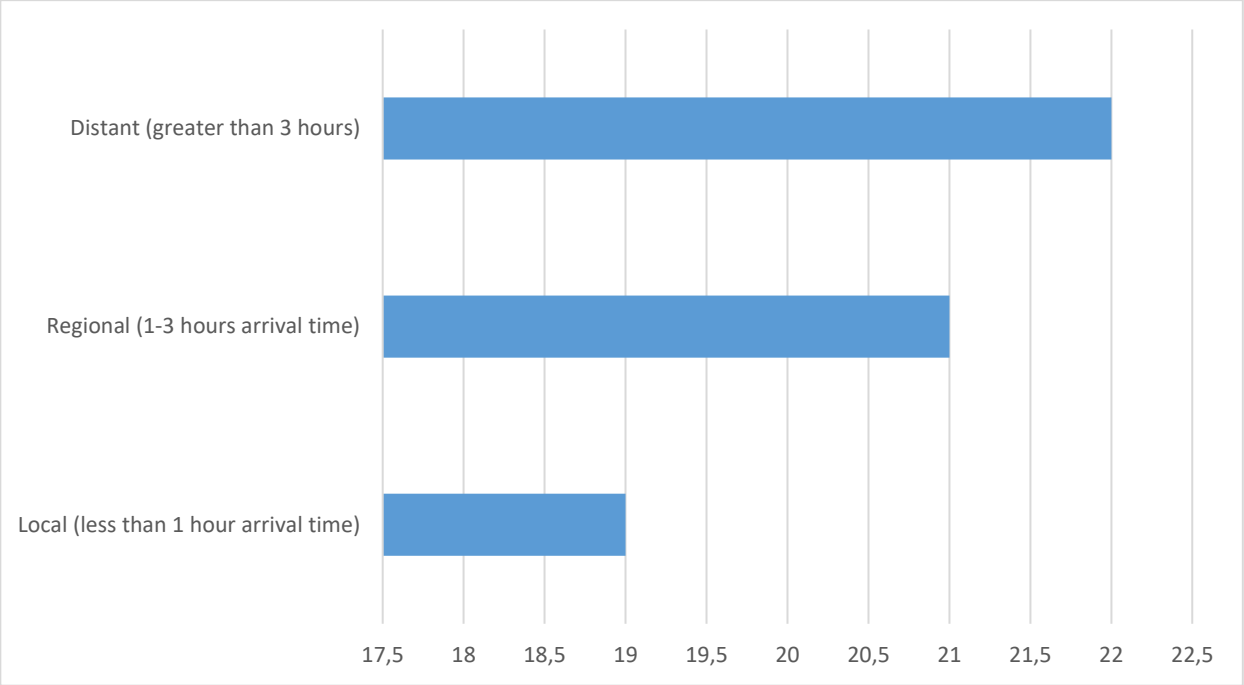


Figure 20. A country tsunami emergency response plan (standard operating procedures) for tsunamis exists.

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

Seventy-seven (77) percent (20) of respondents indicated that their tsunami emergency response plan includes processes to issue Safe-to-Return (All Clear) notices.

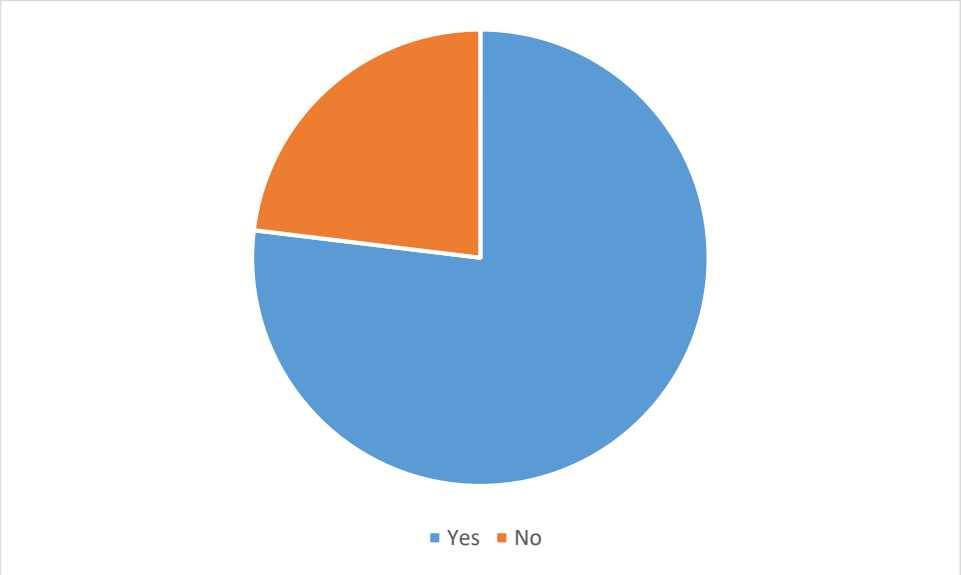


Figure 21. The country tsunami emergency response plan includes processes to issue Safe-to-Return (All Clear) notices.

26. Tsunami exercises are routinely conducted in-country. Specify last exercise and type of exercise scenario (local, regional, distant) in Comments section.

The majority of countries conduct exercises routinely with 81% indicating that regular exercises are conducted. Nineteen (19) percent of respondents do not conduct regular exercises.

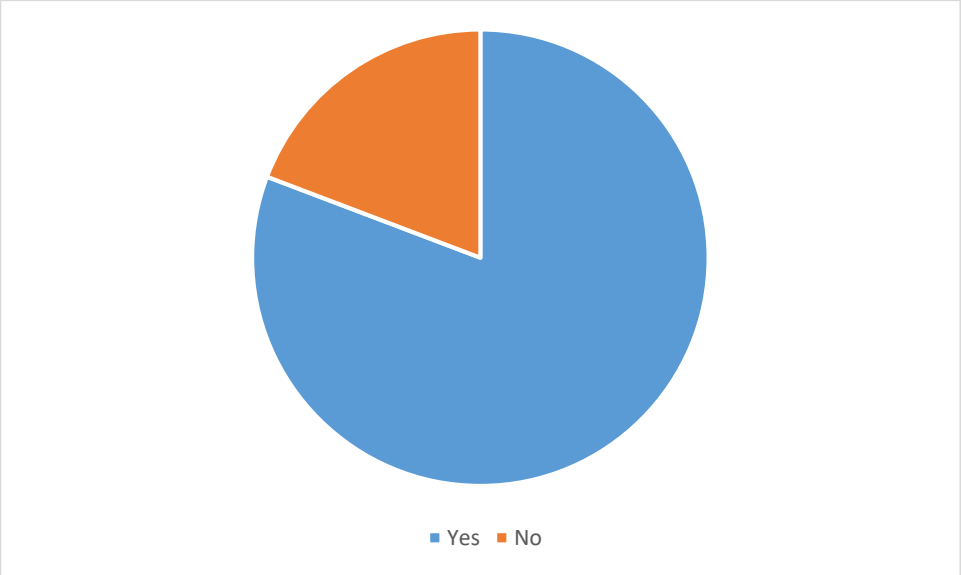


Figure 22. Tsunami exercises are routinely conducted in-country.

Last Tsunami Exercises

- Quarterly tsunami training alerts at the regional level (Russia).
- 2016 for distant tsunami (Singapore).
- The last exercise was on November 29 with the Chile scenario (Nicaragua).
- Regional (French Polynesia, France).
- IOWave2018 (Thailand).
- The last exercise Australia participated in prior to PacWave 18 was IOWave18 on 5 September 2018. The scenario was a M9.3 earthquake occurring on the Sunda Trench off the west coast of northern Sumatra. This was a distant source for mainland Australia and the participating agencies conducted a mixture of desktop and functional exercises (Australia).
- The plan is a draft (Colombia).
- The last national exercise held was in 2016 and was based on a near-regional scenario (just over 1 hour's arrival time) (New Zealand).
- Tsunami drill exercise with 5 schools – local scenario. Tsunami drill exercise with 7 government agencies – local scenario (Fiji).
- In El Salvador during the last three years an exercise is carried out taking as a scenario a local event. This exercise is a memorial of the destructive earthquake of October 10th 1986, organized by the National Emergency Response Organization

with the voluntary participation, schools, government offices, communities, family groups and private offices (El Salvador).

- First exercise of this scale for Wallis and Futuna (New Caledonia, France).
- CaribeWave18, regional (Costa Rica).
- 2016, regional tsunami scenario (Viet Nam).
- Local Tonga 8.1 Mag – evacuation of local village, Manono Uta (Samoa).
- PacWave17 exercise based on a regional scenario (Hong Kong, China).
- January 31 2018, local tsunami (Ecuador).
- Table top exercise for local tsunami scenario (Solomon Islands).
- November 8th, local scenario Magallanes and Chilean Antarctic Territory Region. Schools Evacuation Drill. 37,000 participants (Chile).
- Caribbean Wave 2018 in the Costa above Columbus, this is the first time it occurs in the Pacific. Local scenario (Panama).
- Regional source of Ryukyu Trench Scenario in Jiangsu Province, East China Sea Coast in 2018; Regional source of Manila Trench Scenario in Dayawan Nuclear Power Plants in Guangdong Province in 2018 (China).
- PacWave16, tested evacuating 3 communities on local event scenario (Tonga).

27. Tsunami-related public education and awareness materials have been developed and disseminated?

The majority of countries (88%) have developed and disseminated tsunami-related public education and awareness materials.

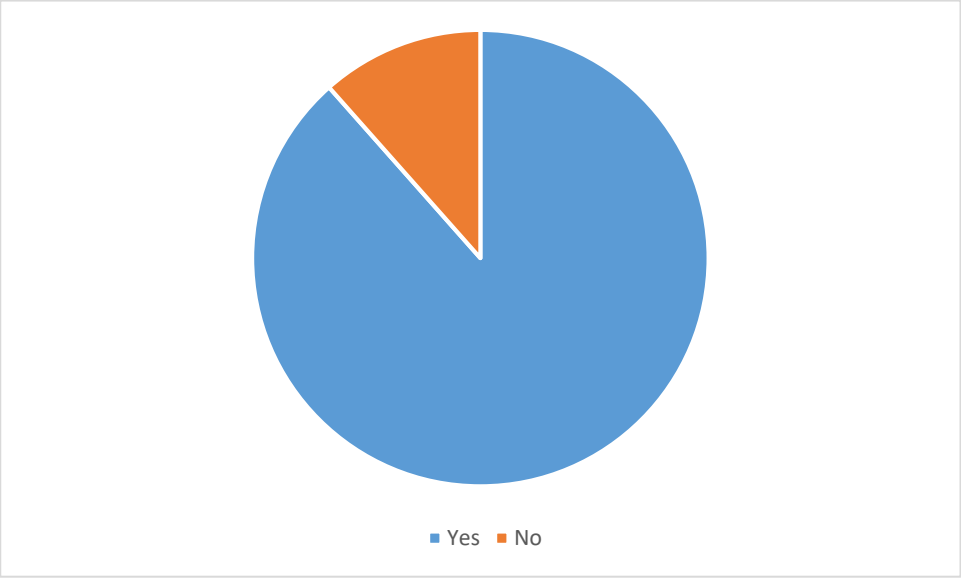


Figure 23. Tsunami-related public education and awareness materials have been developed and disseminated.

28. Tsunami-related curriculum programmes are in place for all levels of education. Note which levels in Comments section.

Participant responses to this question were split, with only 38% (10) countries indicating that tsunami curriculum programmes are in place for all levels of education, and 62% disagreeing with this.

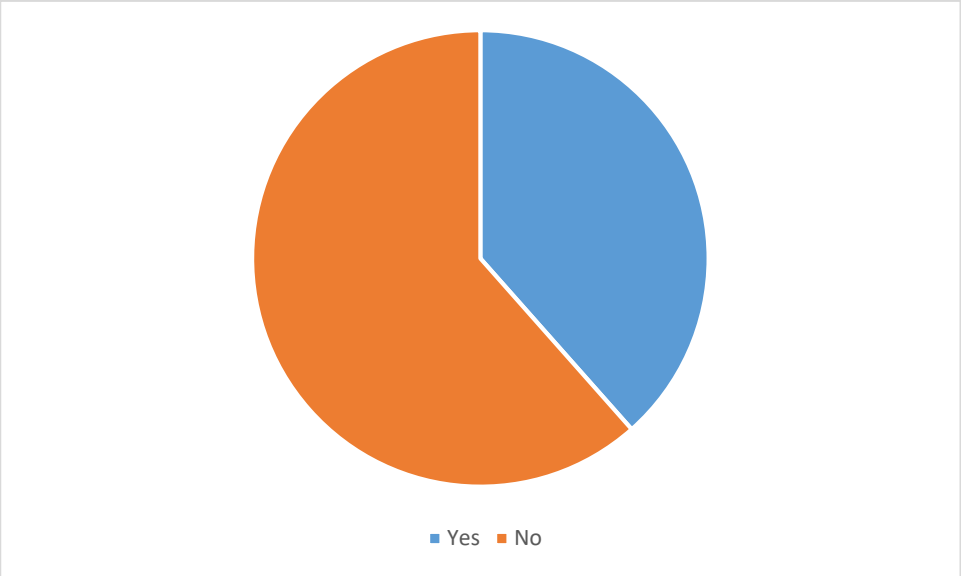


Figure 24. Tsunami-related curriculum programmes are in place for all levels of education.

Comments

- Primary, secondary, post-secondary (Russia).
- N/A (Singapore).
- Primary and secondary (Nicaragua).
- Global programmes readable also by secondary level of education (French Polynesia, France).
- Educational materials such as the online tool “Tsunami: The Ultimate Guide” have been promoted to education departments for curriculum consideration (Australia).
- There are curriculum programmes for pre and primary levels, but these are not specifically for tsunami education but apply to all hazards (New Zealand).
- Primary (Basic Science), Secondary (Geography, Physics), post-secondary (Marine Science) (Fiji).
- Uneven (New Caledonia, France).
- None (Costa Rica).
- General public through HKO website (Hong Kong, China).
- Information (Ecuador).

- Safe Schools Tsunami response plan (Solomon Islands).
- Currently, there are no tsunami-related curriculum programmes for all level of school (Malaysia).
- Primary and secondary only (Panama).
- Secondary (Tonga).

