Intergovernmental Oceanographic Commission
Technical Series
181

EXERCISE INDIAN OCEAN WAVE 23

An Indian Ocean-wide Tsunami Warning and Communications Exercise

4–25 October 2023

Volume 1 Exercise Manual

UNESCO

Intergovernmental Oceanographic Commission
Technical Series
181

EXERCISE INDIAN OCEAN WAVE 23

An Indian Ocean-wide Tsunami Warning and Communications Exercise

4–25 October 2023

Volume 1 Exercise Manual

UNESCO 2023

IOC Technical Series, 181 Vol.1
Perth, July 2023
English only

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

UNESCO/IOC. 2023. *Exercise Indian Ocean Wave 2023: An Indian Ocean-wide Tsunami Warning and Communication Exercise*, *4–25 October 2023. Volume 1: Exercise Manual*. Perth, UNESCO, IOC Technical Series No.181, Vol. 1.

This volume has four supplements:

— Supplement 1: TSP Bulletins for Scenario 1 Andaman Trench
— Supplement 2: TSP Bulletins for Scenario 2 Makran Trench
— Supplement 3: TSP Bulletins for Scenario 3 Heard Island Volcano
— Supplement 4: TSP Bulletins for Scenario 4 Java Trench

IOWave23

Scenario 1, Andaman Trench 4 October 2023 (Wednesday)	Scenario 2, Makran Trench 13 October 2023 (Wednesday)
Scenario 3 Heard Island Vol. 18 October 2023 (Wednesday)	Scenario 4, Java Trench 25 October 2023 (Wednesday)

IOWave23 online evaluation survey should be completed by 30 November 2023.

Further information on Exercise IOWave23 is available at the exercise website: https://oceanexpert.org/event/3916

This document was prepared by the Exercise IOWave23 Task Team for the Intergovernmental Coordination Group for the Indian Ocean Tsunami Warning and Mitigation System.

(IOC/2023/TS/181Vol.1)

TABLE OF CONTENTS

page

1. INTRODUCTION

The Indian Ocean Tsunami Wave Exercise 2023 (IOWave23) Exercise Manual provides further guidance on the exercise. The manual supplements comprise a full set of TSP exercise bulletins and products corresponding to the four scenarios of Andaman Trench (Supplement 1), Makran Trench (Supplement 2), Heard Island Volcano (Supplement 3), and Java Trench (Supplement 4).

2. BACKGROUND

The devastating impact of the 26 December 2004 Indonesia earthquake and Indian Ocean Tsunami (IOT) tragically demonstrated what could happen without an effective tsunami warning system. Tsunamis may not occur often, but when they do, they can affect entire coasts, sometimes across an entire ocean. The 2004 IOT caused damage and casualties across most of the Indian Ocean basin, even as far away as South Africa. Following this event, UNESCO's Intergovernmental Oceanographic Commission (IOC) was requested to establish an Intergovernmental Coordination Group for the Indian Ocean Tsunami Warning and Mitigation System (ICG/IOTWMS), to promote the exchange of seismic and sea level data for rapid tsunami detection and analysis, to provide warnings for such events, and to coordinate mitigation efforts among its Member States. An efficient and effective end-to-end warning system was needed, ready to react 24 hours a day to any potential tsunami threat, alert the at-risk coastal communities, and motivate them to take immediate and appropriate steps to save their lives.

In 2005 with the support the Government of Japan and the Government of the United States of America (USA), an Interim Advisory Service (IAS) was implemented based on the UNESCO-IOC Pacific Tsunami Warning System (PTWS). The Japan Meteorological Agency (Japan) and the Pacific Tsunami Warning Centre (USA) provided tsunami threat information to National Tsunami Warning Centres (NTWCs) established across the Indian Ocean under the guidance of the UNESCO-IOC ICG/IOTWMS. Under the further guidance of the ICG/IOTWMS, Member States collaborated in the development of an independent service supporting the IOTWMS. The IOTWMS is now a system of systems with each NTWC of the active Member States issuing tsunami warnings to their respective communities based on the tsunami threat information provided by the three Tsunami Service Providers (TSPs) operated by Australia, India, and Indonesia (UNESCO/IOC 2019a; UNESCO/IOC in preparation). The independent end-to-end tsunami warning system was initially tested in the Indian Ocean-wide tsunami warning exercise IOWave09 (October 2009; UNESCO/IOC 2009b) and came into operation immediately following IOWave11 (October 2011; UNESCO/IOC 2011). The ICG/IOTWMS subsequently conducted ocean-wide exercises IOWave14 (September 2014; UNESCO/IOC 2014), IOWave16 (September 2016; UNESCO/IOC 2017b), IOWave18 (September 2018; UNESCO/IOC 2019b), and IOWave20 (October 2020; UNESCO/IOC 2022b).[1]

The exercises have been designed to test the receipt and dissemination of tsunami notifications along national tsunami warning chains, as well as test appropriate responses aligned with pre-established Standard Operating Procedures (SOPs) (UNESCO/IOC 2017a). Throughout the IOWave Exercises, the engagement of coastal communities in tsunami education campaigns, preparedness measures, and evacuation drills has grown. Moreover, awareness and adoption of the UNESCO-IOC Tsunami Ready Recognition Programme (TRRP) guidelines (UNESCO/IOC 2022a) have increased.

Key milestones in exercise participation were achieved during IOWave16, where over 60,000 people participated in evacuation drills, and subsequently during IOWave18 where the number of participants exceeded 119,000. Most community evacuations were conducted in India, and

[1] The reports of previous IOWave exercises are available at https://bit.ly/IOWaveReports.

also in Australia, Comoros, Indonesia, Iran, Kenya, Mauritius, Oman, Pakistan, Seychelles, Sri Lanka, Tanzania, Thailand, and Timor Leste where at least some at-risk coastal communities were involved in one or both exercises.

During IOWave20 held during the Covid-19 pandemic, Member States were encouraged to mainly focus on testing communications protocols and conduct virtual tabletop exercises (as a minimum) to assess organisational Standard Operating Procedures (SOPs), plans, and policies for tsunami warning and emergency response. Guidelines for tsunami response during the Covid-19 pandemic were published by UNESCO-IOC and the ICG/IOTWMS IOWave20 Task Team encouraged Member States to update and test their SOPs for a pandemic situation.

Indian Ocean-wide tsunami exercises are effective tools for evaluating the readiness of the IOTWMS and for identifying changes that can improve its effectiveness at the regional and national level. The 13th Session of the ICG/IOTWMS (ICG/IOTWMS-XIII), held from 28 November to 1 December 2022 in Bali, Indonesia, established a Task Team to organise the next Indian Ocean-wide tsunami exercise (IOWave23) in the second half of 2023 and encouraged maximum participation from all Member States, where possible down to community level.

Exercise IOWave23 as outlined in UNESCO-IOC Circular Letter 2945 will simulate Indian Ocean countries being put in a tsunami warning situation and require National Tsunami Warning Centres (NTWCs) and the National and/or Provincial and/or Local Disaster Management Offices (NDMO/PDMO/LDMO) and other relevant authorities in each country to activate their SOPs.

The occurrence of non-seismic and complex source tsunamis (e.g., 2018 Sulawesi, Indonesia; 2018 Anak Krakatau, Indonesia; 2022 Hunga Tonga–Hunga Ha‘apai, Tonga), have served as a reminder that not all tsunamis are generated by undersea subduction earthquakes. For the first time, the IOWave exercise will test the response to a tsunami generated by a non-seismic tsunami source with new threat information products developed by the TSP operated by Australia. Specifically, scenario 3 will simulate a volcanic eruption in the Southern Ocean resulting in a regional tsunami event.

At-risk coastal communities are increasing their preparedness for, and resilience to tsunamis though the UNESCO-IOC TRRP. Exercise IOWave23 provides an opportunity for communities to evaluate their tsunami readiness against the twelve (12) TRRP indicators addressing milestones in tsunami assessment, preparedness, and response.

2.1 NON-SEISMIC AND COMPLEX SOURCE TSUNAMIS

After the destructive tsunamis in Greenland in 2017, Indonesia (Palu and Anak Krakatau separate events) in 2018, and Tonga 2022 that were generated by landslides, volcanic eruptions and earthquakes outside subduction zones, the UNESCO-IOC Working Group on Tsunamis and Other hazards related to sea level Warning and mitigation Systems (TOWS-WG) identified the need to expand the capability of tsunami warning systems (up until now focused on tsunamis generated by subduction zone earthquakes) to cover tsunami events generated by non-seismic and complex sources. Such tsunamis have made up 13% of the world’s confirmed tsunamis. Non-seismic and complex sources of tsunamis include sources, such as underwater volcanic explosions, volcanic pyroclastic flows and large-scale flank collapses, subaerial and underwater landslides, and tsunamis triggered by atmospheric perturbations (meteotsunamis). The TOWS-WG has established *ad hoc* task teams to develop best practices in dealing with such events.

Some Member States, such as Indonesia, have begun implementing dedicated national sea level monitoring and tsunami warning systems with SOPs for warning against such events, particularly in the near-field. The TSP operated by Australia has also developed tsunami threat information services for tsunamis generated by distant non-seismic and complex sources. Member States of the ICG/IOTWMS will be able to test these new TSP services in Exercise IOWave23, with a scenario dedicated to a tsunami generated by an active volcano in the Southern Ocean.

2.2 UNESCO-IOC TSUNAMI READY RECOGNITION PROGRAMME (TRRP)

Exercise IOWave23 will provide an opportunity for Member States to test levels of preparedness against the indicators of the UNESCO-IOC TRRP in communities. The twelve (12) TRRP Indicators are described in Table 1.

The UNESCO-IOC TRRP is a community performance-based programme that facilitates tsunami preparedness as an active collaboration of the public (community), community leaders, and national and local emergency management agencies. The main objectives of this programme are to improve coastal community preparedness for tsunami emergencies, to minimise the loss of life and property, and to ensure a structural and systematic approach in building community preparedness. This can be achieved and enhanced by bringing the ownership of preparedness to the community. This programme is implemented on a voluntary basis and entails a bottom-up process where the community takes the initiative to build their own capacity. Through this approach, it is expected that the programme will ensure ownership that leads to sustainability in the community. This programme provides a structured and systematic approach to community tsunami preparedness through fulfilling the set of best-practice indicators.

TSUNAMI READY INDICATORS	
I	**ASSESSMENT (ASSESS)**
1	**ASSESS-1**. Tsunami hazard zones are mapped and designated.
2	**ASSESS-2**. The number of people at risk in the tsunami hazard zone is estimated.
3	**ASSESS-3**. Economic, infrastructural, political, and social resources are identified.
II	**PREPAREDNESS (PREP)**
4	**PREP-1**. Easily understood tsunami evacuation maps are approved.
5	**PREP-2**. Tsunami information including signage is publicly displayed.
6	**PREP-3**. Outreach and public awareness and education resources are available and distributed.
7	**PREP-4**. Outreach or educational activities are held at least 3 times a year.
8	**PREP-5**. A community tsunami exercise is conducted at least every 2 years.
III	**RESPONSE (RESP)**
9	**RESP-1**. A community tsunami emergency response plan is approved.
10	**RESP-2**. The capacity to manage emergency response operations during a tsunami is in place.
11	**RESP-3**. Redundant and reliable means to timely receive 24-hour official tsunami alerts are in place.
12	**RESP-4**. Redundant and reliable means to timely disseminate 24-hour official tsunami alerts to the public are in place.

Table 1. UNESCO TSUNAMI Ready Recognition Programme (TRRP) Indicators.

2.3 UN EARLY WARNINGS FOR ALL INITIATIVE (EW4ALL)

On 8 November 2022, during the Twenty-seventh Session of the Conference of the Parties (COP27) to the United Nations Framework Convention on Climate Change (UNFCCC), the UN Secretary-General launched the Executive Action Plan on Early Warnings for All (EW4ALL) 2023–2027, which is aimed at ensuring that everyone on the planet is protected by early warning systems by 2027. Achieving this objective is critical in the Indian Ocean, one of the world's most populous and disaster-affected regions.

