

**Intergovernmental Oceanographic Commission  
Technical Series**

**172**



**PACIFIC TSUNAMI WARNING AND  
MITIGATION SYSTEM (PTWS)  
STRATEGY 2022–2030**

**UNESCO**

# **PACIFIC TSUNAMI WARNING AND MITIGATION SYSTEM (PTWS) STRATEGY 2022–2030**

*“Pacific Ocean ICG/PTWS Member States working together to manage tsunami risk and build our community’s resilience to tsunami hazard events in the Pacific Ocean and its marginal seas.”*

IOC Technical Series, 172  
Paris, February 2023  
English only

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

UNESCO/IOC. 2023. *Pacific Tsunami Warning and Mitigation System (PTWS) Strategy 2022–2030*. Paris, UNESCO, IOC Technical Series No 172 (English only).

Published in 2023  
by United Nations Educational, Scientific  
and Cultural Organization  
7, Place de Fontenoy, 75352 Paris 07 SP

UNESCO 2023

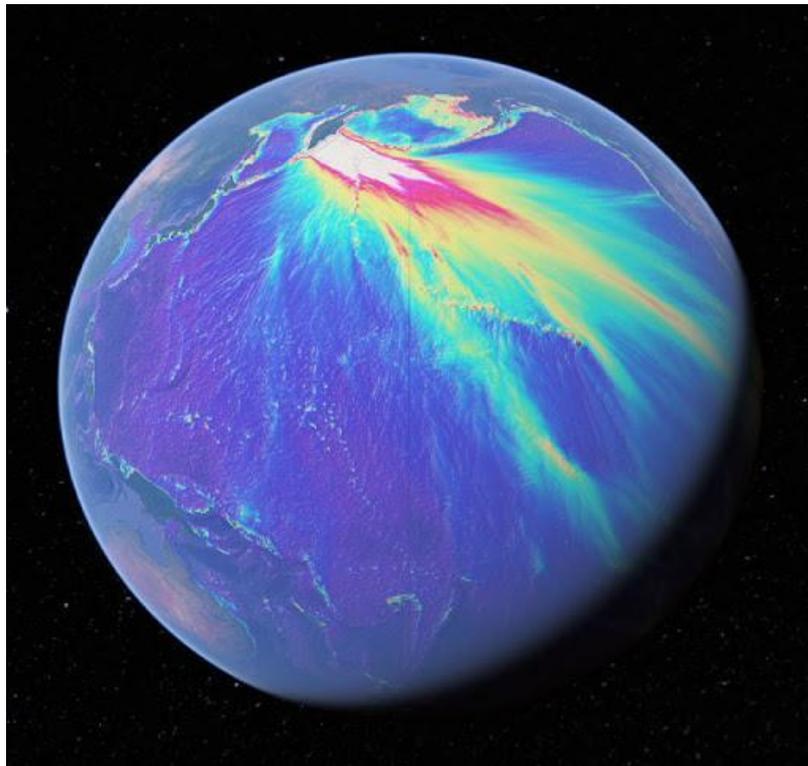
(IOC/2023/TS/172)

## ABOUT THIS STRATEGY

This Strategy has been developed to set our tsunami resilience aspirations for the Pacific Ocean and its marginal seas, with a clear Goal on how to achieve them. Embedded under this Goal are key objectives that will drive our work programmes, projects, and the key performance and monitoring framework we use to deliver on this Strategy.

The Strategy is aligned with:

- The United Nations Decade of Ocean Science for Sustainable Development (2021–2030): [Implementation Plan](#)
- UNESCO’s Medium-Term Strategy for 2022–2029 ([41 C/4](#)).
- The [Intergovernmental Oceanographic Commission \(IOC\) Medium-Term Strategy 2022–2029](#) (the PTWS parent body’s Strategy) that identifies early warning systems as an important part of its strategic vision - Framework for Global Tsunami and Other Ocean Hazards Warning and Mitigation Systems.
- The global targets and priorities for action of the [Sendai Framework for Disaster Risk Reduction \(SFDRR\) 2015–2030](#) – specifically Target G of the SFDRR.
- The ICG/PTWS [Framework Future Goals and Performance Monitoring of Tsunami Risk Reduction, Hazard Warning, and Mitigation](#).



*Figure 1. Indicative wave propagation forecast of the Great Japan Earthquake and Tsunami, 2011.*

*Image from NOAA Historical Tsunami website. Tsunami runup data: National Geophysical Data Center / World Data Service: NCEI/WDS Global Historical Tsunami Database. NOAA National Centers for Environmental Information*

## **Our Vision**

The countries and territories of the Pacific Ocean and its marginal seas are resilient to tsunami risk they face. Our Pacific communities are empowered to manage this risk, and actionably build their resilience so they can live, work, and thrive in a diverse, tsunami prone environment.

## **Our Goal**

To build strong, knowledge aware communities regarding tsunami hazard and risk, by leading and delivering a modern and effective tsunami warning and mitigation system, improving access to tsunami hazard and risk information, and enabling prepared and aware communities. Subsequently, we agree to work together, via Member State participation to reduce risk and build resilience to tsunami hazards.