29. All tsunami-vulnerable communities have tsunami evacuation maps, signage and assembly points for evacuation?

Only 23% of participants indicated that tsunami evacuation routes and maps are available for all tsunami-vulnerable communities.

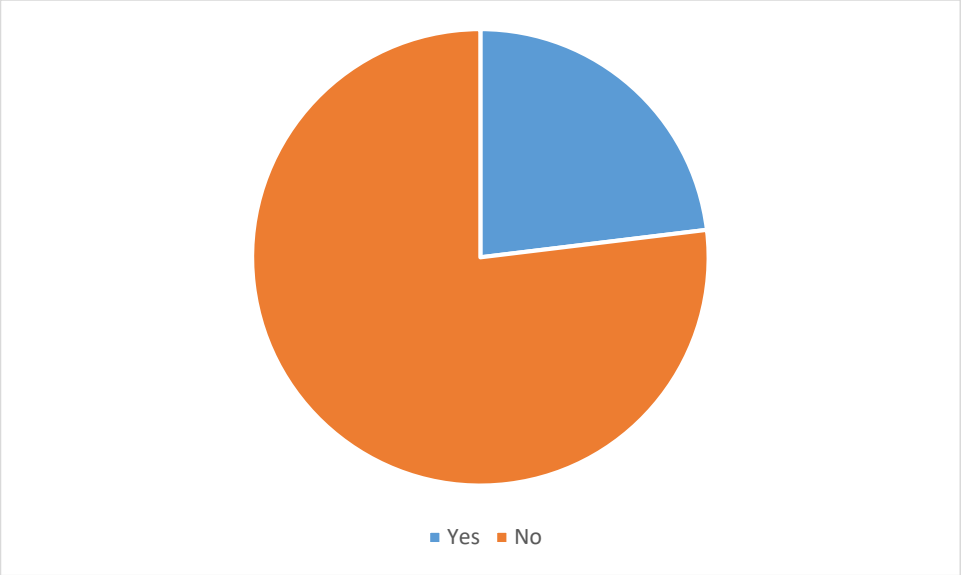


Figure 25. Tsunami-vulnerable communities have tsunami evacuation maps, routes, evacuation signs and assembly points for evacuation areas.

Comments

- Threat of tsunami affecting Singapore is assessed to be low. However, tsunami alerts will be broadcast through the Public Waning System, and resources will be deployed to the ground where evacuation is needed (Singapore).
- Each State/Territory Emergency Service organization has varying amounts of maps, signage, etc. available for community preparedness. Efforts are being made to cover gaps (Australia).
- Responsibility for tsunami evacuation maps and signage lies with the regional/local government level. Many at-risk communities have these arrangements in place. Regional CDEM Groups set out their plans to fill gaps in their CDEM Group Plans, which are prepared every five years (New Zealand).
- Not all areas/communities are covered (New Caledonia, France).
- We have 94 of 144 maps along Peruvian coast (Peru).

- Only 33 communities at the North and Central Pacific coast. Our Pacific coast is over 1000km long. No communities at the Caribbean coast have maps nor signage (Costa Rica).

- In this densely populated city with many high rise buildings, announcements of vertical evacuation would be made (Hong Kong, China).

- Three (Ecuador).

- Tsunami evacuation maps were developed at county level and covered 34 counties along the Chinese coasts with 64 counties identified as high risk (China).

- Only main islands have signage. None in the smaller outer islands (Tonga).

Still Planning

- Currently 53 coastal communities have Tsunami hazards maps. Future plans considers 12 additional communities for 2019-20 period. Most of the coast uses tsunami evacuation routes signage (Chile).

- Future plans in progress (Brunei Darussalam).

- We have maps, signage and assembly points for some tsunami-vulnerable communities. Future plans include rolling out of IOC-Tsunami Ready Programme. Development of more tsunami hazard maps, signage and identification of assembly points for evacuation (Fiji).

- Some coastal communities of the municipalities of La Libertad, Acajutla and Jiquilisco have maps. Currently a tsunami ready pilot plan is in course. With this project it is expected that the coastal communities of the municipality of La Libertad have the appropriate maps, signage and focal point for evacuation (El Salvador).

- On the Nicaraguan Caribbean coast only Corn Island has evacuation maps. It is projected in 2019 to elaborate evacuation maps in the municipality of Bluefields (Nicaragua).

Required Improvement

- We do not have maps of flooding by tsunami in the communities. It is a pending task (Panama).

- All communities have their tsunami safety zone and assembly points but there is not yet tsunami signage in French Polynesia (French Polynesia, France).

30. What type of exercise did you conduct?

Most participants conducted either a table-top or functional exercise for PacWave18. Ten countries carried out functional exercises and five participants undertook a full scale exercise.

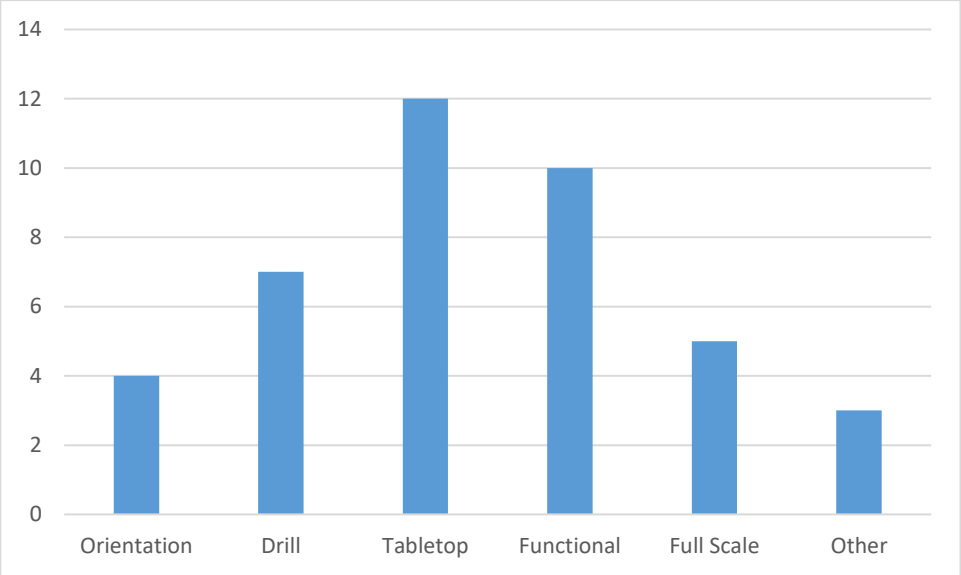


Figure 26.: Type of exercise conducted.

Comments

- Communication test between NTWC and other government agencies (Singapore).
- Unofficial tabletop exercise (Thailand).
- Semi-tabletop with discussions (Brunei Darussalam).

31. Did you conduct community evacuation? Provide details of how many people were evacuated in comments.

Only 38% (10) of participants undertook community evacuation as part of their exercise.

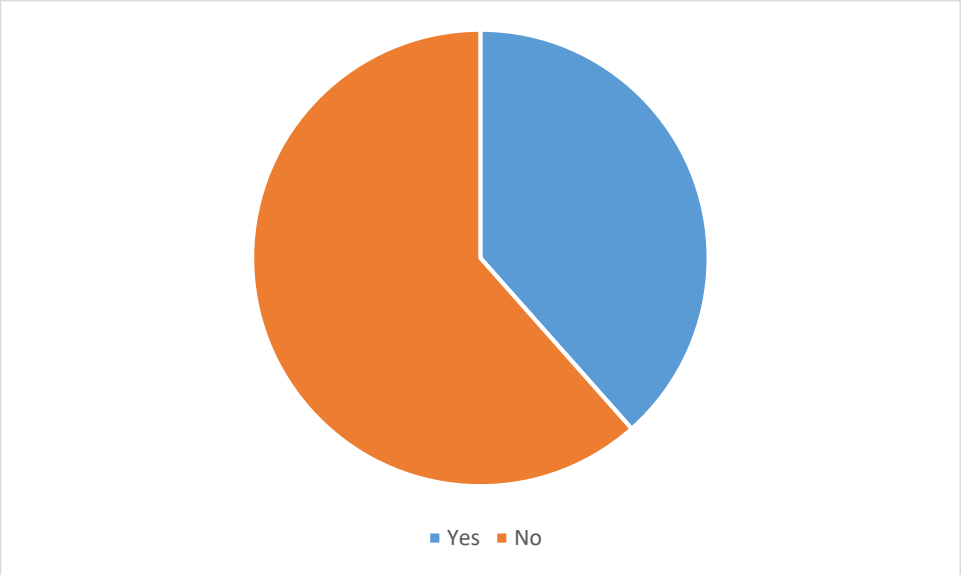


Figure 27. Community evacuation conducted.

The numbers of people evacuated were:

- 20535 (Colombia).
- 730 evacuees reported from 23 agencies (Fiji).
- 150 (El Salvador).
- 6 schools and 1 village. 100s (New Caledonia, France).
- The exercise was conducted only within DHN. 500 people evacuated (Peru).
- 2000 (Viet Nam).
- 500+ (Samoa).
- 42800 (Mexico).
- 700-1000 people (Malaysia).
- About 5000 people (Panama).
- About 10,000 (Tonga).

32. You may add additional individual agency evaluation statements regarding OBJECTIVE 2b in the section below.

The following comments were received from countries in this section:

- Tsunami response planning is the responsibility of State/Territory authorities in Australia. To ensure national consistency, the plans are shared and coordinated by the Australian Tsunami Advisory Group (ATAG) which brings together the NTWC, NDMO, and State/Territory emergency services representatives (Australia).

- Readiness in terms of National Tsunami Response Plan and NWTC SOP. A network of 13 tsunami early warning sirens in place within the Suva Peninsula and work is ongoing for the development of tsunami hazard maps, signage and evacuation zones. Regular awareness training conducted throughout the year with national agencies, schools and communities (Fiji).

- As a country we have a lot of gaps to be filled in especially in tsunami evacuation, mass coastal evacuation plan, early warning plans and response (Brunei Darussalam).

- TWC, DMO and all relevant organizations are aware of the low risk but high impact disaster associated with tsunami SOPs (or contingency plans) are readily available (Hong Kong, China).

- At the national level communication problems existed, however during the development of the exercise the problems were solved (Ecuador).

- All communities and schools with Village Disaster Management Plan are able to test their plans through this exercise PacWave. Also, the Royal Solomon Islands Police Force has mass evacuation plan for Honiara City (Solomon Islands).

- This was the first distant tsunami scenario addressed by NTWC/NDMO, so the objective was to test coordination and SOP. Further exercises will be conducted next year to continue to strengthen our country readiness (Chile).

- The tsunami exercise was done with the scenario of strong earthquake over the Minhassa Trench with the magnitude of 8.5 and depth of 20km. The site for the tsunami arrival was in Tawah, Sabah (Malaysia).

- Know if they know your evacuation route and where to go (Panama).

33. Is your country planning to implement a Community Performance-based Tsunami Recognition Pilot? Provide details in comments.

Forty-four (44) percent of participants indicated that they currently have no plans to implement a Community Performance-based Tsunami Recognition pilot. Only 7 (28%) respondents indicated that they plan to start conducting a UNESCO IOC Tsunami Ready Pilot in 2019.

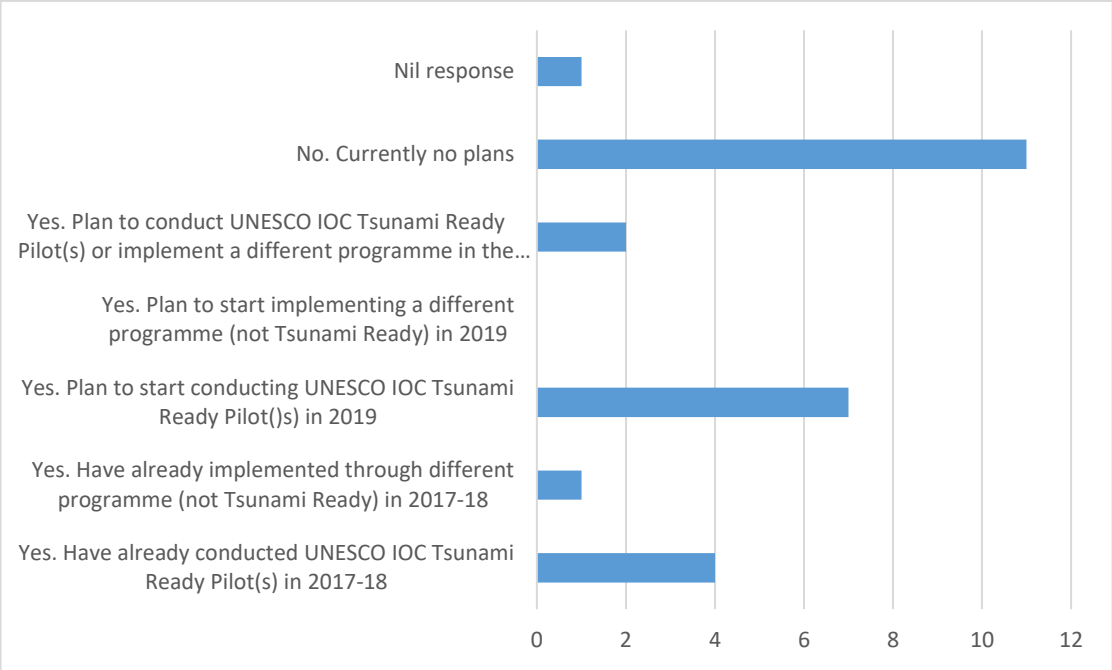


Figure 28. Countries planning to implement a Community Performance-based Tsunami Recognition Pilot.

Comments

- Three. Sakhalin Tsunami Warning Center, Seaside Tsunami Warning Center, Kamchatka Tsunami Warning Center, Federal Service of Russia for Hydrometeorology and Environmental Monitoring (Russia).
- It is planned to conduct the Tsunami Ready program in the communities of Corn Island and Bluefields, 2019. Three more communities are planned for 2020-2021 (Nicaragua).
- Australia plans to conduct an Indian Ocean Tsunami Ready (IOTR) Pilot for its Indian Ocean territories (Christmas and Cocos islands). These are the Australian communities that are most at risk for near-field tsunamis because of their close proximity to the Sunda trench. Planned recognition for Christmas and Cocos Islands between 2019 and 2021 (combined population about 2300) (Australia).
- 10 communities targeted for planned recognition by 2021 (Fiji).
- La Libertad municipality and to be defined another a second one (El Salvador).
- Current plan is to issue risk-based evacuation maps, obtained through high resolution coastal numerical modelling, and historical or hypothetical scenarios (New Caledonia, France).