In a similar vein, the theme of World Tsunami Awareness day (WTAD) in 2023 will mirror the theme of the International Day of Disaster Reduction (IDDR): fighting inequality for a resilient future. Activities should explore the reciprocal relationship between tsunamis and inequality: how inequality makes tsunamis more dangerous for certain populations and how the aftermath of a tsunami can drive vulnerable people further into poverty and exacerbate inequality. WTAD 2023 activities will focus on raising awareness about the underlying disaster risk drivers – poverty, inequality, and vulnerability – that make tsunamis more deadly for those most at risk.

Exercise IOWave23 provides a wonderful opportunity for Member States to support all these initiatives by testing and ensuring procedures are in place for national tsunami warnings to reach all in their at-risk communities, i.e., including those with disabilities, the aged and youth, and regardless of gender

3. CONCEPT OF EXERCISE IOWAVE23

3.1 PURPOSE

The purpose of Exercise IOWave23 is to evaluate and improve the effectiveness of the IOTWMS, through its operational TSPs, NTWCs, NDMOs, LDMOs and other relevant authorities in responding to a potentially destructive tsunami. The exercise will provide an opportunity for Indian Ocean countries to test their operational lines of communications, to review their tsunami warning and emergency response SOPs, and to promote emergency and community preparedness. Regular exercises are important for maintaining staff readiness for real events. This is especially true for tsunamis, which are infrequent but require rapid response when they occur. The pre-exercise planning and post-exercise evaluation process is as important as the actual exercise because they bring all stakeholders to closely coordinate their actions. Every Indian Ocean country is encouraged to participate, down to the community level wherever possible.

3.2 OBJECTIVES

The objectives for Exercise IOWave23 are to validate:

1. Procedures in place to ensure tsunami warnings get to all in the community, including those with disabilities, all genders, elderly, and youth.

2. Level of community awareness, preparedness, and response.

3. SOPs within countries for generating and disseminating tsunami warnings to their relevant emergency response agencies, media, and the public.

4. SOPs within countries for the issuing of public safety messages, ordering evacuations and where possible issuing all-clear messages.

5. Dissemination by TSPs of Tsunami Bulletin Notification Messages to NTWCs via Tsunami Warning Focal Points (TWFPs) of Indian Ocean countries and the reception by NTWCs of the TSP messages.

6. Access by NTWCs to the tsunami bulletins and other products on the TSP websites, and the use of that information to produce national warnings.

7. Reporting by NTWCs to the TSPs of their National Tsunami Warning Status.

8. Receipt and understanding by NTWCs of new TSP service for tsunamis generated by non-seismic and complex sources.

Within the above framework, each country should develop its own specific objectives for the exercise.

3.3 EXERCISE DATES AND SCENARIOS

Exercise IOWave23 includes four tsunami scenarios held over a three-week period during 4 to 25 October 2023 with all scenarios run in real-time. The scenario details are provided in Table 2.

3.4 EXERCISE INVOLVEMENT

The following organisations should ideally be involved in the exercise:

- Tsunami Service Providers (TSPs),
- National Tsunami Warning Centres (NTWCs),
- National Disaster Management Organisations (NDMOs),
- Local Disaster Management Organisations (LDMOs),
- Media Organisations, and
- Local communities, to the extent decided by each Member State.

• Scenario	1. Andaman Trench	2. Makran Trench	3. Heard Island Volcano	4. Java Trench
Date	4 October 2023 (Wednesday)	11 October 2023 (Wednesday)	18 October 2023 (Wednesday)	25 October 2023 (Wednesday)
Time	04:00 UTC	06:00 UTC	06:00 UTC	02:00 UTC
Magnitude	~M9	~M9	n/a	~M9
Depth	10 km	10 km	n/a	10 km
Latitude	7.20N	24.80N	53.10S	10.40S
Longitude	92.90E	58.20E	73.52E	112.80E
Location	Off west coast of Nicobar Islands, India	North-West Indian Ocean	Kerguelen Islands Region, Southern Ocean	South of Java, Indonesia

Table 2. Scenario Details

3.5 MILESTONES FOR MEMBER STATES

Key milestones for Member State participation in Exercise IOWave23 are provided in the checklist in Table 3. The checklist is intended to serve only as a broad reference and is not all-inclusive.

No	Activity	Timeline
1	Announcement by IOC Circular Letter 2945	May 2023
2	Set up IOWave23 Exercise National Coordination Committee involving NTWC, LDMOs, NDMOs, and all other important stakeholders including private industry participants.	May 2023
3	Decide on level of participation and identify communities for evacuation (where applicable).	May 2023
4	Assign agency roles including exercise controller, key participants, and observers.	May 2023
5	Nominate a National Contact for IOWave23.	May 2023
6	Issue of IOWave23 Exercise Manual by the Secretariat.	July 2023
7	Secure funding and support for community activities.	Ongoing
8	Develop a National IOWave23 Exercise Manual to plan/guide activities, including those at community level.	July 2020
9	Address indicators of UNESCO-IOC Tsunami Ready Recognition Programme or similar national initiative (where appropriate).	Ongoing
10	Share IOWave23 Exercise in-country participation plans with the ICG/IOTWMS Secretariat.	July 2023
11	UNESCO-IOC Standard Operating Procedure (SOP) Training Workshops (regionally online and nationally face-to-face).	July and August 2023
12	Organise and hold pre-exercise national workshop(s) and meeting(s) with key stakeholders including media.	July – September 2023
13	Ensure SOPs are in place and up to date.	August – September 2023
14	Prepare and issue a media press release.	One week before the exercise
15	Participate in IOWave23 Exercise.	4 / 11 / 18 / 25 Oct. 2020
16	Hold post-exercise hot and cold debriefs.	After the Exercise
17	Complete the IOWave23 online post-exercise evaluation.	November 2023
18	Revise and improve SOPs in accordance with lessons learnt during the Exercise.	After the Exercise
19	IOC-UNESCO Post-IOWave23 Exercise Lessons Learnt Workshop (online).	November 2023

Table 3. Checklist of activities to enable Member States' preparation and participation in Exercise IOWave23.

3.6 EXERCISE SUCCESS CRITERIA

The exercise will be a success when the core objectives above have been exercised, performance evaluated, and an exercise report produced. The broad success criteria, depending on the level of involvement of each country, are:

- The communication protocols between the TSPs, NTWCs, TWFPs and information dissemination points within countries are tested and understood.

- Areas of improvement in the tsunami warning and response chain are identified.
- Local communities and organisations participate in the exercise (to the extent possible) and increase their knowledge of tsunami preparedness and response.

3.7 TYPES OF EXERCISE

Exercises stimulate the development, training, testing and evaluation of Disaster Plans and SOPs. Exercise participants may use their own past multi-hazard drills (e.g., flood, typhoon, earthquake, etc.) as a framework to conduct Exercise IOWave23.

At a minimum, Exercise IOWave23 should be conducted to a level of readiness that involves communication and decision making at government level, without disrupting or alarming the public. Individual countries are particularly encouraged to maximise the extent of their participation, and where possible, to include public notification and community evacuation.

Exercises can be conducted at various scales of magnitude and sophistication. The types of exercises that can be conducted are:

1. Orientation Exercise
2. Drill
3. Tabletop Exercise
4. Functional Exercise, and
5. Full-scale Exercise.

See Annex II for a more detailed description of each type of exercise.

For Exercise IOWave23, individual Member States should decide what type of exercise they are going to undertake, and whether they will participate in one or multiple scenarios. Participation in multiple scenarios, at least at the NTWC and DMO level, has the advantage of allowing SOP issues identified on the first day to be corrected and exercised again on the subsequent day, and testing different elements of the SOPs because the tsunami arrival times will vary for each scenario.

Member States are encouraged to conduct a functional or full-scale exercise down to community level. Functional or full-scale exercises require an increasing level of planning and preparation, particularly when involving community evacuation. Due care should be taken not to inadvertently alarm the public. If a functional or full-scale exercise is not possible, it is recommended that a tabletop exercise should be conducted as a minimum involving key national stakeholders with an objective to assess organisational SOPs, plans and policies for tsunami warning and emergency response in the backdrop of a pandemic.

3.8 FURTHER INFORMATION

Further detailed information on Exercise IOWave23 is available at the exercise website https://oceanexpert.org/event/3916 and on the UNESCO-IOC Indian Ocean Tsunami Information Centre (IOTIC) website www.iowave.org.

4. SPECIFICS OF CONDUCTING EXERCISE IOWAVE23

4.1 OVERVIEW

The exercise will comprise four scenarios over a three-week period (4–25 October 2023) that will generate simulated tsunami waves travelling across different parts of the Indian Ocean, and a combination of all scenarios covering most of the Indian Ocean basin. Large magnitude earthquakes are chosen in order to maximise ocean coverage and number of Member States impacted for each scenario. While TSPs will issue real-time bulletins for the four scenarios on pre-decided exercise dates, Member States can run their national exercise on any day during the above period using the TSP bulletins provided as supplements to this manual and will be made available for download from the exercise website: https://oceanexpert.org/event/3916

The four exercise scenarios are:

- **Scenario 1** starting at 04:00 UTC on Wednesday 4th October 2023: Magnitude ~9 **earthquake in the Andaman trench** off the west coast of Nicobar Islands, India. The simulated tsunami will take approximately 0 hours* to travel from its source to India; 1 hour to Indonesia; and 1.5 hours to travel to Thailand, Bangladesh, and Sri Lanka. (Refer to Supplement 1.)

- **Scenario 2** starting at 06:00 UTC on Wednesday 11th October 2023: Magnitude ~9 **earthquake in the Makran trench** of the North-West Indian Ocean. The simulated tsunami will take approximately 0 hours* to travel from its source to Iran, Pakistan, and Oman; 0.5 hours to travel to the United Arab Emirates; and 2 hours to travel to India. (Refer to Supplement 2.)

- **Scenario 3** starting at 06:00 UTC (eruption at 05:00 UTC) on Wednesday 18th October 2023: Tsunami generated by **volcanic eruption on Heard Island** in the Kerguelen Islands Region. The simulated tsunami will take approximately 1.5 hours to travel from its source to the French Islands; 6 hours to Madagascar, Mauritius, and Australia; and 6.5 hours to South Africa (mainland). (Refer to Supplement 3.)

- **Scenario 4** starting at 02:00 UTC on Wednesday 25th October 2023: Magnitude ~9 **earthquake in the Java trench** to the south of Java, Indonesia. The simulated tsunami will take approximately 0 hours* to travel from its source to Indonesia; 0.5 hours to travel to Australia; and 1.5 hours to travel to Timor-Leste. (Refer to Supplement 4.)

* Note that the expected arrival times have been approximated to the nearest 0.5 hour (30 minutes). Therefore, a time of 0 hours can be interpreted as less than 15 minutes.

Member States are invited to participate in any or all events, which will be run in real-time. The scenario start times have been chosen to be more convenient for the "near field" (i.e., local) countries for each scenario.

During scenarios 1, 2, and 4 (seismic events), TSPs Australia, India and Indonesia will make exercise bulletins and detailed tsunami threat advice available on their password-protected websites, and send Notification Messages to NTWCs as the data is updated during the events.

During scenario 3 (volcanic event), only TSP Australia will make exercise bulletins and detailed tsunami threat advice available on their password-protected websites, and will send Notification Messages to NTWCs as the data is updated during the event. This is because currently only TSP Australia has actioned response procedures for tsunamis caused by volcanic events.

The approximate timelines for issuance of TSP bulletins for events are given in Tables 3, 5, 7, and 9 below. Note that the actual bulletin issue times on the exercise days may be slightly different because the TSPs will be operating in a real-time simulation mode. Participant countries should use the timelines only as a guide for planning their involvement in the exercise.