## **Our Objectives**

1. Understanding and Managing Tsunami Hazard Risk
2. Tsunami Detection, Measurement, Warning & Dissemination
3. Enhancing tsunami preparedness for effective community response
4. International Coordination and Cooperation and Partnerships



Figure 2. PTWS Vision, Goal and Objectives

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## **1. PURPOSE OF THIS STRATEGY**

The purpose of this Strategy is to provide a structured pathway for the governance and co-ordination of the Pacific Tsunami Warning and Mitigation System (PTWS). Under the leadership of the Intergovernmental Oceanographic Commission (IOC) of UNESCO, the Intergovernmental Coordination Group (ICG) for PTWS will implement this Strategy by establishing the following entities to oversee and conduct work to deliver on the Goal of this Strategy:

- A Steering Committee to provide guidance.
- Working Groups aligned with the Objectives of this Strategy to deliver on programmes of work.
- Task Teams to work on specific projects.

## 2. CONTEXT

### 2.1 Regional Context and Background

The Pacific Ocean is the largest, most diverse, and most tsunami-prone of any of the Earth's ocean basins. There is a more frequent occurrence of tsunami in the Pacific Ocean due to earthquakes associated with the subduction zones and transform faults of the Pacific Rim, also known as the 'Pacific ring of Fire' (Figure 3). Large earthquakes (M7+) are common and often generate large, destructive tsunamis, meaning our coastal communities and nations are exposed and vulnerable to local, regional, and distant source tsunamis. Tsunamis in the Pacific can also be generated by landslides, volcanic explosive activity or cone collapse and meteorite impact. Very large tsunamis have the potential to significantly inundate multiple coastal areas, causing loss of life, injuries, and physical and environmental damage and disruption across multiple regions simultaneously.



*Figure 3. The Pacific Ring of Fire with significant subduction zones identified*

It is therefore important, under the leadership and guidance of the IOC, for us to understand the national, regional, and local risks from tsunami to enable assessment of PTWS priorities, and to better inform decision-making required for effective tsunami risk management.

This Strategy provides a framework for this, by outlining our joint responsibilities and ownership, for in-country tsunami risk management programmes and warning systems and to

engage in the international coordination and collaboration process through the ICG/PTWS (Figure 4). Tsunami Service Providers (TSPs) such as the Pacific Tsunami Warning Center (PTWC), Northwest Pacific Tsunami Advisory Center (NWPTAC), South China Sea Tsunami Advisory Center (SCSTAC) and Central America Tsunami Advisory Center (CATAC) (candidate TSP to date) have provided tsunami threat information and/or tsunami information against regional and distant tsunamis, to advise national tsunami warning systems of Member States. And Member States have primarily depended on tsunami threat information and/or tsunami information issued by TSPs for issuance of national tsunami warning. On the other hand, the national tsunami warning centre (NTWC) of each Member State has an important role against local tsunamis caused by local earthquakes as well as non-seismic sources.

Management of tsunami risk focuses strongly on life safety preparedness, evacuation planning and warnings, and response and recovery. This includes, but is not limited to:

- Monitoring the sources of tsunami;
- Determining the threat;
- Providing emergency management/civil response entities with information of possible and confirmed tsunami threat;
- Preparing communities for an efficient response to a tsunami;
- Communicating threat advice and warnings to the public;
- Tsunami inundation modelling and research into all possible sources; and
- Evacuation mapping, planning, and public education.

Our Strategic Objectives are closely aligned with the above approach to tsunami risk management, to ensure we promote regular monitoring and evaluation of our tsunami risk (changes in likelihood, exposure, and vulnerability to determine increasing or decreasing changes in risk), evaluate the effectiveness of tsunami risk management practices and set priorities for improvements across Pacific countries and territories.