- And will start soon with a second community. One community recognised n 2017-18, two planning recognition in 2019-21. Ostional (2017), Playa Hermosa and El Coco (2020) (Costa Rica).

- We have been carrying out a project to install several tsunami siren stations along the coastal provinces in Viet Nam. We will organize the training courses for the local staff about the system and also plan to conduct the UNESCO IOC Tsunami Ready Pilot in the future (2020 or later) in Danang and Quang Nam provinces (Viet Nam).

- One has been recognised in 2017-2018, village of Savaia Lefaga (Samoa).

- Our country is interested in certifying several communities of the insular region of Galapagos. We planning recognition for three communities in the Galapagos Islands (Ecuador).

- Save Schools Tsunami Ready Project. Babanga (2017), Titiana (2017), Lengana (2018), Tapurai (2018), and Nusasimbo (2018) (Solomon Islands).

- Coastal town of Cartagena will apply for tsunami Ready certification during 2019 (Chile).

- We have piloted communities but not yet recognized. We do not have a recognition body specifically for tsunami (Philippines).

- DIPECHO programme for Central America. Only one Puerto Armuelles (Panama).

- Primary and secondary schools in tsunami inundation zones in 2020 (Tonga).

Objective 3: To test regional communication and cooperation.

34. Did your country engage in communication and cooperation with other countries in the region for PacWave 18?

Eighty-eight (88) percent of participants did not engage in communication and cooperation with other countries in the region for PacWave18.

Figure 29. Engagement in communication and cooperation with other countries in the region for PacWave18.

Comments

- Japan, USA (Russia).
- While this action is listed in the procedure for real event, we did not engage neighbours for this exercise (New Caledonia, France).
- We communicate with Colombia, Ecuador and Chile (Peru).
- Colombia, Peru and Chile (Ecuador).
- Peru, Ecuador and Colombia (Chile).
- Not so far (Panama).
- The Philippines, Malaysia, Brunei, Indonesia, Thailand, Viet Nam, Cambodia, and Singapore (China).

South China Sea Region

Only SCSTAC (hosted by China) sent messages to SCS countries during this exercise.

35. What types of cooperation were conducted?

Of these participants who undertook regional communication and cooperation, the main activities were a joint PacWave18 exercise or event information sharing.

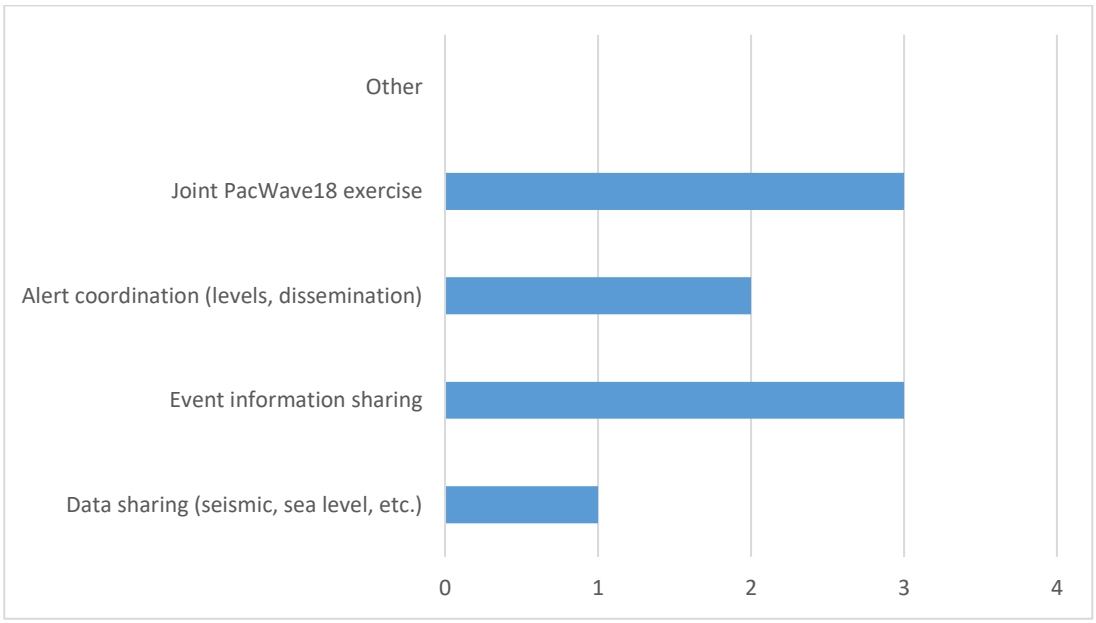


Figure 30. Types of cooperation conducted.

Comments

- Sent SCSTAC products to all SCS countries (China).

36. Did the National Tsunami Warning Centre communicate with other counties during the event?

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

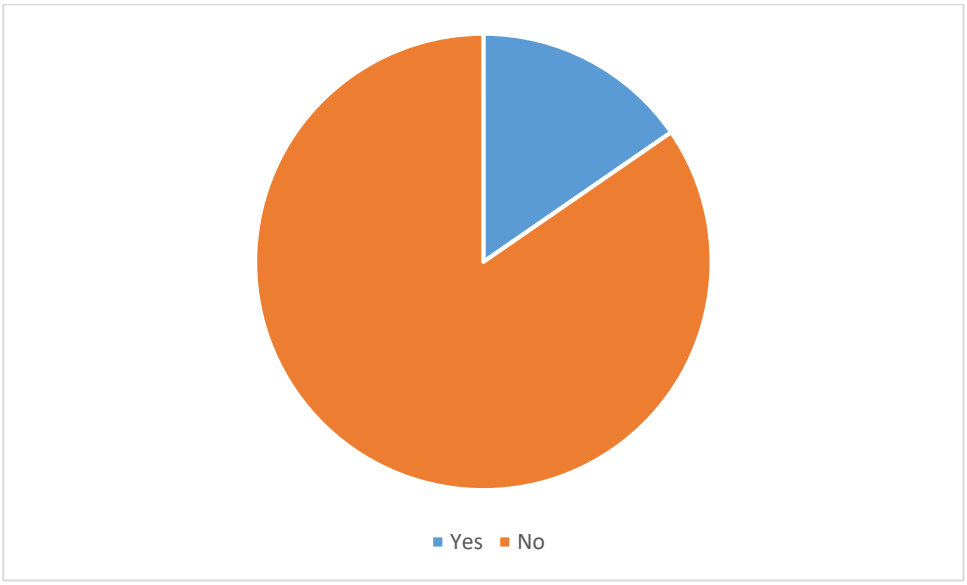


Figure 31. Communication of the NTWC with other countries during the exercise.

Comments

- Ecuador, Peru, Chile (Colombia).
- We communicate with Colombia, Ecuador and Chile (Peru).
- Colombia, Peru and Chile (Ecuador).
- The Philippines, Malaysia, Brunei, Indonesia, Thailand, Viet Nam, Cambodia, and Singapore (China).

37. Did the National Disaster Management Agency communicate with other countries during the event?

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

Figure 32. Communication of the NDMO with other countries during the exercise.

38. Was national information shared with other countries during the event?

Eighty-five (85) percent of participants indicated no national information was shared with other countries during the exercise.

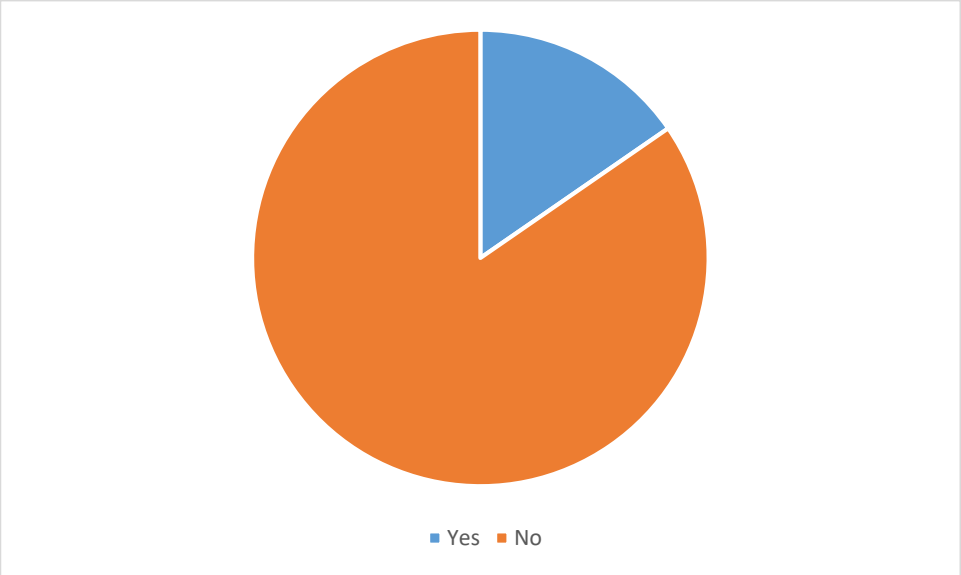


Figure 33. Sharing of national information with other countries.

Comments

- Tsunami threat bulletins and updating bulletins (Peru).
- Tsunami estimated arrival times, measured tsunami amplitudes (Chile).

39. What type of national information did you share?

Of those participants who shared national information, the main types of information shared was the tsunami alert level and tsunami observations.

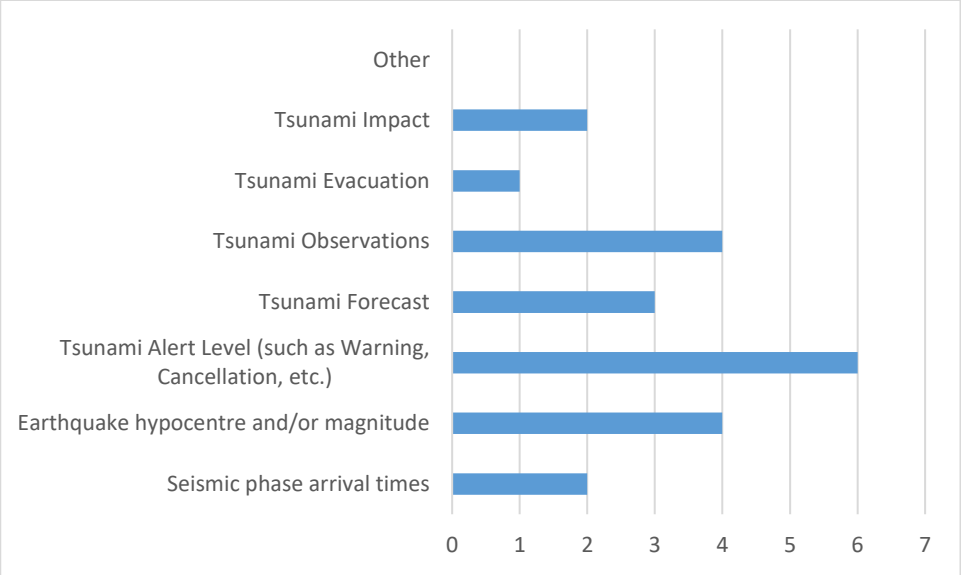


Figure 34. Types of national information shared.

Comments

- Tsunami threat assessment based on PTWC products (Chile).

40. How did you communicate the information?

Email was the primary method of communication with other countries.

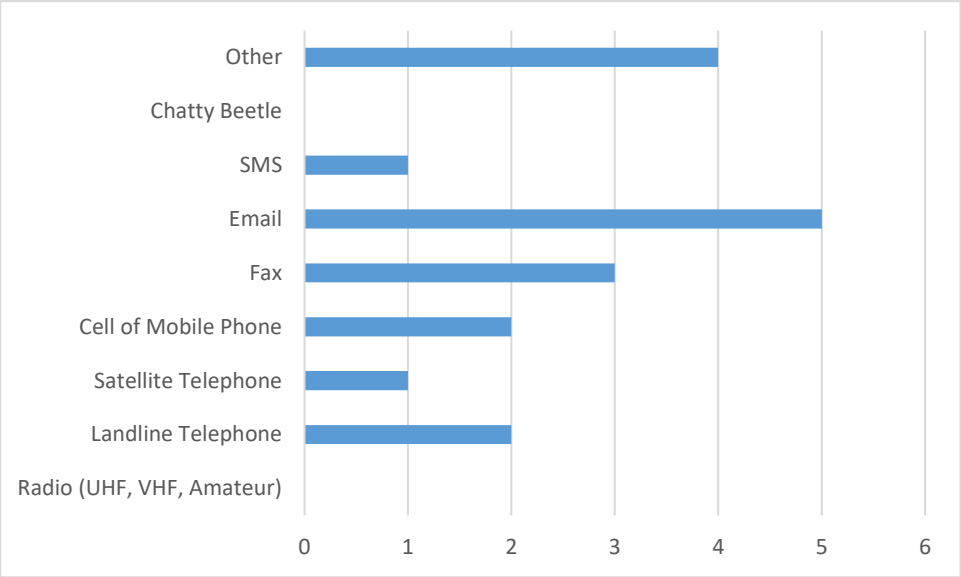


Figure 35. Methods of communication.

Comments

- SRATPS Platform (CPPS) (Colombia).
- Regional platform (SRATPS) (Peru).
- Hong Kong Observatory's website (Hong Kong, China).
- Skype (Ecuador).
- SRATPS cloud based chat system (Chile).

41. You may add additional individual agency evaluation statements regarding OBJECTIVE 3 in the section below.

The following comments were received from countries in this section:

- There was no communication with other countries because it was a table exercise (Nicaragua).
- No communications with other countries was undertaken during our exercise (New Zealand).
- The PacWave 18 Exercise in Fiji was done independently following the scenario that was provided by PTWC (Fiji).

- Regional communications between neighbouring countries especially of tsunami and earthquakes was not exercised because it was a table top exercise (Brunei Darussalam).

- Data and information sharing channel has been made available (Hong Kong, China).

- The coordination at the regional level was very good before, during and after the exercise (Ecuador).

- The exercise conducted was a table top and there is no communication made to any other country (Solomon Islands).

