Intergovernmental Oceanographic Commission
Technical Series

191

EXERCISE PACIFIC WAVE 2024

September–November 2024

Volume 1 Exercise Manual

UNESCO

Intergovernmental Oceanographic Commission
Technical Series

191

EXERCISE PACIFIC WAVE 2024

September–November 2024

Volume 1 Exercise Manual

UNESCO 2024

IOC Technical Series, 191 (Volume 1)
Paris, May 2024
English only

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

IOC-UNESCO. 2024. *Exercise Pacific Wave 2024, September–November 2024 – Volume 1: Exercise Manual.* Paris, UNESCO. (IOC Technical Series No 191 Vol.1) (English only).

Report prepared by: The Intergovernmental Coordination Group
for the Pacific Tsunami Warning
and Mitigation System (ICG/PTWS)

Task Team on PacWave24 Exercise

Published in 2024
by United Nations Educational, Scientific
and Cultural Organization

7, Place de Fontenoy, 75352 Paris 07 SP

(IOC/2024/TS/191 Vol.1)

TABLE OF CONTENT

page

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, ICG/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 TSPs have been, or are being, established in order to improve timeliness and threat assessment accuracy, especially for regional events.

In response to Member States' requests for additional regional information, Japan began operation of its Northwest Pacific Tsunami Advisory Center (NWPTAC) in March 2005, and from April 2006 to November 2019 provided services 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. Between 2018 and 30 April 2024, the NWPTAC issued advisories for 85 events.

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 2019 and commenced full operation on 5 November 2019.

A Pacific-wide tsunami exercise is an effective tool for evaluating the readiness of PTWS countries and identifying changes that can improve its effectiveness. The international tsunami exercises were first conceived and conducted in 2006 by the ICG/PTWS under the leadership of the PTWS Exercises Task Team with strong contributions from the International Tsunami Information Centre (ITIC), PTWC, and Japan Meteorological Agency (JMA). Altogether there have been 10 IOC-coordinated international tsunami exercises: Exercise Pacific Wave (PacWave) 2006 (IOC/INF-1244), 2008 (IOC/2008/TS/82), 2011, (IOC/2011/TS/97 Vol.1 and 2); 2013 (IOC/2013/TS/106 Vol.1 and 2), 2015 (IOC/2015/TS/117 Vol.1 and 2), 2016 (IOC/2015/TS/126 Vol.1 and 2), 2017 (IOC/2016/TS/131 Vol.1 and 2), 2018 (IOC/2018/TS/139 Vol.1 Rev.2 and Vol. 2), 2020 (IOC/2020/TS/155 Vol.1) and 2022 (IOC/2022/TS/175 Vol.1).

The exercises, using a multitude of Pacific scenarios and accompanied by tsunami message products from the TSPs, have been used to evaluate the effectiveness of the system and measure the readiness of countries to respond, as National Tsunami Warning Centres (NTWCs) and emergency response agencies and the public, to distant and local tsunamis.

- Pacific Wave Exercises 2011, 2013 and 2015 were additionally used to introduce and obtain feedback, test, and validate the PTWC new enhanced forecast products, the latter of which became official on 1 October 2014 (refer to IOC Circular Letter, 2535).
- Pacific Wave Exercises 2016 and 2017 were used to evaluate experimental NWPTAC enhanced products and identify necessary modifications before the enhanced products were formally adopted. Exercise Pacific Wave 2017 was also used to support the development of the SCSTAC products.

- Exercise Pacific Wave 2018 was used to validate the NWPTAC enhanced products, which were officially adopted on 28 February 2019 (CL-2753), and test the new SCSTAC products, which were subsequently adopted on 5 November 2019 (CL-2777).
- Exercise Pacific Wave 2020 was used to support the development of tsunami procedures and products by the Central America Tsunami Advisory Centre (CATAC) hosted by the Instituo nicarauense de Estudios Territoriales (INETER), which started full functionality on the interim services on 17 January 2022 (CL-2894).
- Exercise Pacific Wave 2022 intended to support the development of improved PTWS tsunami products and procedures, including products from CATAC.

The ICG/PTWS, at its 30th session held in Tonga in September 2023, approved the conduct of an Exercise Pacific Wave 2024 (PacWave24). The Task Team on PacWave24 is responsible for overseeing the design, conduct, and the evaluation of Exercises Pacific Wave 2024 (Terms of Reference enclosed).

2. PACWAVE 24 EXERCISE

All information can be found on the PacWave24 website http://www.pacwave.info/

It will be useful to link exercises and especially any community activities with either the International Disaster Risk Reduction Day on 13 October 2024, or the World Tsunami Awareness Day on 5 November 2024.

2.1. PURPOSE

PacWave24 provides through the support of TSPs and ITIC a valuable opportunity for Pacific countries to test PTWS Tsunami Service Provider (TSP) arrangements, to test new products (where relevant), to review their tsunami preparedness arrangements and operational procedures to respond and recover from a destructive tsunami, to test internal and external communication systems, to engage with communities through public education activities, and to engage regionally in coordination and cooperation. Regular exercises are important for maintaining staff readiness in case of a real event. This is especially true for tsunamis which are infrequent but require a rapid response when they occur.

PacWave24 will also conduct its first trial transmission of maritime safety products from PTWC to NAVAREA operators through NTWC.

Every PTWS country is encouraged to participate to all applicable modes of exercise, as outlined below, and to support the International Disaster Risk Reduction Day (13 October) and World tsunami Awareness Day (5 November) through:

- One Live communication test from PTWS TSPs to Member States on 5 November 2024 at 0000 UTC;
- One Live NAVAREA communications test from PTWC to each NAVAREA Coordinator through concerned NTWCs on 5 of November 2024 at 0100 UTC;
- A regional Pacific Wave exercise between Member States of a regional tsunami warning and mitigation system;
- A national Pacific Wave exercise between 1 September and 30 November 2024 within each participating country.

2.2. OBJECTIVES

PacWave24 objectives are to:

a) Test communications from the PTWS Tsunami Service Providers (TSP) to the Tsunami Warning Focal Points (TWFP) and National Tsunami Warning Centres (NTWC) of the Member States concerned.

b) Test NAVAREA communications from PTWC to each NAVAREA Coordinator through concerned NTWCs.

c) Test regional communication and cooperation between Member States of the tsunami warning system with a common scenario.

d) Test national communication and cooperation, and readiness within each of the participating countries.

Recalling requests from the International Hydrographic Organization (IHO) to disseminate maritime safety products to NAVAREA coordinators, PacWave24 will conduct a trial transmission of maritime safety products from the PTWC to NAVAREA coordinators through concerned NTWCs.

Each country may organize at its discretion additional PacWave24 activities in line with the three original objectives. These activities could consider:

- Conducting exercises in real time during daytime working hours with full staffing or simulating minimal staffing during nighttime or weekend hours.
- Testing countries' capability to carry out their warning and response responsibilities for the situation where one or more PTWS TSPs is not able to operate.
- Providing guidance in a timely manner.
- Conducting the exercise down to the community level, including where possible an extensive public awareness campaign.
- Using the Sendai Framework for Disaster Risk Reduction seven global targets and four priorities for action, the World Tsunami Awareness Day and/or the UN Decade of Ocean Science for Sustainable Development in designing the exercise.
- Fulfilling one of the 12 UNESCO-IOC Tsunami Ready Recognition Programme indicators.

2.3. PARTICIPATION

All Pacific countries are strongly encouraged to participate in the exercise. At a minimum, to meet the objectives of PacWave24, it is recommended that the TWFP or NTWC participate. Each country's lead agency will be responsible for the following:

<u>During the initial phase of exercise planning</u>:

- Determining their country's level of participation.
- Planning their exercise through the country's Exercise Planning Team, including any regional or joint exercises.
- 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 they are likely to be faced in a real event.

