



2.a. Introduction to TSP Services and Products, including tsunamis generated by non-seismic and complex sources, and NAVAREA products

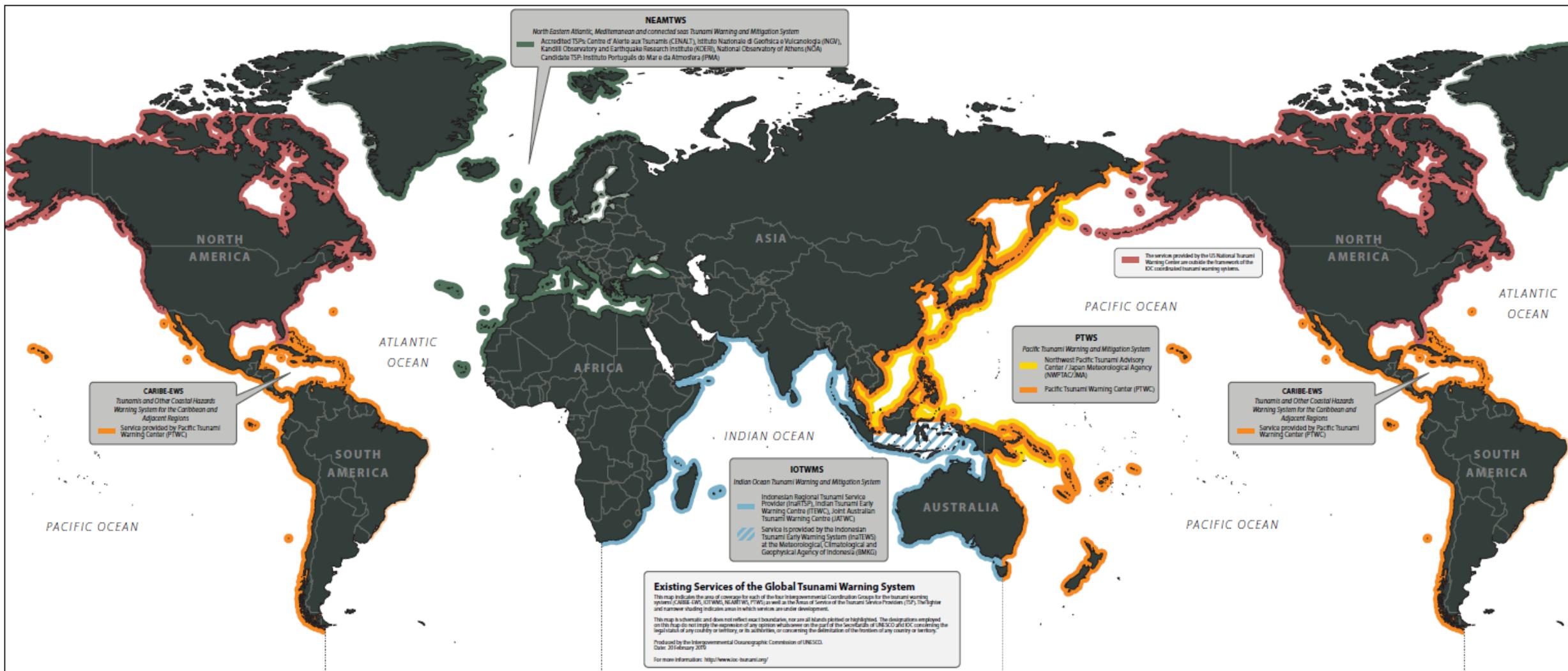
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Session Organization

- **Introduction to TSP Services and Products , NAVAREA Service**
- **Tsunamis generated by non-seismic and complex sources, associated products**

Global Tsunami Warning System

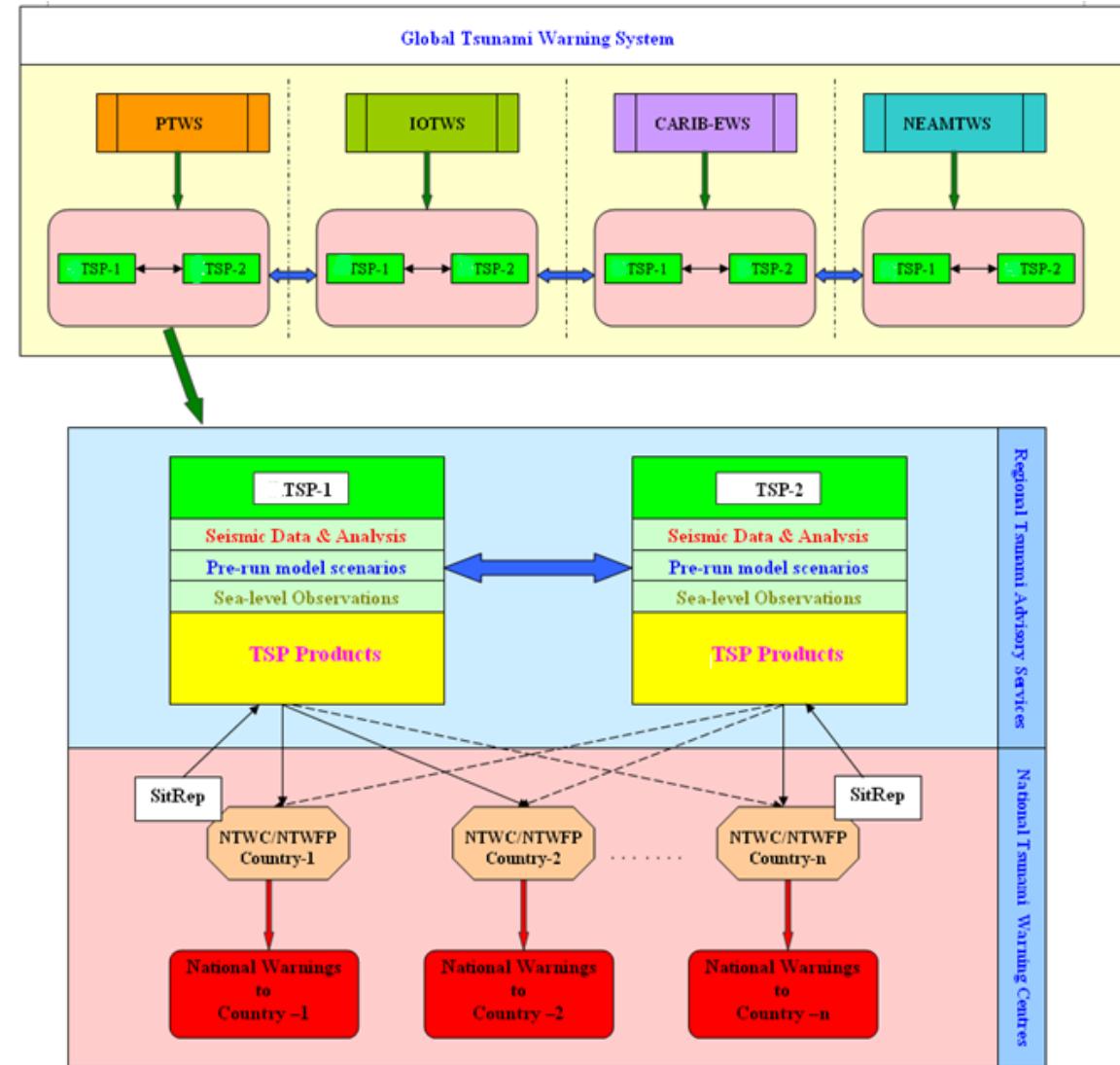


Source: TSUNAMI WATCH OPERATIONS , Global Service Definition Document, IOC Technical series 180

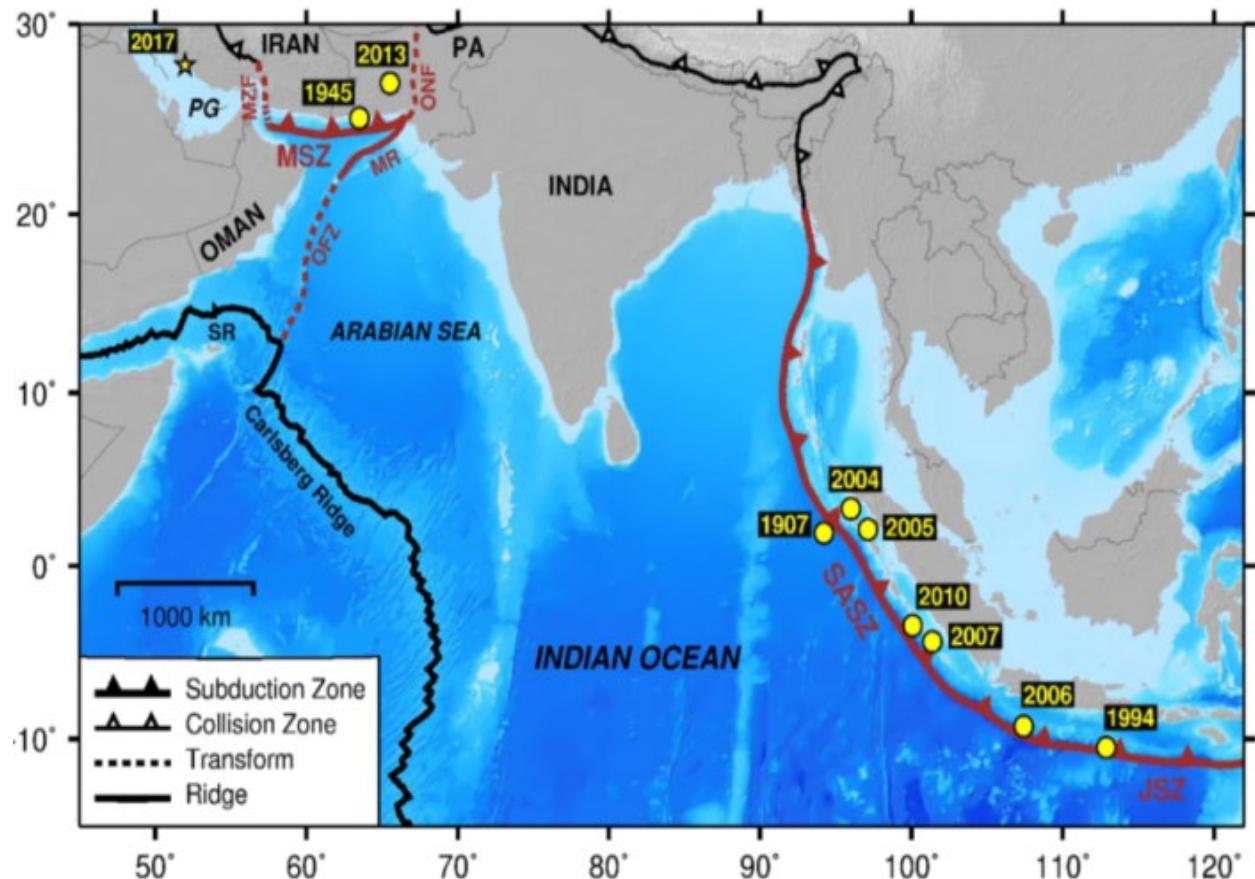
Pre-IOWave25 Workshops on Standard Operating Procedures for NTWCs and DMOs
Hybrid – August 2025

Structure of Each Regional Tsunami Warning System

- Regional Tsunami Warning Systems operating in each Intergovernmental Coordination Group (viz. IOTWMS, PTWS, NEAMTWS, CARIBE-EWS) are the building blocks of a global TWS.
- Each TWS consists of one or more Tsunami Service Providers (TSPs) and multiple National Tsunami Warning Centres (NTWCs) e.g. IOTWMS has 3 TSPs and 27 NTWCs
- TSPs generate real-time products for NTWCs within their region.
- Having multiple TSPs provides redundancy for NTWCs ("system of systems" concept)
- NTWCs are solely responsible for providing warnings to their citizens based on their analysis of the situation
- IOTWMS TSP products are harmonized:
 - Consistent bulletin types, formats, information content and terminology
 - Consistent tsunami wave threat threshold and coastal zone definitions for whole Indian Ocean
 - Consistent content in TSP websites (but different "looks")