- Additional work is required to develop a communication protocol between Regional NTWC to achieve effective and efficient sharing of tsunami threat assessment. Developing common SOP and Tsunami Amplitude threshold and calculations for threat levels is also required, using the same technical terms and definitions. Since this natural disaster propagates along the whole coast of South America, mitigation plans, emergency management and education materials must be as similar as possible throughout the whole region (Chile).

- This was our first year in the Pacific, only made for this community, our neighbouring country, Costa Rica knew of this exercise (Panama).

***Objective 4**:* To test whether the PTWS PTWC/NWPTAC/SCSTAC Tsunami Service Provider (TSP) products are interpreted by Member States accurately and in a timely manner.

42. Information provided by the relevant Tsunami Service Provider (TSP) products was understood by the National Tsunami Warning Centre (NTWC)/National Disaster Management Office (NDMO)?

Ninety-two (92) percent of participants indicated that the information provided by the relevant Tsunami Service Provider products was understood by the NTWC/NDMO.

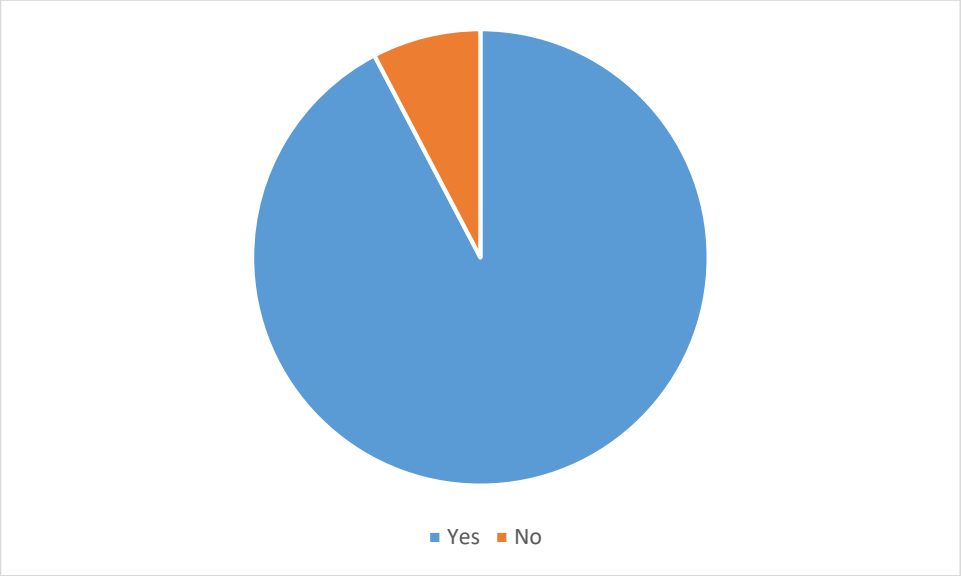


Figure 36. Information provided by the relevant TSP was understood.

Comments

- Australia possesses its own independent tsunami detection and threat assessment capability and the Joint Australian Tsunami Warning Centre (JATWC) did not use the TSP products (Australia).

- NDMO officials have been trained to understand PTWC enhanced messages (New Caledonia, France).

South China Sea Region

The SCSTAC products can be understood and used for decision making by all participating countries and sub national entities.

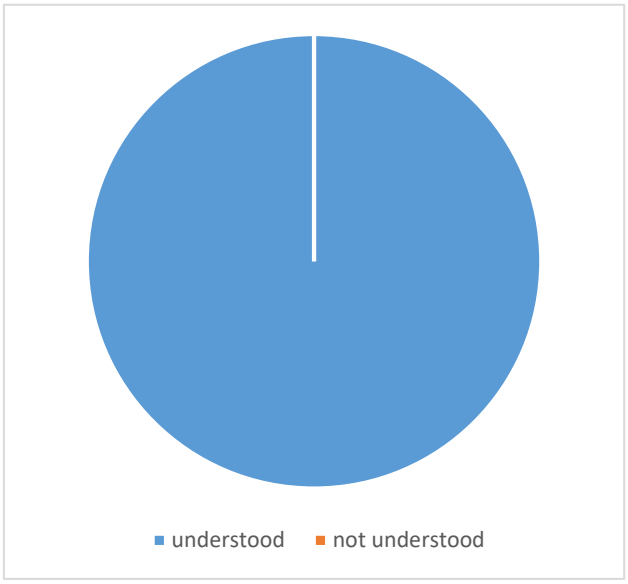


Figure 37. Information provided by the relevant TSP was understood.

43. How did your country assess the tsunami threat during the exercise? Please tick as many as apply.

The responses to this question indicate that there are a number of key methods of assessing tsunami threat, with the most popular being the Tsunami Service Provider forecasts (77%), and national resources (pre-computed tsunami scenarios (69%), tsunami experts (54%) and tsunami forecasts). Least used were the NCEI/WDS tsunami historical database (web) (4%) and communication with outside sources (4%).

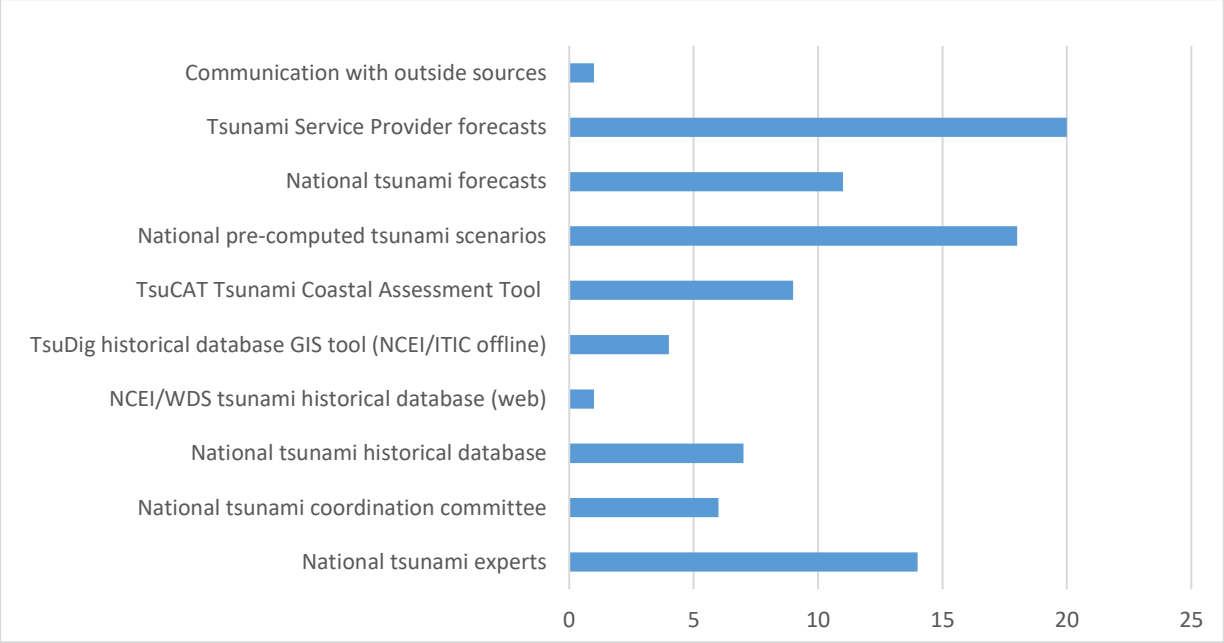


Figure 38. How countries assessed the tsunami threat during the Exercise.

National tsunami experts

- Automated messages to NDMO from EQ early warning from IRD/ORSNET, PTWC messages, in-person expertise by 4 different IRD scientists (if available at the time, no 24/7 duty possible) (New Caledonia, France).

Tsunami Service Provider forecasts

- PTWC forecasts were used during the exercise for evaluation. PTWC messages were sent following the PacWave schedule. On the other side, national tsunami forecast bulletin are used in priority, they were sent automatically following the triggering scenario at 18:30 UTC on 30 November 2018. That way PTWC messages and national tsunami forecasts from CPPT could be evaluated and compared by the NDMO (French Polynesia).
- PTWC, NWPTAC, and SCSTAC (Thailand).
- SCSTAC (Brunei Darussalam).
- PTWC forecasts (Costa Rica).
- PTWC, SCSTAC, NWPTAC (Viet Nam).

Other comments

- Originally, the plan was to use Manila Trench scenario (M8.8). However, the tsunami scenario used for tsunami exercise on the 14th November 2018 was Minhassa Trench scenario (2.0N, 120.0E) with a magnitude of 8.5 and depth 20km. The scenario was changed to Tawau, Sabah due to logistics concerns (Malaysia).
- It helps to better plan evacuations and possible damage (Panama).

44. The information provided assisted with decision making, e.g. warning levels, earthquake parameters, estimated arrival times, forecast wave heights, etc.

Ninety-six (96) percent of respondents agreed with this statement.

Figure 39. The information provided assisted with decision making, e.g. warning levels, earthquake parameters, estimated arrival times, forecast wave heights, etc.

The following information highlights responses from countries:

- Australia made use of its own independent tsunami detection and threat assessment capability (Australia).
- The most useful information are the earthquake parameters and the estimated arrival times. The earthquake parameters provided form the basis for our initial threat assessment (New Zealand).
- Earthquake parameters, estimated arrival times, forecast wave heights (Viet Nam).
- This helped a lot to establish distances to walk to evacuation and optimum evacuation points (Panama).

45. The information issued by your country national Tsunami Warning Focal Point was according to standard operating procedures.

The majority of respondents (96%) agreed with the statement.

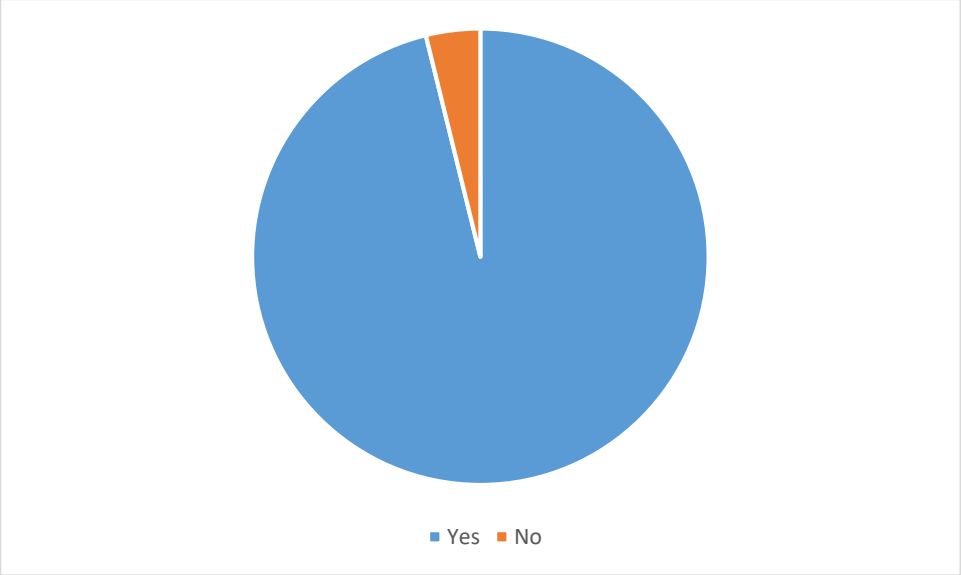


Figure 40. The information issued by your country national Tsunami Warning Focal Point was according to standard operating procedures.

The following information highlights responses from countries:

- The JATWC (also as TWFP) has well developed standard operating procedures which were followed throughout the exercise (Australia).

46. Do you require additional training on the use of TSP products for national threat level decision-making?

A number of respondents indicated that they required additional training on the use of TSP products for national threat level decision-making, mostly with the PTWC products.

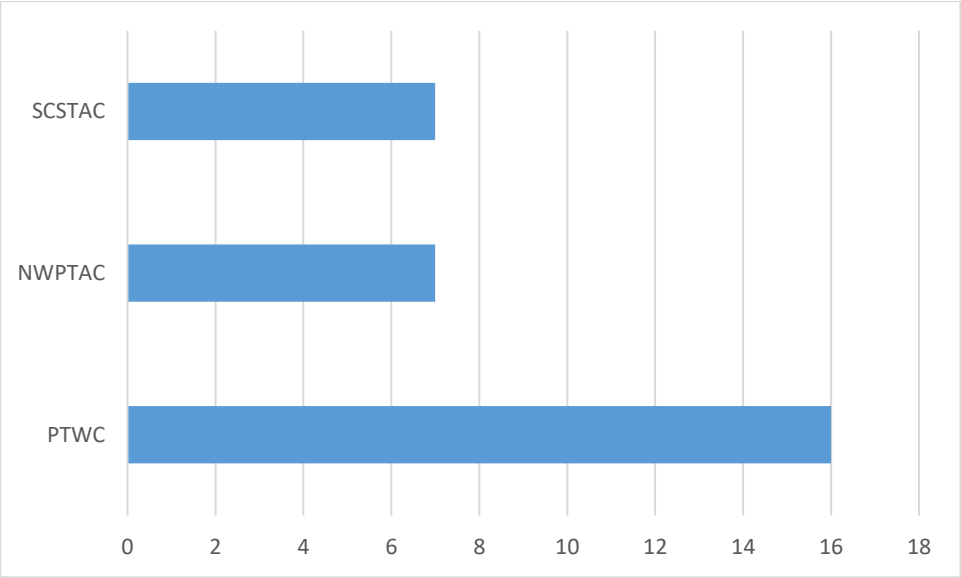


Figure 41. Additional training on TSP products required.

47. You may add additional individual agency evaluation statements regarding OBJECTIVE 4 in the section below.

The following information highlights responses from countries:

- Even with the product knowledge, it is always timely to have ongoing training to strengthen the products issued by PTWC (Nicaragua).
- The NTWC were able to easily interpret the TSP products (Fiji).
- Further training is needed in order to use the products (Brunei Darussalam).
- TSPs products are useful (Hong Kong, China).
- The new product from PTWX PTWC/NWPTAC/SCSTAC Tsunami Service was excellent, but now we have new personnel and they need training. The products are very useful (Ecuador).
- NWPTAC products are not available for this exercise while most TSP products are interpreted by Member States accurately and in a timely manner (Solomon Islands).
- Colour scale for PTWC products containing alert levels, do not match current tsunami amplitude thresholds of less than 0.3, 0.3m to 1 m, 1m to 3m, and above 3m (Chile).
- We have many new staff that need to be trained and other to refresh the knowledge (Panama).
- All persons in the warning center should have this competence. At the moment only half of staff know how to interpret (Tonga).