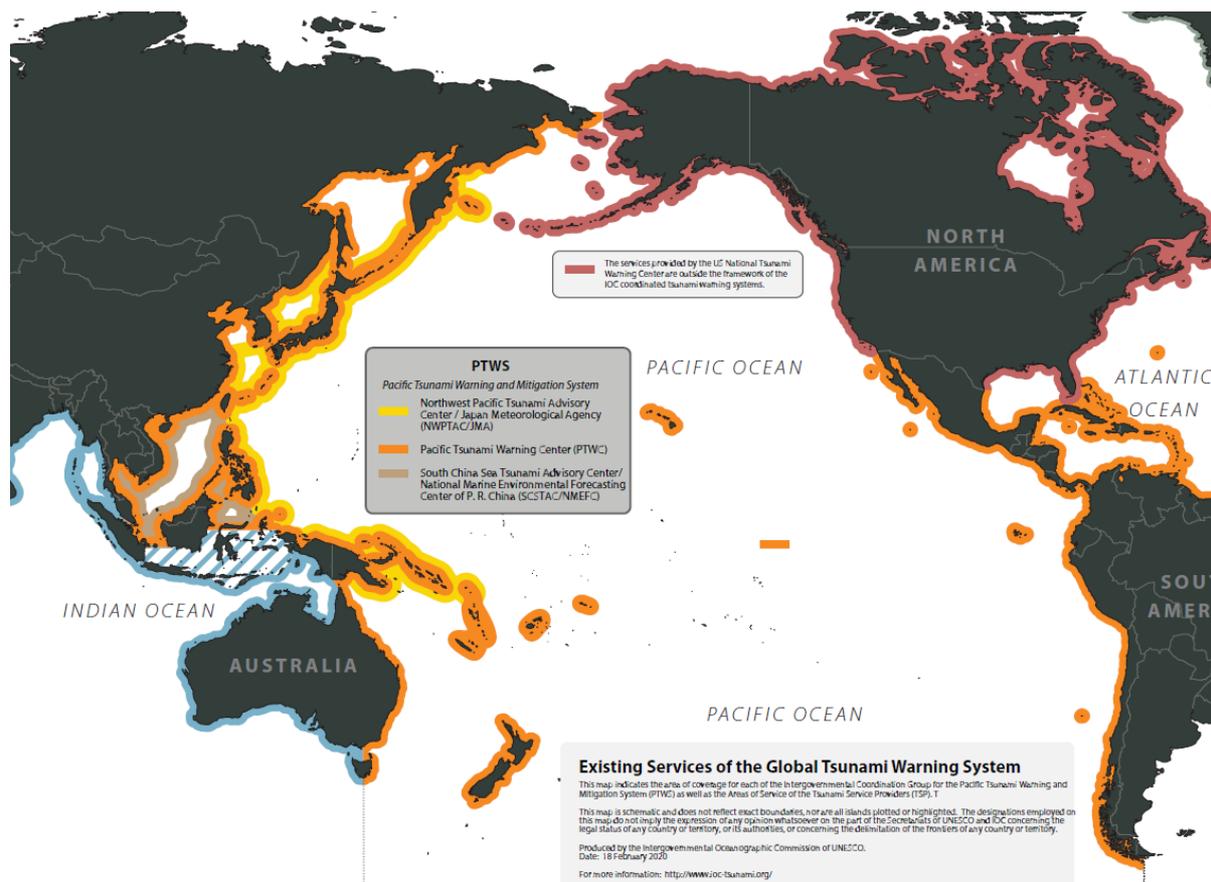


Figure 4. Extent of the Pacific tsunami monitoring, detection, and warning system

## 2.2 Current State of the Pacific Tsunami Warning and Mitigation System (2019–2021)

### Overview

Understanding the ‘current state’ of the PTWS underpins this Strategy. Without knowing ‘where we are’, we can’t adequately understand where we want to be, nor plan for the future state of the PTWS. The current state of the PTWS has been developed from the analysis of Member State’s self-assessment of their performance, against the PTWS Framework for Future Goals and Performance Monitoring of Risk Reduction Tsunami Hazard Warning and Mitigation. The assessment criteria within the Framework, aligns with the goals and priorities of the Medium-term strategy and the Sendai Framework for Disaster Risk Reduction (SFDRR) 2015–2030, specifically, Target G, which aims to “Substantially increase the availability of and access to multi-hazard early warning systems and disaster risk information and assessments to the people by 2030”. This is to ensure international alignment with best practice tsunami risk management, measure status against requirements and assist with obtaining resources for continued improvement. In addition, the Framework contributes to the Executive Council decision EC-LI/3.3. Our overall goal with continuously assessing our performance is to ensure the PTWS is sustainable, continuously improving and adequately monitored. It is important we use these results to stay current and guide the direction of future work programmes.

Key aspects regarding our current state are summarized across the following areas:

- Understanding and managing tsunami hazard and risk;

- Tsunami detection, measurement, warning & dissemination;
- Enhancing tsunami preparedness for effective community response; and
- International coordination and cooperation.

An update of the current state will be provided when this Strategy is reviewed in 2030.

### ***Summary of 'Current State'***

The PTWS and its Member States have developed their collaborative and individual capacity to plan, prepare and respond to tsunami, significantly since the 2004 Indian Ocean earthquake and tsunami. Our strength lies in our ability to detect earthquake sources rapidly, assess whether these are tsunamigenic in 'real-time' and generate tsunami threat information and warnings effectively and efficiently. This has been significantly helped by the final deployment of 12 additional Pacific Ocean 4G DART Buoys located near the Tonga-Kermadec Trench. This brings the total number of DART Buoys in the Pacific to over 50 and addresses a previous critical gap in tsunami monitoring capability in the Southwest Pacific.

Improvements still need to be made in verifying tsunami generation and constraining the tsunami source as this will reduce or eliminate the uncertainty for civil contingencies and emergency management authorities who warn the public. However, collectively we are making discrete investments in research, technologies, and tools to address this. New types of tsunami and earthquake monitoring data and novel methods for forecasting and delivering early warnings are currently being assessed. This includes multiple-observation networks like terrestrial GNSS and the use of sea-based sensor networks, which demonstrates considerable improvement in our tsunami detection and characterisation capability in recent years.

We need to continue to improve our understanding, detection, and warning to multi-source (e.g., landslide/volcanic activity) and local source events. Relatedly, the use of data from seismic and tsunami instrumentation in the region has improved, with interoperability issues decreasing.

In general, Member States are very strong at establishing the means to assess tsunami hazard and model impacts. Improvements need to be made in how we translate this into robust, multi-level risk assessments. If we do not improve this ability, it may result in poor risk-based decision making. We need to ensure this information underpins our excellent work in community preparedness activities and public education. Being able to translate risk (event probabilities) and what to do about this, needs to include the development, implementation and continued use of evacuation zones and maps. Fully understanding tsunami hazard translates to improved risk reduction incentives and initiatives, preparedness, and response planning activities. Given the UN Decade of Ocean Science for Sustainable Development goal, that 100% of communities at risk of tsunami are prepared for and resilient to tsunamis by 2030, this is a critical area for us to understand our current state and select relevant PTWS actions for the next eight years. We have collectively agreed to make a strong commitment to the Decade and intend to develop a Task Team to address the requirements of the Decade regarding tsunami risk and resilience in the Pacific Ocean. The Task Team will ensure the PTWS, and its Member States have adequate capacity and capability to meet Decade targets by 2030, without over-committing countries with over stretched resources.