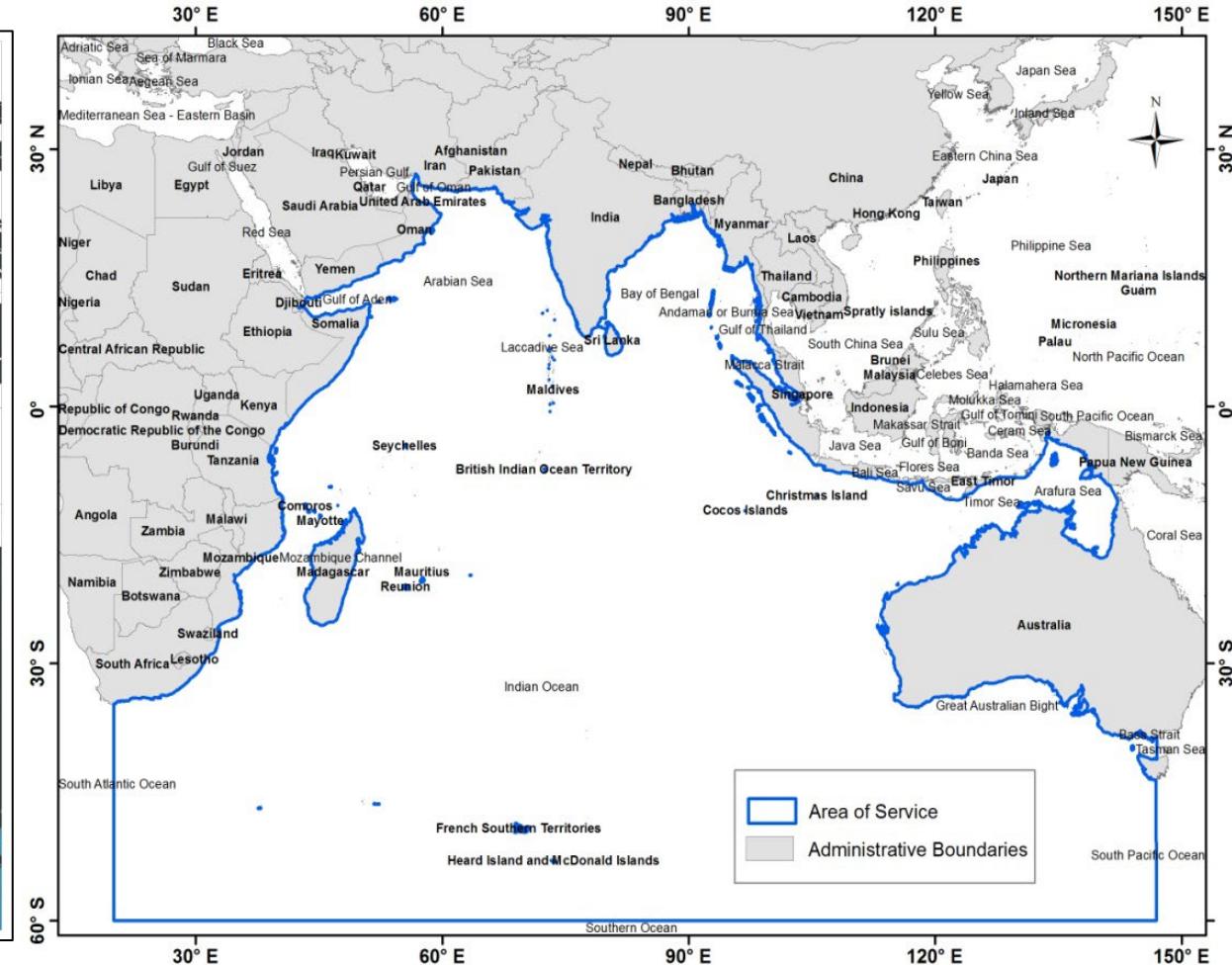
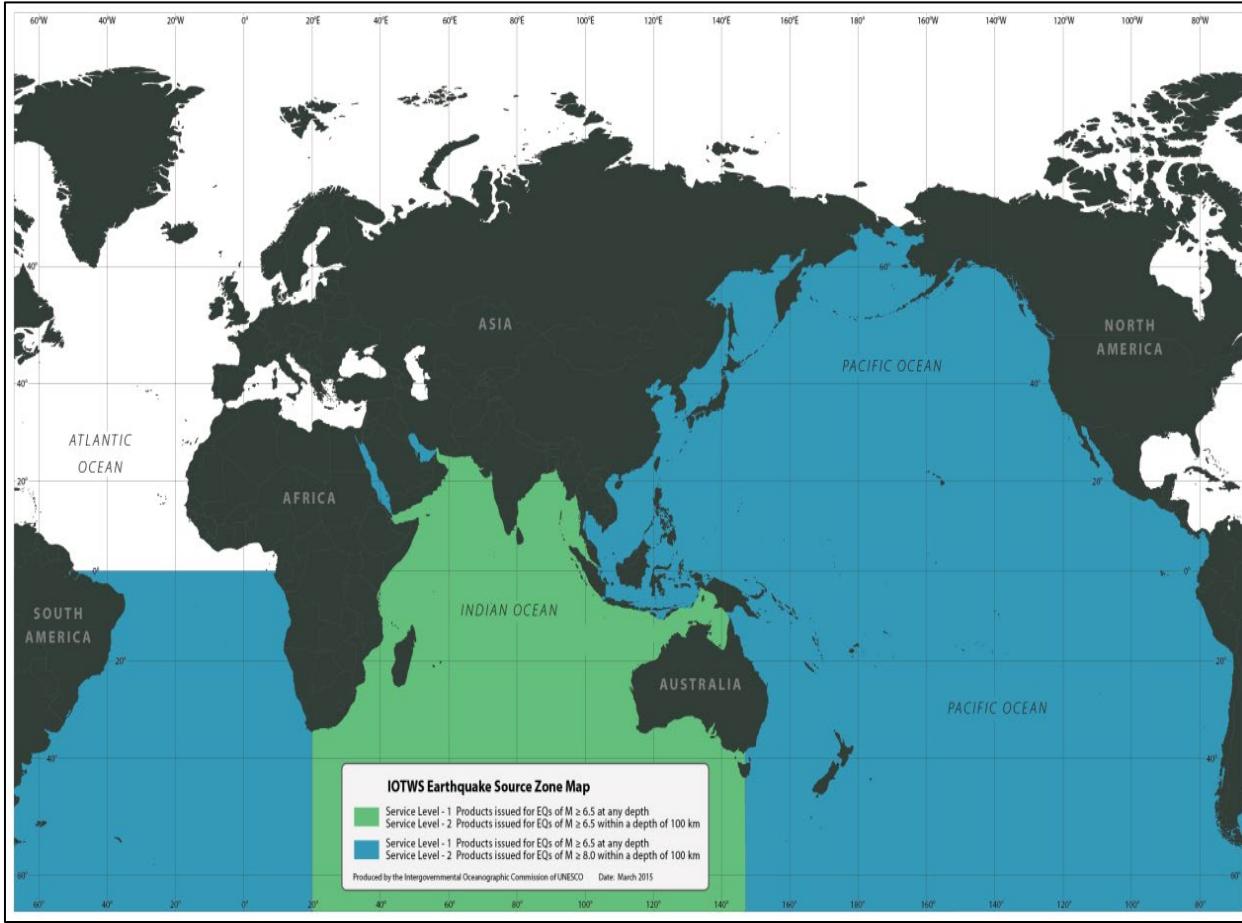


Tsunamigenic Sources in The Indian Ocean



- Subduction Zone: Indian and Australian plates are moving north and eastward relative to Eurasian plate forming a convergent boundary
- Major Subduction Zones
 - Sumatra Andaman Subduction Zone ~6000 km
 - Makran Subduction Zone ~900 km
- Sumatra Andaman Subduction Zone (SASZ) – From Himalayan front southward through Myanmar, Andaman and Nicobar Islands, Sumatra, Java and the Sunda Islands (Sumba, Timor), to the north of Western Australia
- Makran Subduction Zone (MSZ) – lies between southeastern Iran and southwestern Pakistan

IOTWMS Earthquake Source zone and Area of Service



TSP Service Definition Document

WG2 maintains the SDD and update it time to time.

It defines the **role and Responsibilities** of Tsunami Service Providers

It defines **Service Levels and commencement of service**

- Service Level-I (EQ Information)
- Service Level –II (Tsunami Threat Bulletins and Threat Maps)

Harmonize the TSP Products to have

- Consistent bulletin types, formats, information content and terminology
- Consistent tsunami wave threat threshold and coastal zone definitions for the Indian Ocean
- Consistent content in TSP websites

TSP Key Performance Indicators (KPIs)

The **latest version 5.0** introduced the **New TSP product templates** to issue for the **NAVAREA Coordinators**; provision of new **templates for use by TSPs during the non-seismic/complex sources**.

Intergovernmental Oceanographic Commission
Technical Series

146

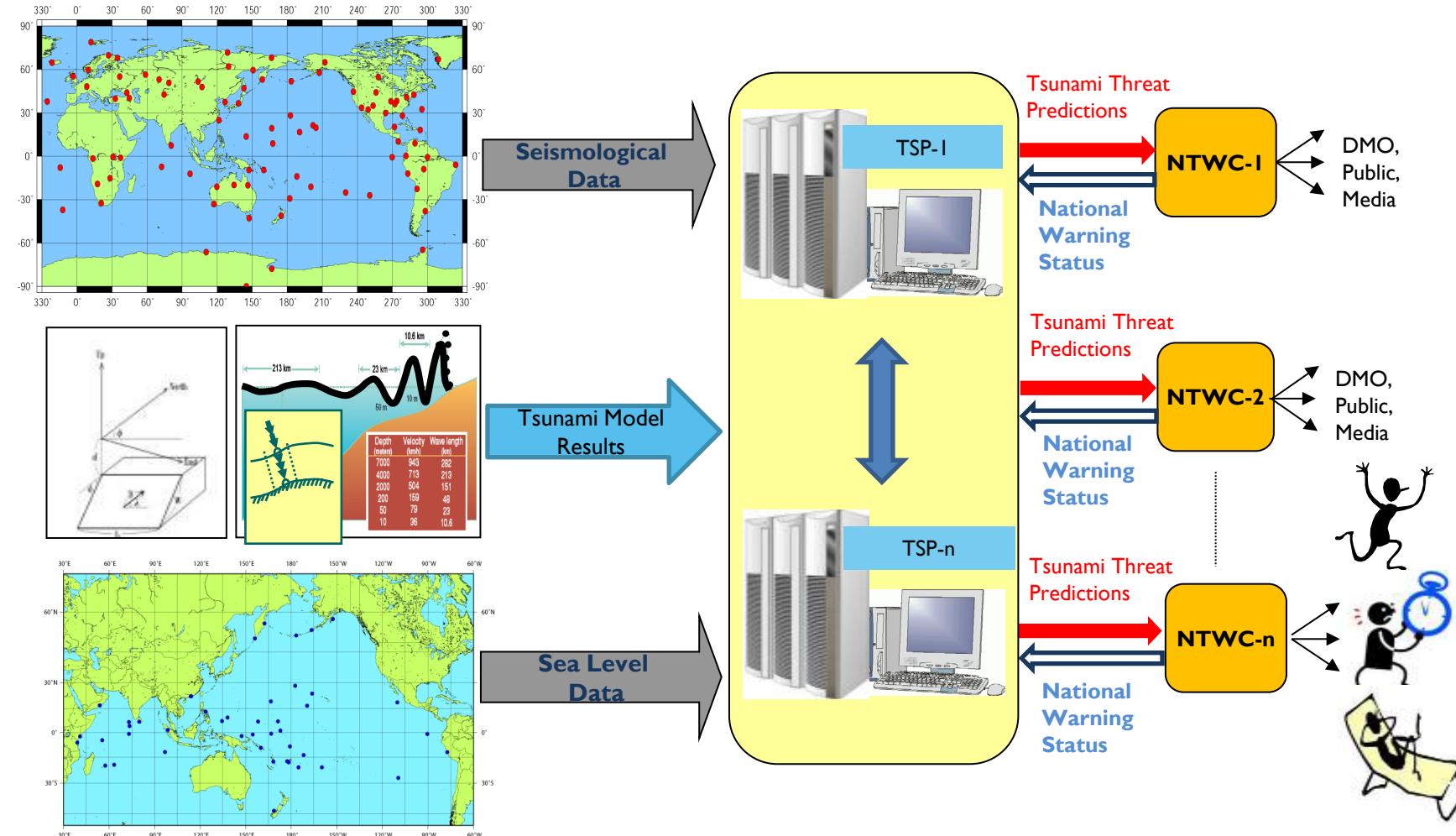


**Definition of Services
provided by Tsunami Service
Providers of the IOTWMS**

Version 5.0

UNESCO

Operational Elements of TSPs

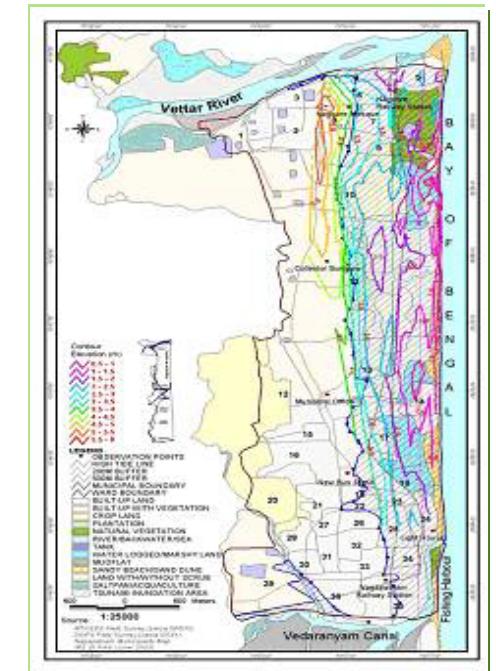
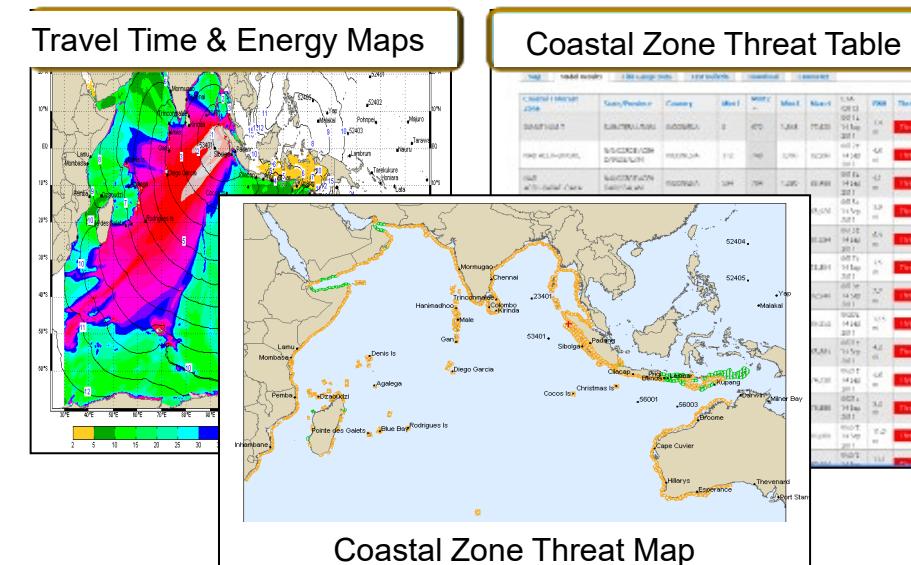


Roles and Responsibilities of TSPs

- Monitor seismic and Non-Seismic sources and provide timely initial information for those that could generate a tsunami (i.e. "potentially tsunamigenic")
- Generate specific coastal-zone threat information for all Indian Ocean countries using tsunami wave propagation models based on the earthquake/non-seismic source information, and later confirmed or adjusted based on sea level observations
- Generate timely tsunami Exchange Bulletins and Threat Maps for use by NTWCs in their preparation and issuing of national tsunami warnings for their countries
- Monitor tsunami propagation and report updated tsunami wave amplitude observations
- Receive National Warning Status Reports from NTWCs and display on TSP Public Webpages
- Issue Public Bulletins containing details of the earthquake, national warning statuses as reported by the NTWCs, and tsunami wave observations
- Serve as a backup centre to other TSPs and as an NTWC for its own country