***Objective 5**:* Validate the format and content of the Northwest Pacific Tsunami Advisory Center (NWPTAC) Enhanced Products (if applicable).

48. Information provided in the Northwest Pacific Tsunami Advisory Center (NWPTAC) messages was understood by and useful to the National Tsunami Warning Centre (NTWC)/National Disaster Management Office (NDMO)?

Forty (40) percent (8) of the respondents to this question agreed that the information provided in the NWPTAC messages was understood by and useful to the NTWC/NDMO. Fifty (50) percent (10) of the respondents to this question indicated that it was not applicable to them.

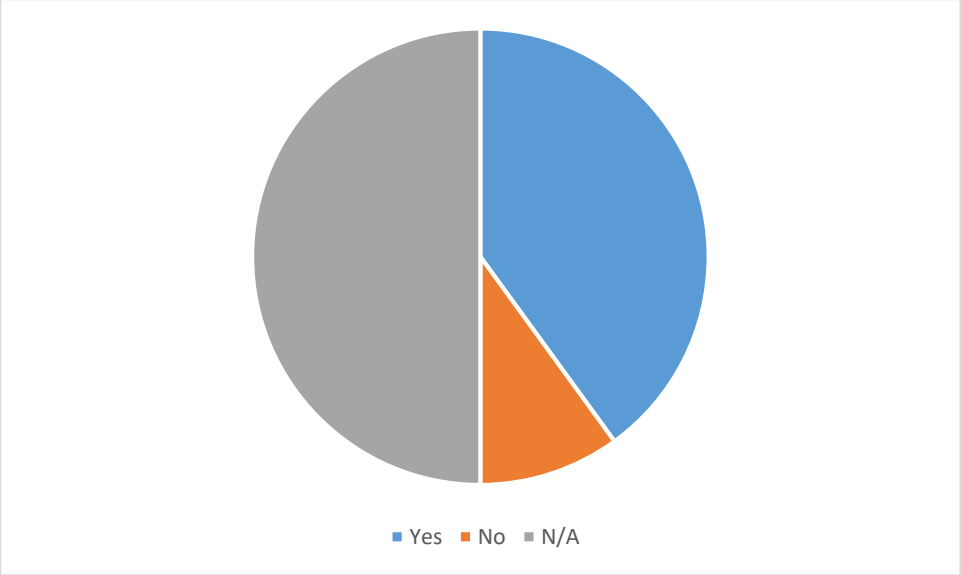


Figure 42. Information provided in the NWPTAC messages was understood and useful.

The following information highlights responses from countries:

- Northwest Pacific Tsunami Advisory Center (NWPTAC) Enhanced Products are not available for this scenario (Solomon Islands).

- No, during this exercise do not use products of NWPTAC, since it was a single exercise for Panama (Panama).

49. Threat information in NWPTAC products was understood and useful

Eight of the respondents to this questions indicated that the threat information in the NWPTAC text products was understood and useful. Six of the respondents to the question agreed that the threat information in the NWPTAC graphical products was understood and useful. A large number of respondents to both questions indicated this was not applicable to them.

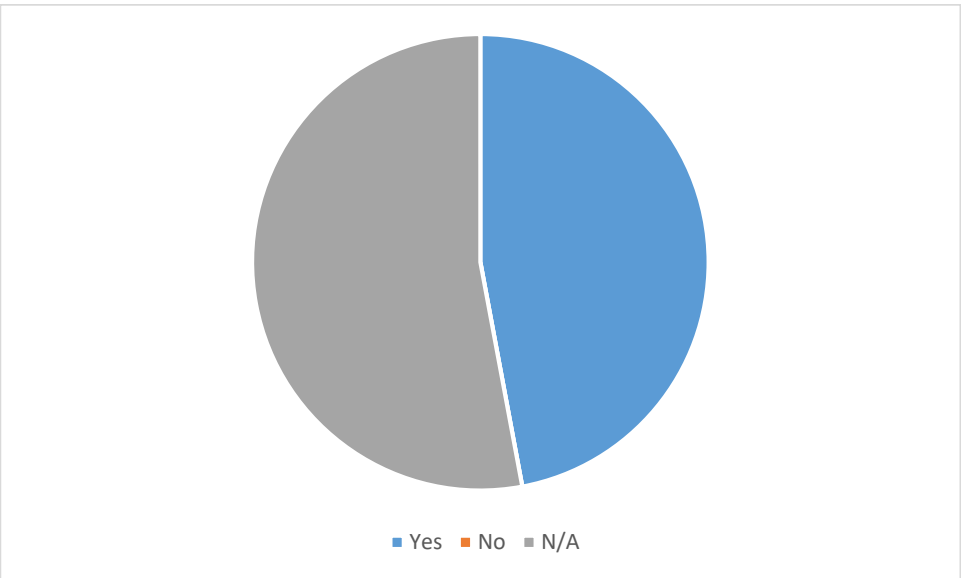


Figure 43. Threat information in the NWPTAC text products was understood and useful.

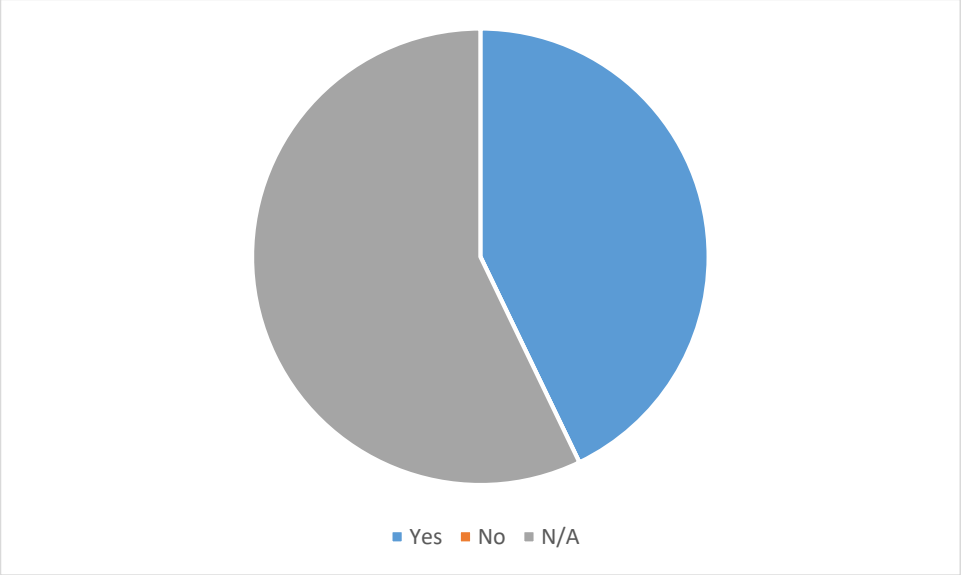


Figure 44. Threat information in the NWPTAC graphical products was understood and useful.

The following information highlights responses from countries:

- The information such as "(Addition)" and "(Revision)" appended to the city name in the text products is useful to help users identify any difference in model output of estimated time of arrival/estimated amplitude of the tsunami without having to compare to the previous bulletin (Singapore).

50. Components of the NWPTAC product suite were understood and useful?

Forty-two (42) percent (8) of the respondents to this questions indicated that the components of the NWPTAC product suite were understood and useful.

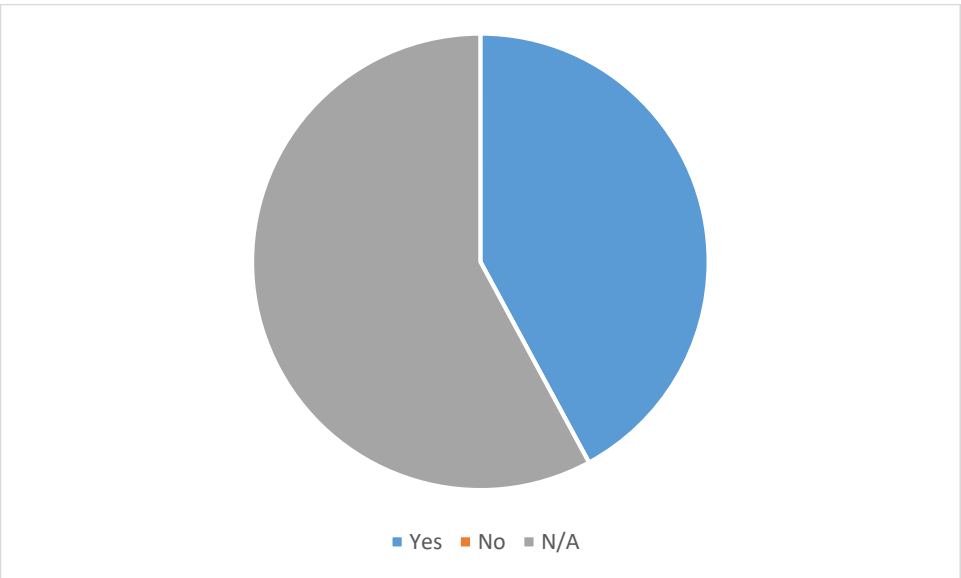


Figure 45. Components of the NWPTAC product suite were understood and useful.

The following information highlights responses from countries:

- Nil (Singapore).

- Suggestions: current methodology of adopting both CMT nodal solutions for deep-ocean and coastal amplitude seemed far too conservative, since one of the CMT solution may physically unsuitable (China).

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

Forty-two (42) percent (8) of the respondents to this questions indicated that the information provided assisted with decision-making. 11 respondents indicated that this was not applicable to them.

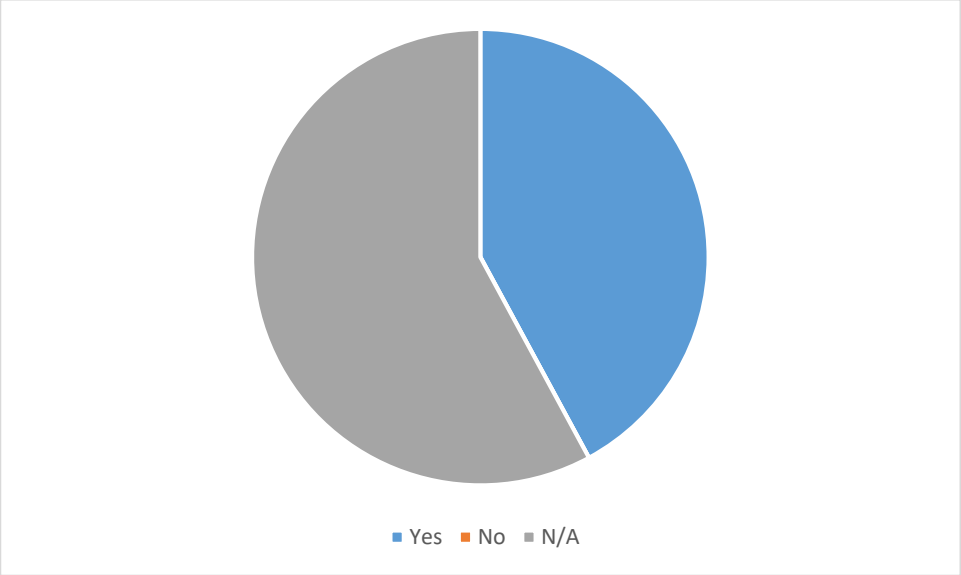


Figure 46. Information assisted with decision-making.

The following information highlights responses from countries:

- Earthquake parameters, warning levels, estimated arrival times, forecast wave heights (Viet Nam).

52. You may add additional individual agency evaluation statements regarding OBJECTIVE 5 in the section below.

The following information highlights responses from countries:

- For the text product, it will be useful if the forecast for additional cities (not included in previous bulletins) can be appended with “(Additional)”, so that the user of the bulletin will know that a new city is included in this particular bulletin. If the estimated amplitude/time of arrival of the tsunami has changed for a city, it will be useful if a text “(Revised)” can be appended to this city name. These additional information will be useful for NTWC to identify and convey any change in assessment to other agencies (Singapore).

- Doesn’t apply to our country (Nicaragua).

- Products by NWPTAC were understood and useful (Hong Kong, China).
- We did not use the products (Ecuador).
- Northwest Pacific Tsunami Advisory Center (NWPTAC) Enhanced Products are not available for this scenario (Solomon Islands).

Objective 6: Validate the format and content of the South China Sea Tsunami Advisory Center (SCSTAC) Enhanced Products (if applicable).

53. Information provided in the South China Sea Tsunami Advisory Center (SCSTAC) messages was understood by and useful to the National Tsunami Warning Centre (NTWC)/National Disaster Management Office (NDMO)?

Thirty-five (35) percent (6) of the respondents to this question agreed that the information provided in the SCSTAC messages was understood by and useful to the NTWC/NDMO. 65% (11) of the respondents to this question indicated that it was not applicable to them.

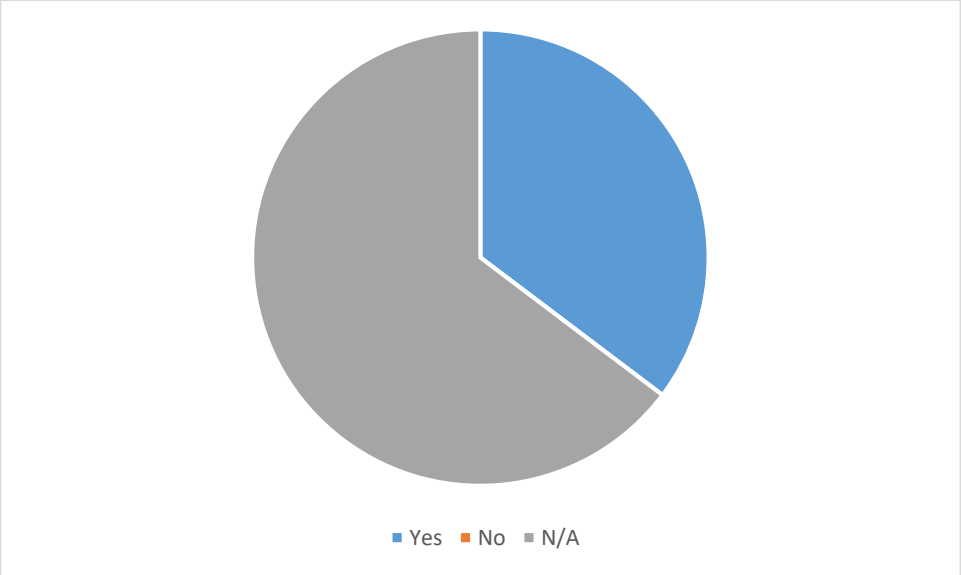


Figure 47. Information provided in the SCSTAC messages was understood and useful.