<u>During the exercise</u>:

- Participating in the live communication test between the TSP and Member States; and/or
- Responding as necessary to fulfil their all-of-government and national, provincial and/or local arrangement obligations; and/or

- 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 PacWave24 Evaluation Forms based on in-country feedback.

1 September – 30 November 2024	PacWave24 Member State national exercise
31 August 2024	Deadline for PTWS Regional Working Groups to inform TSPs if products needed, copied to ITIC
2 weeks before Regional Exercise	TSP products available on regional exercise webpage (accessible at www.pacwave.info)
4 November 2024 (2300 UTC)	PICT Regional Exercise
5 November 2024 (0000 UTC)	Live TSP Communications Test
5 November 2024 (0100 UTC)	Live NAVAREA Coordinators Communication Test from PTWC through concerned NTWCs
21 November 2024	SEP Regional Exercise
15 December 2024	Deadline for Member States to complete and submit online PacWave24 Post-Exercise Evaluation Forms for: • Live TSP Communication Test • Live NAVAREA Coordinators Communication Test • Regional Exercise • National Exercise
15 December 2024	Deadline for Submission of Regional Exercise Reports. • PICT Regional Exercise • SEP Regional Exercise
10 days prior to ICG/PTWS-XXXI (April 2025, exact dates to be determined)	Draft PacWave24 Summary Report shared with Member States
30 June 2025	Final PacWave24 Summary Report published and posted at http://www.pacwave.info/

2.4. TYPES OF EXERCISES AND DATES

Timeline

2.4.1. Tsunami Service Provider

The Live Communications Test will occur at 0000 UTC on 5 November 2024, the PTWS TSPs will issue dummy exercise messages (Annex I) to each of the PTWS TWFPs and NTWCs through their usual methods of message communication.

The TSPs for the PTWS are:

- Pacific Tsunami Warning Center (PTWC, since 1965) hosted by US NOAA;
- Northwest Pacific Tsunami Advisory Center (NWPTAC, since 2006) hosted by JMA;
- South China Sea Tsunami Advisory Center (SCSTAC, since 2019) hosted by China's Ministry of Natural Resources;
- Central America Tsunami Advisory Centre (CATAC) hosted by Nicaragua. (As of 17th January 2022, it is operating at full functionality on the interim service for the Pacific coasts of Central America).

A post-exercise evaluation form will be available at http://www.pacwave.info.

The form should be completed by 15 December 2024 at the latest.

Tsunami Service Provider Points of Contact

TSP	Points of contact	E-Mail
PTWC	Dr Charles McCreery, PTWC, USA Carolina Hincapie, PTWC, USA	charles.mccreery@noaa.gov carolina.hincapie@noaa.gov
NWPTAC	Mr. USHIDA Shing, JMA, Japan Mr NISHIMAE Yuji, JMA, Japan	ushida@met.kishou.go.jp nishimae@met.kishou.go.jp
SCSTAC	Mr Lianda Zhao, MNR, China	zld@nmefc.cn
CATAC	M.Sc. Emilio Talavera, INETER, Nicaragua Dr Wilfred Strauss, INETER, Nicaragua	emilio.talavera@ineter.gob.ni wilfried.strauch@yahoo.com
ITIC	Dr Laura Kong, ITIC, USA	laura.kong@noaa.gov

2.4.2. National Exercises

Participating countries may choose to run their own exercises following PacWave24 objectives at any time between 1 September and 30 November 2024, allowing flexibility to avoid conflict with other important national events. Each country will be responsible for determining what assumptions should be considered as part of its national, provincial, and/or local tsunami exercise (if conducted).

For national exercise, it can be carried out as:

- *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 center or using alternative communications (such as radios).
- *a functional exercise:* it 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 that provides prewritten injects (e.g., emergency situation inputs) and responds to questions and tasks developing out of the exercise.

  Functional exercises normally involve multi-agency participation (real or simulated) and are 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 the exercise control group and are handled by participants as described in relevant plans and procedures. Outcomes are generated that would be expected in a real situation.

  Finally, functional exercises that include a 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.
- *a tabletop exercise:* participants are presented with a situation or problem that they are required to discuss and for which they must 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 key stakeholders such as the NTWC and the NDMO in one country, and/or NTWCs from neighbouring countries, discussing their response to a tsunami threat in a particular area, where the only injects are the tsunami products from the relevant TSPs.

A post-exercise evaluation form will be available at http://www.pacwave.info/.

The form should be completed online by 15 December 2024 at the latest.

2.4.3. Regional Exercises

Key Actions

Deadline	Actions	Responsible
By end of August 2024	Regional Working Groups inform TSP if products are needed, copied to ITIC	Regional Working Groups
2 weeks before Regional Exercise	TSP products available on Regional Exercise web page	TSP, ITIC

The experience from the significant tsunami events in 2021–2022 strengthened the importance of regional coordination to address the challenges of a tsunami from any kind of source. Each region can explore ways to further develop their coordination during exercises, which could be through formal platforms such as emails, HF radio, dedicated regional websites for disseminations of messages or automated SMS, as well as through informal fast coordination channels including instant messaging, group chat rooms or mobile applications to simulate handheld transceivers. These informal coordination tools can be a valuable asset to address non-seismic or unprecedented events which do not comply with the requirements of the automated tools.

If necessary, each regional exercise is free to set up its own exercise evaluation form to complement the PacWave24 post-exercise evaluation form. The regional group will handle the post-exercises evaluation, including the compilation and assessment of the exercise, and share its final report to the PacWave24 Task Team.

Regional groups that would like to organize a joint exercise should contact the relevant TSP focal point, with a copy to the ITIC, one month before regional exercise setup date, and refer to the specific user guide for the different products.

A post-exercise evaluation form will be available at http://www.pacwave.info. The form should be completed by 15 December 2024 at the latest.

2.4.4. Trial Transmission of Maritime Safety Products from PTWC to NAVAREA Coordinators through NTWC

The trial transmission of a dummy maritime safety product (Annex II) from the PTWC to NAVAREA Coordinators in the Pacific and in the Southwest Atlantic (e.g. NAVAREAs VI, X, XI, XII, XIII, XIV, XV, and XVI) through the NTWC of the respective NAVAREA will occur by email only at 0100 UTC on 5 November 2024. The PTWC will directly send the dummy message to the NAVAREA Coordinators in the absence of a NTWC upon their request.

The NTWC will be requested to coordinate with the NAVAREA coordinator about this trial transmission in advance.

3. TOOLS MADE AVAILABLE

3.1. WEBINARS

The PacWave24 Working Team is available to conduct webinars if necessary. The aim of these activities is to provide guidance on how to conduct regional-scale exercises and to allow for discussions among participants about best practices. Additionally, each webinar will seek to address specific questions and concerns from each region. If there is a request from the regional working teams, the information will be sent through formal channels (CL). The information will be available at http://www.pacwave.info/

Participants, nominated at the discretion of each TNC and TWFP, should register through the webinar meeting site. Connection details will be sent to all PTWS Tsunami National Contacts (TNCs) and TWFPs via email and made available on the website.

The topics to be addressed in each case will be consulted with each regional group. If needed, information about TsuCAT (section 3.2) will be provided.

3.2. TSUNAMI COASTAL ASSESSMENT TOOL (TsuCAT)

To help countries with their national tsunami exercises, the International Tsunami Information Centre (ITIC) and the Pacific Marine Environmental Laboratory (PMEL) of the National Oceanic and Atmospheric Administration (US NOAA) are making available TsuCAT (Tsunami Coastal Assessment Tool). TsuCAT enables countries to choose their own scenario and to generate the PTWC's enhanced text and graphical products that they can then use to conduct their exercises.