TSP Service Levels for IOTWMS

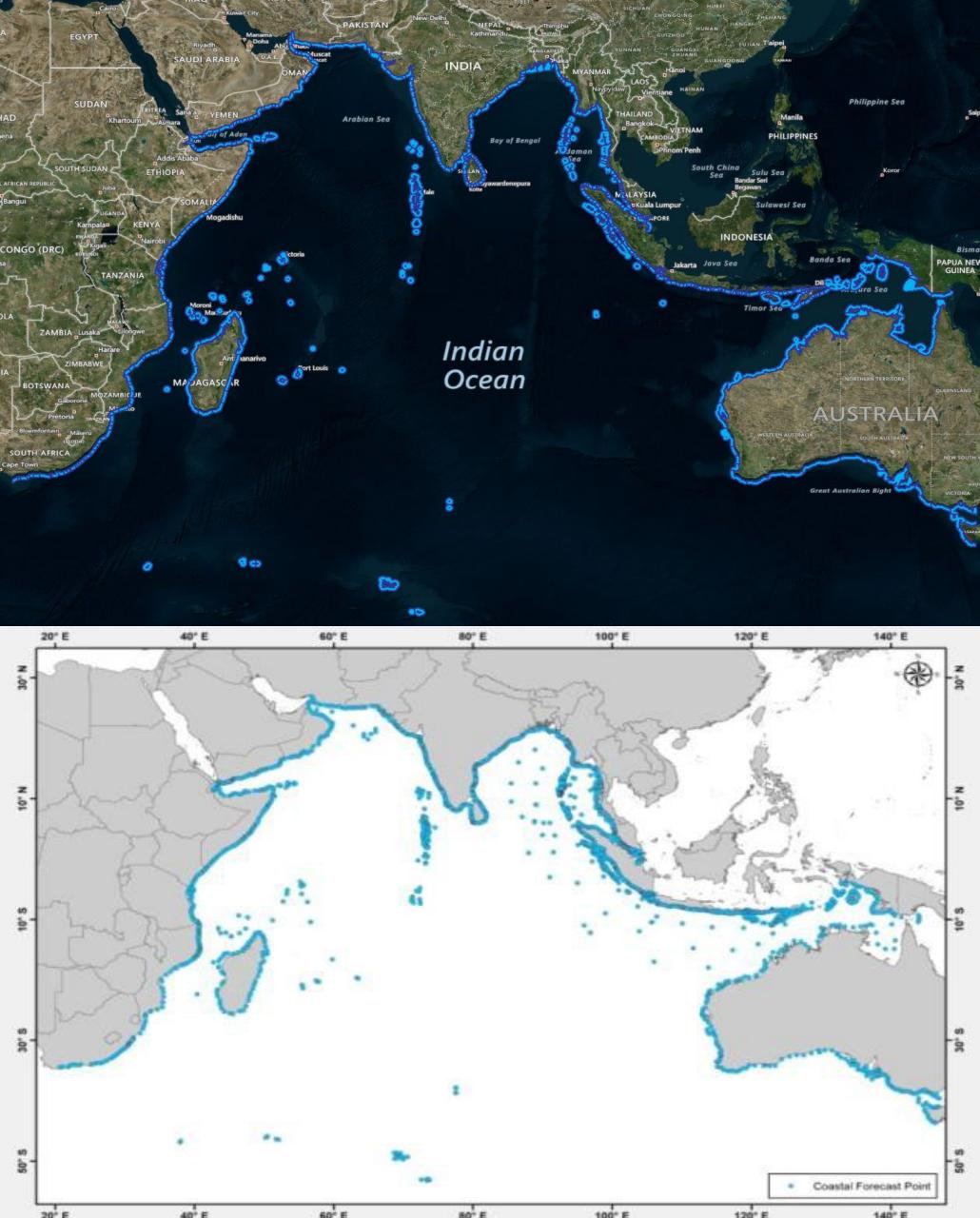
- **Service Level 1** – Earthquake Bulletins (in operation since 2009)
- **Service Level 2** – Tsunami Threat Bulletins and Threat Maps (in operation since 2011)
- **Service Level 3** – Inundation Mapping (not yet in operation)



IOTWMS Coastal Forecast Zones

- Total Coastal Forecast Zones (CFZs) are 581.
- Total Coastal Forecast Points (CFPs) are 2251.
- Each coastal forecast zone is represented by a seamless buffer zone along the coast and 50 km in width across the coast.
- The zone starts from the coastal district administrative boundary instead of 30 m bathymetry as in earlier versions. Divisions made as per Global Administrative Boundaries (GADM-V3.6)
- Updated Version CFZ V 2018 Mar 14

Three TSPs are using the same CFZ shape file maintained by TSP India.



Commencement of TSP bulletins

- TSP services contain **Tsunami Threat Information** for NTWCs – **they are not Warnings**
- **National Tsunami Warnings** are the **responsibility of the NTWCs** (unless bilateral arrangements are established between an NTWC and a TSP)
- Issue SL-1 (earthquake information) bulletin for all IOTWMS Earthquake Source Zone (Indian Ocean, Pacific Ocean, South Atlantic) events of magnitude ≥ 6.5
- SL-2 (threat assessment) bulletins

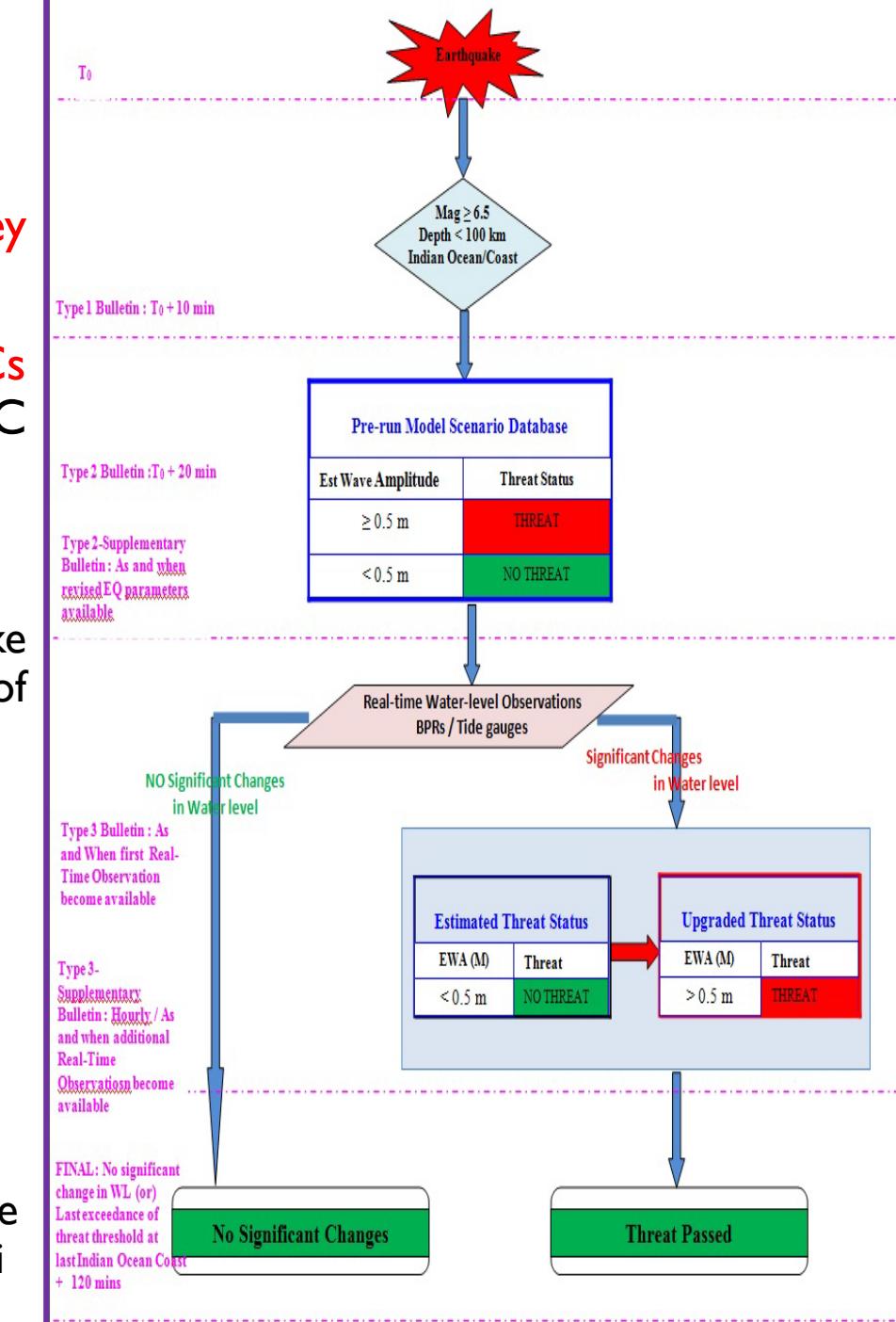
$M \geq 6.5$ in the Indian Ocean

[or]

$M \geq 8.0$ in the Pacific and South Atlantic Oceans

[or]

Any tsunamigenic events (Non-seismic / Complex sources) (i.e.; Volcanos, Marine landslides, etc.) within ESZ that may have probability/likely to generate tsunami in the Indian Ocean Basin



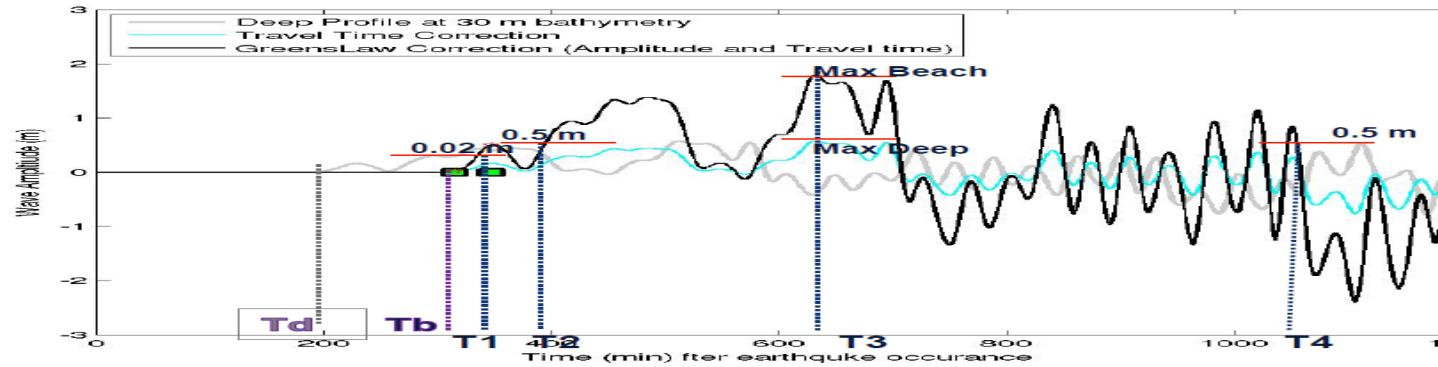
TSP Bulletins- Bulletin Types and Content

- **TSP Tsunami Bulletins** for NTWCs are placed on password-protected websites, in the form of:
 - Earthquake Bulletins
 - Tsunami Threat Assessment Bulletins:
 - No Threat Bulletin
 - Potential Threat Bulletin
 - Confirmed Threat Bulletin with Tsunami Wave Observations
 - Final Bulletin (Threat Passed)
- TSPs transmit **Notification Messages** to NTWCs (by GTS, email, fax, SMS) notifying that the bulletins have been generated and are available on the TSP websites

Bulletin type	Information	Time of issue
TYPE 1 Earthquake Bulletin	Earthquake Information , plus a qualitative threat assessment (e.g. “,,this earthquake may be capable of generating a tsunami...”)	Target: within 10 minutes
TYPE 2 Threat Assessment Bulletin	No Threat Bulletin , based on assessment using model scenarios Potential Threat Bulletin , based on assessment using wave models. Contains specific threat information for each Indian Ocean coastal zone.	Target: within 20 minutes
TYPE 3 Threat Confirmation Bulletin	Confirmed Threat Bulletin , based on real-time sea-level observations confirming a tsunami was generated . Contains specific threat information for each coastal zone.	<ul style="list-style-type: none"> • When the first real-time sea level observation confirming tsunami waves is available • Then hourly updates, or when significant new real-time sea level observations are available
TYPE 4 Final Bulletin	THREAT PASSED – all zones.	120 mins after the last exceedance of 0.5 M threat threshold at last IO country

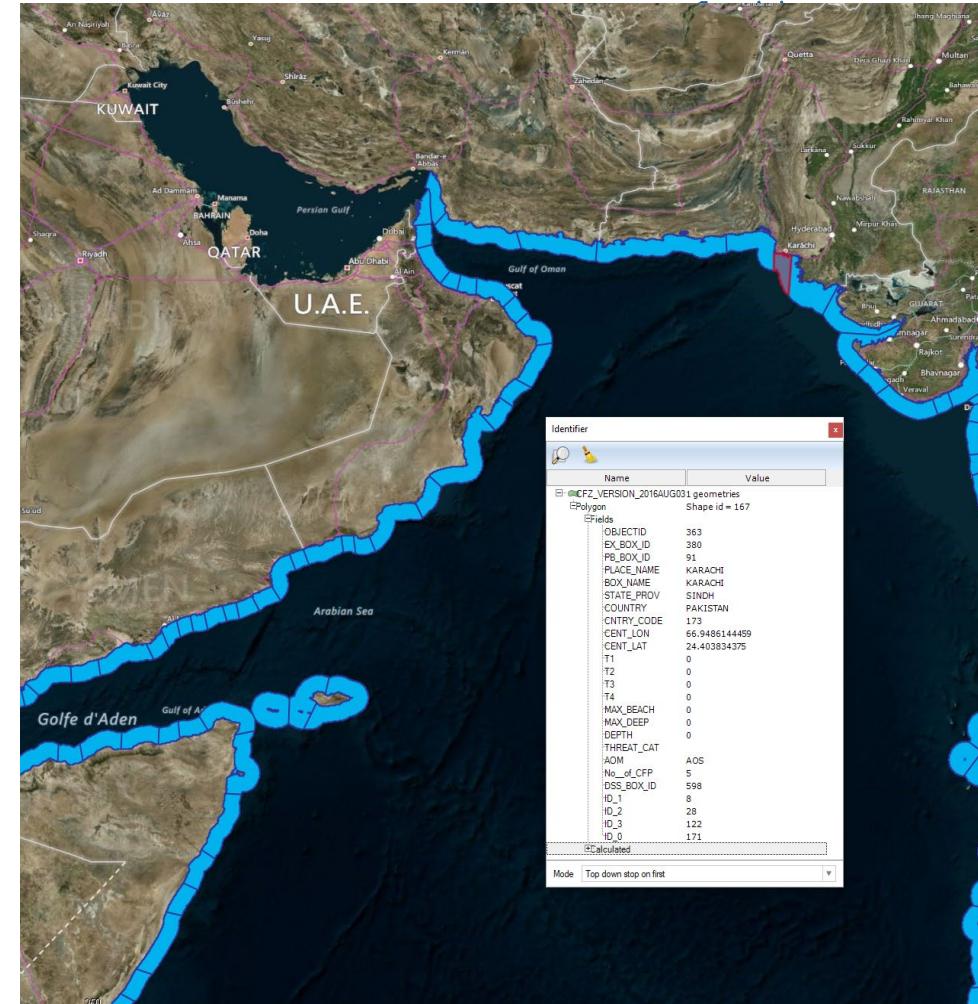
Tsunami Prediction Information

All predictions are provided for each **Coastal Forecast Zone**



Predicted Wave Arrival Times:

- T1** : Time of arrival of first amplitude $> +2\text{cm}$
- T2** : Time of arrival of first wave over $+50\text{cm}$ amplitude on the beach
- T3** : Time of arrival of largest wave ("max beach")
- T4** : Time of arrival of last wave over $+50\text{cm}$ amplitude
- MAX_BEACH** = Expected Tsunami Wave Height at beach in meters
- Threat Category**: Threat or No Threat based on 0.5 m threshold at the coast.