South China Sea Region

The SCSTAC Enhanced Products including text products and graphical products were understood and considered useful by most participating countries and sub national entities.

54. Threat information in SCSTAC products was understood and useful.

Six of the respondents to this questions indicated that the threat information in the SCSTAC text products was understood and useful. Five of the respondents to the question agreed that the threat information in the SCSTAC graphical products was understood and useful. A large number of respondents to both questions indicated this was not applicable to them.

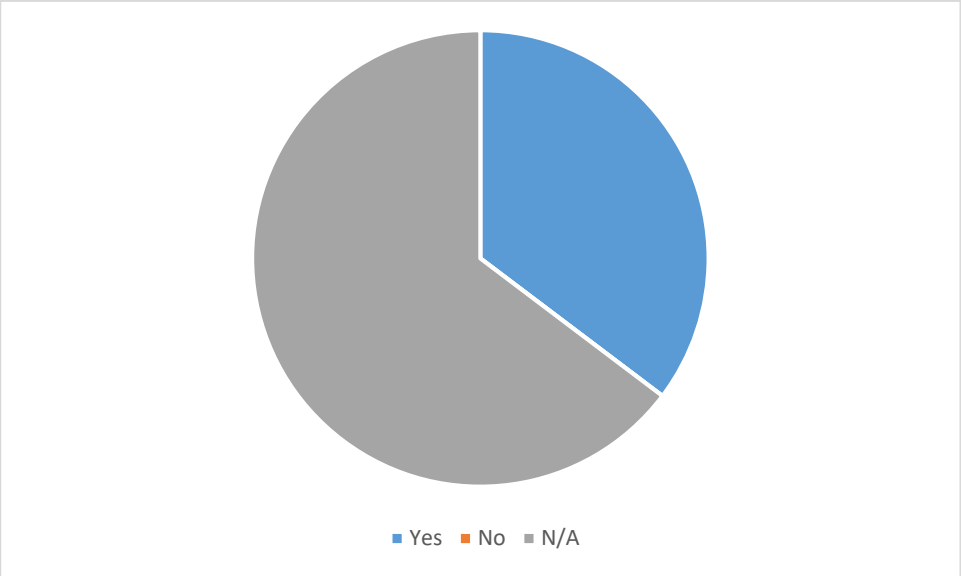


Figure 48. Threat information in the SCSTAC text products was understood and useful.

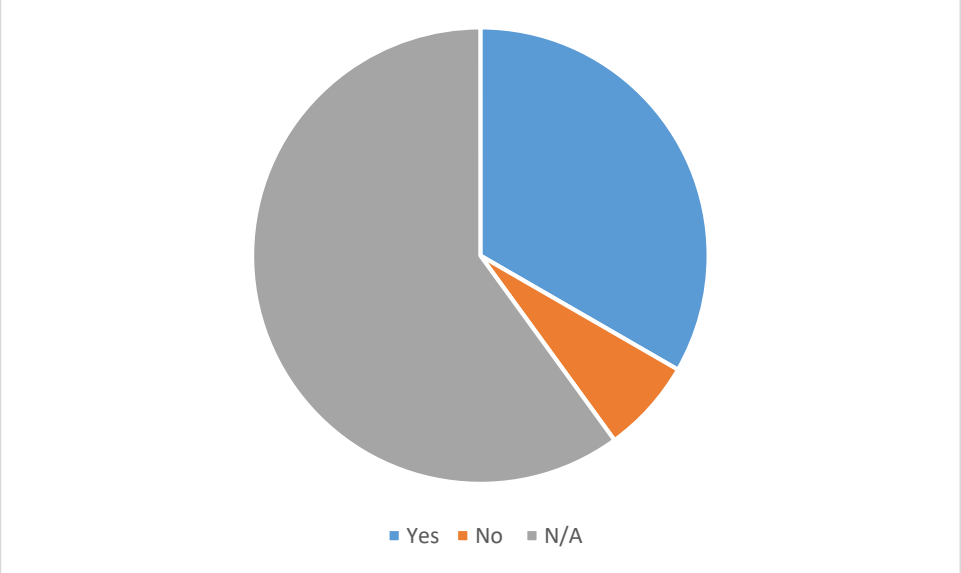


Figure 49. Threat information in the SCSTAC graphical products was understood and useful.

55. Components of the SCSTAC product suite were understood and useful?

Thirty-eight (38) percent (6) of the respondents to this questions indicated that the components of the SCSTAC product suite were understood and useful.

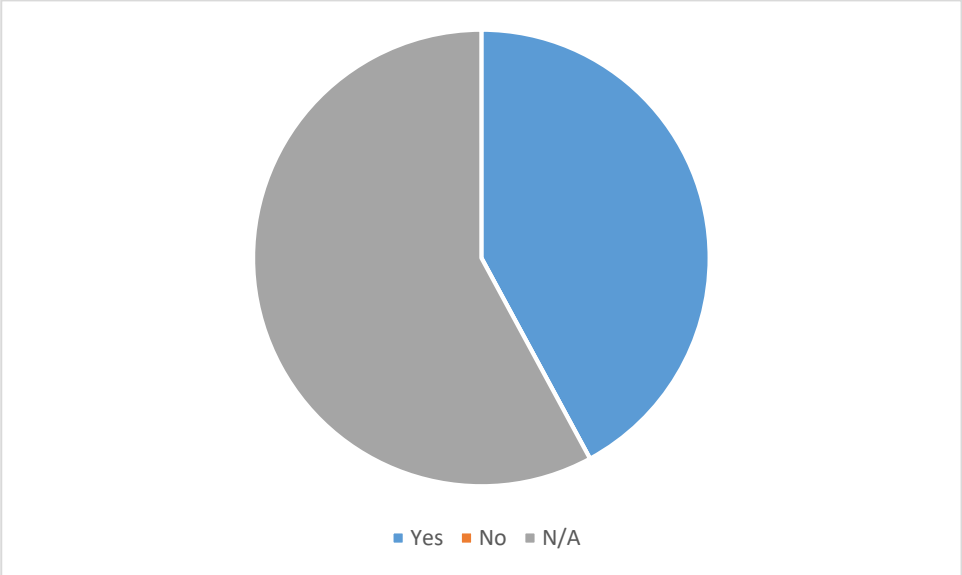


Figure 50. Components of the SCSTAC product suite were understood and useful

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

Thirty-five (35) percent (6) of the respondents to this questions indicated that the information provided assisted with decision-making. 11 respondents indicated that this was not applicable to them.

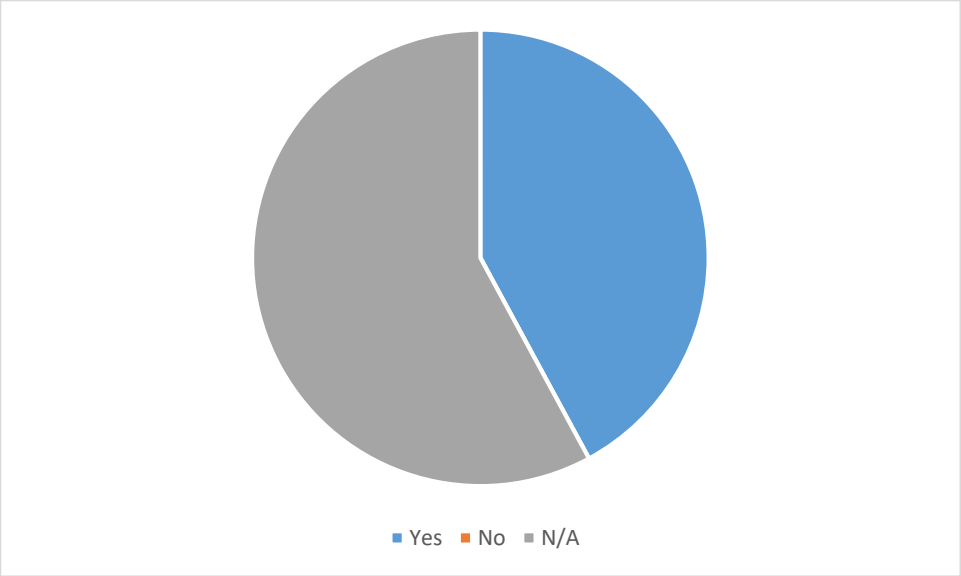


Figure 51. Information assisted with decision-making.

The following information highlights responses from countries:

- Earthquake parameters, warning levels, estimated arrival times, forecast wave heights (Viet Nam).

57. You may add additional individual agency evaluation statements regarding OBJECTIVE 6 in the section below.

The following information highlights responses from countries:

- No apply to our country (Nicaragua).
- Have no problem understanding the information (Brunei Darussalam).
- Product by SCSTAC were understood and useful (Hong Kong, China).

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.

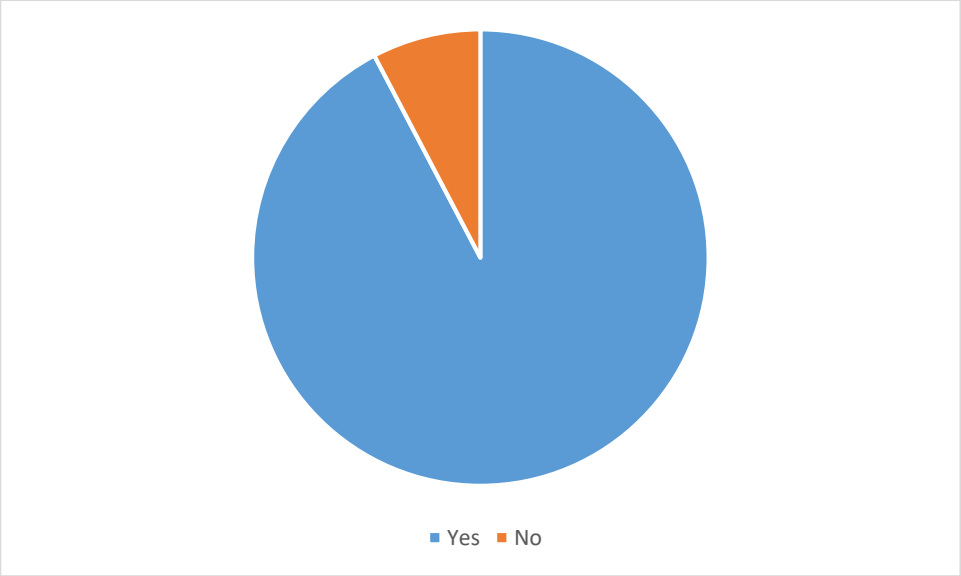


Figure 52. Country stakeholders have a better understanding of the goals, responsibilities and roles in tsunami emergencies.

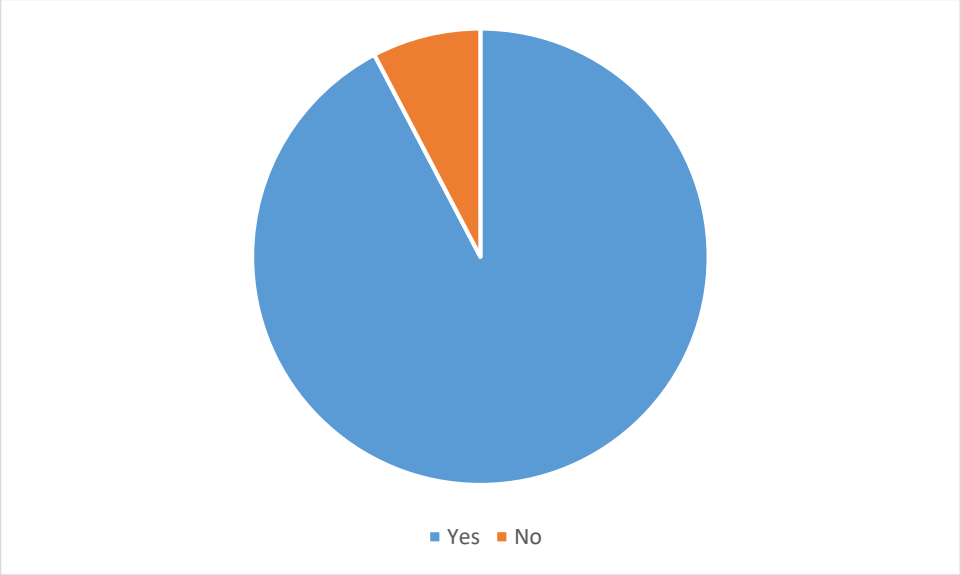


Figure 53. Gaps in capability and capacity have been identified.

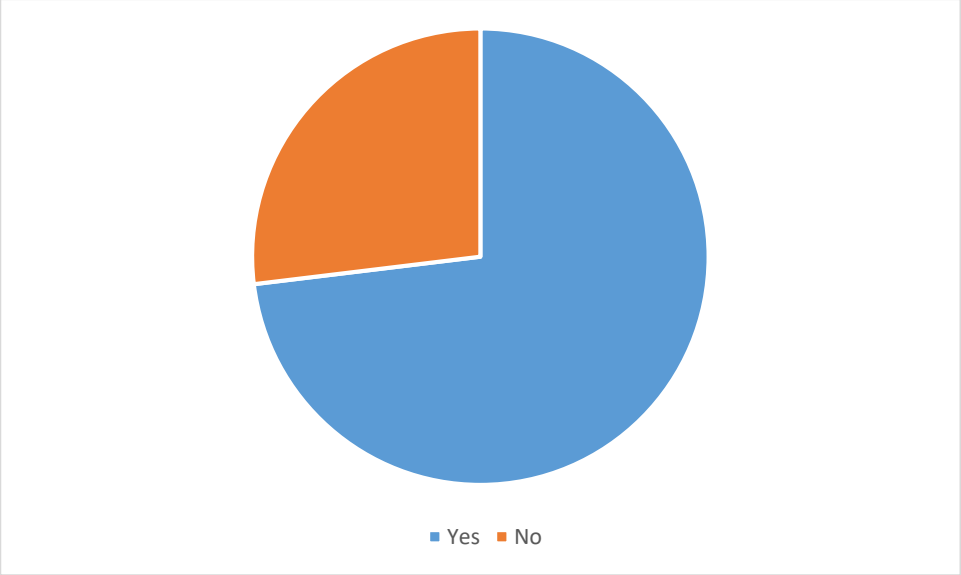


Figure 54. Community have a better understanding of their tsunami risk and are better prepared for tsunami events.