TsuCAT provides access to a Pacific, Caribbean, and Indian Ocean database of tsunami modeling results from NOAA's pre-computed catalog of sources. For the Pacific and Caribbean, it also provides access to the RIFT model, to assist a country in its tsunami hazard assessment, tsunami exercise and response planning, and warning decision-making. It also includes simulations for historical tsunami sources from NOAA's National Center for Environmental Information (NCEI) and the U.S. Geological Survey (USGS) earthquake archive, as well as IOC expert meeting worst-case regional seismic tsunami scenarios. TsuCAT is an independent and 'stand-alone' platform, in that it runs on Windows, Apple, and Linux computing platforms and does not require Internet connectivity. All libraries, databases, and documentation are installed in their entirety on the host machine. The only requirement is a Java v1.8 or higher free installation.

The current version is TsuCAT v4.3.2 (December 2023), which includes improvements in the displays and exercise messages. It is available on request to agencies and authorities responsible for and supporting tsunami warning and mitigation in their countries. To request v4.3.2, please contact ITIC directly (ITIC Director, laura.kong@noaa.gov).

Additional information and video demonstrations can be accessed from the PacWave24 website (www.pacwave.info) and the TsuCAT website:
(http://itic.ioc-unesco.org/index.php?option=com_content&view=category&layout=blog&id=2239&Itemid=2763).

3.3. DOCUMENTATION

Tsunami Service Provider User's Guides:

- *User's Guide for the Pacific Tsunami Warning Center: enhanced products for the Pacific Tsunami Warning System*. Paris, UNESCO, IOC Technical Series No 105, Revised edition, 2014 (English; Spanish) (IOC/2013/TS/105 Rev.3).

- *Users' Guide for the Northwest Pacific Tsunami Advisory Center (NWPTAC): enhanced Products for the Pacific Tsunami Warning System*. Paris, UNESCO, IOC Technical Series No 142, 2019. (English) (IOC/2019/TS/142).
- *User's Guide for the South China Sea Tsunami Advisory Center (SCSTAC) products for the South China Sea Tsunami Warning and Mitigation System*. Paris, UNESCO, IOC Technical Series No 149, 2019. (English) (IOC/2019/TS/149).
- Draft User's Guide for the Central American Tsunami Advisory Centre (CATAC), versions 2021 (English, Spanish).
- *Operational Users Guide for the Pacific Tsunami Warning and Mitigation System (PTWS)*. Paris, UNESCO, IOC Technical Series No 87 rev., 2011. (English) (IOC/2011/TS/87 Rev).

Resources on the development of tsunami SOPs for warning and emergency response, including tsunami evacuation and the planning, conduct, and evaluation of exercises, include the following:

- *Plans and Procedures for Tsunami Warning and Emergency Management*. Paris, UNESCO, IOC Manuals and Guides No. 76, 2017, 72 pp., English. (IOC/2017/MG/76 Rev).

  This guideline has been developed to provide guidance for countries on strengthening tsunami warning and emergency response through the development of plans and SOPs 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.

- *How to Plan, Conduct and Evaluate UNESCO/IOC Tsunami Wave Exercises*. Paris, UNESCO, IOC Manuals and Guides No.58, 2013 (English, Spanish) (IOC/2012/MG/58 Rev).

  This guideline has been developed to aid countries in planning, conducting, and evaluating a tsunami exercise at a national and/or provincial level. It 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, and design, conduct, and evaluate the exercise. A number of case studies are included to provide examples of 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.

- *Preparing for Community Tsunami Evacuations: from inundation to evacuation maps, response plans and exercises*. Paris, UNESCO, IOC Manuals and Guides No. 82, 2020 (English, Spanish) (IOC/2020/MG/82).

  This guideline has been developed to aid countries in preparing communities for the next tsunami. It consists of a guide presenting a high-level summary of each programme module and the rationale behind them, and two Supplements that contain additional detailed information, templates, references to specialized documents, tutorials and best practice examples.

  This guide focuses on actions that communities can take to build resilience to the next tsunami. It affects actions with the end goal of saving lives and reducing tsunami impact by focusing on coordinated stakeholder response planning and preparedness, accompanied by continuous awareness on the end-to-end warning system to sustain advocacy. The actions and products of this guide—tsunami hazard assessments, inundation and evacuation maps, response plans and procedures, awareness, and

exercises—assist communities in making themselves more prepared. The guide, formatted to support the training of people who are responsible for these deliverables, can be used as part of the process to become UNESCO/IOC Tsunami Ready, or simply to enhance preparedness.

- *Standard Guidelines for the Tsunami Ready Recognition Programme*. Paris, UNESCO, IOC Manuals and Guides No. 74, 2022 (English) (IOC/2022/MG/74)

  The Tsunami Ready Recognition Programme is an international community-based recognition programme developed by the UNESCO-IOC. The main goal of the Programme is to improve coastal community preparedness for tsunamis and to minimize the loss of life, livelihood and property. This is achieved through a collaborative effort to meet a standard level of tsunami preparedness through the fulfilment of a set of established indicators.

  The United Nations declared on 5 December 2017 that a Decade of Ocean Science for Sustainable Development would be held from 2021 to 2030 (Ocean Decade). Five years later, in June 2022, the IOC Assembly approved the UNESCO-IOC Tsunami Ready Recognition Programme. Its implementation will be a key contribution to achieving the societal outcome 'A Safe Ocean' of the Ocean Decade.

  The Tsunami Ready Recognition Programme is a voluntary programme. Communities must meet all 12 indicators which cover assessment, preparedness, and response, to be recognized Tsunami Ready by the UNESCO-IOC. This recognition is renewable every four years but does not imply approval or confirmation that a community can or will perform at a certain level in the event of an actual tsunami. Tsunami Ready recognition does not mean that a community is tsunami proof; rather, it is an acknowledgement and recognition that a community has adopted mitigation measures to cope with their tsunami risk. For further information, PTWS Member States can contact International Tsunami Information Centre (Dr Laura Kong, laura.kong@noaa.gov), or visit the Tsunami Ready website (http://itic.ioc-unesco.org/index.php?option=com_content&view=category&layout=blog&id=2234&Itemid=2 758).

4. POST-EXERCISE PHASE

4.1. EVALUATION

All exercises should have a learning focus. Learning is maximized when there is a continuous process of review to draw out the lessons identified. Review is the process of evaluating and validating the exercise.

A review should evaluate the effectiveness of arrangements in place and identify if there are any corrective actions and gaps to fill. All participating member countries are requested to provide feedback through the PacWave24 Evaluation Form (Annex III), divided into three sections. The first part is dedicated to evaluating the TSP telecommunication test; the second questionnaire relates to national and regional exercises. Lastly, the third questionnaire has been specifically created for the NAVAREA test. The online evaluation forms will be available at www.pacwave.info.

4.2. 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 during future exercises/real events.

Each agency that participates in PacWave24 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 and published by the 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/documents/publications/guidelines/information-series/is-06-05-organisational-debriefing.pdf

4.3. EXERCISE VALIDATION

The final stage of the exercise process is to determine whether 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.

4.3.1. Evaluation Criteria

The PacWave24 objectives provided in Section 2.2 relate to two types of validation criteria:

1. International criteria for the PTWS TSP services – Section 2.2, Objectives a and b
2. Country criteria in which each country validates its own procedures – Section 2.2., Objectives b and c).

In compiling the Exercise Pacific Wave 2024 Summary Report, the Exercise Task Team will require ONE (overall) Evaluation Form per participating country.

4.3.2. 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.

4.3.3. Evaluation Tools

The goal of exercise evaluation is to validate strengths and identify opportunities for improvement within the participating organizations. 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 organizations. At the international level, this would involve the ICG/PTWS as the ICG 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 only be for use by the specific participating agency and is not required for the PTWS Exercise Pacific Wave 2024 Summary Report (volume 2 of this publication).