Coverage: All Member States are encouraged to participate. Estimated tsunami arrival times and maximum wave amplitudes to all threatened IOTWMS countries are included in the TSP bulletins and products (refer to Tables 4, 6, 8, and 10; Figures 1–11 for summary information; and Supplements 1, 2, 3, and 4 for detailed information).

Messages: The TSPs will issue an initial Exercise Announcement Message to start the exercise on each day. Thereafter, NTWCs will receive Notification Messages from the TSPs according to the timelines shown in Table 3 (Andaman Trench), Table 5 (Makran Trench), Table 7 (Heard Island Volcano), and Table 9 (Java Trench), which will direct NTWCs to the TSP password-protected websites to view the detailed exercise bulletins and detailed threat information. Examples of the TSP Notification Messages are given in Supplements 1, 2, 3, and 4.

Threat Details: The following section 4.2 provides the essential scenario details to facilitate the exercise plan. They include the estimated tsunami arrival times of the first significant wave above threat level and the maximum wave amplitudes for each affected country (Table 4-Java Trench, Table 6-Andaman Trench, Table 8-Heard Island Volcano (arrival times only), and Table 10-Makran Trench). Also provided are the sample threat map, the maximum wave amplitude map, and the tsunami travel time map of the first detectable wave in the Indian Ocean (Figures 1-3 for Java Trench, Figures 4-6 for Andaman Trench, Figures 7-8 for Heard Island Volcano, and Figures 9-11 for Makran Trench).

Countries are encouraged to conduct the exercise in real-time and use the TSP websites to access the bulletins and other threat information available there. To facilitate the conduct of exercising in compressed timeline, for conduct of tabletop exercises, and for planning evacuation exercises, the full set of TSP exercise bulletins and products are separately provided in Supplement 1 (Scenario 1 – Andaman Trench), Supplement 2 (Scenario 2 – Makran Trench), Supplement 3 (Scenario 3 – Heard Island Volcano), and Supplement 4 (Scenario 4 – Java Trench) .

4.2 EXERCISE SPECIFICS

4.2.1 Scenario 1, Andaman Trench

This is the scenario of a magnitude ~9 earthquake in the Andaman Trench off the west coast of Nicobar Islands, India (epicentre 7.20N, 92.90E), starting at 04:00 UTC on Wednesday 4 October 2023. The simulated tsunami will reach the coast of Nicobar Islands in minutes, take approximately 1 hour to travel from its source to Indonesia; and 1.5 hours to travel to Thailand, Bangladesh, and Sri Lanka.

Table 4 contains the bulletin timelines for Scenario 1, Andaman Trench. The full set of TSP exercise bulletins and products for are provided in Supplement 1.

TSP AUSTRALIA			TSP INDIA			TSP INDONESIA		
Time (UTC)	**Bulletin Number**	**Bulletin Type**	**Time (UTC)**	**Bulletin Number**	**Bulletin Type**	**Time (UTC)**	**Bulletin Number**	**Bulletin Type**
04:00		*Announcement Message*	*04:00*		*Announce-ment Message*	*04:00*		*Announce-ment Message*
04:10	*1*	*Earthquake Bulletin (M8.2)*	*04:08*	*1*	*Earthquake Bulletin (M8.6)*	*04:08*	*1*	*Earthquake Bulletin (M8.5)*
04:12	*2*	*Potential Threat Bulletin (M8.2)*	*04:15*	*2*	*Potential Threat Bulletin (M9.0)*	*04:13*	*2*	*Potential Threat Bulletin (M8.9)*
04:30	*3*	*Potential Threat Bulletin (M8.9)*	*04:30*	*3*	*Confirmed Threat Bulletin (M9.0)*	*04:30*	*3*	*Confirmed Threat Bulletin (M9.0)*
04:40	*4*	*Confirmed Threat Bulletin (M9.0)*	*05:00*	*4*	*Confirmed Threat Bulletin (M9.0)*	*05:00*	*4*	*Confirmed Threat Bulletin (M9.0)*
05:40	*5*	*Confirmed Threat Bulletin (M9.0)*	*06:00*	*5*	*Confirmed Threat Bulletin (M9.0)*	*06:00*	*5*	*Confirmed Threat Bulletin (M9.0)*
06:40	*6*	*Confirmed Threat Bulletin (M9.0)*	*07:00*	*6*	*Confirmed Threat Bulletin (M9.0)*	*07:00*	*6*	*Confirmed Threat Bulletin (M9.0)*
07:40	*7*	*Confirmed Threat Bulletin (M9.0)*	*08:00*	*7*	*Confirmed Threat Bulletin (M9.0)*	*08:00*	*7*	*Confirmed Threat Bulletin (M9.0)*
08:40	*8*	*Confirmed Threat Bulletin (-M9.0)*	*09:00*	*8*	*Confirmed Threat Bulletin (M9.0)*	*09:00*	*8*	*Confirmed Threat Bulletin (M9.0)*
09:40	*9*	*Confirmed Threat Bulletin (M9.0)*	*10:00*	*9*	*Confirmed Threat Bulletin (M9.0)*	*10:00*	*9*	*Confirmed Threat Bulletin (M9.0)*
10:40	*10*	*Confirmed Threat Bulletin (M9.0)*	*11:00*	*10*	*Confirmed Threat Bulletin (M9.0)*	*11:00*	*10*	*Confirmed Threat Bulletin (M9.0)*
11:40	*11*	*Confirmed Threat Bulletin (M9.0)*	*12:00*	*11*	*Confirmed Threat Bulletin (M9.0)*	*12:00*	*11*	*Confirmed Threat Bulletin (M9.0)*
12:40	*12*	*Confirmed Threat Bulletin (M9.0)*	*13:00*	*12*	*Confirmed Threat Bulletin (M9.0)*	*13:00*	*12*	*Confirmed Threat Bulletin (M9.0)*
13:40	*13*	*Confirmed Threat Bulletin (M9.0)*	*14:00*	*13*	*Confirmed Threat Bulletin (M9.0)*	*14:00*	*13*	*Confirmed Threat Bulletin (M9.0)*
14:40	*14*	*Confirmed Threat Bulletin (M9.0)*	*15:00*	*14*	*Confirmed Threat Bulletin (M9.0)*	*15:00*	*14*	*Confirmed Threat Bulletin (M9.0)*

TSP AUSTRALIA			TSP INDIA			TSP INDONESIA		
Time (UTC)	**Bulletin Number**	**Bulletin Type**	**Time (UTC)**	**Bulletin Number**	**Bulletin Type**	**Time (UTC)**	**Bulletin Number**	**Bulletin Type**
15:40	*15*	*Final Bulletin*	*16:00*	*15*	*Final Bulletin*	*16:00*	*15*	*Final Bulletin*

Table 4. Bulletin Timelines for Scenario 1, Andaman Trench

The estimated tsunami arrival times and maximum wave amplitudes for Scenario 1, Andaman Trench are given in Table 5. T2 in UTC is the Estimated Tsunami Arrival Times (ETAs) for the first wave above the Threat Level of 0.5 m. The earliest T2 out of the three TSPs is used for each listed country. MAX BEACH in metres is the estimated Maximum Wave Amplitude at the beach. The largest MAX BEACH out of the three TSPs is used for each listed country. No values are given for those countries assessed by all three TSPs as not under threat.

No	Country	T2 (UTC)	Max Beach (m)
1	Australia	06:18	2.0
2	Bangladesh	06:40	2.8
3	Comoros	12:12	1.2
4	Djibouti	13:56	0.7
5	France (Indian Ocean Territories)	10:48	1.7
6	India	04:00	14.4
7	Indonesia	04:20	19.2
8	Iran	12:05	0.7
9	Kenya	12:11	1.9
10	Madagascar	11:30	1.6
11	Malaysia	07:21	2.5
12	Maldives	07:04	9.7
13	Mauritius	09:44	1.6
14	Mozambique	12:45	1.3
15	Myanmar	04:56	4.6
16	Oman	10:35	1.3
17	Pakistan	11:40	0.7
18	Seychelles	10:08	1.9
19	Singapore	-	-
20	Somalia	11:02	3.1
21	South Africa	15:11	0.7
22	Sri Lanka	05:36	10.4
23	Tanzania	12:33	1.2
24	Thailand	05:28	8.6
25	Timor-Leste	-	-
26	United Arab Emirates	07:36	4.2
27	Yemen	10:44	3.0

Table 5. Estimated Tsunami Arrival Times and Maximum Wave Amplitudes for Scenario 1, Andaman Trench.

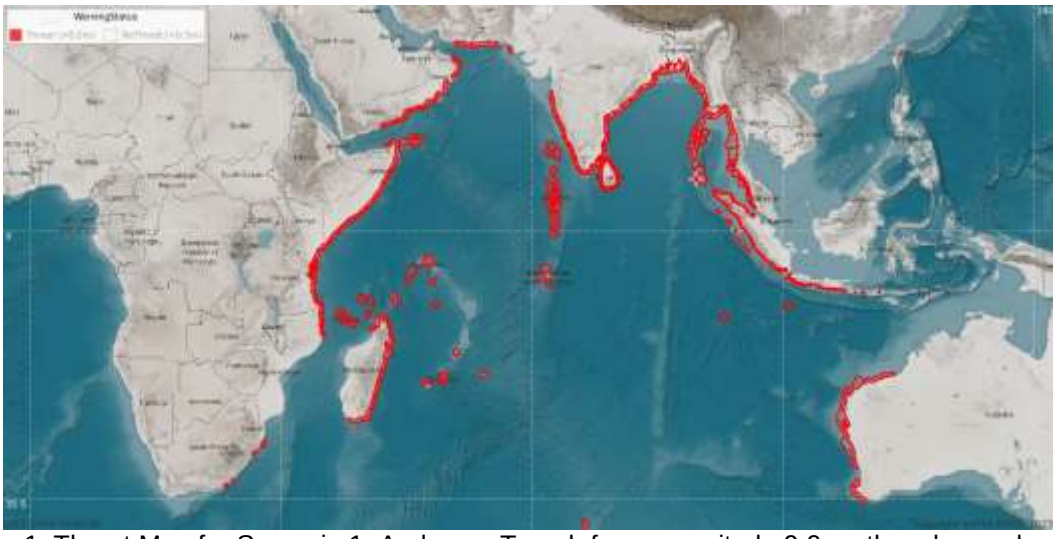

Figure 1. Threat Map for Scenario 1, Andaman Trench for a magnitude 9.0 earthquake produced by TSP Indonesia.

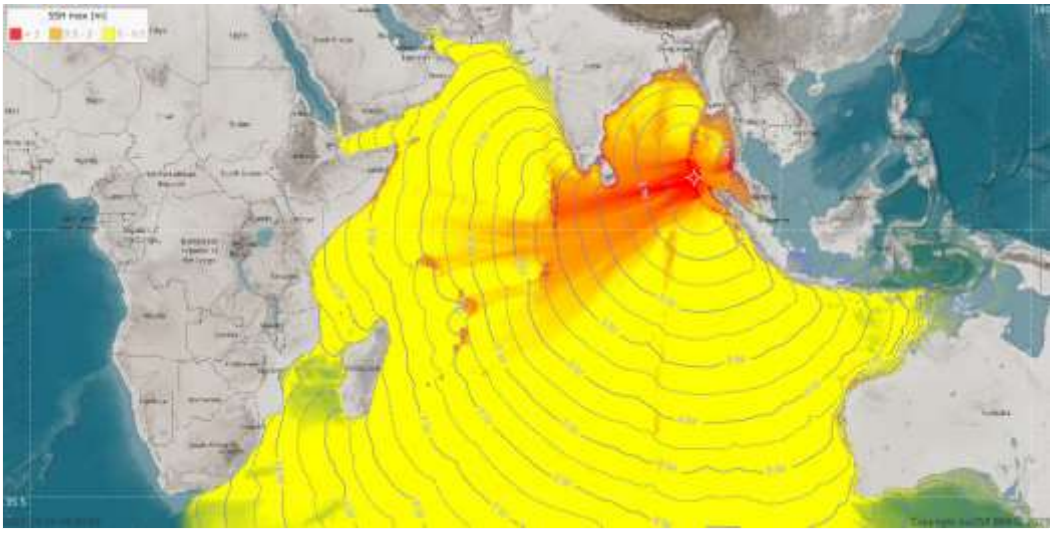

Figure 2. The Maximum Wave Amplitude Map for Scenario 1, Andaman Trench for a magnitude 9.0 earthquake produced by TSP Indonesia.