As a system, the PTWS have made great strides regarding understanding tsunami hazard and risk. Supported by the IOC, the PTWS have been able to hold multi-regional scientific expert meetings to better understand tsunami sources, hazards, risk and uncertainties associated with some of the Pacific's largest subduction zones. These meetings have increased international cooperation and collaboration, built relationships between sector professionals (e.g., scientists and emergency responders), raised awareness and successfully driven local changes to modelling and plans. The PTWS will continue to support the development of these workshops and seek engagement from IOC in this level of capacity building and brokering of knowledge.

Exercising continues to be a strength across the Pacific and at the Member State level. We need to ensure we use the Key Performance Indicator (KPI) assessments and exercise debriefs to full effect, by taking lessons identified and making useful adaptations to our systems and processes for response. This includes considering our consistency in performance with all IOC-ICG's. The current Global KPI Task Team of the Working Group on Tsunamis and Other Hazards Related to Sea-Level Warning and Mitigation Systems (TOWS-WG) is looking to address this by developing a Global Key Performance and Monitoring Framework which includes a streamlined reporting tool.

In country budgets for tsunami continue to be tight in many Member States across the Pacific. This has only been hampered by the Covid-19 Pandemic. As with previous years, the budget for the ICG/PTWS, provided by the governing body, IOC-UNESCO, and donated by Member States, is not adequate to support all critical ICG/PTWS activities. Appetite to build enduring relationships with international donor organizations/technical agencies such as the International Strategy for Disaster Reduction (ISDR), United Nations Development Programme (UNDP), Australian Agency for International Development (AusAID), New Zealand Agency for International Development (NZAid), United States Agency for International Development (USAid), Japan International Cooperation Agency (JICA), Swiss Agency for Development and Cooperation (SDC) or European Commission Humanitarian Aid department's Disaster Preparedness Programme (DIPECHO), to improve regional tsunami risk management and warning capability could be explored further. In addition, country-to-country capacity building can and should be further encouraged.

Reflecting on the impact of the Covid-19 pandemic may be useful for the PTWS. While it has slowed down some of our work programme progress, we can use the experience to better understand the communication of probabilities and risk.

For a more detailed summary of PTWS performance, please refer to the annual KPI Task Team Report presented at the PTWS Steering Committee.

### **2.3 Aligned Global Frameworks**

There are several existing Frameworks and Strategies that have been referred to in the development of this Strategy. They either relate to the core values of IOC's Global work, or have goals and aspirations related to ocean sciences, sustainability, or hazard risk management. As such, they will also be used to guide our work and delivery of this Strategy. A summary of these Frameworks is provided below.

***United Nations Ocean Decade of Ocean Science for Sustainable Development  
(2021–2030)***

*“Moving from the ocean we have to the ocean we want”*

Perhaps one of the most influential Strategies is the United Nations Decade of Ocean Science for Sustainable Development, ‘the Decade’ (Figure 5). On 5 December 2017, the United Nations proclaimed a Decade of Ocean Science for Sustainable Development to be held from 2021 to 2030. The Ocean Decade launched in January 2021 and provides a common framework to ensure that ocean science can fully support countries’ actions to sustainably manage the Oceans and more particularly to achieve the 2030 Agenda for Sustainable Development (Figure 3). It will provide a ‘once in a lifetime’ opportunity to create a new foundation, across the science-policy interface, to strengthen the management of our oceans and coasts for the benefit of humanity. Through stronger international cooperation (i.e., strengthening dialogues, developing partnerships and capacity building, and leveraging funds/investment), the Ocean Decade will bolster scientific research and innovative technologies to ensure science responds to the needs of society.

There are seven outcomes and nine challenges in the Ocean Decade. The outcome and challenge(s) related to tsunami are as follows:

**Outcome:** A safe ocean where life and livelihoods are protected from ocean-related hazards.

**Challenge(s):** Enhance multi-hazard early warning services for geophysical, ecological, biological, weather, climate and anthropogenic related ocean and coastal hazards and mainstream community preparedness and resilience.

In June 2021, IOC-UNESCO approved the Ocean Decade Tsunami Programme (ODTP) in response to the call to action by the Ocean Decade to reduce the uncertainty and warning time for the tsunami forecast and preparedness of coastal communities.

The first objective of the ODTP is to develop the warning systems’ capability to issue actionable and timely tsunami warnings for tsunamis from all identified precisely estimated sources to 100% of coasts at risk. Most urgently, the ODTP will provide tsunami confirmation within 10 minutes or less of origin for the most at-risk coastlines. This is challenging, as current warning systems depend upon quick detection and characterization of tsunamigenic earthquakes using only seismic sensors. This objective would require expanding existing monitoring systems and implementing further scientific and technological advances, and to also include non-seismic tsunami sources.