The evaluation tool aims to inform and facilitate individual participant country evaluations as well as the Exercise Pacific Wave 2024 Summary Report.

4.3.4. Exercise PACIFIC WAVE 2024 Summary Report

The Exercise Task Team will compile the Exercise Pacific Wave 2024 Summary Report based on the official Post-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, and
- Recommendations on plans of action for improvement.

5. OBSERVERS

Exercise Pacific Wave 2024 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.

6. REAL EVENTS DURING EXERCISE PLAY

In the case of a real event occurring during the exercise, PTWC, NWPTAC, SCSTAC and CATAC 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.

7. 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 2024 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 organizations in advance of the exercise.

Annex IV contains a sample press release that can be customized by Member States. The sample press release is provided in English.

ANNEX I

TSUNAMI SERVICE PROVIDER COMMUNICATIONS TEST MESSAGES

The following messages will be used by each approved Tsunami Service Provider (PTWC, NWPTAC, SCSTAC) and the interim Tsunami Service Provider (CATAC) for the Live Communications Test at 0000 UTC on 05 November 2024.

PACIFIC TSUNAMI WARNING CENTER (PTWC)

```
TEST... DUMMY MESSAGE FOR PACWAVE24 EXERCISE...TEST
NWS PACIFIC TSUNAMI WARNING CENTER EWA BEACH HI
0000 UTC TUE NOV 05 2024

...THIS MESSAGE IS FOR TEST PURPOSES ONLY...
...TEST PACWAVE24 TSUNAMI EXERCISE TEST...

THIS IS A TEST. THIS MESSAGE IS BEING ISSUED AS A PART OF THE
PACWAVE24 TSUNAMI EXERCISE. ITS PURPOSE IS TO TEST
COMMUNICATIONS BETWEEN THE PACIFIC TSUNAMI WARNING CENTER
AND THE TSUNAMI WARNING FOCAL POINTS AND NATIONAL TSUNAMI
WARNING CENTERS OF THE COUNTRIES AND TERRITORIES THAT MAKE
UP THE UNESCO-IOC PACIFIC TSUNAMI WARNING AND MITIGATION
SYSTEM. THE MESSAGE IS BEING SENT OVER

 - THE WMO GLOBAL TELECOMMUNICATIONS SYSTEM
 - THE AERONAUTICAL FIXED TELECOMMUNICATIONS NETWORK
 - THE EMERGENCY MANAGERS WEATHER INFORMATION NETWORK
 - EMAIL
 - TELEFAX
 - AND OTHER SYSTEMS

THIS IS A TEST. PLEASE NOTE THE TIME AND MEANS OF
ARRIVAL OF THIS MESSAGE FOR REPORTING IN THE POST-EXERCISE
EVALUATION BEFORE 15 of December
```

NORTHWEST PACIFIC TSUNAMI ADVISORY CENTER (NWPTAC)

```
NWPTA COMMUNICATIONS TEST FOR EXERCISE PACIFIC WAVE 24
  ISSUED BY NWPTAC(JMA)
  ISSUED AT 0000Z 05 NOV 2024
PART 01 OF 01 PARTS

THIS IS A TEST MESSAGE FOR EXERCISE PACIFIC WAVE 24.
THIS MESSAGE IS FOR TEST PURPOSES ONLY.

THIS TEST MESSAGE HAS BEEN SENT TO EACH RECIPIENT ORGANIZATION
IN ORDER TO TEST RECEIPT OF NWPTAC MESSAGES AS PART OF EXERCISE
PACIFIC WAVE (PACWAVE)24.

YOUR ACTION IS REQUIRED
PLEASE TAKE NOTE OF THE TIME YOU RECEIVE THIS MESSAGE AND THE
```

METHOD(S) BY WHICH YOU RECEIVE THIS MESSAGE AND REPORT BACK
THROUGH THE EXERCISE PACWAVE POST-EXERCISE ONLINE EVALUATION
SURVEY BY 15 DECEMBER 2024.

SOUTH CHINA SEA TSUNAMI ADVISORY CENTER (SCSTAC)

WESS31 BABJ 050000

TEST PACWAVE24 TSUNAMI EXERCISE **TEST**

ISSUED BY SOUTH CHINA SEA TSUNAMI ADVISORY CENTER (SCSTAC)

ISSUED AT 0000Z 05 NOV 2024

THIS IS A COMMUNICATION TEST BULLETIN FOR PACWAVE24 TSUNAMI EXERCISE.

THIS IS A TEST TO VERIFY COMMUNICATION LINKS AND DETERMINE

TRANSMISSION TIMES INVOLVED IN THE DISSEMINATION OF OPERATIONAL

TSUNAMI ADVICE PRODUCTS FROM THE SOUTH CHINA SEA TSUNAMI ADVISORY

CENTER TO DESIGNATED 24-HOUR TSUNAMI WARNING FOCAL POINTS OF THE SOUTH

CHINA SEA TSUNAMI WARNING SYSTEM.

THIS TEST MESSAGE IS SENT BY GTS, FAX AND EMAIL.

RECIPIENTS ARE REQUESTED TO PLEASE RESPOND BACK TO ICG PTWS TASK TEAM

ON PACWAVE24. GUIDANCE FOR THE EXERCISE CAN BE FOUND IN
THE PACWAVE24 EXERCISE MANUAL LOCATED A WWW.PACWAVE.INFO

CENTRAL AMERICA TSUNAMI ADVISORY CENTER (CATAC)

PRUEBA... MENSAJE FICTICIO PARA EL EJERCICIO PACWAVE24...PRUEBA

CENTRO DE ASESORAMIENTO DE TSUNAMI DE AMÉRICA CENTRAL (CATAC)

Enviado por el CATAC a las 18:00 Hora Local de Centroamérica,
el lunes 04 de noviembre de 2024.

...ESTE MENSAJE ES SOLO PARA FINES DE PRUEBA...

...PRUEBA - EXERCICIO DE TSUNAMI PACWAVE24 - PRUEBA...

Esto es una prueba. Este mensaje se emite como parte del ejercicio de tsunami PACWAVE24. Su propósito es probar comunicaciones entre el CATAC y los puntos focales de alerta de tsunamis y los Centros Nacionales de Alerta de Tsunamis de los países de América Central que participan en el sistema de la UNESCO y la COI para la alerta y mitigación de tsunamis en el Pacífico.

Este mensaje se envía a través de los siguientes medios:

- por el correo electrónico,

- por redes sociales,

- por teléfono,

- por comunicación directa computadora-computadora,

- y por otros sistemas.

Se trata de una prueba. Favor, anote la hora y el medio de llegada de este mensaje para informar en la evaluación posterior al ejercicio antes del 15 de diciembre de 2024.

ANNEX II

TRIAL PTWC MARITIME MESSAGE FOR NAVAREA OPERATORS

TEST... DUMMY MARITIME MESSAGE FOR PACWAVE24 EXERCISE...TEST
NWS PACIFIC TSUNAMI WARNING CENTER EWA BEACH HI
0100 UTC TUE NOV 05 2024

...THIS MESSAGE IS FOR TEST PURPOSES ONLY...
...TEST PACWAVE24 TSUNAMI EXERCISE MARITIME PRODUCTS TEST...

THIS IS A TEST. THIS MESSAGE IS BEING ISSUED AS A PART OF THE PACWAVE24 TSUNAMI EXERCISE. ITS PURPOSE IS TO TEST THE END TO END COMMUNICATIONS BETWEEN THE PACIFIC TSUNAMI WARNING CENTER AND PACIFIC REGION NAVAREA COORDINATORS THROUGH THE NATIONAL TSUNAMI WARNING CENTERS OF THE COUNTRIES RESPONSIBLE FOR THOSE NAVAREAS. THIS MESSAGE IS BEING SENT ONLY BY EMAIL TO THOSE NATIONAL TSUNAMI WARNING CENTERS FOR PROMPT RELAY TO THEIR NAVAREA COORDINATORS BY APPROPRIATE MEANS.