TSP Websites for NTWCs

TSP Password-Protected Websites containing all the generated tsunami bulletins, threat maps and threat tables, plus the NTWC Warning Status Reporting Form.

IOTWMS-TSP Australia

Tsunami Service Provider for the Indian Ocean Tsunami Warning and Mitigation Service (IOTWMS)
 A service provided by the Joint Australian Tsunami Warning Centre (JATWC), operated by the Australian Bureau of Meteorology and Geoscience Australia

Recent Events

14:27 UTC 02 July 2023 Mag 6.7
Tonga Islands
1.Earthquake Bulletin 1038UTC 02 Jul 2023

EARTHQUAKE: Tonga Islands 10:27 UTC 02 July 2023 Mag 6.7

18:06 UTC 15 June 2023 Mag 7.0

18:06 UTC 07 June 2023 Mag 9.0

NICOBAR ISLANDS, INDIA REGION *** TEST EVENT ***

14:56 UTC 21 May 2023 Mag 6.8

Prince Edward Islands Region

01:50 UTC 20 May 2023 Mag 7.3

Southeast of Loyalty Islands

02:57 UTC 19 May 2023 Mag 7.6

Southeast of Loyalty Islands

16:02 UTC 10 May 2023 Mag 7.5

Tonga Islands

03:13 UTC 28 April 2023 Mag 6.5

South of Fiji Islands

This bulletin applies to areas within and bordering the Indian Ocean. It is issued in support of the UNESCO/IOC Indian Ocean Tsunami Warning and Mitigation System (IOTWMS).

20:00 UTC 24 April 2023 Mag 6.9

Southern Sumatra, Indonesia

08:41 UTC 24 April 2023 Mag 7.2

Kermadec Islands Region

IOTWMS-TSP AUSTRALIA has detected an earthquake with the following preliminary information:

Magnitude: 6.7 Mwp
Depth: 227km
Date: 02 Jul 2023
Origin Time: 1027 UTC
Latitude: 17.8775
Longitude: 174.982W
Location: Tonga Islands

2. EVALUATION

Although this earthquake may be capable of generating a tsunami in the Pacific or South Atlantic Ocean, based on historical data and tsunami modelling it is not capable of generating a tsunami affecting the Indian Ocean region. However IOTWMS-TSP AUSTRALIA will monitor the situation and may issue further bulletins if new information becomes available.

<https://tsunami.incois.gov.in/TEWS/TSPindex.php>

Indian Tsunami Early Warning System

Ministry of Earth Sciences - Government of India

ESSO

INCOIS

Home About TSP Archived Events COMMS TEST

Seismic Activity for past 90 days with magnitude $\geq 6.5M$

EARTHQUAKE: Tonga Islands 10:27 UTC 02 July 2023 Mag 6.7

INFORMATION FOR BULLETIN 1.Earthquake Bulletin 1038UTC 02 Jul 2023

Exchange Bulletins Threat Map Threat Table Deep Water Wave Amplitude Map Travel Times Map NTWC Status Reporting Form Other

Origin Time(UTC) Region Name Latitude(Deg) Longitude(Deg) Depth(km) Magnitude Regional Bulletins

02 Jul 2023 10:27:00	Tonga Islands	17.795	175.17W	243.0	6.5M	Public Exchange
15 Jun 2023 18:06:00	South of Fiji Islands	23.095	176.96W	193.0	6.6M	Public Exchange
20 May 2023 01:50:00	Southeast of Loyalty Islands	22.945	170.51E	10.0	7.0M	Public Exchange
19 May 2023 02:57:00	Southeast of Loyalty Islands	23.175	170.75E	10.0	7.4M	Public Exchange
10 May 2023 16:02:00	Tonga Islands	15.655	174.56W	220.0	7.1M	Public Exchange
24 Apr 2023 20:00:00	Southern Sumatra, Indonesia	.69S	98.71E	10.0	6.8M	Public Exchange

<https://tsunami.incois.gov.in/TEWS/TSPindex.php>

AGENCY FOR METEOROLOGY CLIMATOLOGY AND GEOPHYSICS

Indonesia - Tsunami Service Provider

You are logged as: USER

Home Public Bulletin About InaTSP Seismic Network Contact Us Logout

Earthquake Event List

Earthquake Event List Earthquake Event Map

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Origin Time (UTC)	Mag	Depth (km)	Latitude	Longitude	Location	Type	Bulletin Number	Bulletin Type	Event Group
2023-07-02 10:27:27	7.2	82	17.795	174.75W	Tonga Islands	REAL EVENT	1	EARTHQUAKE BULLETIN	202307021027
2023-06-15 18:06:22	6.9	161	22.82S	176.44W	South of Fiji Islands	REAL EVENT	1	EARTHQUAKE BULLETIN	202306151806
2023-06-07 06:00:09	9.0	10	7.2N	92.9E	Nicobar Islands, India Region	TEST (Com/TEST-Jun-2023)	4	FINAL BULLETIN	202306070600C0M
2023-06-07 06:00:09	9.0	10	7.2N	92.9E	Nicobar Islands, India Region	TEST (Com/TEST-Jun-2023)	3,1	CONFIRMED THREAT	202306070600C0M
2023-06-07 06:00:09	9.0	10	7.2N	92.9E	Nicobar Islands, India Region	TEST (Com/TEST-Jun-2023)	2	THREAT ASSESSMENT	202306070600C0M
2023-06-07 06:00:09	9.0	10	7.2N	92.9E	Nicobar Islands, India Region	TEST (Com/TEST-Jun-2023)	1	EARTHQUAKE	202306070600C0M
2023-05-20 01:50:59	7.5	17	22.86S	170.57E	Southeast of Loyalty Islands	REAL EVENT	1	EARTHQUAKE BULLETIN	202305200150
2023-05-19 02:57:05	7.9	28	23.13S	170.81E	Southeast of Loyalty Islands	REAL EVENT	1	EARTHQUAKE BULLETIN	202305190257
2023-05-10 16:02:01	7.5	224	15.67S	174.48W	Tonga Islands	REAL EVENT	1	EARTHQUAKE BULLETIN	202305101602
2023-04-20 03:13:36	6.5	589	24.95S	170.94E	South of Fiji Islands	REAL EVENT	1	EARTHQUAKE BULLETIN	202304200313
2023-04-24 20:00:57	6.9	84	0.93S	90.39E	Southern Sumatra, Indonesia	REAL EVENT	2	THREAT ASSESSMENT	202304242000
2023-04-24 20:00:57	7.3	84	0.93S	98.39E	Southern Sumatra, Indonesia	REAL EVENT	1	EARTHQUAKE BULLETIN	202304242000
2023-04-24 00:41:56	7.0	62	29.98S	177.29W	Kermadec Islands, New Zealand	REAL EVENT	1	EARTHQUAKE BULLETIN	202304240041
2023-04-14 09:55:48	6.5	604	6.12S	112E	Java, Indonesia	REAL EVENT	1	EARTHQUAKE BULLETIN	202304140955
2023-04-03 03:06:55	6.7	75	53N	158.3E	Near East Coast of Kamchatka	REAL EVENT	1	EARTHQUAKE	202304030305

<https://tsunami.incois.gov.in/TEWS/TSPindex.php>

TSP- Australia

<https://reg.bom.gov.au/tsunami/rtsp/>

TSP- India

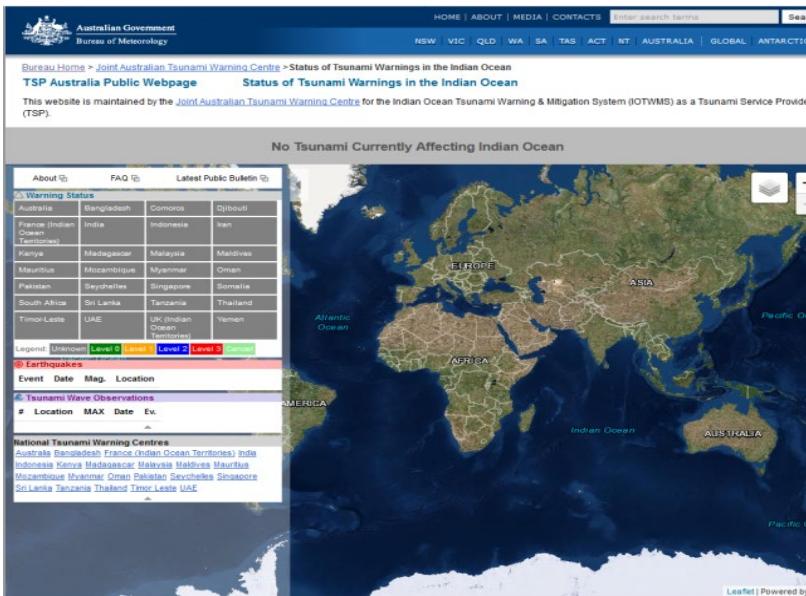
<https://tsunami.incois.gov.in/TEWS/TSP>

TSP- Indonesia

<https://rtsp.bmkg.go.id/>

TSP Websites for Public

TSP Public Websites and Public Bulletins with information about the tsunami source, tsunami wave observations, and the **national warning status of each Indian Ocean country**.



Australian Government Bureau of Meteorology

TSP Australia Public Webpage

Status of Tsunami Warnings in the Indian Ocean

This website is maintained by the [Joint Australian Tsunami Warning Centre](#) for the Indian Ocean Tsunami Warning & Mitigation System (IOTWMS) as a Tsunami Service Provider (TSP).

No Tsunami Currently Affecting Indian Ocean

Legend: Uninformed | Level 0 | Level 1 | Level 2 | Level 3 | Green

Earthquakes

#	Location	MAX Date	Ev.
1	Australia	2025-08-04	1
2	Indonesia	2025-08-04	1
3	Maldives	2025-08-04	1
4	Sri Lanka	2025-08-04	1
5	Thailand	2025-08-04	1
6	Yemen	2025-08-04	1

Tsunami Wave Observations

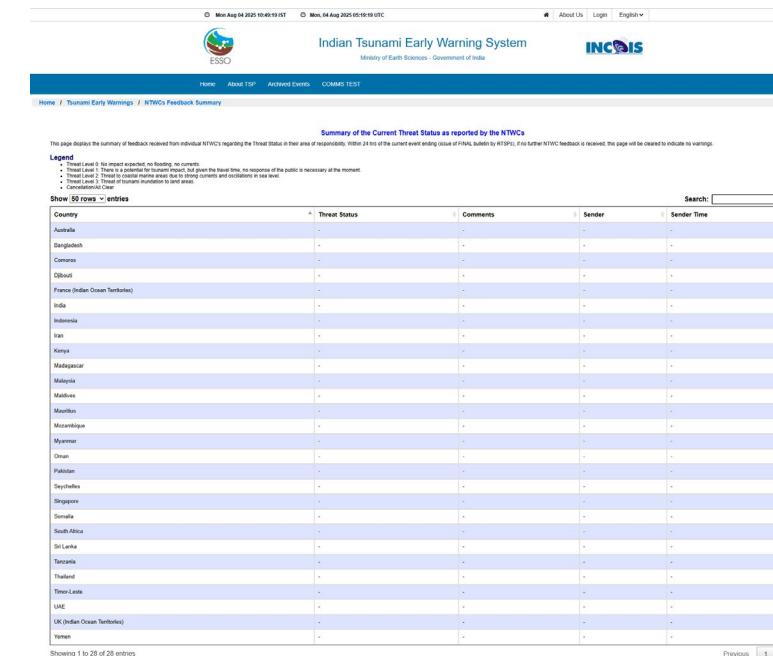
#	Location	MAX Date	Ev.
1	Australia	2025-08-04	1
2	Indonesia	2025-08-04	1
3	Maldives	2025-08-04	1
4	Sri Lanka	2025-08-04	1
5	Thailand	2025-08-04	1
6	Yemen	2025-08-04	1

National Tsunami Warning Centres

#	Country	Location	MAX Date	Ev.
1	Australia	Joint Australian Tsunami Warning Centre	2025-08-04	1
2	India	Joint Indian Tsunami Warning Centre	2025-08-04	1
3	Maldives	Joint Maldives Tsunami Warning Centre	2025-08-04	1
4	Sri Lanka	Joint Sri Lankan Tsunami Warning Centre	2025-08-04	1
5	Thailand	Joint Thailand Tsunami Warning Centre	2025-08-04	1
6	Yemen	Joint Yemeni Tsunami Warning Centre	2025-08-04	1

Leaflet | Powered by [OpenStreetMap](#)

TSP- Australia



Indian Tsunami Early Warning System

INCOIS

Summary of the Current Threat Status as reported by the NTWCs

This page displays the summary of feedback received from individual NTWCs regarding the Threat Status in their area of responsibility. Within 24 hrs of the current event ending (issue of FINAL bulletin by ITPSI), if no further NTWC feedback is received, this page will be cleared to indicate no warning.