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.

- About 10 people (French Polynesia, France).
- We estimate participated 258 people of the National Tsunami Warning System and 20535 people was evacuated (Colombia).
- Communities were not involved in our exercise. There was no media coverage of the exercise in New Zealand. Approximately 50-60 people participated in the exercise in New Zealand (New Zealand).
- The number of evacuees from the targeted agencies was 730 in total. Approximately 1000 personnel from Government and Non-Government Agencies took part in the exercise (Fiji).

- 10 people. Future planning and gap in capability and capacity needs further discussion (Brunei Darussalam).

- 70 people participated (Costa Rica).

- We expect around 10,000-15,000 participants for each coastal province in Viet Nam (Viet Nam).

- Around 100 people from government agencies participated in PacWave18. Observers from NGOs including Red Cross and Hong Kong Academy of Medicine were also invited (Hong Kong, China).

- There are many gaps that must be covered. It requires more effort and preparation by authorities (Ecuador).

- 120 participated as it is a table top exercise (Solomon Islands).

- 42884 (Mexico).

- 6,000-10,000 people (Panama).

- 100 persons has been involved in this exercise (China).

Other Comments

- PacWave18 was conducted as a communication test between the Meteorological Service Singapore (MSS) and other government agencies ion Singapore, without activating the national tsunami response plan on the ground. MSS nonetheless conducted a few rounds of briefing for response agencies prior to the exercise to communicate the anticipated impact of the tsunami on Singapore and the respective roles of the response agencies (Singapore).

- The public were not involved in this exercise. 13 National/State/Territory agencies participated in PacWave18 (Australia).

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 satisfactory and that exercise planning at the national level went well. There is room for improvement in exercise planning at both the international level, and at the provincial/local level.

The majority of respondents indicated the PacWave18 website pages were useful and the evaluation form was easy to use. The PacWave18 Exercise Manual and the IOC Manual and Guides were all found to be useful by the majority of exercise participants.

Comments

- All according to plan (Nicaragua).

- Evaluation form should have another box not only yes/no cause some session we didn't have done that so we will only answer no which are not correct for the evaluation information (Thailand).

- The provincial/local level was not involved in the exercise so was not involved in the planning. Although the evaluation form was relatively easy to use, some of the questions were difficult to answer with timings, as a number of different activities made up the exercise overall. The option for countries to be able to complete their exercises over a prolonged time frame (Sep-Nov) means that some of the evaluation questions were difficult to interpret and answer (New Zealand).

- The IOC Manual and Guideline 58 was used to design the exercise format and style. The provision of guidelines and manuals through the Pacwave website was very useful. The use of the IOC Guidelines and Manuals for exercise planning at national level went well. The exercise planning at the provincial/local level went well and they were actively involved in the exercise. The PacWave18 exercise website pages were very useful and informative. The Evaluation Form was user-friendly. The PacWave18 exercise manual greatly informed our exercise planning. IOC Manual and Guideline 76 was very useful and informative. The IOC Manual and Guideline 58 was very useful and informative (Fiji).

- The manual is useful and very detailed (Brunei Darussalam).

- The exercise was well planned and coordinated. It gave participating organizations enough flexibility to choose the type of exercise, scope and scenarios to fit their needs (Hong Kong, China).

- The PacWave are always well structured and organized (Ecuador).

- Generally the planning was satisfactory (Solomon Islands).

- The exercise was done at the national level. The scenario supplied for the PacWave18 was not used (Malaysia).

- Need more work coordinating with remote islands and communities (Tonga).

EXERCISE PLANNING.

58. Please provide a general statement of what went well.

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

- Everything went according to plan. Internally, we must raise levels of participation (Nicaragua).

- With the limited time for preparation and a few staff, we were completed as plan as we expect (Thailand).

- Overall, the planning and the PacWave 18 Exercise went well (Fiji).

- Schools in tsunami risk areas know where to evacuate in a local tsunami event (Tonga).

Messages & Information

- The message was received timely (Malaysia).
- We tried to catch as real as possible a tsunami time line based on previous alert. PTWC messages were re-sent by mail by an agent following PacWave schedule. National tsunami products were triggered as a real event in real-time, we only triggered an automatic first earthquake location at OT+6 minutes. The new PacWave global schedule giving 3 months for countries to plan and conduct their exercise was grateful. We chose a regional scenario to always track where we can facilitate and improve emergency response (French Polynesia, France).

Preparation

- We were able to provide exercise materials on time (Philippines).
- Readiness to conduct the PacWave 18 in the country (Viet Nam).
- Planning the exercise with GNS Science provided a good opportunity to improve each other's knowledge of our processes to better align our actions and SOPs (New Zealand).

PacWave 18 Exercise Manual

- All the necessary information was available to choose the appropriate scenario and the actions to follow (El Salvador).
- The exercise manual for PacWave Exercise is very useful (Singapore).
- Exercise documentation was useful and timely available (Chile).

IOC Manual & Guides, 58

- The manual "How to Plan, Conduct and Evaluate UNESCO/IOC Tsunami Wave Exercises" was accessible and understandable (Russia).

Stakeholders & Communication

- Coordination between the agencies of the national system (Colombia).
- To be a local exercise participation of students and the public in general (Panama).
- The increase of participation to the emergency management authorities and the military institutions in support of the civilian population (Mexico).
- The local scheduled communication test and master scenario were well prepared (Hong Kong, China).
- The regional coordination was very well (Ecuador).
- The regional organization for conducting the exercise was well coordinated previously. At least two regional meetings were held in order to plan properly (Peru).
- Australia prepared a national exercise manual prior to the exercise and all participating agencies were appropriately briefed. Since IOWave18 took place at

about the same time, the manual included information on both exercises. Almost all appropriate National/State/Territory agencies took part in PacWave18 at some level (Australia).

- Most municipal communities were engaged in the exercise (Costa Rica).

SOPs

- Discussions and planning as well as going through the tsunami SOPs went well (Brunei Darussalam).
- SOP tested, NEOC arrangements tested, Tsunami sub plan tested (Solomon Islands).
- SOPs testing (Samoa).

59. Please provide a general statement about what did not go went well.

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

Comments

- All was ok (Nicaragua).
- Not use timeline for planning and lack of awareness for tsunami in Pacific Ocean side (Thailand).
- Australia participated in IOWave18 and PacWave18 in quick succession and some national agencies chose to participate in only one of these exercises as a result (Australia).
- None (Samoa).
- Nil (Hong Kong, China).

Messages and Information

- The format of the bulletins from PTWC, NWPTAC and SCSTAC are all different. This makes it hard for us to compare information from these three products (Singapore).
- We were unable to use the scenario suggested for the PacWave18 (Malaysia).
- The SMS message was not clear and detail (Viet Nam).
- Provision of local injects (Philippines).

Stakeholders & Communication

- Participation some partners and sectors committee weak, budget not available, communication between the planning team need improvement (Solomon Islands).
- Was difficult to convoke the civilian population to evacuate the risk areas (Mexico).

- The participation of the community, lack of signs that indicate tsunami evacuation routes, more disclosure (Panama).

- Some committees didn't take it seriously and did not attend (Costa Rica).

- The outcome of the media briefing. Delay in the installation of tsunami hazard signs. Lack of dedicated handheld radios for the exercise (Fiji).

- Coordination in the local agencies and communities (Colombia).

- Some members of the public still take the tsunami issue lightly,. Perhaps because they have never experienced a tsunami (Tonga).

Preparation and Planning

- Our national coordination was poor. The National Risk Agency was not participate completely (Ecuador).

- Coordinating the exercise was at short notice and did not have enough time to plan (Brunei Darussalam).

- Planning with GNS could have started earlier to enable further planning which would have contributed to a smoother exercise overall (New Zealand).

60. Please provide a general statement about what could be improved.

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

- Improve the content and delivery of the media briefing. Ensure that tsunami hazard signs are installed by the responsible contractor before the exercise. Ensure that there are dedicated handheld radios for the exercise (Fiji).

- Regular exercises (Costa Rica).

- How officers on duty react if real situation happens – to be comfortable and not panic (Samoa).

- Nil (Hong Kong, China).

- More tsunami training for communities/agencies (Tonga).

Stakeholders & Communication

- The participation of the community, local authorities and all walks of life that make up the National Committee for Tsunami (Panama).

- Increase the participation of the civil population to evaluate the response capacity of the Emergency Management Authorities (Mexico).

- The National coordination, the risk management authorities should show more interest in the participation of the exercises, we will need to disseminate more the exercise by the NTP (Ecuador).

- Communication between agencies, the tsunami SOPs and the focal points should be clearly identified (Brunei Darussalam).

Messages & Information

- Using non-historical scenario means that PTWC/NWPTAC and SCSTAC have chosen a generic earthquake and they should before PacWave share the tsunami source parameter (focal mechanism, fault parameter, etc.) that national tsunami forecast could be used in their tsunami tools to allow also comparison of the forecast. Indeed for generic scenario National Tsunami Forecast and PTWC can show a significant difference relative to the huge uncertainties in the chosen tsunami parameters that are based only on an epicentre location and earthquake magnitude. In that case NDMO, can be during the exercise be very surprised of the big difference in tsunami impact between local and international products (French Polynesia).

- It will be good if the bulletin format of the PTWC, NWPTAC and SCSTAC can be standardized (Singapore).

- Looking for a new method to disseminate the information to the public such as Viber, WhatsApp (Viet Nam).

- Real time delivery of TSP bulletins (Chile).

Planning

- Set the timeline and implement it and may be set the committee for conduct the exercise (Thailand).

- Australia would prefer the planning of the IOWave and PacWave exercises be coordinated such that they are held in alternate years. This would facilitate the deployment of interstate observers from our State/Territory agencies and maximise the involvement of the national agencies in each exercise (Australia).

- Planning of the exercise at the local and community level (Colombia).

- Start planning earlier and have more regular engagement earlier with other participating organisations (New Zealand).

- A more option for earthquake scenarios (Malaysia).

- Planning and draft tsunami sub-plan to link with the new NDM plan 2018 (Solomon Islands).

- Choose a local scenario (Philippines).

EXERCISE CONDUCT

61. Please provide a general statement about what went well.

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

- All was ok (Nicaragua).
- PacWave schedule was followed. National tsunami products as well (French Polynesia, France).
- Due to the preparation time not too much and a few staff. We have been conduct the tabletop exercise which find the gap in the SOP that really useful for us (Thailand).
- The warning was sent in time. Coordination with United Nations agencies (Colombia).
- Participants engaged well with the scenario and approached the exercise with realism. It provided a good test of our processes and procedures (New Zealand).
- Overall the PacWave18 Exercise went well (Fiji).
- The exercise was done on the planned date and time (Brunei Darussalam).
- Most committees applied their multi hazard training (Costa Rica).
- SMD-NDC staff are well versed with what to do (Samoa).
- We were able to practice our Standard Operating Procedures for tsunami with our newly hired staff (Philippines).

Messages, Manual, and Information

- Bulletins contain useful information (Singapore).
- Overall speed of alert messages and evacuation. Good organisation of NDMO on Wallis Island. Multiplication of means to inform the public (TV, radio, social networks). Good participation of school districts (public and private), and some villages (New Caledonia, France).
- The communication between regional NTWC and national management agencies went well. National procedures were well performed and timely (Peru).
- Receiving of tsunami information from international agencies and dissemination of the exercise information (Viet Nam).
- Exercise control worked well. No test messages were inadvertently leaked to the public. Tsunami procedures were functionally tested at the Joint Australian Tsunami Warning centre (JATWC) while other participating agencies conducted limited functional or desktop exercises. The first National Watch was issued 9 minutes after earthquake's occurrence (Australia).

Coordination

- Coordination with NDMO (Chile).
- The exercise was well coordinated and smoothly conducted. All agencies know their specific roles and participants were responded timely (Hong Kong, China).

- Coordination between community leaders and the national tsunami warning (El Salvador).

- Good coordination between Warning Centre and NDMO (Tonga).

Communications

- Communication between the SIMS, NDMO and the provincial level was done in a timely manner (Solomon Islands).

- The information was provided at time (Ecuador).

- The community was responsive and cooperate well (Malaysia).

- The transmission of data on time through bulletins issued by the Mexican Tsunami Warning Center (Mexico).

- High efficiency in communicating information (Russia).

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

Areas that did not go so well during the exercise included some confusion about what messages were going to be received and what these messages would include, the lack of participation of some important stakeholders and some issues with the delivery of messages.

Exercise

- All was ok (Nicaragua).

- This exercise from Thailand is an unofficial exercise, due to the official document process. This should improve and make this for official one (Thailand).

- Some emergency response agencies were required to limit their activities on the day due to issues outside their control (Australia).

- All municipalities of the Pacific Coast did not participate (Colombia).

- The exercise highlighted a number of issues with the general understanding of some of our procedures, and the timeliness of when these were able to be completed. These issues are being addressed through a review of our relevant SOPs (New Zealand).

- Misinterpretation of the PacWave18 Exercise threat messages by the media (Fiji).

- Not all agencies were contacted in a timely manner. NDMO on Futuna Island is limited in personnel and infrastructure. Failure of some sirens. Some delays in SMS delivery to the public and some agencies. Issues remain for evacuation procedure for lagoon and islets. Little participation on the island of Futuna. Some evacuation routes were found to be blocked by vegetation (New Caledonia, France).

- Since planning was very lacking, there was no time to recruit extra human resources to be used for the exercise (Brunei Darussalam).

- Some committees had no idea how to proceed for tsunamis (Costa Rica).

- Reaction from the response organizations to the exercise (Viet Nam).
- Since this is an exercise – the real product from PTWC is what needed to be realistic (Samoa).
- Nil (Hong Kong, China).
- Coordination between sectors (Solomon Islands).
- The lack of enthusiasm from some agencies, especially at municipality level, even when they were part in the exercise (Mexico).
- Coordination between NTWC SOP of different countries at regional level (Chile).
- The exercise was done on a weekdays and most students were having their exams (Malaysia).
- Provision of local injects (Philippines).
- Still many people did not know where to evacuate to (Tonga).