THIS IS A TEST. IN THE CASE OF AN ACTUAL TSUNAMI THREAT... THIS MESSAGE WOULD CONTAIN INFORMATION ABOUT THE TSUNAMI SOURCE... POTENTIALLY AFFECTED COASTAL AREAS... AND RELATED INFORMATION. NAVAREA COORDINATORS CAN RELAY THIS INFORMATION TO SHIPS AT SEA FOR THEIR AWARENESS.

THIS IS A TEST. PLEASE RECORD THE TIME OF ARRIVAL OF THIS MESSAGE BY NATIONAL TSUNAMI WARNING CENTERS AND NAVAREA COORDINATORS FOR REPORTING IN THE POST-EXERCISE EVALUATION BEFORE 15 of December.

ANNEX III

PACWAVE 2024 EVALUATION FORM

Post-Exercise Evaluation Forms are to be completed by each participating agency and forwarded to the country Exercise Pacific Wave 2024 National Contact, or the country Tsunami National Contact (TNC).

The PacWave24 National Contact will compile the country Post-Exercise Evaluation Form and complete and submit this online no later than 15 December 2024.

Only ONE (1) on-line evaluation form is to be completed per country.

According to the conducted exercises, three Evaluation Forms are available. These are available from the PacWave24 web site http://www.pacwave.info/

The preferred method is for the PacWave24 National Contact to submit the country evaluation forms online. Alternatively, the country evaluation forms can be submitted by email to the Exercise Pacific Wave 2024 Task Team Chairs: Margarita Martinez, mmartinez@senapred.gob.cl

ANNEX IV

SAMPLE PRESS RELEASE

TEMPLATE FOR NEWS RELEASE

USE AGENCY MASTHEAD

Contact: (insert name) **FOR IMMEDIATE RELEASE**

(insert phone number) (insert date)

(insert email address)

ELEVENTH PACIFIC TSUNAMI EXERCISE SET FOR 5 OF NOVEMBER 2024

(Insert country name) will join 46 countries around the Pacific Rim as a participant in a live tsunami exercise on 13 October 2024, International Disaster Risk Reduction Day and also support the World Tsunami Awareness Day on 5 November 2024. The purpose of this Pacific-wide exercise is to test communications from the UNESCO Intergovernmental Oceanographic Commission's Tsunami Service Providers (TSP) in the Pacific to every country's official tsunami warning authority. Exercise messages will be sent from the Pacific Tsunami Warning Center (PTWC) in Hawaii, USA, the Northwest Pacific Tsunami Advisory Center (NWPTAC) in Japan, the South China Sea Tsunami Advisory Center (SCSTAC) in China, and the developing Central America Tsunami Advisory Center (CATAC) in Nicaragua.

Tsunamis are no-notice, fast onset natural hazards that can cause catastrophic impacts. It is impossible to know when or where the next tsunami will hit, but we know that early warnings will save lives. For distant tsunamis, the Tsunami Service Providers provide timely alerts to country National Tsunami Warning Centres who evaluate their own tsunami threat and issue tsunami warnings to their coastal communities. And for local tsunamis, continuous education is essential so that everyone self-evacuates upon recognizing nature's natural tsunami warnings. If people do not evacuate in time, thousands of lives will be lost and massive losses incurred that will have long lasting humanitarian, social and economic impacts.

" insert quote " said (insert name of appropriate official).

The exercise, titled Exercise Pacific Wave 2024 (PacWave2), will ensure that the communications system to officially alert countries of the Pacific Tsunami Warning and Mitigation System is working. It is the tenth such exercise with the first having been carried out in 2006, and subsequent exercises held in 2008, 2011, 2013, 2015, 2016, 2017, 2018, 2020 and 2022

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 2024 information site: http://www.pacwave.info

Media Resources, International Tsunami Information Centre http://itic.ioc-unesco.org/index.php?option=com_content&view=category&layout=blog&id=1150&Itemid=1 150

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

South China Sea Tsunami Advisory Center: http://scstac.oceanguide.org.cn/index.htm Central America Tsunami Advisory Center: http://catac.ineter.gob.ni/

ANNEX V

LIST OF ACRONYMS

CATAC	Central America Tsunami Advisory Centre
CL	Circular Letter
DISCEX	Discussion Exercise or Tabletop Exercise
ICG	Intergovernmental Coordination Group
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 (now renamed ICG/PTWS)
ICG/PTWS	The Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System
INETER	Instituto Nicaragüense de Estudios Territoriales
IOC	Intergovernmental Oceanographic Commission of UNESCO
ITIC	International Tsunami Information Center
JMA	Japan Meteorological Agency
MNR	China Ministry of Natural Resources
MTS	Medium-term Strategy
NCEI	National Centres for Environmental Information
NDMO	National Disaster Management Offices
NOAA	US National Oceanic and Atmospheric Administration
NTWC	National Tsunami Warning Centre
NWPTAC	Northwest Pacific Tsunami Advisory Center
PacWave	Exercise Pacific Wave
PMEL	Pacific Marine Environmental Laboratory
PTWC	Pacific Tsunami Warning Center
PTWS	Pacific Tsunami Warning and Mitigation System
SCSTAC	South China Sea Tsunami Advisory Center
SOP	Standard Operating Procedure
TNC	Tsunami National Contact
TOWS-WG	IOC Working Group on Tsunamis and Other Hazards related to Sea-Level Warning and Mitigation Systems
TSP	Tsunami Service Provider
TsuCAT	Tsunami Coastal Assessment Tool
TT	Task Team
TWFP	Tsunami Warning Focal Point
UNESCO	United Nations Educational, Scientific and Cultural Organization
USGS	U.S. Geological Survey

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
48	Neotectonics and fluid flow through seafloor sediments in the Eastern Mediterranean and Black Seas - Parts I and II. 1997	E only
49	Global Temperature Salinity Profile Programme: Overview and Future. 1998	E only
50	Global Sea-Level Observing System (GLOSS) Implementation Plan-1997. 1997	E only
51	L'état actuel de 1'exploitation des pêcheries maritimes au Cameroun et leur gestion intégrée dans la sous-région du Golfe de Guinée *(cancelled)*	F only
52	Cold water carbonate mounds and sediment transport on the Northeast Atlantic Margin. 1998	E only
53	The Baltic Floating University: Training Through Research in the Baltic, Barents and White Seas - 1997. 1998	E only
54	Geological Processes on the Northeast Atlantic Margin (8th training-through-research cruise, June-August 1998). 1999	E only
55	Bruun Memorial Lectures, 1999: Ocean Predictability. 2000	E only
56	Multidisciplinary Study of Geological Processes on the North East Atlantic and Western Mediterranean Margins (9th training-through-research cruise, June-July 1999). 2000	E only
57	Ad hoc Benthic Indicator Group - Results of Initial Planning Meeting, Paris, France, 6-9 December 1999. 2000	E only
58	Bruun Memorial Lectures, 2001: Operational Oceanography – a perspective from the private sector. 2001	E only
59	Monitoring and Management Strategies for Harmful Algal Blooms in Coastal Waters. 2001	E only
60	Interdisciplinary Approaches to Geoscience on the North East Atlantic Margin and Mid-Atlantic Ridge (10th training-through-research cruise, July-August 2000). 2001	E only
61	Forecasting Ocean Science? Pros and Cons, Potsdam Lecture, 1999. 2002	E only
62	Geological Processes in the Mediterranean and Black Seas and North East Atlantic (11th training-through-research cruise, July- September 2001). 2002	E only
63	Improved Global Bathymetry – Final Report of SCOR Working Group 107. 2002	E only
64	R. Revelle Memorial Lecture, 2006: Global Sea Levels, Past, Present and Future. 2007	E only
65	Bruun Memorial Lectures, 2003: Gas Hydrates – a potential source of energy from the oceans. 2003	E only
66	Bruun Memorial Lectures, 2003: Energy from the Sea: the potential and realities of Ocean Thermal Energy Conversion (OTEC). 2003	E only