Figure 3. The first detectable wave Tsunami Travel Time contours for Scenario 1, Andaman Trench produced by TSP Indonesia.

4.2.2 Scenario 2, Makran Trench

This is the scenario of a magnitude ~9 earthquake in the Makran Trench of the North-West Indian Ocean (epicentre 24.80N, 58.20E), starting at 06:00 UTC on Wednesday 11 October 2023. The simulated tsunami will reach the coasts of Iran, Oman, and Pakistan within minutes, take approximately 0.5 hours to travel from its source to the United Arab Emirates; and 2 hours to travel to India.

Table 6 contains the bulletin timelines for Scenario 2, Makran Trench. The full set of TSP exercise bulletins and products for are provided in Supplement 2.

TSP AUSTRALIA			**TSP INDIA**			**TSP INDONESIA**		
Time (UTC)	**Bulletin Number**	**Bulletin Type**	**Time (UTC)**	**Bulletin Number**	**Bulletin Type**	**Time (UTC)**	**Bulletin Number**	**Bulletin Type**
06:00		*Announcement Message*	*06:00*		*Announce-ment Message*	*06:00*		*Announce-ment Message*
06:0	*1*	*Earthquake Bulletin (M8.0)*	*06:08*	*1*	*Earthquake Bulletin (M.8.5)*	*06:05*	*1*	*Earthquake Bulletin (M8.3)*
06:12	*2*	*Potential Threat Bulletin (M8.0)*	*06:15*	*2*	*Potential Threat Bulletin (M9.0)*	*06:10*	*2*	*Potential Threat Bulletin (M8.7)*
06:15	*3*	*Confirmed Threat Bulletin (M8.0)*	*06:30*	*3*	*Confirmed Threat Bulletin (M9.0)*	*06:30*	*3*	*Confirmed Threat Bulletin (M9.0)*
06:30	*4*	*Confirmed Threat Bulletin (M8.9)*	*07:00*	*4*	*Confirmed Threat Bulletin (M9.0)*	*07:00*	*4*	*Confirmed Threat Bulletin (M9.0)*
07:30	*5*	*Confirmed Threat Bulletin (M8.9)*	*08:00*	*5*	*Confirmed Threat Bulletin (M9.0)*	*08:00*	*5*	*Confirmed Threat Bulletin (M9.0)*
08:30	*6*	*Confirmed Threat Bulletin (M8.9)*	*09:00*	*6*	*Confirmed Threat Bulletin (M9.0)*	*09:00*	*6*	*Confirmed Threat Bulletin (M9.0)*
09:30	*7*	*Confirmed Threat Bulletin (M8.9)*	*10:00*	*7*	*Confirmed Threat Bulletin (M9.0)*	*10:00*	*7*	*Confirmed Threat Bulletin (M9.0)*
10:30	*8*	*Confirmed Threat Bulletin (M8.9)*	*11:00*	*8*	*Confirmed Threat Bulletin (M9.0)*	*11:00*	*8*	*Confirmed Threat Bulletin (M9.0)*
11:30	*9*	*Confirmed Threat Bulletin (M8.9)*	*12:00*	*9*	*Confirmed Threat Bulletin (M9.0)*	*12:00*	*9*	*Confirmed Threat Bulletin (M9.0)*
12:30	*10*	*Confirmed Threat Bulletin (M8.9)*	*13:00*	*10*	*Confirmed Threat Bulletin (M9.0)*	*13:00*	*10*	*Confirmed Threat Bulletin (M9.0)*
13:30	*11*	*Confirmed Threat Bulletin (M8.9)*	*14:00*	*11*	*Confirmed Threat Bulletin (M9.0)*	*14:00*	*11*	*Confirmed Threat Bulletin (M9.0)*

TSP AUSTRALIA			TSP INDIA			TSP INDONESIA		
Time (UTC)	**Bulletin Number**	**Bulletin Type**	**Time (UTC)**	**Bulletin Number**	**Bulletin Type**	**Time (UTC)**	**Bulletin Number**	**Bulletin Type**
14:30	*12*	*Confirmed Threat Bulletin (M8.9)*	*15:00*	*12*	*Confirmed Threat Bulletin (M9.0)*	*15:00*	*12*	*Confirmed Threat Bulletin (M9.0)*
15:30	*13*	*Confirmed Threat Bulletin (M8.9)*	*16:00*	*13*	*Confirmed Threat Bulletin (M9.0)*	*16:00*	*13*	*Confirmed Threat Bulletin (M9.0)*
16:30	*14*	*Confirmed Threat Bulletin (M8.9)*	*17:00*	*14*	*Confirmed Threat Bulletin (M9.0)*	*17:00*	*14*	*Confirmed Threat Bulletin (M9.0)*
17:30	*15*	*Final Bulletin*	*18:00*	*15*	*Final Bulletin*	*18:00*	*15*	*Final Bulletin*

Table 6. Bulletin Timelines for Scenario 2, Makran Trench

The estimated tsunami arrival times and maximum wave amplitudes for Scenario 2, Makran Trench are given in Table 7. T2 in UTC is the Estimated Tsunami Arrival Times (ETAs) for the first wave above the Threat Level of 0.5 m. The earliest T2 out of the three TSPs is used for each listed country. MAX BEACH in metres is the estimated Maximum Wave Amplitude at the beach. The largest MAX BEACH out of the three TSPs is used for each listed country. No values are given for those countries assessed by all three TSPs as not under threat.

No	Country	T2 (UTC)	Max Beach (m)
1	Australia	19:40	1.0
2	Bangladesh	-	-
3	Comoros		0.8
4	Djibouti	11:12	2.0
5	France (Indian Ocean Territories)	13:30	1.0
6	India	07:48	2.5
7	Indonesia	-	-
8	Iran	06:00	9.0
9	Kenya	13:00	1.2
10	Madagascar	12:18	0.7
11	Malaysia	-	-
12	Maldives	09:22	1.6
13	Mauritius	11:52	1.2
14	Mozambique	15:23	0.6
15	Myanmar	-	-
16	Oman	06:12	11.7
17	Pakistan	06:00	8.3
18	Seychelles	10:38	1.6
19	Singapore	-	-
20	Somalia	09:22	1.3
21	South Africa	-	-
22	Sri Lanka	10:48	0.8
23	Tanzania	12:52	0.6

No	Country	T2 (UTC)	Max Beach (m)
24	Thailand	-	-
25	Timor-Leste	-	-
26	United Arab Emirates	06:28	4.7
27	Yemen	08:28	1.3

Table 7. The Estimated Tsunami Arrival Times and the Maximum Wave Amplitudes for Scenario 2, Makran Trench.

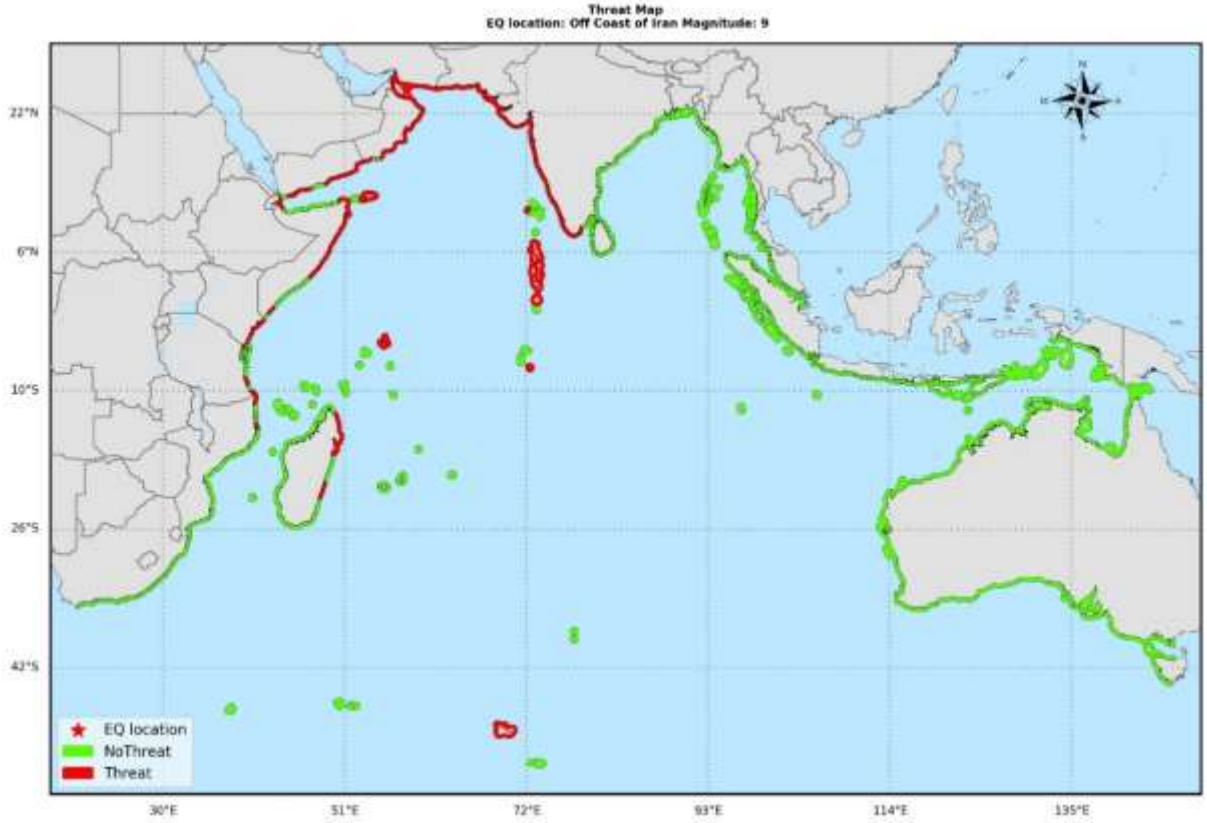

Figure 4. Threat Map for Scenario 2, Makran Trench for a magnitude 9.0 earthquake produced by TSP India.