Legend:

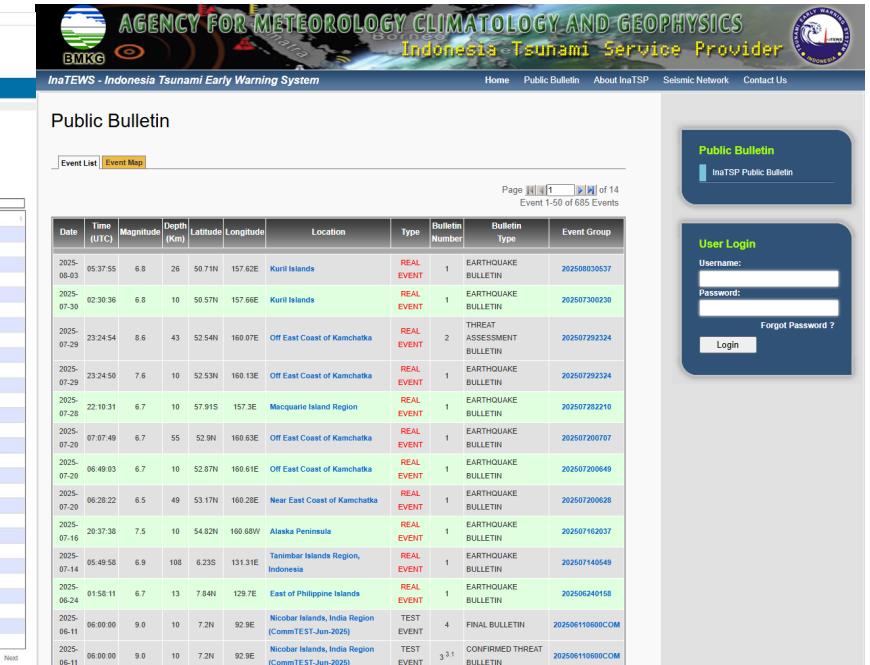
- Threat Level 0: No impact expected, no flooding, no currents.
- Threat Level 1: There is a potential for tsunami impact, but given the travel time, no response of the public is necessary at the moment.
- Threat Level 2: There is a potential for tsunami impact, but given the travel time, no response of the public is necessary at the moment.
- Threat Level 3: Threat of tsunami inundation to land areas.
- Comments: Additional information provided by the NTWC.

Event List | **Event Map**

Country	Threat Status	Comments	Sender	Sender Time
Australia	-	-	-	-
Bangladesh	-	-	-	-
Comoros	-	-	-	-
Djibouti	-	-	-	-
France (Indian Ocean Territories)	-	-	-	-
India	-	-	-	-
Indonesia	-	-	-	-
Iran	-	-	-	-
Kenya	-	-	-	-
Maldives	-	-	-	-
Mauritius	-	-	-	-
Myanmar	-	-	-	-
Oman	-	-	-	-
Pakistan	-	-	-	-
Sri Lanka	-	-	-	-
Tanania	-	-	-	-
Thailand	-	-	-	-
Timor-Leste	-	-	-	-
UAE	-	-	-	-
UK (Indian Ocean Territories)	-	-	-	-
Yemen	-	-	-	-

Showing 1 to 28 of 28 entries

TSP- India



AGENCY FOR METEOROLOGY CLIMATOLOGY AND GEOPHYSICS

Indonesia Tsunami Service Provider

InaTEWS - Indonesia Tsunami Early Warning System

Public Bulletin

Event List | **Event Map**

Page 1 of 14 Event 1-50 of 665 Events

Date	Time (UTC)	Magnitude	Depth (Km)	Latitude	Longitude	Location	Type	Bulletin Number	Bulletin type	Event Group
2025-08-03	05:37:55	6.8	26	50.71N	157.62E	Kuril Islands	REAL EVENT	1	EARTHQUAKE BULLETIN	202508030537
2025-08-30	02:30:36	6.8	10	50.57N	157.68E	Kuril Islands	REAL EVENT	1	EARTHQUAKE BULLETIN	202507300230
2025-07-29	23:24:54	8.8	43	52.54N	160.07E	Off East Coast of Kamchatka	REAL THREAT EVENT	2	ASSESSMENT BULLETIN	202507292224
2025-07-29	23:24:50	7.6	10	52.53N	160.13E	Off East Coast of Kamchatka	REAL EVENT	1	EARTHQUAKE BULLETIN	202507292224
2025-07-28	22:10:31	6.7	10	57.91S	157.3E	Macquarie Island Region	REAL EVENT	1	EARTHQUAKE BULLETIN	202507292210
2025-07-20	07:07:49	6.7	55	52.9N	160.63E	Off East Coast of Kamchatka	REAL EVENT	1	EARTHQUAKE BULLETIN	202507200707
2025-07-29	06:49:03	6.7	10	52.87N	160.61E	Off East Coast of Kamchatka	REAL EVENT	1	EARTHQUAKE BULLETIN	202507200649
2025-07-20	08:26:22	6.5	49	53.17N	160.20E	Near East Coast of Kamchatka	REAL EVENT	1	EARTHQUAKE BULLETIN	202507200628
2025-07-16	20:37:38	7.5	10	54.82N	160.68W	Alaska Peninsula	REAL EVENT	1	EARTHQUAKE BULLETIN	202507162037
2025-07-14	05:49:58	6.9	108	6.23S	131.31E	Tanimbar Islands Region, Indonesia	REAL EVENT	1	EARTHQUAKE BULLETIN	202507140549
2025-06-24	01:58:11	6.7	13	7.84N	129.7E	East of Philippine Islands	REAL EVENT	1	EARTHQUAKE BULLETIN	202506240158
2025-06-11	06:00:00	9.0	10	7.2N	92.9E	Nicobar Islands, India Region (CommTEST-Jun-2025)	TEST EVENT	4	FINAL BULLETIN	202506110600COM
2025-06-11	06:00:00	9.0	10	7.2N	92.9E	Nicobar Islands, India Region (CommTEST-Jun-2025)	TEST EVENT	3 1	CONFIRMED THREAT BULLETIN	202506110600COM

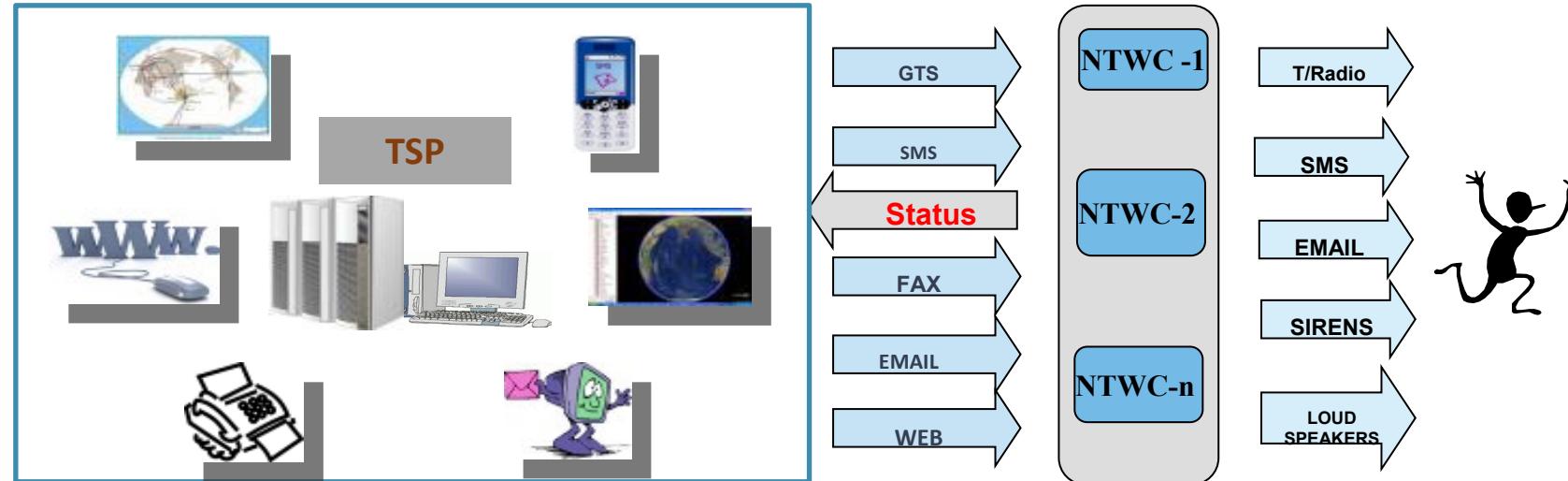
Public Bulletin

Event List | **Event Map**

Page 1 of 14 Event 1-50 of 665 Events

TSP- Indonesia

- **Bulletin Notification Messages** are issued in text format
- **Bulletins** are in text format on the websites
- **Threat Tables** in html format and **Threat Maps** in jpg or png format on the websites
- **Spatial data** is also available in dbf format on the websites



TSPs adopted multi channel dissemination

- SMS,
- E-Mail
- FAX,
- GTS,
- Dedicated Websites, Mobile Apps and Social Media

Bulletin Notification Message – Sent to NTWCs

TSUNAMI **BULLETIN NOTIFICATION** MESSAGE NUMBER 1
REGIONAL TSUNAMI SERVICE PROVIDER - TSP AUSTRALIA [JATWC]
ISSUED AT 1205 UTC SUNDAY 01 SEPTEMBER 2024

TO: INDIAN OCEAN NATIONAL TSUNAMI WARNING CENTRES [NTWCs]
FROM: TSP AUSTRALIA

NOTIFICATION:

TSP AUSTRALIA HAS **JUST ISSUED TSUNAMI BULLETIN NUMBER 1** FOR THE
INDIAN OCEAN, BASED ON THE FOLLOWING EARTHQUAKE EVENT:

MAGNITUDE: 6.5 MWP
DEPTH: 116KM
DATE: 01 SEP 2024
ORIGIN TIME: 1152 UTC
LATITUDE: 7.60S
LONGITUDE: 128.33E
LOCATION: BANDA SEA, SUNDA ARC

TO VIEW THE BULLETIN GO TO THE TSP AUSTRALIA WEBSITE AT:

<http://reg.bom.gov.au/tsunami/rtsps/index.shtml>

NOTE: THIS IS A RESTRICTED-ACCESS WEBSITE CONTAINING TECHNICAL DATA
FOR NATIONAL TSUNAMI WARNING CENTRES ONLY. IT IS NOT FOR GENERAL
PUBLIC ACCESS.

GENERAL PUBLIC INFORMATION FOR THIS EVENT IS AVAILABLE FROM:

JOINT AUSTRALIAN TSUNAMI WARNING CENTRE [JATWC]
BUREAU OF METEOROLOGY
MELBOURNE, AUSTRALIA
<http://www.bom.gov.au/tsunami>

END OF NOTIFICATION MESSAGE

Earthquake Bulletin – On TSP websites only

TSUNAMI BULLETIN NUMBER 1 ([TYPE-I EARTHQUAKE BULLETIN](#))
IOTWMS TSUNAMI SERVICE PROVIDER INDONESIA (InaTEWS)
ISSUED AT 0505 UTC THURSDAY 09 FEBRUARY 2023

... EARTHQUAKE BULLETIN ...

This bulletin applies to areas within and bordering the Indian Ocean. It is issued in support of the UNESCO/IOC Indian Ocean Tsunami Warning and Mitigation System (IOTWMS).

1. EARTHQUAKE INFORMATION

IOTWMS-TSP INDONESIA has detected an earthquake with the following preliminary information:

Magnitude: 9.0 Mwp
Depth: 10 km
Date: 09 Feb 2023
Origin Time: 0500 UTC
Latitude: 7.20N
Longitude: 92.90E
Location: Nicobar, India

2. EVALUATION

Based on historical data and tsunami modelling, **this earthquake may be capable of generating a tsunami** affecting the Indian Ocean region.

IOTWMS-TSP INDONESIA will monitor sea level gauges near the earthquake to determine if a tsunami was generated and will issue further bulletins for this event.

Further information on this event will be available at:
<http://inatews.bmkg.gov.id>

3. ADVICE

This bulletin is being issued as advice. Only national/state/local authorities and disaster management officers have the authority to make decisions regarding the official threat and warning status in their coastal areas and any action to be taken in response.

...continued

Potential Threat Bulletin – On TSP websites only

TSUNAMI BULLETIN NUMBER 2 ([TYPE-II THREAT ASSESSMENT BULLETIN](#))
IOTWMS TSUNAMI SERVICE PROVIDER INDONESIA (InaTEWS)
issued at 0515 UTC THURSDAY 09 February 2011

... POTENTIAL TSUNAMI THREAT IN THE INDIAN OCEAN ...

This bulletin applies to areas within and bordering the Indian Ocean. It is issued in support of the UNESCO/IOC Indian Ocean Tsunami Warning and Mitigation System (IOTWMS).

1. EARTHQUAKE INFORMATION

IOTWMS-TSP INDONESIA has detected an earthquake with the following details:

Magnitude: 9.0 Mwp ([UPDATED](#))
Depth: 10km
Date: 09 Feb 2023
Origin Time: 0500 UTC
Latitude: 7.20N
Longitude: 92.90
Location: Nicobar, India

2. EVALUATION

Earthquakes of this size are capable of generating tsunamis. However, so far there is no confirmation about the triggering of a tsunami.

An investigation is under way to determine if a tsunami has been triggered. This TSP will monitor sea level gauges and report if any tsunami wave activity has occurred.

Based on pre-run model scenarios, **[the zones listed below are POTENTIALLY UNDER THREAT](#)**.

3. TSUNAMI THREAT FOR THE INDIAN OCEAN

The list below shows the forecast arrival time of the first wave estimated to exceed 0.5m amplitude at the beach in each zone (or a different threshold nominated by an NTWC), and the amplitude of the maximum beach wave predicted for the zone. Zones where the estimated wave amplitudes are less than the threshold amplitude at the beach are not shown.

Potential Threat Bulletin (continued)

The list is grouped by country (alphabetic order) and ordered according to the earliest estimated times of arrival at the beach.

Please be aware that actual wave arrival times may differ from those below, and the initial wave may not be the largest. A tsunami is a series of waves and the time between successive waves can be five minutes to one hour.

The threat is deemed to have passed two hours after the forecast time for last exceedance of the 0.5m threat threshold for a zone. As local conditions can cause a wide variation in tsunami wave action, CANCELLATION of national warnings and ALL CLEAR determination must be made by national/state/local authorities.