The second objective of the ODTP is that 100% of communities at risk be prepared and resilient to tsunamis by 2030 through programmes like the IOC-UNESCO Tsunami Ready Programme, which was approved by the IOC-UNESCO Executive Council in 2022. It embodies 12 Assessment, Preparedness and Response Indicators that support communities at risk to build capacities to effectively respond to warning and tsunami threats.

The Ocean Decade Tsunami Programme Research and Development Plan highlights how to achieve the objectives of the ODTP, through addressing the four pillars of Early Warning Systems described in the Early Warnings for All Action Plan (WMO, UN, COP 27, 2022): (i)

Tsunami Disaster Risk Knowledge; (ii) Detection, Monitoring, Analysis and Forecasting of the tsunami hazard and possible consequences; (iii) Warning Dissemination and Communication; and (iv) Preparedness and Response Capabilities. These four components are underpinned by Capacity Development, and Governance, including collaboration mechanisms, and Financing. A pathway towards implementation is also provided.



Figure 5. The Ocean Decade in 'a nutshell'.

### **Sendai Framework for Disaster Risk Reduction**

The SFDRR is a global framework that aims to achieve “substantial reduction of disaster risk and loss to life, livelihoods and health, and in the economic, physical, social, cultural and environmental assets of persons, businesses, communities and countries.” The SFDRR was adopted by 187 UN Member States (including many PTWS Member States) at the Third UN World Conference in Sendai, Japan, on 18 March 2015. These Member States are committed to the goals and actions of the SFDRR and agreed to report, nationally, on their progress in reducing overall disaster risk.

The SFDRR has seven global targets, A-G, (Figure 6) aimed at measuring progress against national, in-country targets and indicators that contribute to the achievement of its overall outcome and goal. Target G of the SFDRR aims to “Substantially increase the availability of and access to multi-hazard early warning systems and disaster risk information and assessments to the people by 2030”. Key components of Target G focus on improved detection, monitoring, analysis, and forecasting of hazards and possible consequences, and dissemination and communication, by an official source, of authoritative, timely, accurate, and

actionable alerts and associated information on likelihood and impact. This specifically relates to the IOC Tsunami Programme and ICGs' objectives. The IOC, through the Tsunami Programme and ICG, will contribute to the expected outcomes of the Sendai Framework (the substantial reduction of disaster risk and losses in lives, livelihoods, and health and in economic, physical, social, cultural, and environmental assets of persons, business, communities, and countries).

Alignment of the SFDRR with this Strategy will allow us to effectively monitor our progress and improve on our 'Future Goals and Performance Monitoring of Tsunami Risk Reduction, Hazard Warning, and Mitigation'. It also ensures international alignment with best practice tsunami risk management and assists with targeting resourcing for continued improvement.



Figure 6. The Seven Global Targets of the Sendai Framework for Disaster Risk Reduction

### **IOC Strategy – A Framework for Global Tsunami and Other Ocean Hazards Warning and Mitigation Systems**

The Framework for Global Tsunami and Other Ocean Hazards Warning and Mitigation Systems supports ICGs and their Member States to assess tsunami risk, implement Tsunami Early Warning Systems (TEWS) and educate communities at risk of tsunami. The PTWS is therefore an important component of the TOWS-WG. The PTWS reflects the key principles of the Framework for the Global Tsunami and other Ocean Hazards Warning and Mitigation Systems in this Strategy:

- Identifying warning and mitigation system requirements unique to the Pacific Ocean basin.
- Capitalizing, to the extent practicable, on existing international groups with relevant responsibilities such as Global Sea Level Observing System (GLOSS), Joint WMO-IOC Collaborative Board (JCB), Federation of Digital Seismograph Networks (FDSN) and the Comprehensive Nuclear Test-Ban Treaty Organisation (CTBTO) and the International Union of Geodesy and Geophysics (IUGG) Joint Tsunami Commission.

- Harmonising structure, standards, and practices among ICGs.
- Integrating with other international systems and organizations such as International Hydrographic Organization (IHO), particularly its Regional Hydrographic Commissions (SEPHC; SWPHC, MACHC and EAHC), World Meteorological Organization (WMO) and United Nations Office for Disaster Risk Reduction (UNDRR).
- Collaborate on research and development across ICGs.

### **3. GUIDING PRINCIPLES**

The implementation of the Strategy will be guided by the following principles. They are designed to inform our culture, be participative and inclusive, and guide the performance of the PTWS:

#### ***International Cooperation***

Cooperation between all PTWS Member States, with our equivalent systems in other oceans, and with other relevant international structures, is crucial to building and operating a meaningful PTWS. We must strive for continued, close cooperation between science and emergency management communities to continually improve across all aspects of tsunami warning and mitigation. Sharing in this manner allows us to work together to achieve our common goal in tsunami risk management.

#### ***Participation***

The PTWS strives for an inclusive, engaging, and supportive relationship with all its Member States. The PTWS is a community in which we work through challenges together, co-design and make decisions together, and implement solutions together.

#### ***Coherence***

The PTWS is part of a global disaster risk reduction framework and as such our work needs to be coherent with global priorities. This is an important principle for ensuring our system stays current and relevant in its practices, and strong in its relationships. It is therefore important that all work completed under the PTWS is done so in consideration of other global targets and priorities (for example, the SFRDD).