Communication

- During the Communication Test on 5 November 2018, some of the bulletins were not received via FAZ, GTS and Email (as detailed in Objective 1 comments section) (Singapore).

63. Please provide a general statement about what could be improved.

For future exercises, some of the areas that could be improved included using different scenarios and further developing existing scenarios, clearer guidance on what kinds of messages will be disseminated during the exercise and more stakeholder participation, especially community participation.

Comments

- All was ok (Nicaragua).
- Coordination between SMD and DMO in case of a real event. Must be clear and timely – executing tasks allocated (Samoa).
- Coordination with sector committees and dissemination of information (Solomon Islands).
- Common practices for tsunami data processing and reporting (Chile).
- We could do drill or functional exercise (Philippines).

Scenarios

- Scenarios/arrangements could be fine-tuned to better simulate the real environment (Hong Kong, China).

Preparation

- Geoscience Australia (which together with the Bureau of Meteorology comprise the JATWC) used pre-canned earthquake messages during PacWave18. Future exercises could re-run seismic observations from past large event. The high-level National Crisis Committee could be convened during future exercises. Australia has not yet involved the community in any PacWave exercise and will look to do so in the future. Also, Australia could look to conduct a multi-day exercise to test other phases including recovery (Australia).

- Timeline should not overlap or near the timeline of IOWave (Thailand).

Messages

- SMS message should be clear and detail (Viet Nam).

Stakeholder participation

- Governments should be involved (Peru).

- Improve next year's with more levels in the exercise as communities, emergencies (city/district level and public (French Polynesia, France).

- More training on tsunami evacuation (Tonga).

- Motivate the agencies to do well their participation in the simulacrum, so they can identify strengths and weaknesses in their local emergency plans (Mexico).

- The training of the municipalities to have a greater number of participants (Colombia).

- Regular awareness raising for the media personnel (Fiji).

SOPs

- A better SOP and more time to plan the exercise (Brunei Darussalam).

- Our SOPs are being reviewed alongside those of GNS to improve communication, understanding and the timeliness of actins (New Zealand).

- Specific tsunami SOPs (Costa Rica).

EXERCISE DEBRIEF OR EVALUATION

64. Please provide a general statement about what went well.

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

Comments

- All was ok (Nicaragua).

- The test of "Rapid Kinetic Procedure" was successful. In a regional scenario, all early products from international centre are welcome and used in addition to the national products (French Polynesia, France).

- Follow SOPs (Samoa).
- All problems was solved in case of NTP (Ecuador).
- Coordination between NTWC and NDMO (Chile).

Exercise

- The bulletin sent to all the different units was received in due time and proper form. New products from the PTWC were very useful for analysing the information. Emergency meetings were held by the authorities before the tsunami threat. In some areas, the exercise was spread through the media (Mexico).

Messages & Bulletin

- Messages were promptly sent to players through various channels. More importantly, it provided agencies with an opportunity to review their SOPs and contact lists (Hong Kong, China).

Communication & Participation

- Improved interaction between regional participants of the exercise (Russia).
- We were able to have discussions using our Standard Operating Procedure (Philippines).
- The community response and voluntary participation (El Salvador).
- The communication between NTWC and NDMO went well (Viet Nam).

Evaluation

- Positive feedback from the NEOC functional teams on their roles and responsibilities, including the challenges they encounter (Solomon Islands).
- Highlighted some of the issues and what could be improved (Brunei Darussalam).
- Many lessons were obtained (Peru).
- Evaluation format is clear and easy to fill (Colombia).
- Participants provided constructive feedback in the exercise debriefs (New Zealand).
- Overall, the PacWave 18 Exercise Debrief and Evaluation went well as facilitated by SPC (Fiji).
- Everyone participated and can identified the gap of SOP (Thailand).
- A hot debrief involving JATWC staff was held immediately following the exercise. A national debrief involving the participating agencies was held 9 days after completion of the exercise (Australia).
- They recognized their gaps and limitations (Costa Rica).
- A debrief was done immediately after the event (Tonga).

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

Aspects of the evaluation that did not go so well included some difficulties with understanding and using the online evaluation form, and the inability of some participants to attend the debrief and contribute to the evaluation.

Exercise

- All was ok (Nicaragua).
- In the PacWave scenario we assumed that magnitude and location is constant from start to the end. Whereas in many real cases we can see in the first 30 minutes or first hour many changes in earthquake parameters that impact tsunami forecast and so local emergency response. We should take that into account (French Polynesia, France).
- Everything went well (Fiji).
- Timeliness of staff arrival (Samoa).
- Nil (Hong Kong, China).
- Evacuation protocols are needed before an imminent danger of tsunami. This was presented as the greatest weakness of the units responsible for civil protection (Mexico).
- We came up with different results on what information to issue (Philippines).

Participants

- Not all of the participating agencies were able to attend the national debrief and some provided written responses instead (Australia).
- No people from central part (NDMO/EOC) or expert from outside give the feedback (Thailand).
- Our communication had problems (Ecuador).
- Participation of the N-DOC sector committees in the debrief need improvement (Solomon Islands).
- The total participation of the community members was not reached (El Salvador).
- Lack of input from a professional standpoint (Brunei Darussalam).
- Not so many organizations involved in the exercise (Viet Nam).
- Some people did not evacuate (although evacuating was optional for people) (Tonga).

Evaluation

- As above, holding the exercise with a number of activities meant that some to the evaluation questions were difficult to answer, especially those related to when messages were received and disseminated (New Zealand).

66. Please provide a general statement about what could be improved.

The evaluation process could be improved by improving the usability of the online evaluation form, allowing more time for the completion of the evaluation form, and conducting more exercises.

Comments

- Improvement for national tsunami centre: CPPT. The second bulletin send to NDMO by CPPT gives the preliminary forecast of maximal tsunami height at coast with inundation maps. These forecast are obtained by an automatic tsunami simulation initialized by centroid moment tensor issued from an early W phase inversion, the fault geometry is based on scaling laws. So, this forecast product can be easily improved by sending it 15 minutes earlier (so at OT+25-30 mins) (French Polynesia, France).

- To organize conscientization campaigns about tsunami threat (El Salvador).

- A better future planning on the next exercise and to highlight focal points as well as improvement in the SOP (Brunei Darussalam).

- More exercises (Costa Rica).

- To conduct more exercises (Viet Nam).

- Readiness of each staff member to make the exercise a real event (Samoa).

- Nil (Hong Kong, China).

- To elaborate maps including tsunami evacuation routes. To update evacuation plans with the participation of local authorities (Mexico).

- Updating our Standard Operating Procedure and familiarization of the different systems used for earthquake and tsunami (Philippines).

- Specifically for Panama and the community of Puerto Armuelles, would improve, the participation of all the authorities and responsible for Tsunami response, improve the dissemination by the media of communication, improving support for children during the event, provide bottled water, have better signage of routes of evacuation and meeting points (Panama).

Exercise

- Our managers are concerned about solving the problems that arose during the exercise (Ecuador).

- To have another nationwide drill where it would be compulsory for everyone to evacuate (Tonga).

Stakeholders

- Participation of population during evacuation drills (Chile).

- Should have the expert and NDMO participate in the debrief and also in the exercise (Thailand).

- To include more independent evaluators in future exercises (Fiji).

Evaluation Form

- Method of evaluation require improvement. Each functional teams should report against their SOPs (Solomon Islands).

- We suggested to include questions to ask the communities about the exercise conduct (Colombia).

- We used an online survey to support the capture of feedback alongside our usual debrief process. Although this provided some useful information, not all participants completed the survey (New Zealand).

- Photos could be included in the evaluation form (Peru).

ANNEX IV

PREPARATION OF THE FINAL REPORT

The planning, conduct, and evaluation of Exercise PacWave18 was coordinated by the PTWS Exercise PacWave18 Task team (TT). The Exercise PacWave18 Summary Report and Annex III were compiled by Ms Jo Guard and Mrs Sara Mitchell (Ministry of Civil Defence & Emergency Management, New Zealand), and Dr Laura Kong (International Tsunami Information Center). Translation of Annex III evaluation comments from Spanish to English was provided by ITIC. The Summary Report for Exercise Pacific Wave 2018 in the South China Sea was compiled by the South China Sea Tsunami Advisory Center.

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ANNEX V

LIST OF ACRONYMS

DISCEX	Discussion Exercise' or Tabletop Exercise
ICG/ITSU	International Coordination Group for the Tsunami Warning System in the Pacific
ICG/PTWS	Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System
IOC	Intergovernmental Oceanographic Commission (UNESCO)
ITIC	International Tsunami Information Center
JATWC	Joint Australian Tsunami Warning Centre
JMA	Japan Meteorological Agency
MNR	China's Ministry of Natural Resources
MSEL	Master Schedule of Events List
NDMO	National Disaster Management Office
NTWC	National Tsunami Warning Centre
NWPTAC	Northwest Pacific Tsunami Advisory Center
PTWC	Pacific tsunami Warning Center
PTWS	Pacific Tsunami Warning and Mitigation System
SCSTAC	South China Sea Tsunami Advisory Center
SOA	China State Oceanic Administration
SOP	Standard Operating Procedures
TNC	Tsunami National Centre
TSP	Tsunami Service Provider
TWFP	Tsunami Warning Focal Point
UNESCO	United Nations Educational, Scientific and Cultural Organization

IOC Technical Series

No.	Title	Languages
1	Manual on International Oceanographic Data Exchange. 1965	(out of stock)
2	Intergovernmental Oceanographic Commission (Five years of work). 1966	(out of stock)
3	Radio Communication Requirements of Oceanography. 1967	(out of stock)
4	Manual on International Oceanographic Data Exchange - Second revised edition. 1967	(out of stock)
5	Legal Problems Associated with Ocean Data Acquisition Systems (ODAS). 1969	(out of stock)
6	Perspectives in Oceanography, 1968	(out of stock)
7	Comprehensive Outline of the Scope of the Long-term and Expanded Programme of Oceanic Exploration and Research. 1970	(out of stock)
8	IGOSS (Integrated Global Ocean Station System) - General Plan Implementation Programme for Phase I. 1971	(out of stock)
9	Manual on International Oceanographic Data Exchange - Third Revised Edition. 1973	(out of stock)
10	Bruun Memorial Lectures, 1971	E, F, S, R
11	Bruun Memorial Lectures, 1973	(out of stock)
12	Oceanographic Products and Methods of Analysis and Prediction. 1977	E only
13	International Decade of Ocean Exploration (IDOE), 1971-1980. 1974	(out of stock)
14	A Comprehensive Plan for the Global Investigation of Pollution in the Marine Environment and Baseline Study Guidelines. 1976	E, F, S, R
15	Bruun Memorial Lectures, 1975 - Co-operative Study of the Kuroshio and Adjacent Regions. 1976	(out of stock)
16	Integrated Ocean Global Station System (IGOSS) General Plan and Implementation Programme 1977-1982. 1977	E, F, S, R
17	Oceanographic Components of the Global Atmospheric Research Programme (GARP) . 1977	(out of stock)
18	Global Ocean Pollution: An Overview. 1977	(out of stock)
19	Bruun Memorial Lectures - The Importance and Application of Satellite and Remotely Sensed Data to Oceanography. 1977	(out of stock)
20	A Focus for Ocean Research: The Intergovernmental Oceanographic Commission - History, Functions, Achievements. 1979	(out of stock)
21	Bruun Memorial Lectures, 1979: Marine Environment and Ocean Resources. 1986	E, F, S, R
22	Scientific Report of the Interealibration Exercise of the IOC-WMO-UNEP Pilot Project on Monitoring Background Levels of Selected Pollutants in Open Ocean Waters. 1982	(out of stock)
23	Operational Sea-Level Stations. 1983	E, F, S, R
24	Time-Series of Ocean Measurements. Vol.1. 1983	E, F, S, R
25	A Framework for the Implementation of the Comprehensive Plan for the Global Investigation of Pollution in the Marine Environment. 1984	(out of stock)
26	The Determination of Polychlorinated Biphenyls in Open-ocean Waters. 1984	E only
27	Ocean Observing System Development Programme. 1984	E, F, S, R
28	Bruun Memorial Lectures, 1982: Ocean Science for the Year 2000. 1984	E, F, S, R
29	Catalogue of Tide Gauges in the Pacific. 1985	E only
30	Time-Series of Ocean Measurements. Vol. 2. 1984	E only
31	Time-Series of Ocean Measurements. Vol. 3. 1986	E only
32	Summary of Radiometric Ages from the Pacific. 1987	E only
33	Time-Series of Ocean Measurements. Vol. 4. 1988	E only
34	Bruun Memorial Lectures, 1987: Recent Advances in Selected Areas of Ocean Sciences in the Regions of the Caribbean, Indian Ocean and the Western Pacific. 1988	Composite E, F, S
35	Global Sea-Level Observing System (GLOSS) Implementation Plan. 1990	E only

(continued)

36	Bruun Memorial Lectures 1989: Impact of New Technology on Marine Scientific Research. 1991	Composite E, F, S
37	Tsunami Glossary - A Glossary of Terms and Acronyms Used in the Tsunami Literature. 1991	E only
38	The Oceans and Climate: A Guide to Present Needs. 1991	E only
39	Bruun Memorial Lectures, 1991: Modelling and Prediction in Marine Science. 1992	E only
40	Oceanic Interdecadal Climate Variability. 1992	E only
41	Marine Debris: Solid Waste Management Action for the Wider Caribbean. 1994	E only
42	Calculation of New Depth Equations for Expendable Bathymerographs Using a Temperature-Error-Free Method (Application to Sippican/TSK T-7, T-6 and T-4 XBTS. 1994	E only
43	IGOSS Plan and Implementation Programme 1996-2003. 1996	E, F, S, R
44	Design and Implementation of some Harmful Algal Monitoring Systems. 1996	E only
45	Use of Standards and Reference Materials in the Measurement of Chlorinated Hydrocarbon Residues. 1996	E only
46	Equatorial Segment of the Mid-Atlantic Ridge. 1996	E only
47	Peace in the Oceans: Ocean Governance and the Agenda for Peace; the Proceedings of *Pacem in Maribus* XXIII, Costa Rica, 1995. 1997	E only
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