AUSTRALIA

COCOS ISLAND	0718Z 09 Feb 2023	1.3m
CHRISTMAS ISLAND	0755Z 09 Feb 2023	0.9m
KALBARRI TO NORTH CAPE	1005Z 09 Feb 2023	2.4m

BANGLADESH

KUTUBDIA ISLAND	0752Z 09 Feb 2023	0.9m
BARISAL	0816Z 09 Feb 2023	1.3m

4. ADVICE

This bulletin is being issued as advice. Only national/state/local authorities and disaster management officers have the authority to make decisions regarding the official threat and warning status in their coastal areas and any action to be taken in response.

5. UPDATES

Additional bulletins will be issued by IOTWMS-TSP INDONESIA for this event as more information becomes available.

Other IOTWMS-TSPs may issue additional information at:

IOTWMS-TSP AUSTRALIA: <http://reg.bom.gov.au/tsunami/rtsps/>
IOTWMS-TSP INDIA: <https://tsunami.incois.gov.in/TSP>

6. CONTACT INFORMATION

IOTWMS-TSP INDONESIA:

METEOROLOGICAL CLIMATOLOGICAL AND GEOPHYSICAL AGENCY (BMKG)
Address: Jl. Angkasa I no.2 Kemayoran, Jakarta, Indonesia, 10720
Tel.: +62 (21) 4246321/6546316
Fax: +62 (21) 6546316/4246703
P.O. Box 3540 Jakarta

Confirmed Threat Bulletin – On TSP websites only

TSUNAMI BULLETIN NUMBER 4 (**TYPE-III CONFIRMED THREAT BULLETIN**)
IOTWMS TSUNAMI SERVICE PROVIDER INDONESIA (InaTEWS)
issued at 0555 UTC THURSDAY 09 February 2023

... **CONFIRMED TSUNAMI THREAT** IN THE INDIAN OCEAN ...

This bulletin applies to areas within and bordering the Indian Ocean. It is issued in support of the UNESCO/IOC Indian Ocean Tsunami Warning and Mitigation System (IOTWMS).

1. EARTHQUAKE INFORMATION

IOTWMS-TSP INDONESIA has detected an earthquake with the following details:

Magnitude: 9.0 Mwp
Depth: 10km
Date: 09 Feb 2023
Origin Time: 0500 UTC
Latitude: 7.20N
Longitude: 92.90E
Location: Nicobar, India

2. EVALUATION

Sea level observations have **confirmed that a TSUNAMI WAS GENERATED**.

Maximum wave amplitudes observed so far:

Nicobar (India)	12.34N 91.65E 0520Z 09 Feb 2023 2.7m
Padang (Indonesia)	3.34S 93.42E 0550Z 09 Feb 2023 1.3m

Based on pre-run model scenarios, the zones listed below are POTENTIALLY UNDER THREAT.

3. TSUNAMI THREAT FOR THE INDIAN OCEAN

The list below shows the forecast arrival time of the first wave estimated to exceed 0.5m amplitude at the beach in each zone (or a different threshold nominated by an NTWC), and the amplitude of the maximum beach wave predicted for the zone. Zones where the estimated wave amplitudes are less than the threshold amplitude at the beach are not shown.

...continues as for Potential Threat Bulletin...

Final Bulletin – On TSP websites

TSUNAMI BULLETIN NUMBER 9 (TYPE-IV FINAL BULLETIN)
IOTWMS TSUNAMI SERVICE PROVIDER INDONESIA (InaTEWS)
issued at 1220 UTC THURSDAY 09 February 2023

... FINAL TSUNAMI BULLETIN FOR THE INDIAN OCEAN ...

This bulletin applies to areas within and bordering the Indian Ocean. It is issued in support of the UNESCO/IOC Indian Ocean Tsunami Warning and Mitigation System (IOTWMS).

1. EARTHQUAKE INFORMATION

IOTWMS-TSP INDONESIA detected an earthquake with the following details:

Magnitude: 9.0 Mwp
Depth: 10km
Date: 09 Feb 2023
Origin Time: 0500 UTC
Latitude: 7.20N
Longitude: 92.90E
Location: Nicobar, India

2. EVALUATION

Data from sea-level gauges confirmed that a tsunami was generated.

The **expected period of significant tsunami waves is now over** for all threatened Indian Ocean countries, based on IOTWMS-TSP INDONESIA modelling.

Because local conditions can cause a wide variation in tsunami wave action, **CANCELLATION of national warnings and ALL CLEAR determination must be made by national/state/local authorities**. Please be aware that dangerous currents can continue for several hours after the main tsunami waves have passed.

3. TSUNAMI WAVE OBSERVATIONS

Listed below are maximum wave amplitudes recorded at the specified locations. Note that wave amplitude is measured relative to normal sea level: it is NOT the crest-to-trough wave height.

LOCATION	LAT	LON	TIME	DATE	AMPL
Campbell Bay (Nicobar)	6.90N	93.74E	0504Z	09 Feb 2023	11.0m
Nancowry (Nicobar)	7.96N	93.53E	0515Z	09 Feb 2023	10.0m

TSP Threat Table - On TSP websites

Country	State/Territory	Zone	T1(UTC)	T2(UTC)	T3(UTC)	T4(UTC)	Amplitude(m)	ThreatStatus
IRAN	SISTAN AND BALUCHESTAN	BIR	11-Oct-2023 06:04	11-Oct-2023 06:04	11-Oct-2023 06:06	12-Oct-2023 07:00	6.3	Threat
IRAN	SISTAN AND BALUCHESTAN	PUSHIT	11-Oct-2023 06:04	11-Oct-2023 06:04	11-Oct-2023 07:05	12-Oct-2023 07:00	6.8	Threat
IRAN	HORMOZGAN	MISKI	11-Oct-2023 06:05	11-Oct-2023 06:06	11-Oct-2023 16:14	12-Oct-2023 07:00	4.7	Threat
OMAN	MUSCAT	MUSCAT	11-Oct-2023 06:13	11-Oct-2023 06:16	11-Oct-2023 06:22	12-Oct-2023 07:00	7.9	Threat
OMAN	AL BATNAH	BARKA	11-Oct-2023 06:16	11-Oct-2023 06:20	11-Oct-2023 10:51	12-Oct-2023 07:00	6.5	Threat
OMAN	MUSANDAM	EAST MUSANDAM	11-Oct-2023 06:16	11-Oct-2023 06:20	11-Oct-2023 21:45	12-Oct-2023 07:00	4.9	Threat
OMAN	MUSCAT	QURAYYAT	11-Oct-2023 06:19	11-Oct-2023 06:21	11-Oct-2023 06:36	12-Oct-2023 06:56	8.9	Threat
PAKISTAN	BALUCHISTAN	ORMARA	11-Oct-2023 06:19	11-Oct-2023 06:24	11-Oct-2023 17:13	12-Oct-2023 07:00	4.5	Threat
OMAN	AL BATNAH	AL KHABURAH	11-Oct-2023 06:20	11-Oct-2023 06:24	11-Oct-2023 14:18	12-Oct-2023 06:49	5.5	Threat
OMAN	AL BATNAH	SOHAR	11-Oct-2023 06:25	11-Oct-2023 06:29	11-Oct-2023 13:10	12-Oct-2023 06:59	5.7	Threat
UNITED ARAB EMIRATES	UAE	KALBA	11-Oct-2023 06:26	11-Oct-2023 06:29	11-Oct-2023 06:41	12-Oct-2023 07:00	6.6	Threat
OMAN	AL SHARQIYAH	AL ASHKHARAH	11-Oct-2023 06:28	11-Oct-2023 06:33	11-Oct-2023 07:14	12-Oct-2023 06:51	4.4	Threat
OMAN	AL SHARQIYAH	MASIRAH	11-Oct-2023 06:42	11-Oct-2023 06:48	11-Oct-2023 07:04	12-Oct-2023 06:41	2.8	Threat
OMAN	AL SHARQIYAH	RAS AR RUWAYS	11-Oct-2023 06:57	11-Oct-2023 07:03	11-Oct-2023 17:09	12-Oct-2023 06:41	1.3	Threat
PAKISTAN	BALUCHISTAN	WINDER	11-Oct-2023 07:02	11-Oct-2023 07:11	11-Oct-2023 12:36	12-Oct-2023 06:47	1.8	Threat
OMAN	AL SHARQIYAH	AD DUQM	11-Oct-2023 07:17	11-Oct-2023 07:30	11-Oct-2023 12:13	12-Oct-2023 07:00	1.7	Threat
PAKISTAN	SINDH	KARACHI	11-Oct-2023 07:24	11-Oct-2023 07:31	11-Oct-2023 17:41	12-Oct-2023 07:00	2	Threat
PAKISTAN	SINDH	SINDH	11-Oct-2023 07:50	11-Oct-2023 08:07	11-Oct-2023 17:44	12-Oct-2023 06:34	2.9	Threat
OMAN	AL WUSTA	AL JAZER	11-Oct-2023 08:01	11-Oct-2023 08:18	11-Oct-2023 20:09	12-Oct-2023 06:06	1	Threat
OMAN	DHOFAR	HASIKER	11-Oct-2023 07:50	11-Oct-2023 08:32	11-Oct-2023 08:14	-	1.4	Threat
OMAN	DHOFAR	SALALAH	11-Oct-2023 08:14	11-Oct-2023 08:34	11-Oct-2023 18:01	-	1.1	Threat
INDIA	GUJARAT	MANDVI	11-Oct-2023 08:30	11-Oct-2023 08:42	12-Oct-2023 04:47	12-Oct-2023 07:00	1.6	Threat
INDIA	GUJARAT	DWARKA	11-Oct-2023 08:29	11-Oct-2023 08:44	11-Oct-2023 09:19	12-Oct-2023 06:55	2.2	Threat



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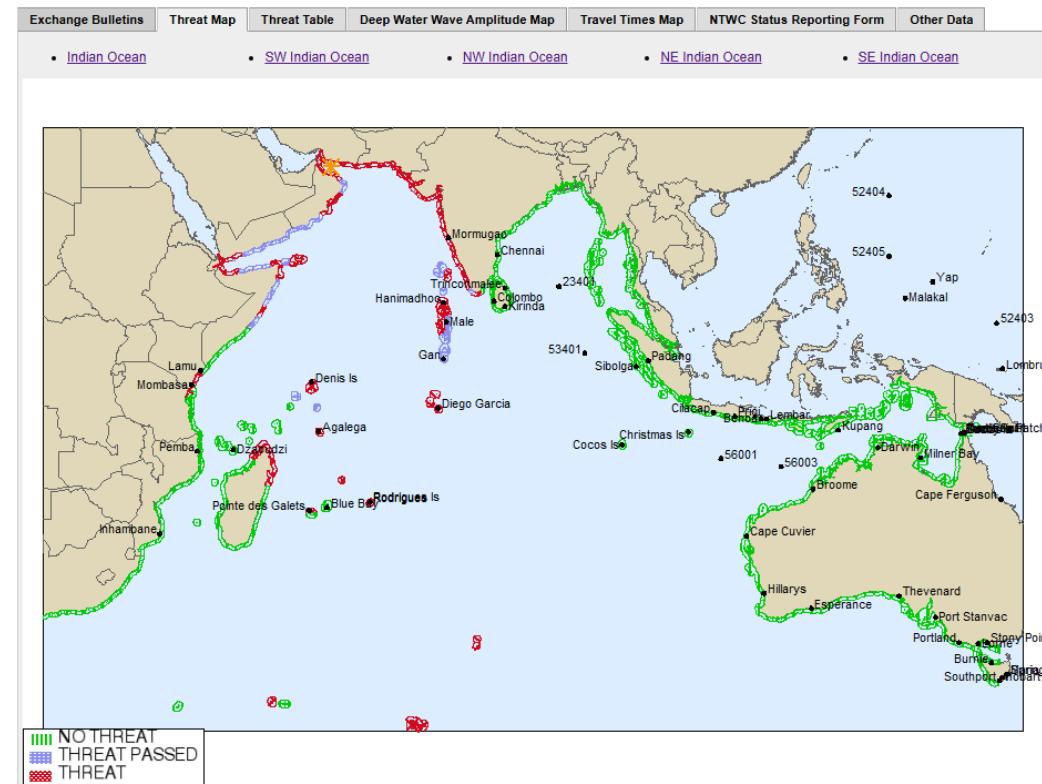
Event Detail

[« Back to the lists](#)