#### ***Progressive and innovative***

With new science and experiences comes the opportunity to examine the way we operate and strive for the best system. Welcoming new ideas, having an open mind to research and approaches will keep the PTWS at the forefront of tsunami risk management.

#### ***Knowledge and data driven***

Staying informed of new and emerging science and research will result in a data driven, hazard and risk informed, responsive PTWS. Assessment of research is essential to ensure its relevance and suitability for the system. Each Member State must be able to understand its risk and know ways in which they can mitigate the hazard, provide warning to its populations in a timely manner, and be able to carry out awareness and preparedness activities to sustain knowledge and ability-to-respond across generations.

#### ***Interoperable***

A coherent PTWS requires all Member States' end-to-end tsunami warning systems to be interoperable with systems of other PTWS Member States and with TSPs. This ensures full and open access, to tsunami-relevant observational data, analysis, advisory, and warning information, operational techniques, procedures, and technologies, and best practices. Our systems must also be interoperable with other ocean hazards warning and mitigation systems to use and share data, analyses, and awareness and preparedness, and other common elements of such systems.

### ***Capable***

Substantial experience, knowledge, and best practices have been accumulated over the years by the PTWS and its Member States. Improved capability in our readiness and response comes from sharing this information and completing regular, relevant exercises and training. Exercises, training courses and national, cross-sector and inter-regional workshops are excellent ways in which to build skill sets and at the same time, support networking between countries.

### ***Thriving***

The growth of the PTWS requires funding to be viable and evolve to meet new needs and incorporate new technologies. There is a need for renewed Member State commitment to invest in national tsunami warning and mitigation systems and to contribute—in whatever way possible—to the operation of the PTWS. In addition, there is a need to engage donor agencies and organizations to support all elements of the end-to-end tsunami warning and mitigation system in the Pacific Ocean. Implementing this Strategy will require additional investment from within and outside the PTWS Member States.

## 4. ACHIEVING OUR GOAL

### 4.1 Strategic Objectives

To achieve our vision, we have developed four Strategic Objectives. The ICG/PTWS and its Member States will take ownership of the activities developed within the Objectives.

#### **Objective 1: Understanding and Managing Tsunami Hazard Risk**

All ICG/PTWS Member States should understand their tsunami risk, relevant to all the potential tsunami sources, in all its dimensions including vulnerability, exposure of persons and assets, the many possible and/or likely tsunami hazard scenario and their characteristics, event frequency, uncertainties, and associated consequences. Such knowledge should be translated into prevention, mitigation, preparedness, and response planning activities. This involves the following elements:

- Tsunami hazard modelling
- Tsunami hazard risk assessment
- Tsunami risk reduction
- Response
- Immediate recovery/scientific and technical advice to support recovery (if required)

The PTWS will support Member States to deliver on and implement the above by:

#### *Tsunami hazard modelling:*

- I. Development of a methodology and supporting guidance for the designation and mapping of tsunami inundation and evacuation zones, including bespoke methodologies for Atolls and Small Island States.
- II. Implementation and designation of tsunami evacuation zones.

#### *Tsunami hazard risk assessment:*

- I. Development of a methodology for tsunami hazard risk assessments including multi-scenario, location-based risk assessment of tsunami hazard characteristics vulnerability, exposure, likelihood, and consequences.
- II. Conduct and periodically review tsunami hazard risk assessments.
- III. Strengthening technical and scientific capability in the Pacific to support locally informed risk assessments.
- IV. Strengthening technical and scientific information to inform and build on existing knowledge and identify gaps.

#### *Tsunami Risk Reduction:*

- I. Identify and plan for ways to reduce tsunami risk in the short, medium, and long term, including, for example, through the development of measures such as land use, maritime planning, critical facilities/infrastructure, and structural standards.

*Response:*

- I. Development of national and local tsunami response plans.
- II. Undertaking post event analysis by evaluating, recording, and integrating tsunami related impacts and losses into assessments to improve knowledge of tsunami hazard frequency and impacts.
- III. Developing, managing, and functioning Emergency Operation Centres (EOC's).

*Immediate recovery and science advice for recovery (if required):*

- I. The roles and responsibilities of the TEWs naturally stops once evacuation occurs and in-country civil protection/emergency management authorities take over. We do, however, wish to acknowledge that cooperation and sharing are key principles of the PTWS, notably in the sharing of scientific information and advice. Should this advice or cooperation be required during the immediate recovery phase, following tsunami response, the PTWS will look to support this where possible.

**Objective 2: Tsunami Detection, Measurement, Warning & Dissemination**

Effective tsunami warning depends on rapid detection and assessment of an earthquake or other potentially tsunamigenic event, verification that a tsunami has been generated, forecasting of wave propagation and the likely threatened areas, and dissemination to the “last mile” information about the threat to enable communities to respond quickly and effectively. As such, All ICG/PTWS Member States should receive and generate timely, accurate, reliable, and effective warnings for tsunami sources. This involves the following elements:

- Monitoring and Detection Networks
- National Warning Systems
- Ocean-wide and regional tsunami warning systems
- Tsunami alerts and warnings

The PTWS will support Member States including TSPs with regards to the above elements in:

*Monitoring and Detection Networks:*

- I. Making seismic (real-time) and other observational seismic data needed from seismic monitoring networks for rapid tsunami source detection and evaluation, available freely, accurately, and timely to TSPs and NTWCs.
- II. Making sea level (real-time) and other observational data needed for rapid confirmation, characterization, and monitoring of tsunami waves available freely, accurately, and timely to TSPs and NTWCs from monitoring networks.