67	Interdisciplinary Geoscience Research on the North East Atlantic Margin, Mediterranean Sea and Mid-Atlantic Ridge (12th training-through-research cruise, June-August 2002). 2003	E only
68	Interdisciplinary Studies of North Atlantic and Labrador Sea Margin Architecture and Sedimentary Processes (13th training-through-research cruise, July-September 2003). 2004	E only
69	Biodiversity and Distribution of the Megafauna / Biodiversité et distribution de la mégafaune. 2006 Vol.1 The polymetallic nodule ecosystem of the Eastern Equatorial Pacific Ocean / Ecosystème de nodules polymétalliques de l'océan Pacifique Est équatorial Vol.2 Annotated photographic Atlas of the echinoderms of the Clarion-Clipperton fracture zone / Atlas photographique annoté des échinodermes de la zone de fractures de Clarion et de Clipperton Vol.3 Options for the management and conservation of the biodiversity — The nodule ecosystem in the Clarion Clipperton fracture zone: scientific, legal and institutional aspects	E F
70	Interdisciplinary geoscience studies of the Gulf of Cadiz and Western Mediterranean Basin (14th training-through-research cruise, July-September 2004). 2006	E only
71	Indian Ocean Tsunami Warning and Mitigation System, IOTWS. Implementation Plan, 7–9 April 2009 (2nd Revision). 2009	E only
72	Deep-water Cold Seeps, Sedimentary Environments and Ecosystems of the Black and Tyrrhenian Seas and the Gulf of Cadiz (15th training-through-research cruise, June–August 2005). 2007	E only
73	Implementation Plan for the Tsunami Early Warning and Mitigation System in the North-Eastern Atlantic, the Mediterranean and Connected Seas (NEAMTWS), 2007–2011. 2007 *(electronic only)*	E only
74	Bruun Memorial Lectures, 2005: The Ecology and Oceanography of Harmful Algal Blooms – Multidisciplinary approaches to research and management. 2007	E only
75	National Ocean Policy. The Basic Texts from: Australia, Brazil, Canada, China, Colombia, Japan, Norway, Portugal, Russian Federation, United States of America. (Also Law of Sea Dossier 1). 2008	E only
76	Deep-water Depositional Systems and Cold Seeps of the Western Mediterranean, Gulf of Cadiz and Norwegian Continental margins (16th training-through-research cruise, May–July 2006). 2008	E only
77	Indian Ocean Tsunami Warning and Mitigation System (IOTWS) – 12 September 2007 Indian Ocean Tsunami Event. Post-Event Assessment of IOTWS Performance. 2008	E only
78	Tsunami and Other Coastal Hazards Warning System for the Caribbean and Adjacent Regions (CARIBE EWS) – Implementation Plan 2013–2017 (Version 2.0). 2013	E only
79	Filling Gaps in Large Marine Ecosystem Nitrogen Loadings Forecast for 64 LMEs – GEF/LME global project Promoting Ecosystem-based Approaches to Fisheries Conservation and Large Marine Ecosystems. 2008	E only
80	Models of the World's Large Marine Ecosystems. GEF/LME Global Project Promoting Ecosystem-based Approaches to Fisheries Conservation and Large Marine Ecosystems. 2008	E only
81	Indian Ocean Tsunami Warning and Mitigation System (IOTWS) – Implementation Plan for Regional Tsunami Watch Providers (RTWP). 2008	E only
82	Exercise Pacific Wave 08 – A Pacific-wide Tsunami Warning and Communication Exercise, 28–30 October 2008. 2008	E only
83.	*Cancelled*	
84.	Global Open Oceans and Deep Seabed (GOODS) Bio-geographic Classification. 2009	E only
85.	Tsunami Glossary	E, F, S
86	Pacific Tsunami Warning System (PTWS) Implementation Plan	*Electronic publication*

(continued)

87.	Operational Users Guide for the Pacific Tsunami Warning and Mitigation System (PTWS) – Second Edition. 2011	E only
88.	Exercise Indian Ocean Wave 2009 (IOWave09) – An Indian Ocean-wide Tsunami Warning and Communication Exercise – 14 October 2009. 2009	E only
89.	Ship-based Repeat Hydrography: A Strategy for a Sustained Global Programme. 2009	E only
90.	12 January 2010 Haiti Earthquake and Tsunami Event Post-Event Assessment of CARIBE EWS Performance. 2010	E only
91.	Compendium of Definitions and Terminology on Hazards, Disasters, Vulnerability and Risks in a coastal context	*Under preparation*
92.	27 February 2010 Chile Earthquake and Tsunami Event – Post-Event Assessment of PTWS Performance (Pacific Tsunami Warning System). 2010	E only
93.	Exercise CARIBE WAVE 11 / LANTEX 11—A Caribbean Tsunami Warning Exercise, 23 March 2011	
	Vol. 1 Participant Handbook / Exercise CARIBE WAVE 11 —Exercice d'alerte au tsunami dans les Caraïbes, 23 mars 2011. Manuel du participant / Ejercicio Caribe Wave 11. Un ejercicio de alerta de tsunami en el Caribe, 23 de marzo de 2011. Manual del participante. 2010	E/F/S
	Vol. 2 Report. 2011	E only
	Vol. 3 Supplement: Media Reports. 2011	E/F/S
94.	Cold seeps, coral mounds and deep-water depositional systems of the Alboran Sea, Gulf of Cadiz and Norwegian continental margin (17th training-through-research cruise, June–July 2008)	E only
95.	International Post-Tsunami Survey for the 25 October 2010 Mentawai, Indonesia Tsunami	E only
96.	Pacific Tsunami Warning System (PTWS) 11 March 2011 Off Pacific coast of Tohoku, Japan, Earthquake and Tsunami Event. Post-Event Assessment of PTWS Performance	E only
97.	Exercise PACIFIC WAVE 11: A Pacific-wide Tsunami Warning and Communication Exercise, 9–10 November 2011	
	Vol. 1 Exercise Manual. 2011	E only
	Vol. 2 Report. 2013	E only
98.	Tsunami Early Warning and Mitigation System in the North-Eastern Atlantic, the Mediterranean and connected seas. First Enlarged Communication Test Exercise (ECTE1). Exercise Manual and Evaluation Report. 2011	E only
99.	Exercise INDIAN OCEAN WAVE 2011 – An Indian Ocean-wide Tsunami Warning and Communication Exercise, 12 October 2011	E only
	Vol. 1 Exercise Manual. 2011 Supplement: Bulletins from the Regional Tsunami Service Providers	
	Vol. 2 Exercise Report. 2013	
100.	Global Sea Level Observing System (GLOSS) Implementation Plan – 2012. 2012	E only
101.	Exercise Caribe Wave/Lantex 13. A Caribbean Tsunami Warning Exercise, 20 March 2013. Volume 1: Participant Handbook. 2012 Volume 2: Final Report	E only
102.	Tsunami Early Warning and Mitigation System in the North-Eastern Atlantic, the Mediterranean and Connected Seas — Second Enlarged Communication Test Exercise (CTE2), 22 May 2012.	E only
	Vol. 1 Exercise Manual. 2012	
	Vol. 2 Evaluation Report. 2014	
103.	Exercise NEAMWAVE 12. A Tsunami Warning and Communication Exercise for the North-eastern Atlantic, the Mediterranean, and Connected Seas Region, 27–28 November 2012. Vol. 1: Exercise Manual. 2012 Vol. 2: Evaluation Report. 2013	E only
104.	Seísmo y tsunami del 27 de agosto de 2012 en la costa del Pacífico frente a El Salvador, y seísmo del 5 de septiembre de 2012 en la costa del Pacífico frente a Costa Rica. Evaluación subsiguiente sobre el funcionamiento del Sistema de Alerta contra los Tsunamis y Atenuación de sus Efectos en el Pacífico. 2012	Español solamente (resumen en inglés y francés)