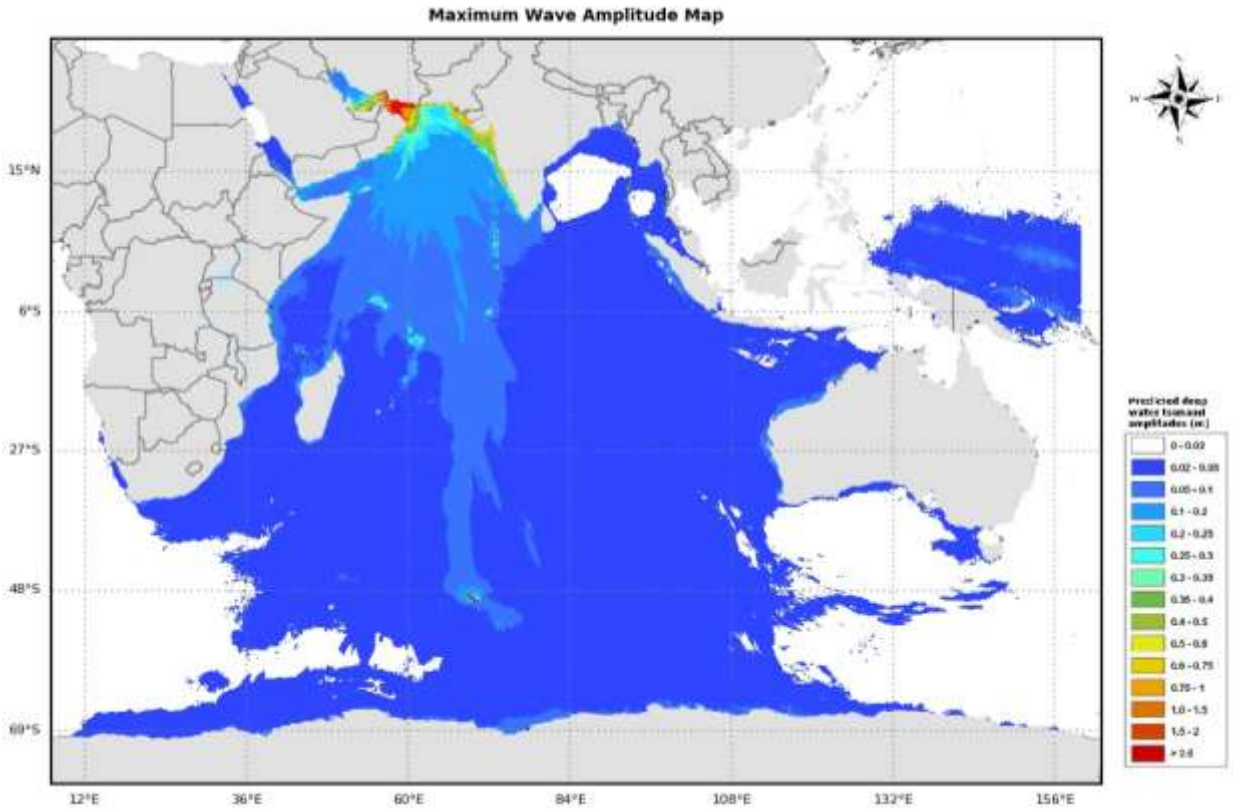

Figure 5. The Maximum Wave Amplitude Map produced by TSP India for Scenario 2, Makran Trench for a magnitude 9.0 earthquake.

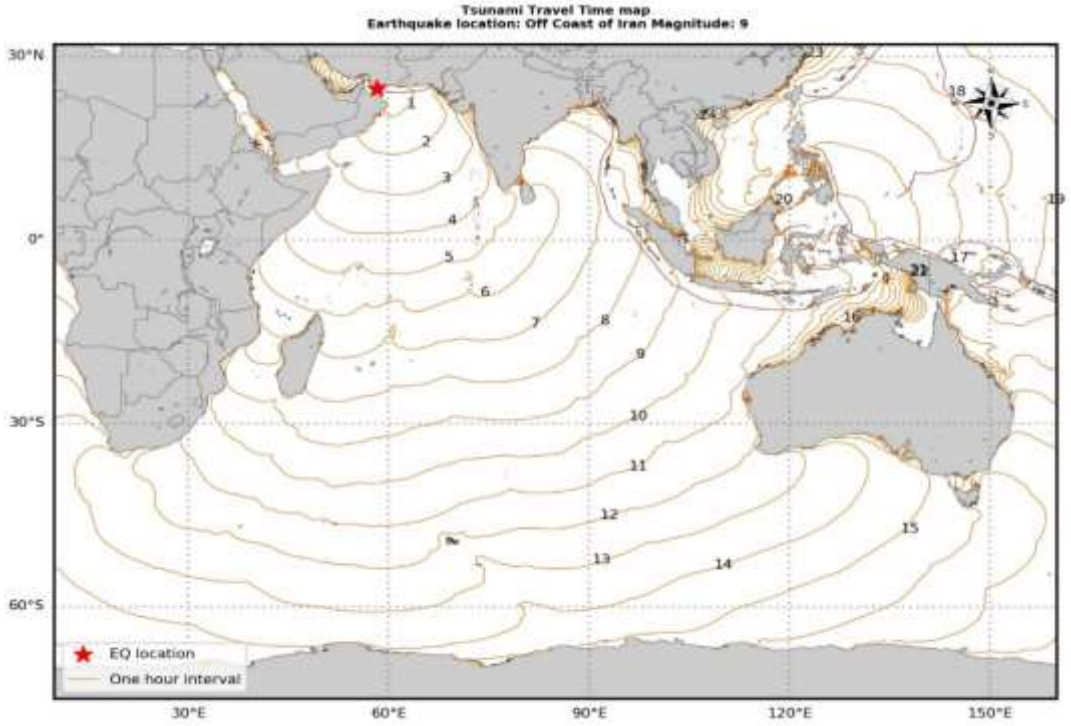

Figure 6. The first detectable wave Tsunami Travel Time contours for Scenario 2, Makran Trench produced by TSP India.

4.2.3 Scenario 3, Heard Island Volcano

This is the scenario of a volcanic eruption at Heard Island in the Southern Ocean (epicentre 53.10S, 73.52E), starting at 06:00 UTC on Wednesday 18 October 2023. The simulated tsunami will take approximately 1.5 hours to travel from its source to the French Indian Ocean Territories; 6 hours to Madagascar, Mauritius, and Australia; and 6.5 hours to South Africa.

Table 8 contains the bulletin timelines for Scenario 3, Heard Island Volcano. The full set of TSP exercise bulletins and products for are provided in Supplement 3.

TSP AUSTRALIA		
Time (UTC)	**Bulletin Number**	**Bulletin Type**
04:00		*Eruption*
06:00		*Announcement Message*
06:05	*1*	*Earthquake Bulletin*
06:30	*2*	*Potential Threat Bulletin*
07:30	*3*	*Confirmed Threat Bulletin*
08:30	*4*	*Confirmed Threat Bulletin*
09:30	*5*	*Confirmed Threat Bulletin*
10:30	*6*	*Confirmed Threat Bulletin*
11:30	*7*	*Confirmed Threat Bulletin*
12:30	*8*	*Confirmed Threat Bulletin*
13:30	*9*	*Confirmed Threat Bulletin*
14:30	*10*	*Confirmed Threat Bulletin*
15:30	*11*	*Confirmed Threat Bulletin*
16:30	*12*	*Confirmed Threat Bulletin*
17:30	*13*	*Final Bulletin*

Table 8. Bulletin Timelines for Scenario 3, Heard Island Volcano

The estimated tsunami arrival times for Scenario 3, Heard Island Volcano are given in Table 9. Please note, due to present limitations on our understanding of the generation and propagation of such tsunami events, these are based on an estimated propagation of an assumed sea level anomaly. We presently have no absolute forecasts for the amplitudes of such anomalies. T2 in UTC is the Estimated Tsunami Arrival Times (ETAs) for when the first wave is assumed to be above the Threat Level of 0.5 m from TSP Australia. No values are given for those countries assessed as not under threat. Note that no values for Maximum Wave Amplitude at the beach are provided for non-seismic events. Countries under threat may experience dangerous currents and some inundation of the immediate foreshore, but generally not major land inundation unless local threat.

No	Country	T2 (UTC)
1	Australia	10:15
2	Bangladesh	-
3	Comoros	12:18
4	Djibouti	-
5	France (Indian Ocean Territories)	05:34
6	India	14:31
7	Indonesia	12:44
8	Iran	-
9	Kenya	13:29
10	Madagascar	09:54
11	Malaysia	-
12	Maldives	13:03
13	Mauritius	09:55
14	Mozambique	11:02
15	Myanmar	15:55
16	Oman	15:36
17	Pakistan	-
18	Seychelles	11:33
19	Singapore	-
20	Somalia	13:28
21	South Africa	07:53
22	Sri Lanka	13:54
23	Tanzania	13:08
24	Thailand	15:45
25	Timor-Leste	14:12
26	United Arab Emirates	-
27	Yemen	14:46

Table 9. The Estimated Tsunami Arrival Times for Scenario 3, Heard Island Volcano compiled by TSP Australia.

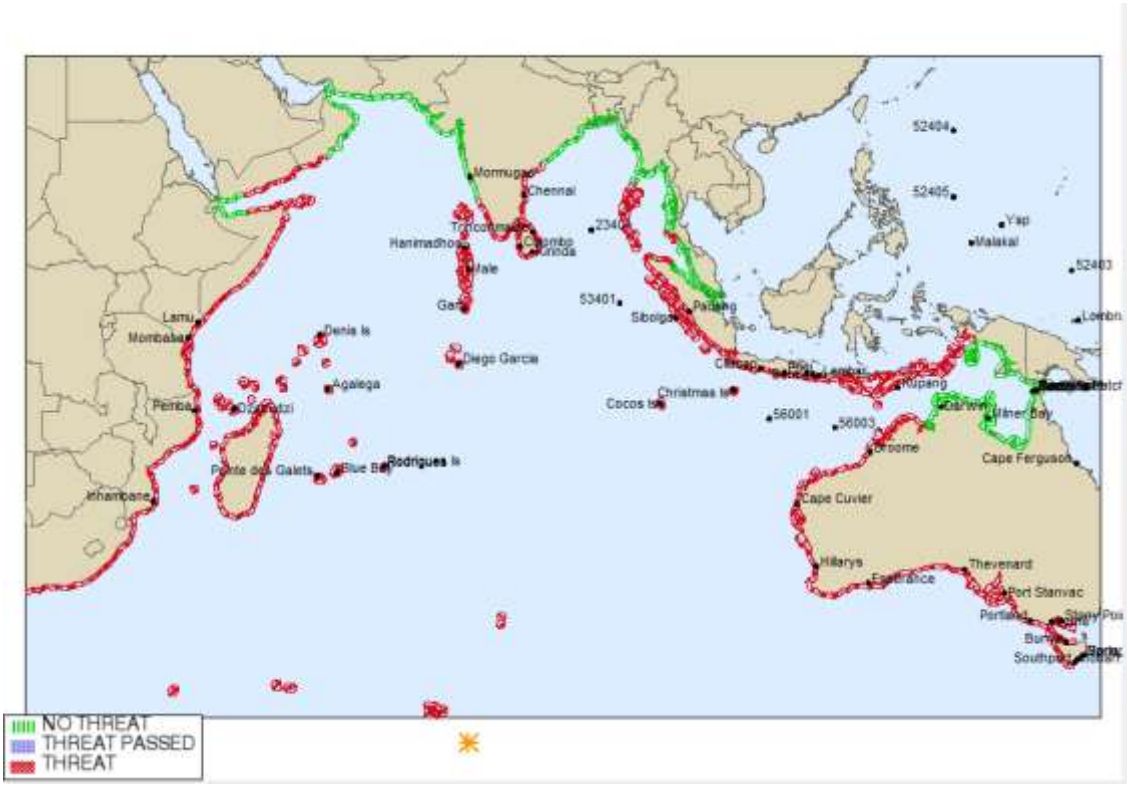

Figure 7. Threat Map produced by TSP Australia for Scenario 3 Heard Island Volcano produced by TSP Australia.