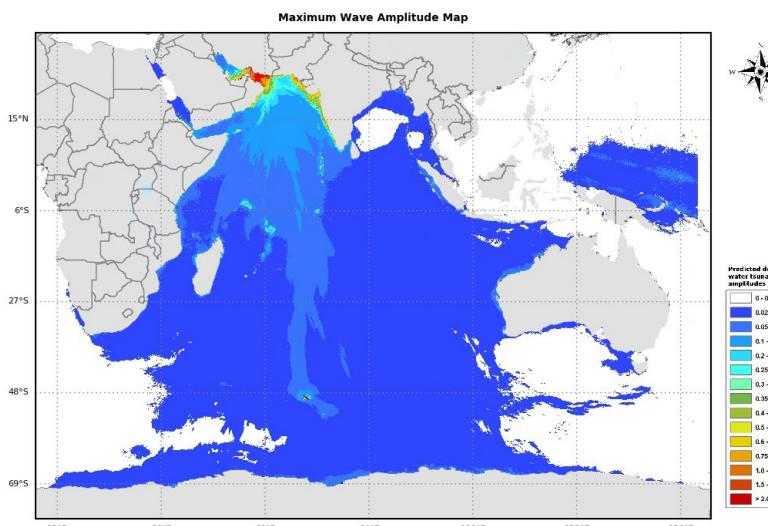
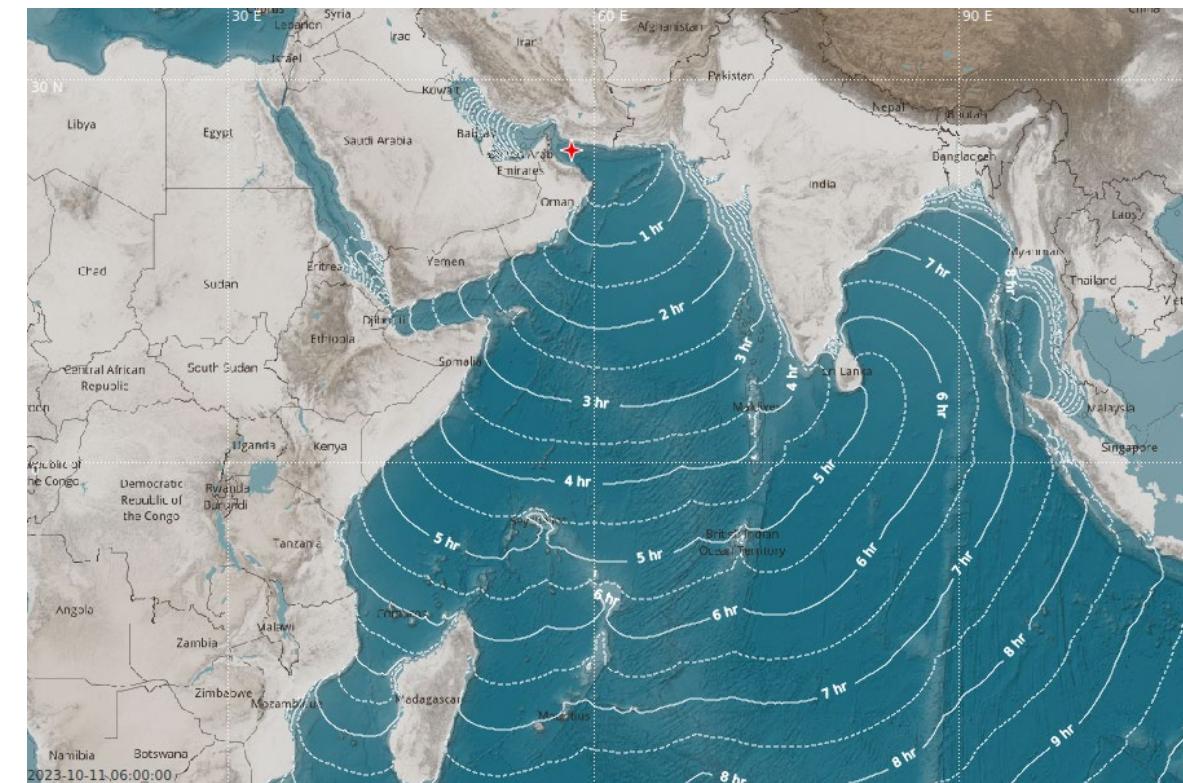
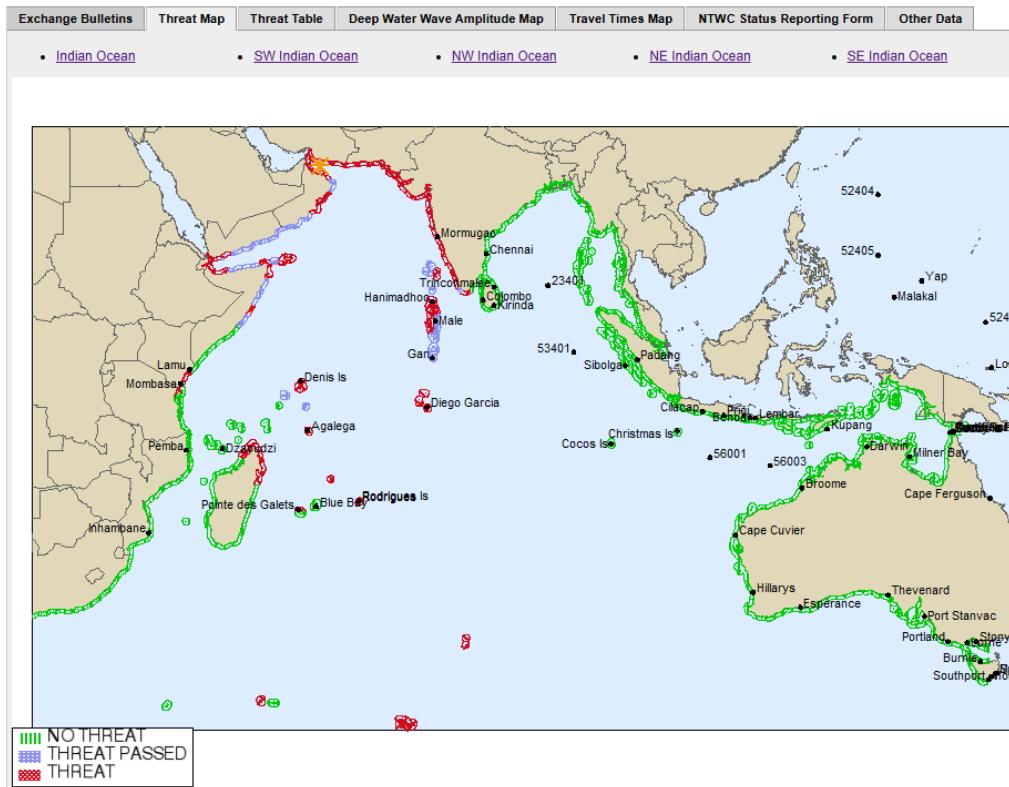
Magnitude **9,0**

Origin Time : 2023-10-11 06:00:00 UTC
 Location : 24.8N - 58.2E (Gulf of Oman (Test IOWave-Oct-2023))
 Depth : 10 Km
 Bulletin : 8.3.6 (CONFIRMED THREAT BULLETIN)
 Type : TEST EVENT

Public Bulletin								
Country		Location		T1 (UTC)		T2 (UTC)		EWH
ALL IO COUNTRIES		NW ARTA	2023-10-11 10:43:15	2023-10-11 15:58:45	2023-10-11 16:15:15	2023-10-11 17:54:30	0.67	Threat
INDIA	MANDVI	2023-10-11 08:10:45	2023-10-11 08:15:15	2023-10-11 15:12:00	2023-10-11 17:44:45	2023-10-11 17:54:30	1.59	Threat
INDIA	DWARKA	2023-10-11 08:13:15	2023-10-11 08:18:45	2023-10-11 14:19:00	2023-10-11 18:00:00	2023-10-11 18:00:00	1.8	Threat
INDIA	PORBANDAR	2023-10-11 08:14:45	2023-10-11 08:19:30	2023-10-11 14:34:30	2023-10-11 17:54:45	2023-10-11 17:54:45	1.78	Threat
INDIA	JAMNAGAR	2023-10-11 08:16:15	2023-10-11 08:23:30	2023-10-11 13:14:00	2023-10-11 18:00:00	2023-10-11 18:00:00	1.78	Threat
INDIA	MANGROL	2023-10-11 08:29:15	2023-10-11 08:35:15	2023-10-11 17:40:45	2023-10-11 18:00:00	2023-10-11 18:00:00	1.65	Threat
INDIA	HAZIRA, DIU	2023-10-11 08:35:30	2023-10-11 08:42:00	2023-10-11 17:16:00	2023-10-11 18:00:00	2023-10-11 18:00:00	1.45	Threat
INDIA	AGATTI	2023-10-11 08:48:30	2023-10-11 08:53:45	2023-10-11 11:40:15	2023-10-11 18:00:00	2023-10-11 18:00:00	0.85	Threat
INDIA	AMINI	2023-10-11 08:50:45	2023-10-11 08:57:30	2023-10-11 13:54:15	2023-10-11 17:46:45	2023-10-11 17:46:45	1.08	Threat
INDIA	MINICOY	2023-10-11 09:13:30	2023-10-11 09:20:00	2023-10-11 15:49:30	2023-10-11 18:00:00	2023-10-11 18:00:00	0.68	Threat
INDIA	ANDROTH	2023-10-11 09:14:30	2023-10-11 09:20:45	2023-10-11 13:00:30	2023-10-11 17:56:15	2023-10-11 17:56:15	0.91	Threat

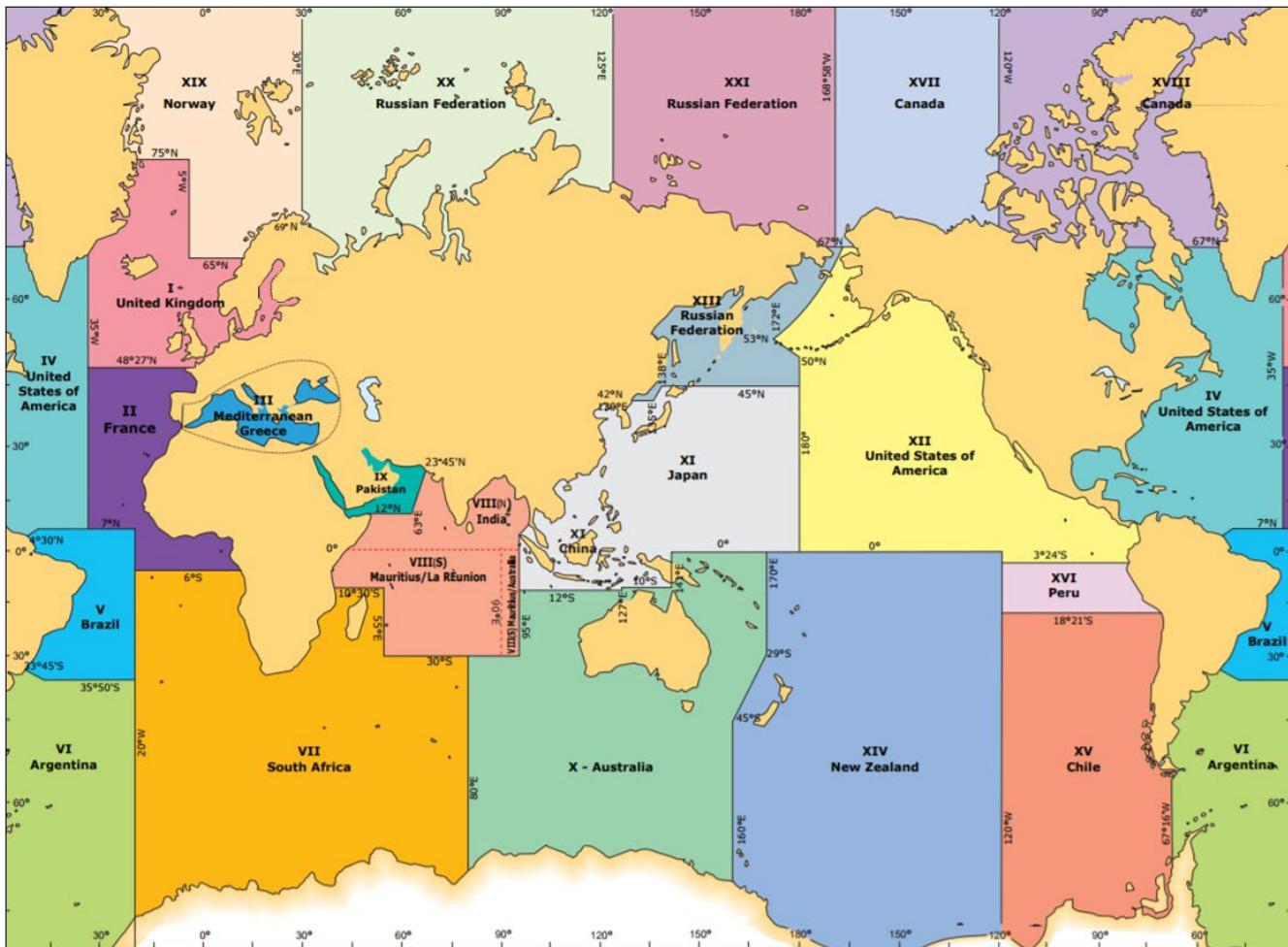


Threat Map, Travel Time Map, Energy Map – On TSP websites



NAVAREA Products

IOTWMS covers 5 NAVAREAs of VII, VIII, IX, X, XI



COUNTRY	NAVAREA	Indian Ocean Area
AUSTRALIA	X	East
BANGLADESH	VIII	North
COMOROS	VII	West
DJIBOUTI	IX	Northwest
FRANCE (Indian Ocean Territories)	VIII	West
INDIA	VIII	Northwest
INDONESIA	XI	North
IRAN	IX	Northwest
KENYA	VII	West
MADAGASCAR	VII	West
MALAYSIA	XI	North
MALDIVES	VIII	West
MAURITIUS	VIII	West
MOZAMBIQUE	VII	West
MYANMAR	VIII	North
OMAN	IX	Northwest
PAKISTAN	IX	Northwest
SEYCHELLES	VIII	West
SINGAPORE	XI	North
SOMALIA	VIII	West
SOUTH AFRICA	VII	West
SRI LANKA	VIII	North
TANZANIA	VIII	West
THAILAND	XI	North
TIMOR-LESTE	XI	East
UNITED ARAB EMIRATES	IX	Northwest
UNITED KINGDOM (Indian Ocean Territories)	VIII	West
YEMEN	IX	Northwest

NAVAREA-TEMPLATES

A) Type 2 NAVAREA POTENTIAL THREAT BULLETIN Template:

(Variable fields in red; modification required for non-seismic and complex source events highlighted in yellow)

TSP AUSTRALIA TSUNAMI BULLETIN NUMBER 1 FOR
NAVAREA VII, NAVAREA VIII, NAVAREA X, NAVAREA XI
EAST INDIAN OCEAN, NORTH INDIAN OCEAN, SOUTHWEST INDIAN OCEAN, WEST INDIAN OCEAN
TSUNAMI THREAT MESSAGE ISSUED BY TSUNAMI SERVICE PROVIDER AUSTRALIA IN SUPPORT OF THE UNESCO/IOC INDIAN OCEAN TSUNAMI WARNING AND MITIGATION SYSTEM AT 0016 UTC Monday 01 May 2015.
A TSUNAMI IS POSSIBLE TO BE GENERATED BY A MAGNITUDE 8.9 EARTHQUAKE THAT OCCURRED NEAR SOUTH OF BALI, INDONESIA [10.00S, 115.97E] AT 0000 UTC 01 May 2015.
HAZARDOUS TSUNAMI WAVES ARE FORECAST FOR SOME COASTS OF AUSTRALIA, FRANCE (INDIAN OCEAN TERRITORIES), INDONESIA, MADAGASCAR, MAURITIUS, SOUTH AFRICA, SRI LANKA, TIMOR-LESTE
TSUNAMI WAVES ARE NOT A HAZARD TO SHIPS IN DEEP WATER BUT CAN CAUSE STRONG CURRENTS AND RAPID SEA LEVEL CHANGES IN SHALLOW WATER, AS WELL AS INUNDATION OF THE COAST.
SHIPS APPROACHING THE COAST SHOULD CONSULT LOCAL AUTHORITIES REGARDING LOCAL CONDITIONS AND ADVICES.