*National Warning Systems:*

- I. Investing in, developing, and maintaining tsunami hazard, multi-sectoral forecasting, and early warning systems.

- II. Receiving tsunami threat information from Tsunami Warning Focal Points (TWFPs) from TSPs for each Member State with coastal communities at risk.
- III. Performing analyses to rapidly detect and then accurately characterize potential tsunami sources.
- IV. Developing national 24/7 capability to receive tsunami threat information from TSPs and generate tsunami warnings and issue tsunami warnings to coastal communities at risk.

*Tsunami alerts and warnings:*

- I. Establishing multiple and redundant channels to receive tsunami warnings.
- II. Developing and investing in public alerting systems.

*Ocean-wide and regional tsunami warning systems:*

- I. Maintaining the present service level of TSPs for ocean-wide and regional tsunami warning.
- II. Improving methods for rapid detection of tsunamis and tsunami impact forecast.
- III. Making efforts for enhancement of TSPs' products.

**Objective 3: Enhancing tsunami preparedness for effective community response**

Science and research post disaster events has shown that knowing the warning signs of possible tsunami event and the right action to take can save lives, and in some instances, property, infrastructure, and agriculture. All ICG/PTWS Member States will implement tsunami preparedness and awareness activities and conduct strong public education programmes, for more effective response and recovery to tsunami events.

The Strategy promotes targeted, evidence-based public education campaigns, tools, and resources, that are developed and suitable for the wide and varying audiences across the Pacific and within Member State jurisdictions. Public education should be flexible and adaptable, with the ability to be promoted across various education sources. World Tsunami Awareness Day (WTAD) and national memorial days are important instruments. The PTWS will support Member States with regards to the above elements in public education by developing, promoting, and using national public education strategies and campaigns.

Community awareness and preparedness is aligned with public education. This includes the development, use and translation of community response tools and testing these with at risk communities. This is essential for effective response to tsunami threats. Tsunami exercises increase tsunami awareness and preparedness.

The PTWS will ensure Member States are supported to:

- I. Develop and establish tsunami evacuation zones, signs, routes, procedures, and maps in conjunction with community engagement.

- II. Conduct regular tsunami evacuation drills and exercises using a multi-stakeholder approach at all levels.

#### **Objective 4: International Coordination and Cooperation and Partnerships**

Like many challenges in the global hazard risk management space, the management of tsunami risk requires international cooperation and participation. This does not just extend to how countries work together in response to an event, but for example, the sharing of science, data, and knowledge to improve how we respond, prior to an event. It is rare a large tsunami in the Pacific will only effect one country—what is a local threat for some will be a distant threat to others. How we build relationships and partnerships in ‘peace time’ strengthens how we work together in response and recovery.

This Objective spans all the work we do to deliver on this Strategy, and by working together we can achieve great things, such as the development of new technologies, to make the Pacific Ocean a safer place.

The Ocean Decade and Sendai Framework (SFDRR) also promote international cooperation via global monitoring and analysis, implementation of the framework and where appropriate, financial support and aid.

Aligning with UNDRR and the IOC Tsunami Programme, the PTWS and all its Member States will work together to detect tsunami threat, reduce risk, and build capacity and capability to respond.

The PTWS will support Member States to achieve the above through enhancing capacity and capabilities to respond to a tsunami threat.

#### **4.2 How we will achieve the Objectives**

While honouring our guiding principles, this Strategy will support and enable activities that involve, collaborate, and empower us to reduce risk from and build resilience to tsunami hazard in the Pacific. Alongside our functional and regional Working Groups, the International Tsunami Information Center (ITIC) is a key enabler in this regard.

Activities may include, but are not limited to:

- Enhancing community ‘buy-in’ and participation by providing them with the ability to engage in policy, planning, and practice for tsunami hazard and risk.
- Improving the accuracy and certainty of tsunami impact forecasts.
- Improving community preparedness and effective community engagement.
- Reducing the impacts to critical infrastructure, marine assets must be in place to enable quicker post-tsunami restoration of services.
- Improving our understanding of the hazard by expanding our knowledge of past or potential tsunami sources.
- Identifying critical tsunami generation parameters through the optimal use and real-time sharing of new and existing sensors and data.

- Developing new, rapid tsunami source characterization techniques to leverage new data sources, such as the GNSS ground station network.
- Endorsing new technologies, specifically those that allow for rapid detection and measurement of tsunamis directly, through ocean observations including instrumentation of undersea telecommunications cables.
- Ensuring 100% of tsunami-vulnerable communities in the Pacific meet the indicators of the IOC-UNESCO Tsunami Ready programme; and
- Partnering with the Seabed 2030 hydrographic survey initiative to ensure nearshore coastal zones have complete bathymetric/topographic data coverage.

### **4.3 Role of Member States**

Member States including their TSPs are expected to align their activities with this strategy and contribute to the fulfilment of its objectives, to improve tsunami risk management in their coastal communities.

## **5. MONITORING OUR PROGRESS**

Monitoring the performance of the PTWS against this Strategy is critical to ensure we are progressing toward our Vision; we are held accountable and can identify gaps and opportunities.