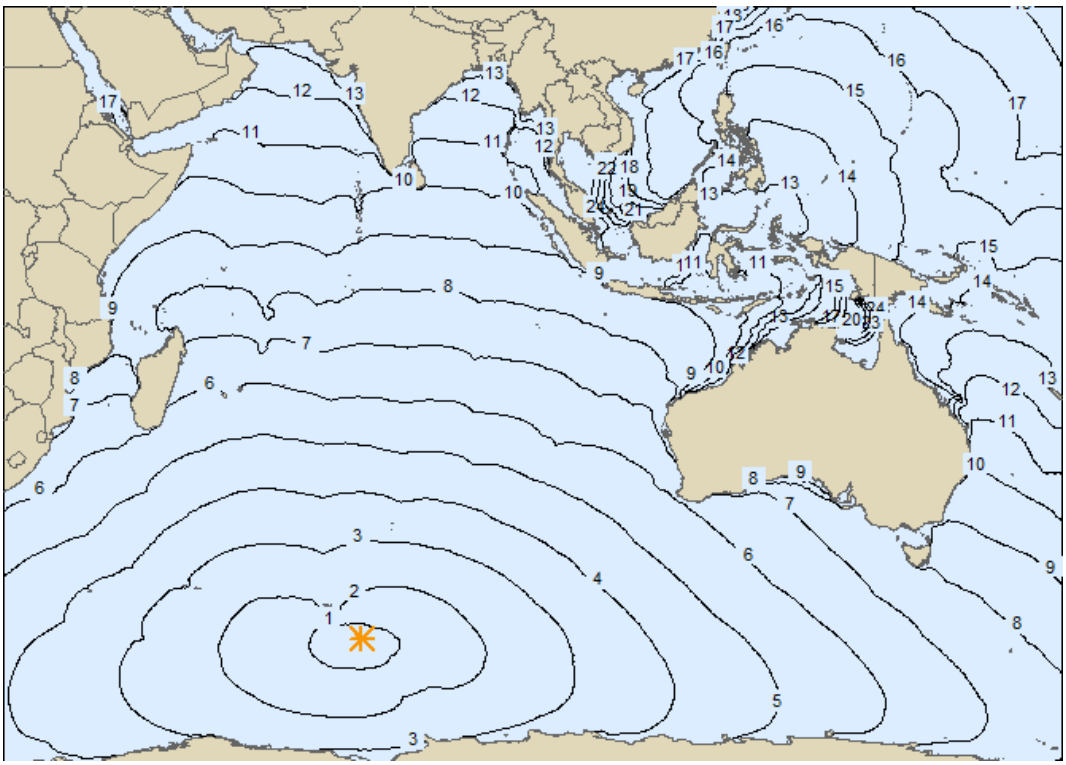

Figure 8. The first detectable wave Tsunami Travel Time contours for Scenario 3 Heard Island Volcano produced by TSP Australia.

4.2.4 Scenario 4, Java Trench

This is the scenario of a magnitude ~9 earthquake south of Java off the coast of Indonesia (epicentre at 10.40S 112.80E), starting at 02:00 UTC on Wednesday 25 October 2023. The simulated tsunami will reach the nearest coasts of Indonesia within minutes and take approximately 0.5 hours to travel from its source to Australia, and 1.5 hours to travel to Timor-Leste.

Table 10 contains the bulletin timelines for Scenario 4, Java Trench. The full set of TSP exercise bulletins and products for are provided in Supplement 4.

TSP AUSTRALIA			**TSP INDIA**			**TSP INDONESIA**		
Time (UTC)	**Bulletin Number**	**Bulletin Type**	**Time (UTC)**	**Bulletin Number**	**Bulletin Type**	**Time (UTC)**	**Bulletin Number**	**Bulletin Type**
02:00		*Announce-ment Message*	*02:00*		*Announce-ment Message*	*02:00*		*Announce-ment Message*
02:10	*1*	*Earthquake Bulletin (M8.3)*	*02:08*	*1*	*Earthquake Bulletin (M8.6)*	*02:08*	*1*	*Earthquake Bulletin (M8.5)*
02:12	*2*	*Potential Threat Bulletin (M8.3)*	*02:15*	*2*	*Potential Threat Bulletin (M8.8)*	*02:13*	*2*	*Potential Threat Bulletin (M8.9)*
02:30	*3*	*Potential Threat Bulletin (M8.9)*	*02:30*	*3*	*Confirmed Threat Bulletin (M9.1)*	*02:30*	*3*	*Confirmed Threat Bulletin (M9.0)*
02:40	*4*	*Confirmed Threat Bulletin (M9.0)*	*03:00*	*4*	*Confirmed Threat Bulletin (M9.1)*	*03:00*	*4*	*Confirmed Threat Bulletin (M9.0)*
02:50	*5*	*Confirmed Threat Bulletin (M9.1)*	*04:00*	*5*	*Confirmed Threat Bulletin (M9.1)*	*04:00*	*5*	*Confirmed Threat Bulletin (M9.0)*
03:50	*6*	*Confirmed Threat Bulletin (M9.1)*	*05:00*	*6*	*Confirmed Threat Bulletin (M9.1)*	*05:00*	*6*	*Confirmed Threat Bulletin (M9.0)*
04:50	*7*	*Confirmed Threat Bulletin (M9.1)*	*06:00*	*7*	*Confirmed Threat Bulletin (M9.1)*	*06:00*	*7*	*Confirmed Threat Bulletin (M9.0)*
05:50	*8*	*Confirmed Threat Bulletin (M9.1)*	*07:00*	*8*	*Confirmed Threat Bulletin (M9.1)*	*07:00*	*8*	*Confirmed Threat Bulletin (M9.0)*
06:50	*9*	*Confirmed Threat Bulletin (M9.1)*	*08:00*	*9*	*Confirmed Threat Bulletin (M9.1)*	*08:00*	*9*	*Confirmed Threat Bulletin (M9.0)*
07:50	*10*	*Confirmed Threat Bulletin (M9.1)*	*09:00*	*10*	*Confirmed Threat Bulletin (M9.1)*	*09:00*	*10*	*Confirmed Threat Bulletin (M9.0)*
08:50	*11*	*Confirmed Threat Bulletin (M9.1)*	*10:00*	*11*	*Confirmed Threat Bulletin (M9.1)*	*10:00*	*11*	*Confirmed Threat Bulletin (M9.0)*
09:50	*12*	*Confirmed*	*11:00*	*12*	*Confirmed*	*11:00*	*12*	*Confirmed*

TSP AUSTRALIA			TSP INDIA			TSP INDONESIA		
Time (UTC)	**Bulletin Number**	**Bulletin Type**	**Time (UTC)**	**Bulletin Number**	**Bulletin Type**	**Time (UTC)**	**Bulletin Number**	**Bulletin Type**
		Threat Bulletin (M9.1)			*Threat Bulletin (M9.1)*			*Threat Bulletin (M9.0)*
10:50	*13*	*Confirmed Threat Bulletin (M9.1)*	*12:00*	*13*	*Confirmed Threat Bulletin (M9.1)*	*12:00*	*13*	*Confirmed Threat Bulletin (M9.0)*
11:50	*14*	*Confirmed Threat Bulletin (M9.1)*	*13:00*	*14*	*Confirmed Threat Bulletin (M9.1)*	*13:00*	*14*	*Confirmed Threat Bulletin (M9.0)*
12:50	*15*	*Confirmed Threat Bulletin (M9.1)*	*14:00*	*15*	*Final Bulletin*	*14:00*	*15*	*Final Bulletin*
13:50	*16*	*Final Bulletin*						

Table 10. Bulletin Timelines for Scenario 4, Java Trench

The estimated tsunami arrival times and maximum wave amplitudes for Scenario 4, Java Trench are given in Table 11. T2 in UTC is the Estimated Tsunami Arrival Times (ETAs) for the first wave above the Threat Level of 0.5 m. The earliest T2 out of the three TSPs is used for each listed country. MAX BEACH in metres is the estimated Maximum Wave Amplitude at the beach. The largest MAX BEACH out of the three TSPs is used for each listed country. No values are given for those countries assessed by all three TSPs as not under threat.

No	Country	T2 (UTC)	MAX BEACH (m)
1	Australia	02:22	28.3
2	Bangladesh	-	-
3	Comoros	-	-
4	Djibouti	-	-
5	France (Indian Ocean Territories)	07:58	2.8
6	India	10:03	1.4
7	Indonesia	02:02	29.6
8	Iran	-	-
9	Kenya	17:48	0.8
10	Madagascar	10:52	2.6
11	Malaysia	-	-
12	Maldives	07:14	1.2
13	Mauritius	08:40	1.6
14	Mozambique	14:52	1.0
15	Myanmar	22:16	0.7
16	Oman	13:02	0.9
17	Pakistan	-	-
18	Seychelles	13:23	0.9
19	Singapore	-	-
20	Somalia	13:58	1.2
21	South Africa	13:20	2.0

No	Country	T2 (UTC)	MAX BEACH (m)
22	Sri Lanka	08:28	1.3
23	Tanzania	16:28	0.8
24	Thailand	00:32 on 26 Oct	0.5
25	Timor-Leste	03:36	1.3
26	United Arab Emirates	-	-
28	Yemen	12:28	0.9

Table 11. The Estimated Tsunami Arrival Times and the Maximum Wave Amplitudes for Scenario 4, Java Trench.

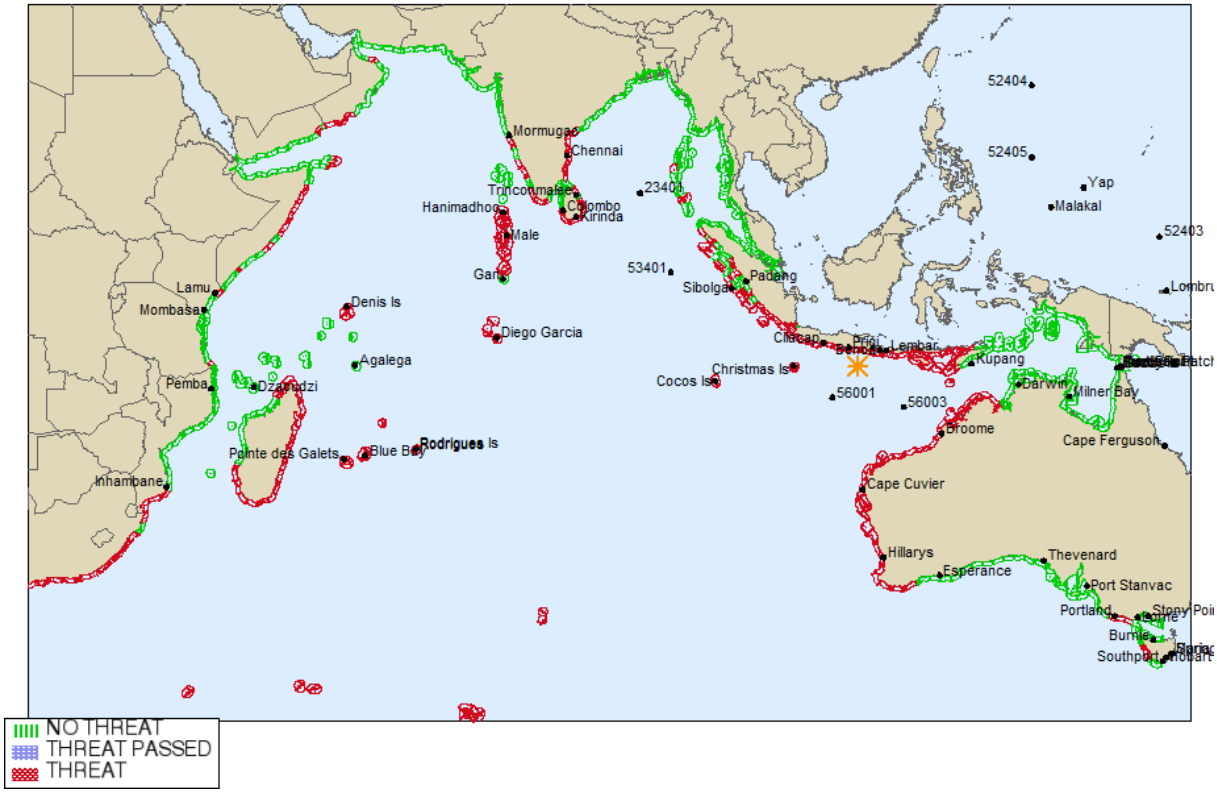

Figure 9. Threat Map for Scenario 4 Java Trench for a magnitude ~9 earthquake produced by TSP Australia.