105.	Users Guide for the Pacific Tsunami Warning Center Enhanced Products for the Pacific Tsunami Warning System, August 2014. Revised Edition. 2014	E, S
106.	Exercise Pacific Wave 13. A Pacific-wide Tsunami Warning and Enhanced Products Exercise, 1–14 May 2013. Vol. 1 Exercise Manual. 2013 Vol. 2 Summary Report. 2013	E only
107.	Tsunami Public Awareness and Educations Strategy for the Caribbean and Adjacent Regions. 2013	E only
108.	Pacific Tsunami Warning and Mitigation System (PTWS) Medium-Term Strategy, 2014−2021. 2013	E only
109.	Exercise Caribe Wave/Lantex 14. A Caribbean and Northwestern Atlantic Tsunami Warning Exercise, 26 March 2014. Vol. 1 Participant Handbook. 2014 Vol. 2 Evaluation Report. 2015 (English only)	E/S
110.	Directory of atmospheric, hydrographic and biological datasets for the Canary Current Large Marine Ecosystem, 3rd edition: revised and expanded. 2017	E only
111.	Integrated Regional Assessments in support of ICZM in the Mediterranean and Black Sea Basins. 2014	E only
112.	11 April 2012 West of North Sumatra Earthquake and Tsunami Event - Post-event Assessment of IOTWS Performance	E only
113.	Exercise Indian Ocean Wave 2014: An Indian Ocean-wide Tsunami Warning and Communication Exercise. Vol.1 Manual Vol. 2 Exercise Report. 2015	E only
114.	Exercise NEAMWAVE 14. A Tsunami Warning and Communication Exercise for the North-Eastern Atlantic, the Mediterranean, and Connected Seas Region, 28–30 October 2014 Vol. 1 Manual Vol. 2 Evaluation Report – Supplement: Evaluation by Message Providers and Civil Protection Authorities	E only
115.	Oceanographic and Biological Features in the Canary Current Large Marine Ecosystem. 2015 *(revised in 2016)*	E only
116.	Tsunami Early Warning and Mitigation System in the North-Eastern Atlantic, the Mediterranean and Connected Seas. Third Enlarged Communication Test Exercise (CTE3), 1st October 2013. Vol. 1 Exercise Manual Vol. 2 Evaluation Report	E only
117.	Exercise Pacific Wave 15. A Pacific-wide Tsunami Warning and Enhanced Products Exercise, 2–6 February 2015 Vol. 1: Exercise Manual; Vol. 2: Summary Report	E only
118.	Exercise Caribe Wave/Lantex 15. A Caribbean and Northwestern Atlantic Tsunami Warning Exercise, 25 March 2015 (SW Caribbean Scenario) Vol. 1: Participant Handbook Vol. 2: Summary Report	E only
119.	Transboundary Waters Assessment Programme (TWAP) Assessment of Governance Arrangements for the Ocean Vol 1: Transboundary Large Marine Ecosystems; Supplement: Individual Governance Architecture Assessment for Fifty Transboundary Large Marine Ecosystems Vol 2: Areas Beyond National Jurisdiction	E only
120.	Transboundary Waters Assessment Programme (TWAP) – Status and Trends in Primary Productivity and Chlorophyll from 1996 to 2014 in Large Marine Ecosystems and the Western Pacific Warm Pool, Based on Data from Satellite Ocean Colour Sensors. 2017	E only
121.	Exercise Indian Ocean Wave 14, an Indian Ocean wide Tsunami Warning and Communications Exercise, 9–10 September 2014	*In preparation*
122.	Tsunami Early Warning and Mitigation System in the North-Eastern Atlantic, the Mediterranean and Connected Seas. Sixth Communication Test Exercise (CTE6), 29 July 2015. Vol. 1: Exercise Manual Vol. 2: Evaluation Report	E only

(continued)

123	Preparing for the next tsunami in the North-Eastern Atlantic, the Mediterranean and Connected Seas – Ten years of the Tsunami Warning System (NEAMTWS). 2017 —*Cancelled*	*(see IOC/INF-1340)*
124	Indicadores Marino Costeros del Pacífico Sudeste / Coastal and Marine Indicators of the Southeast Pacific (SPINCAM)	E/S
125	Exercise CARIBE WAVE 2016: A Caribbean and Adjacent Regions Tsunami Warning Exercise, 17 March 2016 (Venezuela and Northern Hispaniola Scenarios) Volume 1: Participant Handbook Volume 2: Final Report	E only
126	Exercise Pacific Wave 16. A Pacific-wide Tsunami Warning and Enhanced Products Exercise, 1-5 February 2016. Volume 1: Exercise Manual. Volume 2: Summary Report	E only
127	Experiencias locales de manejo costero integrado: casos piloto SPINCAM en el Pacífico Sudeste. (ICAM Dossier nº9)	S only
128.	Exercise Indian Ocean Wave 2016: An Indian Ocean-wide Tsunami Warning and Communications Exercise, 7–8 September 2016 Vol 1: Participant Manual Vol. 2: Exercise Report	E only
129	What are Marine Ecological Time Series telling us about the Ocean – A status report	E only
130	Tsunami Watch Operations – Global Service Definition Document	E only
131	Exercise Pacific Wave 2017. A Pacific-wide Tsunami Warning and Enhanced Products Exercise, 15-17 February 2017. Volume 1: Exercise Manual Volume 2: Exercise Report	E only
132.	2nd March 2016 Southwest of Sumatra Earthquake and Tsunami Event Post-Event Assessment of the Performance of the Indian Ocean Tsunami Warning and Mitigation System; Supplement: Tsunami Service Provider Bulletins and Maps	E only
133.	Exercise CARIBE WAVE 17. A Caribbean and Adjacent Regions Tsunami Warning Exercise, 21 March 2017 (Costa Rica, Cuba and Northeastern Antilles Scenarios). Volume 1: Participant Handbook Volume 2: Final Report	E only
134.	Tsunami Exercise NEAMWave17 – A Tsunami Warning and Communication Exercise for the North-eastern Atlantic, the Mediterranean, and Connected Seas Region, 31 October – 3 November 2017 Volume 1: Exercise Instructions. 2017 Volume 2: Evaluation Report. 2018 Supplement: Evaluation by Message Providers and Civil Protection Authorities	E only
135.	User's Guide for the Pacific Tsunami Warning Center Enhanced Products for the Tsunami and other Coastal Hazards Warning System for the Caribbean and Adjacent Regions (CARIBE-EWS), October 2017	E only
136.	Exercise CARIBE WAVE 18. Tsunami Warning Exercise, 15 March 2018 (Barbados, Colombia and Puerto Rico Scenarios). Volume 1: Participant Handbook. 2017 Volume 2: Final Report	E only
137.	The Ocean is losing its breath: declining oxygen in the world's ocean and coastal waters	(under preparation)
138.	Exercise Indian Ocean Wave 2018: An Indian Ocean-wide Tsunami Warning and Communication Exercise, 4–5 September 2018 Volume 1: Exercise Manual & Supplements Volume 2: Exercise Report. 2019	E only
139.	Exercise Pacific Wave 2018. A Pacific-wide Tsunami Warning and Enhanced Products Exercise, September to November 2018. Volume 1: Exercise Manual. Volume 2: Summary Report	E only
140	Analysis of transboundary Water Ecosystems and Green and Blue Infrastructures: Intercontinental Biosphere Reserve of the Mediterranean: Andalusia (Spain) – Morocco	E F S