Since 2015, IOC-ICGs have been requested to monitor their performance against targets of the SFDRR. This will be completed using the PTWS Key Performance Monitoring and Assessment framework: 'Future Goals and Performance Monitoring for Tsunami Risk Reduction, Warning and Mitigation'. KPIs will relate to the Objectives of this Strategy.

Measuring progress will rely on the annual assessment of ICG/PTWS Working Groups, Task Teams and Member State contributions and participation. Our capacity as a collective and individual Member States will be dependent on our resources and abilities. These can be identified via annual review.

ANNEX

**LIST OF ACRONYMS**

<b>AusAid</b>	Australian Agency for International Development
<b>CATAC</b>	Central America Tsunami Advisory Centre
<b>CoP</b>	Conference of the Parties
<b>CTBTO</b>	Comprehensive Nuclear Test-Ban Treaty Organisation
<b>DART</b>	Deep-ocean Assessment and Reporting of Tsunami
<b>DIPECHO</b>	European Commission Humanitarian Aid Department's Disaster Preparedness Programme
<b>EAHC</b>	East Asia Hydrographic Commission
<b>EOCs</b>	Emergency Operation Centres
<b>FDSN</b>	Federation of Digital Seismograph Networks
<b>GLOSS</b>	Global Sea Level Observing System
<b>GNSS</b>	Global Navigation Satellite System
<b>ICG/PTWS</b>	Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System
<b>ICG</b>	Intergovernmental Coordination Group
<b>IHO</b>	International Hydrographic Organization
<b>IOC</b>	Intergovernmental Oceanographic Commission of UNESCO
<b>ISDR</b>	International Strategy for Disaster Reduction
<b>ITIC</b>	International Tsunami Information Center
<b>IUGG</b>	International Union of Geodesy and Geophysics
<b>JCB</b>	Joint WMO-IOC Collaborative Board
<b>JICA</b>	Japan International Cooperation Agency
<b>KPIs</b>	Key Performance Indicators
<b>MACHC</b>	Meso American and Caribbean Hydrographic Commission
<b>NTWC</b>	National Tsunami Warning Centres
<b>NWPTAC</b>	Northwest Pacific Tsunami Advisory Centre
<b>NZAid</b>	New Zealand Agency for International Development
<b>ODTP</b>	Ocean Decade Tsunami Programme

<b>PTWC</b>	Pacific Tsunami Warning Center
<b>SCSTAC</b>	South China Sea Tsunami Advisory Center
<b>SDC</b>	Swiss Agency for Development and Cooperation
<b>SEPHC</b>	South-East Pacific Hydrographic Commission
<b>SFDRR</b>	Sendai Framework for Disaster Risk Reduction
<b>SWPHC</b>	South-West Pacific Hydrographic Commission
<b>TEWS</b>	Tsunami Early Warning Systems
<b>TOWS-WG</b>	IOC Working Group on Tsunamis and Other Hazards Related to Sea-Level Warning and Mitigation Systems
<b>TSP</b>	Tsunami Service Provider
<b>TT DMP</b>	TOWS-WG Task Team on Disaster Management and Preparedness
<b>TWFP</b>	Tsunami Warning Focal Point
<b>UN</b>	United Nations
<b>UNDP</b>	United Nations Development Programme
<b>UNDRR</b>	United Nations Office for Disaster Risk Reduction
<b>UNESCO</b>	United Nations Educational, Scientific and Cultural Organization
<b>WMO</b>	World Meteorological Organization
<b>WTAD</b>	World Tsunami Awareness Day

**IOC Technical Series**

<b>No.</b>	<b>Title</b>	<b>Languages</b>
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)
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8	IGOSS (Integrated Global Ocean Station System) - General Plan Implementation Programme for Phase I. 1971	(out of stock)
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13	International Decade of Ocean Exploration (IDOE), 1971-1980. 1974	(out of stock)
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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
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19	Bruun Memorial Lectures - The Importance and Application of Satellite and Remotely Sensed Data to Oceanography. 1977	(out of stock)
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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

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36	Bruun Memorial Lectures 1989: Impact of New Technology on Marine Scientific Research. 1991	Composite E, F, S
37	Tsunami Glossary - A Glossary of Terms and Acronyms Used in the Tsunami Literature. 1991	E only
38	The Oceans and Climate: A Guide to Present Needs. 1991	E only
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88.	Exercise Indian Ocean Wave 2009 (IOWave09) – An Indian Ocean-wide Tsunami Warning and Communication Exercise – 14 October 2009. 2009	E only
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90.	12 January 2010 Haiti Earthquake and Tsunami Event Post-Event Assessment of CARIBE EWS Performance. 2010	E only
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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 / Exercice 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
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	Vol. 3 Supplement: Media Reports. 2011	E/F/S
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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
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101.	Exercise Caribe Wave/Lantex 13. A Caribbean Tsunami Warning Exercise, 20 March 2013.	E only
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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
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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)

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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
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121.	Exercise Indian Ocean Wave 14, an Indian Ocean wide Tsunami Warning and Communications Exercise, 9–10 September 2014	<i>In preparation</i>
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

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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
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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
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176.	State-of-the-Art of Ocean Literacy. 2022	E only
177.	<i>Marine Spatial Planning and The Blue Economy in Kenya</i>	In preparation
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.	E only