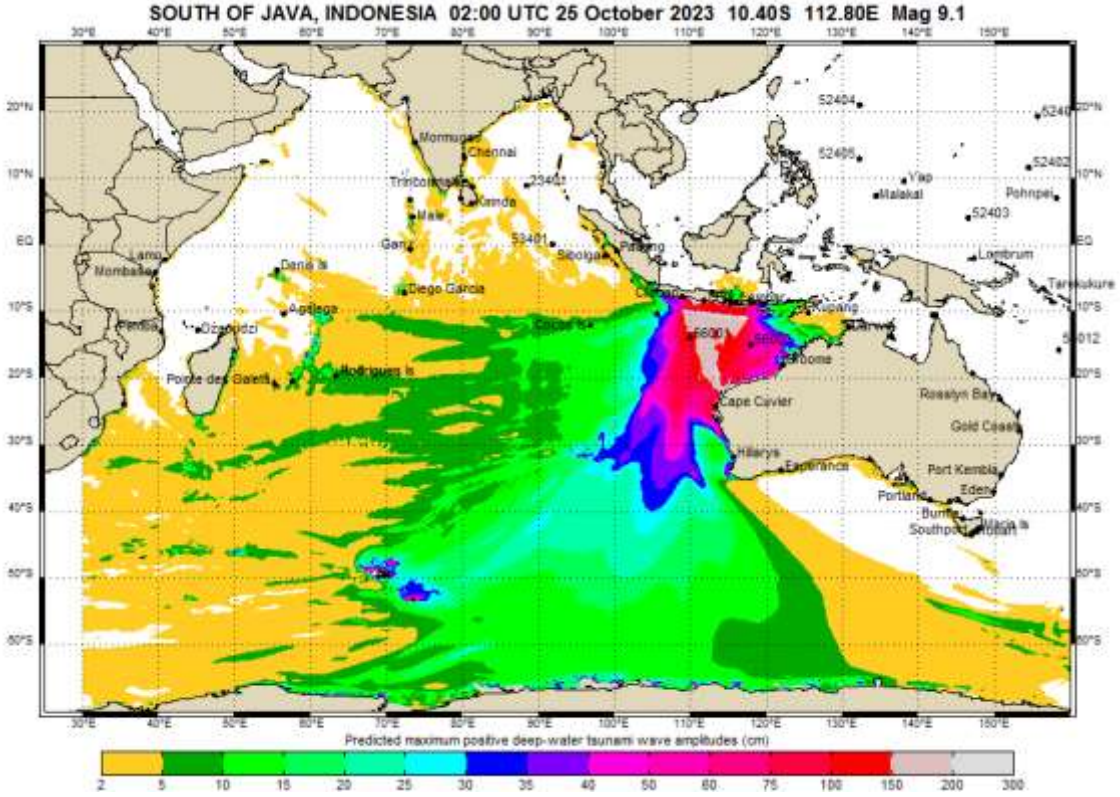

Figure 10. The Maximum Wave Amplitude Map produced by TSP India for Scenario 4 Java Trench produced by TSP Australia.

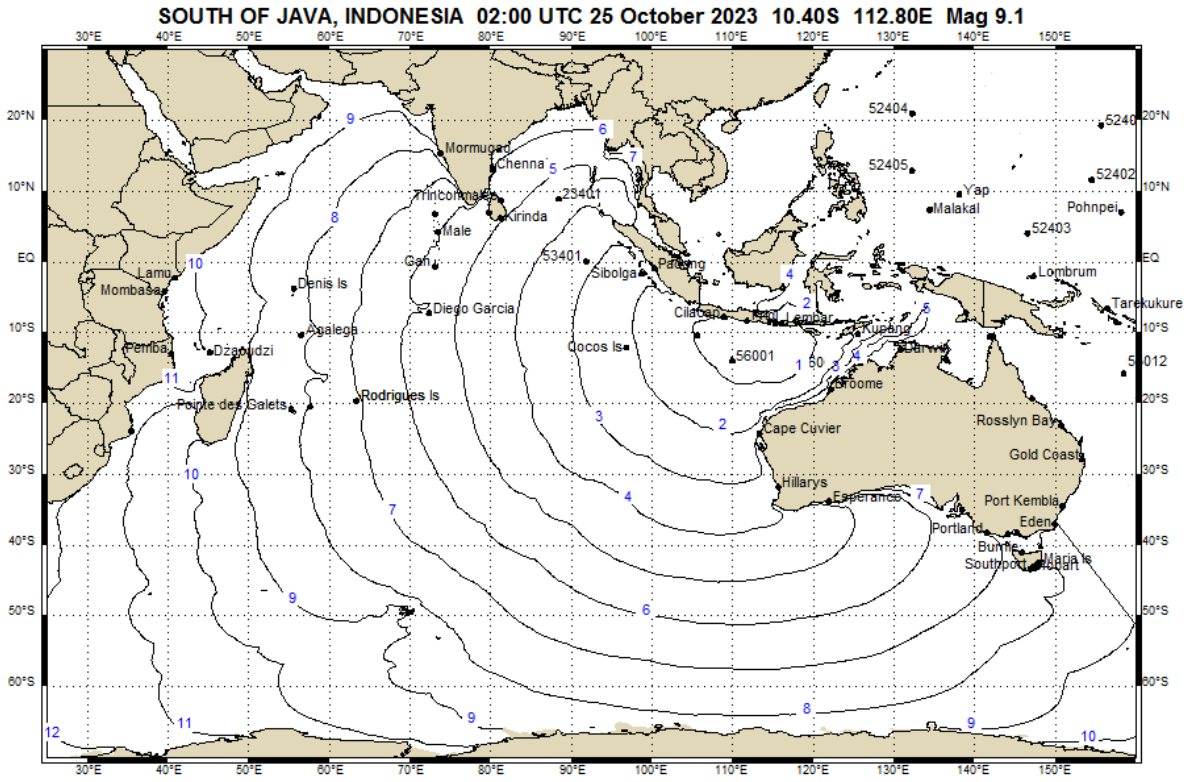

Figure 11. The first detectable wave Tsunami Travel Time contours produced by TSP Indonesia for Scenario 4 Java Trench produced by TSP Australia

4.3 LOGGING AND STATUS REPORTING PROCEDURE

During the exercise, NTWCs are requested to log the times of reception of TSP Bulletin Notification Messages and of accessing TSP websites, and of reporting their National Warning Status via the TSP websites. The logging can be done either directly via the online evaluation form or via log forms.

Detailed logging and reporting procedure:

1. Following the reception of each TSP Bulletin Notification Message, NTWCs should:
    - Log the time of reception of the TSP Notification Message, and how it was received (GTS, email, fax, SMS).
    - Use a web browser to access the password-protected website for the TSP given in the Notification Message and log the success or otherwise of this access.
2. Following the times at which the first simulated National Warning would be issued by the NTWC or NDMO in each country, and then every time the simulated National Warning status would change, the issuing agency should:
    - Report the National Tsunami Warning Status for their country via the web based “NTWC Warning Status” form available on each TSP website.
    - Log the time of the status report and which TSP's website was used for the report. NOTE: **Only one status report is required on each occasion**, using the form on **any** of the TSP websites.

4.4 WEBSITE PASSWORDS

The usernames and passwords for accessing each of the TSP password-protected websites are not included here. Please be reminded that the login credentials used by NTWCs for operational events and communications tests can be used to access IOWave23 bulletins. If any NTWC is unsure of their login credentials, please contact the IOTWMS Secretariat at iotwms@unesco.org. Please note that the websites are for operational exchanges between the TSPs and NTWCs and not intended to be viewed by the public.

4.5 ACTIONS IN CASE OF A REAL EVENT

All documentation and correspondence relating to this exercise is to be clearly identified as **Exercise IOWave23** and **For Exercise Purposes Only**. In the case of a real event occurring during the exercise, TSPs and NTWCs will alert the national authorities and the public that the exercise is over, and then issue their normal message products for the event. Such messages will be given full priority and all TSPs should stop the exercise immediately and send an Announcement Message to that effect.

4.6 RESOURCING

Although participating countries will have advance notice of the exercise and may elect to stand up a special dedicated shift to allow normal core business to continue uninterrupted, it is suggested that realistic resource levels be deployed to reflect some of the issues that are likely to be faced in a real event.

4.7 MEDIA INVOLVEMENT

The media have an important role in the national tsunami warning chains and raising tsunami awareness to the public. Member States are therefore encouraged to involve the media in the

exercise. Each country is responsible for the coordination of national in-country media operations and communications for the exercise. Media may be invited to participate or be simulated by exercise control staff.

The degree of media involvement in the exercise will vary from country to country, such as exercise of Media SOPs for communicating national Tsunami Warnings to the public in the national tsunami warning chain, a paragraph in a newspaper, television coverage of an evacuation drill or information transmitted to the public via media networks. In all cases, it is important to ensure that the media and public know about the exercise beforehand so that they do not mistake it for a real tsunami warning.

Participating agencies should seek guidance from their National Contact for Exercise IOWave23 regarding responses to individual approaches by in-country media concerning the exercise.

4.8 PRESS RELEASE

The UNESCO External Relations and Information department (ERI) will issue an international Media Advisory to alert the press of Exercise IOWave23 about one week before the exercise.

ICG/IOTWMS Member States should consider issuing one or two exercise press releases to their respective country's media in conjunction with the UNESCO release. Member States' press releases will give adequate alert to their country's population and give their local media time to conduct interviews and documentaries with participating exercise organisations in advance of the exercise. Annex I contains a sample press release that can be customised by Member States.

A second Member State press release, one week before the exercise, could provide a more detailed description of exercise activities to take place in-country.

5. POST-EXERCISE EVALUATION

5.1 EVALUATION AND DEBRIEFING

Following the exercise, participating countries are requested to complete the online Exercise Evaluation Survey. The evaluation aims to inform and facilitate individual participant country evaluations as well as the integrated IOWave23 Report. Please note that all participant countries are requested to complete the questionnaire online by 30 November 2023. The link to the questionnaire will be provided to the IOWave23 National Exercise Contacts before the exercise. The online survey will be set up in such a way that Member States can select which sections to answer based on the exercise scenario and the scope (full/limited) of their participation. This feedback will assist in the evaluation of Exercise IOWave23 and in the development of subsequent exercises.

The goal of exercise evaluation is to validate SOPs and to identify opportunities for improvement within the participating organisations. This is to be accomplished by collating supporting data, analysing the data to compare effectiveness against requirements, and determining what changes need to be made by participating organisations as well as the IOTWMS as a collective to support effective tsunami warning and decision-making.

Evaluation of this exercise will 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 and the community response.

Member States are encouraged to appoint Exercise Evaluators within each of their in-country agencies participating in the exercise, who would collect information during the exercise for the purposes of the Post-Exercise Evaluation. Member States are also encouraged to conduct formal exercise debriefs inclusive of all participants in their respective agencies, to facilitate a collective and official national evaluation. For details of how to conduct a national evaluation refer to Annex II.

5.2 EXERCISE OBSERVERS

It is recommended that independent and objective Exercise Observers be appointed at all exercise points to support the collection of such data. Observers are to be guided by the exercise objectives and the information required in the Post-Exercise Evaluation questionnaire. They should have expertise in the warning process for natural hazards and its implementation with respect to national warning chains and Standard Operating Procedures (SOPs), preferably with regards to tsunami warning.

International observers can be made available to Member States upon request and on the understanding that the Member States will fund the observers' travel costs and per diems. Benefits of international observers include providing an independent assessment of the in-country response and level of preparedness, recommendations on improvements to SOPs and communication linkages consistent with international best practice and help in evaluating the overall success of the exercise in an Indian Ocean-wide context.

The Terms of Reference for Exercise Observers are:

1. Provide a chronology of the events and actions that you observed.
2. Where appropriate, provide a statement of your observations in relation to each of the core exercise objectives 1–8 (as provided in section 3.2 above).
3. Comment on the testing and understanding of communication protocols between the TSPs, NTWCs, TWFPs and information dissemination points within countries.
4. Identify strengths in the tsunami warning and response chain.
5. Identify areas of potential improvement in the tsunami warning and response chain.
6. Comment on the extent that local communities participated in the exercise.
7. Provide examples of how community knowledge of tsunami preparedness and response has been demonstrated and may have increased as a result of the exercise.
8. Where communities have been recognised as Tsunami Ready under the UNESCO-IOC TRRP, communities demonstrate successful performance against the Tsunami Ready Indicators addressing milestones in tsunami assessment, preparedness, and response.