141	Exercise Caribe Wave 2019. A Caribbean and Adjacent Region Tsunami Warning Exercise, 14 March 2019. Volume 1: Participant handbook. Volume 2: Summary Report	E only
142	Users' Guide for the Northwest Pacific Tsunami Advisory Center (NWPTAC) – Enhanced Products for the Pacific Tsunami Warning System. 2019	E only
143	Capacity Assessment of Tsunami Preparedness in the Indian Ocean, Status Report, 2018 + Supplement: National Reports	E only
144	Indian Ocean Tsunami Warning and Mitigation System (IOTWMS): Medium Term Strategy, 2019–2024	E only
145	IOTWMS Users Guide for National Tsunami Warning Centres	(under preparation)
146	Definition of Services provided by the Tsunami Service Providers of the IOTWMS	E only
147	UNESCO-IOC International Tsunami Survey Team Samoa (ITST Samoa) Interim Report of Field Survey, 14–21 October 2009 (29 September 2009 Tsunami)	E only
148	Ejercicio TSUNAMI-CA 19. Un simulacro de tsunami para Centroamérica, 19 de agosto de 2019. Volumen 1, Manual para participantes.	S only
149	User's Guide for the South China Sea Tsunami Advisory Center (SCSTAC) products for the South China Sea Tsunami Warning and Mitigation System	E only
150	Limitations and Challenges of Early Warning Systems: A Case Study from the 28 September 2018 Palu-Donggala Tsunami	E, Bahasa
151	Exercise CARIBE WAVE 20. Tsunami Warning Exercise, 19 March 2020 (Jamaica and Portugal). Volume 1: Participant Handbook Volume 2: Summary Report	E only
152	Technical Report on the status of coastal vulnerability in central African countries (ICAM Dossier no 10)	E, F
153	Exercise Indian Ocean Wave 2020: An Indian Ocean-wide Tsunami Warning and Communication Exercise, 6–20 October 2020. Volume 1: Exercise Manual Supplement 1: TSP Bulletins for Scenario 1 South of Java Supplement 2: TSP Bulletins for Scenario 2 Andaman Islands Supplement 3: TSP Bulletins for Scenario 3 Off Coast of Pakistan Volume 2: Exercise Report	E only
154	La contribución de las actividades marítimas a la economía de los países del Pacífico Sur	S only
155	Exercise Pacific Wave 2020: A Pacific-wide Tsunami Service Provider Communications Exercise,5 November 2020 Volume 1: Exercise Manual	E only
156	Ejercicio Tsunami-CA 20 – Ejercicio de respuesta en caso de tsunami para América Central: un terremoto lento y tsunami frente al golfo de Fonseca, 11 de noviembre de 2020. Vol.1: Manual para participantes	S only
157	Exercise Caribe Wave 21. Tsunami Warning Exercise, 11 March 2021 (Jamaica and Northern Lesser Antilles). Volume 1: Participant Handbook. Volume 2: Summary Report	E only
158.	Integrated Ocean Science Research: A summary of Ocean Carbon Research, and Vision of Coordinated Ocean Carbon Research and Observations for the next Decade (IOC-R). 2021	E only
159.	*Lessons learnt on Coastal Risk Mitigation at Local Scale*	*In preparation*
160	Current conditions and compatibility of maritime uses in the Western Mediterranean: technical report	E, F
161	Current conditions and compatibility of maritime uses in the Gulf of Guayaquil: technical report	E, S
162	Future conditions and scenarios for marine spatial planning and sustainable blue economy opportunities in the Western Mediterranean: technical report	E, F
163	Future conditions and scenarios for marine spatial planning and sustainable blue economy opportunities in the Gulf of Guayaquil: technical report	E, S

(continued)

164	NEAMWave 21 Tsunami Exercise. A Tsunami Warning and Communication Exercise for the North-eastern Atlantic, the Mediterranean, and Connected Seas Region. Exercise Manual (Vol.1): Exercise Instructions (Part 1) and Exercise Supplements (Part 2).	E only
165	A Sustainable Blue Economy for Cabo Verde/Uma Economia Azul Sustentável para Cabo Verde (2021)	E/P(bilingual)
166	A Sustainable Blue Economy for Trinidad and Tobago (2021)	E only
167	Recommendations to promote knowledge exchange and transfer on MSP (Marine Spatial Planning)	E only
168	Pacific Islands Marine Bioinvasions Alert Network (PacMAN) Monitoring Plan	E only
169	MSPglobal Initiative (Marine Spatial Planning): Lessons learned	E only
170	CARIBE WAVE 22, A Caribbean and Adjacent Regions Tsunami Warning Exercise, 10 March 2022 (Western Muertos Trough & Northern Panama Scenarios) Volume 1: Participant Handbook Volume 2: Summary Report	E only
171	Strategy of the Intergovernmental Coordination Group for the Tsunami Early Warning and Mitigation System in the North-Eastern Atlantic, the Mediterranean and Connected Seas (ICG/NEAMTWS) 2021–2030	E only
172	Pacific Tsunami Warning and Mitigation System (PTWS) Strategy 2022–2030. 2023	E only
173	IOC State of the Ocean Report – Pilot edition 2022	E only
174	Biofouling prevention and management in the marine aquaculture industry Volume 1: Best practices in biofouling management. 2022	E only
175	Exercise Pacific Wave 2022. A Pacific-wide Tsunami Warning and Communications Exercise, 1 September – 30 November 2022. Volume 1: Exercise Manual Volume 2: Summary Report	E only
176.	State-of-the-Art of Ocean Literacy. 2022	E only
177.	Marine Spatial Planning and The Blue Economy in Kenya	E only
178	Exercise CARIBE WAVE 23. A Caribbean and Adjacent Regions Tsunami Warning Exercise, 23 March 2023 (Gulf of Honduras and Mount Pelée Scenarios). Volume 1: Participant Handbook Volume 2: Summary Report	E only
179.	Poverty and Gender Perspectives in Marine Spatial Planning: Lessons from Kwale County in Coastal Kenya. 2024	E only
180.	Research, Development and Implementation Plan for the Ocean Decade Tsunami Programme. 2023	E only
181.	*INDIAN OCEAN WAVE 23. An Indian Ocean-wide Tsunami Warning and Communications Exercise, 4–25 October 2023* *Volume 1: Exercise manual*	*In preparation*
182.	Updated Joint Roadmap to accelerate Marine/Maritime Spatial Planning processes worldwide – MSProadmap (2022–2027)	E only
183.	Monitoring and Warning for Tsunamis Generated by Volcanoes	E only
184.	Exercise NEAMWave 23. A Tsunami Warning and Communication Exercise for the North-eastern Atlantic, the Mediterranean, and Connected Seas Region, Volume 1: Exercise Manual.	E only
185.	*Ocean Acidification Research for Sustainability – A Community Vision for the Ocean Decade'*	*In preparation*
186.	Developing Metrics of Poverty and Gender Considerations in Marine Spatial Planning: A synthesis of case studies in Kenya, Madagascar and Tanzania	E only
187.	EXERCISE CARIBE WAVE 2024 – A Caribbean and Adjacent Region Tsunami Warning Exercise, 21 March 2024 Volume 1: Participant Handbook	E only
188.	'Hunga Tonga – Hunga Ha`apai' type Volcanic Tsunami Hazard Response: IOC-PTWC Procedures and PTWS Products User's Guide (version 1.6). 2024	E only
189.	Engaging Indigenous Peoples and Local Communities, and Embracing Indigenous and Local Knowledge in Marine Spatial Planning Volume 1 – Basic Concepts	E only

190. *IOC State of the Ocean Report – edition 2024* *In press*

191. EXERCISE PACIFIC WAVE 2024 E only
A Pacific-wide Tsunami Warning and Communications Exercise, September–November 2024
Volume 1: Exercise Manual

(continued)