The guidelines for Exercise Observers are:

- Remain within the designated observation area,
- Do not interfere with exercise play,
- Follow the instructions of the organiser of the observer program in any of your interaction with the exercise participants, and
- Direct any questions to the organiser of the observer program or other designated individual.

Exercise Observers are requested to submit their reports to the ICG/IOTWMS Secretariat at iotwms@unesco.org by **30 November 2023**.

5.3 EXERCISE REPORT

In completing the online Post-Exercise Evaluation questionnaire, participating organisations are encouraged to note areas for improvement and actions that they plan to take. All official Post-Exercise Evaluation questionnaire responses are designated as “For Official Use Only” and will be restricted for use by the IOWave23 Task Team for the purpose of compilation of the Exercise Report.

The Exercise Report will be submitted to the ICG/IOTWMS for endorsement. Member States will have the opportunity to review and provide comments. The report will be published as Volume 2 of this IOC Technical Series no. 181, and will be in the public domain (i.e., available on the IOC website and UNESCO document e-repository). Member States may also choose to share their national evaluation reports with their public. The Exercise Report will help the ICG/IOTWMS to evaluate the status of implementation of the IOTWMS and areas requiring enhancement and capacity development.

6. REFERENCES

Documents are available from UNESCO’s digital library: unesdoc.unesco.org.

UNESCO/IOC 2009. Indian Ocean Tsunami Warning and Mitigation System (IOTWS). Exercise Indian Ocean Wave 2009: An Indian Ocean-wide Tsunami Warning and Communication Exercise. Paris, UNESCO, IOC Technical Series No. 88.

UNESCO/IOC 2011. Exercise Indian Ocean Wave 2011: An Indian Ocean-wide Tsunami Warning and Communication Exercise, 12 October 2011. Paris, UNESCO, IOC Technical Series No. 99.

UNESCO/IOC. 2013. How to Plan, Conduct and Evaluate UNESCO/IOC Tsunami Wave Exercises. Paris, UNESCO, IOC Manuals and Guides No. 58 rev.

UNESCO/IOC 2014. Exercise Indian Ocean Wave 2014: An Indian Ocean-wide Tsunami Warning and Communication Exercise, 9–10 September 2014. Paris, UNESCO, IOC Technical Series No. 113.

UNESCO/IOC. 2017a. Plans and Procedures for Tsunami Warning and Emergency Management. Paris, UNESCO, IOC Manuals and Guides, 76.

UNESCO/IOC 2017b. Exercise Indian Ocean Wave 2016: An Indian Ocean-wide Tsunami Warning and Communications Exercise, 7- 8 September 2016. Perth, UNESCO, IOC Technical Series No. 128.

UNESCO/IOC. 2019a. IOTWMS TSP Service Definition Document: Version 4.0. Paris, UNESCO, IOC Technical Series 146.

UNESCO/IOC. 2019b. Exercise Indian Ocean Wave 18: An Indian Ocean-wide Tsunami

Warning and Communications Exercise, 4–5 September 2018. Perth, UNESCO, IOC Technical Series No. 138.

UNESCO/IOC. 2020. Preparing for Community Tsunami Evacuations: from inundation to evacuation maps, response plans and exercises. Paris, UNESOC, IOC Manuals and Guides, 82.

UNESCO/IOC. 2022a. Standard Guidelines for the Tsunami Ready Recognition Programme. Paris, UNESCO, IOC Manuals and Guides,74.

UNESCO/IOC. 2022b. Exercise Indian Ocean Wave 2020: An Indian Ocean-wide Tsunami Warning and Communications Exercise, 6–20 October 2020. Perth, UNESCO, IOC Technical Series No. 153.

UNESCO/IOC. 2023. IOTWMS TSP Service Definition Document: Version 5.0. Paris, UNESCO, IOC Technical Series 146 rev. (Draft in Publication)

ANNEX I

SAMPLE PRESS RELEASE

TEMPLATE FOR NEWS RELEASE - USE AGENCY LETTERHEAD

Contact: *(insert name)* **FOR IMMEDIATE RELEASE** *(insert phone number) (insert date) (insert email address)*

INDIAN OCEAN-WIDE TSUNAMI EXERCISE SET FOR OCTOBER 2023

(Insert country name) will join countries from around the Indian Ocean Rim as a participant in mock tsunami scenarios on 4th, 11th, 18th, and 25th October 2023. *(Insert country name)* will exercise the Andaman Trench scenario on 4th October, Makran Trench scenario on 11th October, Heard Island Volcano scenario on 18th October, and/or Java Trench scenario on 25th October *(select appropriate scenario(s))*.

The purpose of this Indian Ocean-wide exercise is to increase tsunami preparedness, evaluate response capabilities in each country, and improve coordination throughout the region. The aim is to exercise the tsunami warning chain and responses to test preparedness.

"The 2004 Indian Ocean Tsunami and subsequent events in the Indian and Pacific Oceans have brought to the attention of the world the urgent need to be more prepared for such events," said *(insert name of appropriate official)*. "This important exercise will test the current procedures of the UNESCO-IOC Indian Ocean Tsunami Warning and Mitigation System and help identify operational strengths and weaknesses in each country."

The exercise, titled Exercise Indian Ocean Wave 2023 (IOWave23), will simulate Indian Ocean countries being put into a Tsunami Warning situation requiring decision-making by the authorities. It builds on previous Indian Ocean exercises conducted in 2009 (IOWave09), 2011 (IOWave11), 2014 (IOWave14), 2016 (IOWave16), 2018 (IOWave18), and 2020 (IOWave20) *and on prior national tsunami warning drills carried out on (insert dates) (delete if not applicable)*.

During the exercise the three UNESCO-IOC Indian Ocean Tsunami Service Providers (TSPs) of Australia, India and Indonesia will provide simulated tsunami threat information to all National Tsunami Warning Centres (NTWCs) in the Indian Ocean region. Each NTWC will then evaluate the information and formulate test national tsunami warnings, which will be disseminated to the disaster response agencies and other authorities participating in the exercise. *Due care will be taken to ensure the public is not inadvertently alarmed.*

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

Should any actual tsunami threat occur during the time of the exercise, the exercise will be terminated, and normal tsunami warning operations activated.

Following the exercise, a review and evaluation will be conducted by all participating countries and agencies.

"We see this exercise as an essential element in the routine maintenance of the UNESCO-IOC Indian Ocean Tsunami Warning and Mitigation System," said *(insert name of appropriate official)*.

“Our goal is to ensure the timely and effective notification of impending tsunamis, to educate communities at risk about safety preparedness, and to improve our overall coordination. We will evaluate what works well, where improvements are needed, make necessary changes, and continue to implement best-practices.”

The exercise is in the Work Plan of the UNESCO-IOC Intergovernmental Coordination Group of the Indian Ocean Tsunami Warning and Mitigation System (ICG/IOTWMS). ICG/IOTWMS is a body of UNESCO Exercise IOWave23 Information: www.iowave.org.

ANNEX II

EXERCISE FORMAT

TYPES OF EXERCISE

1. An Orientation Exercise lays the groundwork for a comprehensive exercise programme. It is a planned event, developed to bring together individuals and officials with a role or interest in multi-hazard response planning, problem solving, development of standard operational procedures (SOPs), and resource integration and coordination. An Orientation Exercise will have a specific goal and written objectives and result in an agreed upon Plan of Action.

2. A Drill is a planned activity that tests, develops, and/or maintains skills in a single or limited emergency response procedure. Drills generally involve operational response of single departments or agencies, organisations, or facilities, but may be a subset of full-scale exercises. Drills can involve internal notifications and/or field activities. Limited evacuation may or may not be conducted, such as within a school, pilot hotel, or village.

3. A Tabletop Exercise is a planned activity in which local officials, key staff, and organisations with disaster management responsibilities are presented with simulated emergency situations. It is usually informal, in a conference room environment, and is designed to elicit constructive discussion from the participants to assess plans, policies, and procedures. Individuals are encouraged to discuss decisions based on their organization's Standard Operating Procedures (SOPs) with emphasis on slow-paced problem solving, rather than rapid, real-time decision-making. A Tabletop Exercise should have specific goals, objectives, and a scenario narrative.

4. A Functional Exercise is a planned activity designed to test and evaluate individual functions, multiple activities within a function, or interdependent groups of functions among various agencies. It is based on a simulation of a realistic emergency situation. The Functional Exercise gives the decision-makers a fully simulated experience of being in a major disaster event. It should take place at the appropriate coordination locations (e.g., warning centres and emergency operations centres) and activate all the appropriate members designated by the plan. Organisations should test their SOPs using real-time simulation tsunami bulletins. Public evacuations may or may not be included. A Functional Exercise should have specific goals, objectives, and a scenario narrative.

5. A Full-scale Exercise is the culmination of a progressive exercise programme that has grown with the capacity of the community to conduct exercises. A Full-Scale exercise is a planned activity in a "challenging" environment that encompasses most of the tsunami warning and emergency management functions, and involves multiple layers of government (national, provincial, local). This type of exercise involves the actual mobilization and deployment of the appropriate personnel and resources needed to demonstrate operational capabilities. DMOs (Disaster Management Office) and other local command centres are required to be activated. It tests all aspects of emergency response and should demonstrate inter-agency cooperation. A full-scale exercise is the largest, costliest, and most complex exercise type. It may or may not include public evacuations.

NATIONAL EXERCISE EVALUATION

It is recommended that both a hot and a cold debrief be held following the exercise. Held immediately after an exercise, a hot debrief is an opportunity for all participants to provide feedback while the exercise is still fresh in their minds. A suggested format for this is:

- Have a short break for about 10 to 20 minutes after the end of the exercise.
- The in-country/agency Exercise Director gives his or her initial feedback.
- Obtain participant round-table feedback.
- Evaluators provide their feedback.
- Provide appropriate acknowledgements.

A cold debrief is a more formal debrief held within four weeks following the exercise. The debrief process should include:

- What happened during the exercise?
- What went well?
- What needs improvement?
- What plans, procedures or training programmes need amendments?
- What follow up is required, including identifying any capability gaps for future capacity building?
- Was the exercise realistic?
- How could the exercise have been improved?

ANNEX III

LIST OF ACRONYMS

ETA	Estimated Tsunami Arrival Times
EW4ALL	UN Early Warnings For All Initiative
ICG/IOTWMS	Intergovernmental Coordination Group for the Indian Ocean Tsunami Warning and Mitigation System
IDDR	Intergovernmental Oceanographic Commission
IOC	International Day of Disaster Risk Reduction
IOT24	Indian Ocean Tsunami 2004
IOTIC	UNESCO IOC Indian Ocean Tsunami Information Centre
IOTWMS	Intergovernmental Coordination Group for the Indian Ocean Tsunami Warning and Mitigation System
IOWave23	Indian Ocean Exercise Wave 2023
LDMO	Local Disaster Management Offices
PDMO	Provincial Disaster Management Office
NDMO	National Disaster Management Offices
NTWC	National Tsunami Warning Centre
PHTA	Probabilistic Tsunami Hazard Assessment
SOP	Standard Operating Procedures
T2	Estimated Tsunami Arrival Times (ETAs) for the first wave above the Threat Level of 0.5 m
TOWS-WG	UNESCO-IOC Working Group on Tsunamis and Other hazards related to sea level Warning and mitigation Systems
TSP	Tsunami Service Providers
TRRP	Tsunami Ready Recognition Programme
TWFP	Tsunami Warning Focal Points
UNESCAP	United Nations Economic and Social Commission for Asia and the Pacific
UNESCO	United Nations Educational, Scientific and Cultural Organization

UTC	Coordinated Universal Time
WHO	World Health Organization Emergency Operations Centre
WTAD	World Tsunami Awareness Day