B) Type 3 NAVAREA CONFIRMED THREAT BULLETIN Template:

(Variable fields in red; modification required for non-seismic and complex source events highlighted in yellow)

TSP AUSTRALIA TSUNAMI BULLETIN NUMBER 2 FOR
NAVAREA VII, NAVAREA VIII, NAVAREA X, NAVAREA XI
EAST INDIAN OCEAN, NORTH INDIAN OCEAN, SOUTHWEST INDIAN OCEAN, WEST INDIAN OCEAN
TSUNAMI CONFIRMED THREAT MESSAGE ISSUED BY TSUNAMI SERVICE PROVIDER AUSTRALIA IN SUPPORT OF THE UNESCO/IOC INDIAN OCEAN TSUNAMI WARNING AND MITIGATION SYSTEM AT 0016 UTC Monday 01 May 2015.
A TSUNAMI HAS BEEN GENERATED BY A MAGNITUDE 8.9 EARTHQUAKE THAT OCCURRED NEAR SOUTH OF BALI, INDONESIA [10.00S, 115.97E] AT 0000 UTC 01 May 2015.
HAZARDOUS TSUNAMI WAVES ARE FORECAST FOR SOME COASTS OF AUSTRALIA, FRANCE (INDIAN OCEAN TERRITORIES), INDONESIA, MADAGASCAR, MAURITIUS, SOUTH AFRICA, SRI LANKA, TIMOR-LESTE
TSUNAMI WAVES ARE NOT A HAZARD TO SHIPS IN DEEP WATER BUT CAN CAUSE STRONG CURRENTS AND RAPID SEA LEVEL CHANGES IN SHALLOW WATER, AS WELL AS INUNDATION OF THE COAST.
SHIPS APPROACHING THE COAST SHOULD CONSULT LOCAL AUTHORITIES REGARDING LOCAL CONDITIONS AND ADVICES.

C) Type 4 NAVAREA FINAL BULLETIN Template – Tsunami Observed:

(Variable fields in red; modification required for non-seismic and complex source events highlighted in yellow)

TSP AUSTRALIA TSUNAMI BULLETIN NUMBER 13 FOR
NAVAREA VII, NAVAREA VIII, NAVAREA X, NAVAREA XI
EAST INDIAN OCEAN, NORTH INDIAN OCEAN, SOUTHWEST INDIAN OCEAN, WEST INDIAN OCEAN
TSUNAMI CANCELLATION MESSAGE ISSUED BY TSUNAMI SERVICE PROVIDER AUSTRALIA IN SUPPORT OF THE UNESCO/IOC INDIAN OCEAN TSUNAMI WARNING AND MITIGATION SYSTEM AT 0000 UTC 01 May 2015.
THE THREAT HAS NOW LARGELY PASSED FOR THE TSUNAMI GENERATED BY A MAGNITUDE 8.9 EARTHQUAKE THAT OCCURRED NEAR SOUTH OF BALI, INDONESIA [10.00S, 115.97E] AT 0000 UTC 01 May 2015.
HOWEVER, SHIPS APPROACHING THE COAST SHOULD STILL CONSULT LOCAL AUTHORITIES REGARDING LOCAL CONDITIONS AND ADVICES.

D) Type 4 NAVAREA FINAL BULLETIN Template – No Tsunami Observed:

(Variable fields in red; modification required for non-seismic and complex source events highlighted in yellow)

TSP AUSTRALIA TSUNAMI BULLETIN NUMBER 13 FOR
NAVAREA VII, NAVAREA VIII, NAVAREA X, NAVAREA XI
EAST INDIAN OCEAN, NORTH INDIAN OCEAN, SOUTHWEST INDIAN OCEAN, WEST INDIAN OCEAN
TSUNAMI CANCELLATION MESSAGE ISSUED BY TSUNAMI SERVICE PROVIDER AUSTRALIA IN SUPPORT OF THE UNESCO/IOC INDIAN OCEAN TSUNAMI WARNING AND MITIGATION SYSTEM AT 0000 UTC 01 May 2015.
NO TSUNAMI WAS OBSERVED FROM A MAGNITUDE 8.9 EARTHQUAKE THAT OCCURRED NEAR SOUTH OF BALI, INDONESIA [10.00S, 115.97E] AT 0000 UTC 01 May 2015.
HOWEVER, SHIPS APPROACHING THE COAST SHOULD STILL CONSULT LOCAL AUTHORITIES REGARDING LOCAL CONDITIONS AND ADVICES.

Tsunami Warning Chain for Maritime Community (NAVAREA Product)



Tsunamis generated by non-seismic and complex sources

Atypical event types (Non-Seismic and Complex Sources)

Volcanic Eruption



Landslide



Unknown



Volcanic Eruption

(1) Issue no products and monitor for any potential tsunami: This action should be taken if there is little to no stratospheric injection and there is no evidence a tsunami has been generated.

(2) Create the event with a Severity of 1 hour: This action should be taken if there is little to no stratospheric injection and there is evidence that a small tsunami has been generated and the impacts are consistent with a low-level Marine Threat.

(3) Create the event with a Severity of 3 hours: This action should be taken if there is obvious stratospheric injection consistent with a VEI of 4 and/or there are reliable observations or reports that indicate a tsunami has been generated and the impacts are consistent with a high-level Marine Threat or low-level Land Threat.

(4) Create the event with a Severity of 6 hours: This action should be taken if there is significant stratospheric injection consistent with a VEI of 5+ and/or there are reliable observations or reports that indicate a catastrophic tsunami has been generated.

JATWC Threat Assessment technique

	0	1	2	3	4	5	6	7	8
General Description	Non- Explosive	Small	Moderate	Moderate- Large	Large	Very Large			
Volume of Tephra (m ³)	1x10 ⁴	1x10 ⁶	1x10 ⁷	1x10 ⁸	1x10 ⁹	1x10 ¹⁰	1x10 ¹¹	1x10 ¹²	
Cloud Column Height (km)	<0.1	0.1-1	1-5	3-15	10-25	>25			
Above crater Above sea level									
Qualitative Description	"Gentle," "Effusive"	"Explosive"	"Cataclysmic," "paroxysmal," "colossal"	"Severe," "violent," "terrific"					
Eruption Type		Strombolian			Plinian				
	Hawaiian		Vulcanian		Ultra-Plinian				
Duration (continuous blast)	<1 hour		1-6 hrs		>12 hrs				
			6-12 hrs						
CAVW max explosivity (most explosive activity listed in CAVW)	Lava flow			Explosion or Nuée ardente					
	Dome or mudflow	Phreatic							
Tropospheric Injection	Negligible	Minor	Moderate	Substantial					
Stratospheric Injection	None	None	None	Possible	Definite	Significant			
Eruptions (total in file)	755	963	3631	924	307	106	46	4	0

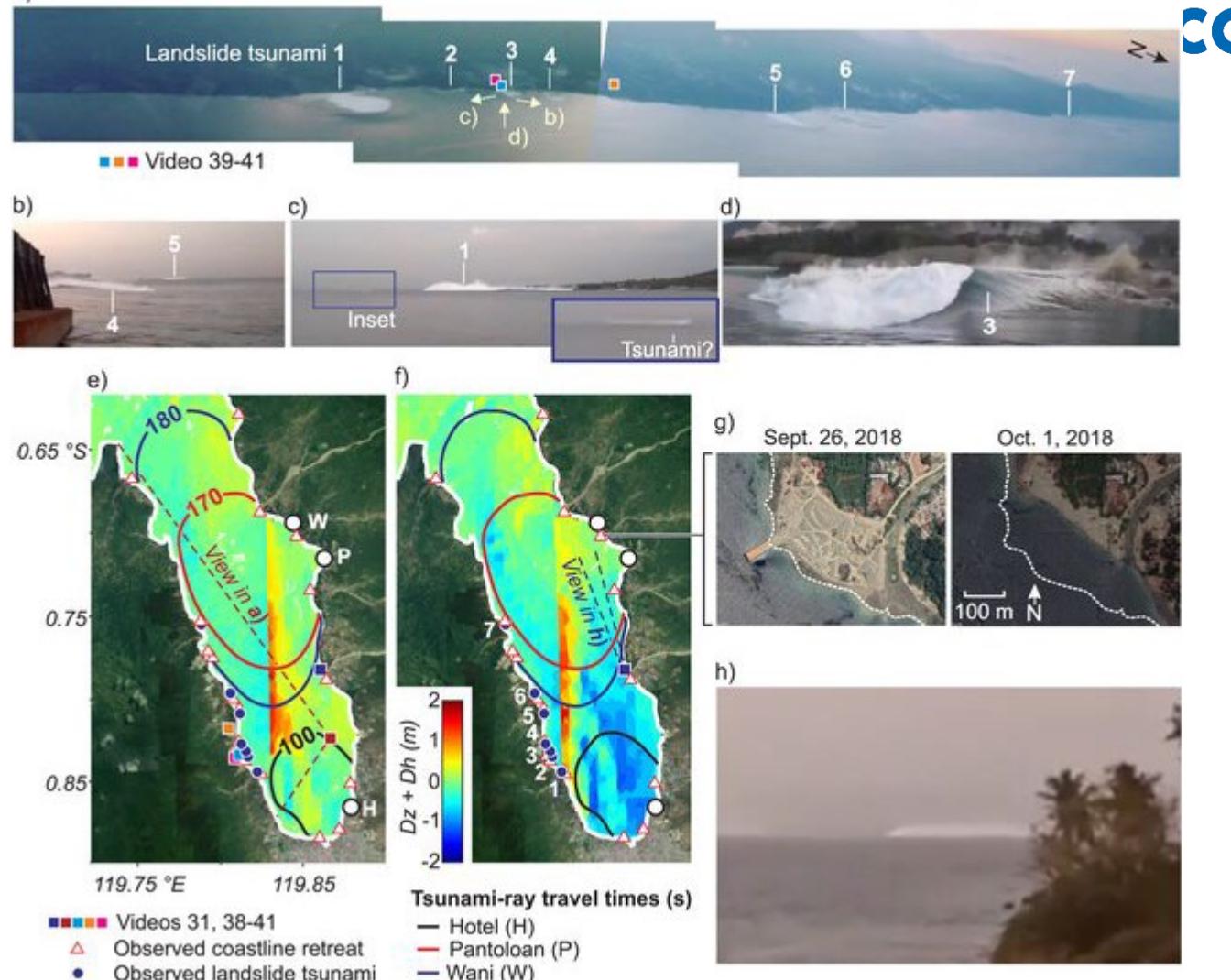
Example Use Case: Hunga Tonga 2022

- A VEI 5–6 eruption created atmospheric pressure waves that circled the globe.
- Generated tsunamis not through traditional seafloor displacement but shock wave-induced uplift.
- Key takeaway: Traditional earthquake-based thresholds miss such events — volcano-aware systems are essential.

Landslide

- (1) Create the event with a Severity of 1 hour: This action should be taken if there are reliable observations or reports that indicate a small tsunami has been generated.
- (2) Create the event with a Severity of 3 hours: This action should be taken if there are reliable observations or reports that indicate a tsunami has been generated and the impacts are consistent with a low-level Marine Threat.
- (3) Create the event with a Severity of 6 hours: This action should be taken if there are reliable observations or reports that indicate a catastrophic tsunami has been generated and the impacts are consistent with a high-level Marine Threat or low-level Land Threat.

The 2018 Sulawesi tsunami in Palu city as a result of several landslides and co-seismic tsunamis



Courtesy: DOI: [10.1029/2019GL082578](https://doi.org/10.1029/2019GL082578)

TSP Bulletin Types

TSP Bulletin Type 1: Earthquake Bulletin

- Not Issued for atypical events

TSP Bulletin Type 2: No Threat Bulletin

- Issued as soon as possible

TSP Bulletin Type 2: Potential Tsunami Threat Bulletin

- Issued as soon as possible
- Only applicable to Volcanic Eruption and Celestial Impact events

TSP Bulletin Type 3: Confirmed Tsunami Threat Bulletin

- Issued as soon as possible
- Could be the first bulletin issued for any atypical event

TSP Bulletin Type 4: Final Tsunami Bulletin

- No Change to criteria compared to earthquake event

TSP Australia Bulletin Examples: Notification Message

-
TSUNAMI BULLETIN NOTIFICATION MESSAGE NUMBER 1 IOTWMS TSUNAMI SERVICE PROVIDER AUSTRALIA [JATWC] ISSUED AT 1046 UTC THURSDAY 13 FEBRUARY 2020

TO: INDIAN OCEAN NATIONAL TSUNAMI WARNING CENTRES [NTWCs]
FROM: IOTWMS-TSP AUSTRALIA

NOTIFICATION:

IOTWMS-TSP AUSTRALIA HAS JUST ISSUED TSUNAMI BULLETIN NUMBER 1 FOR THE INDIAN OCEAN, BASED ON THE FOLLOWING EARTHQUAKE EVENT:

MAGNITUDE: 6.9 MWP
DEPTH: 145KM
TYPE: LANDSLIDE
DATE: 13 FEB 2020
ORIGIN TIME: 1033 UTC
LATITUDE: 45.65N
LONGITUDE: 148.99E
LOCATION: KURIL ISLANDS

TO VIEW THE BULLETIN GO TO THE IOTWMS-TSP AUSTRALIA WEBSITE AT:

<http://reg.bom.gov.au/tsunami/rtsp/index.shtml>

NOTE: THIS IS A RESTRICTED-ACCESS WEBSITE CONTAINING TECHNICAL DATA FOR NATIONAL TSUNAMI WARNING CENTRES ONLY. IT IS NOT FOR GENERAL PUBLIC ACCESS.

GENERAL PUBLIC INFORMATION FOR THIS EVENT IS AVAILABLE FROM:

JOINT AUSTRALIAN TSUNAMI WARNING CENTRE [JATWC] BUREAU OF METEOROLOGY MELBOURNE, AUSTRALIA <http://www.bom.gov.au/tsunami>

END OF NOTIFICATION MESSAGE

-

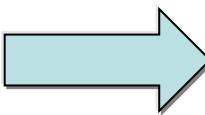
-
TSUNAMI BULLETIN NOTIFICATION MESSAGE NUMBER 1 IOTWMS TSUNAMI SERVICE PROVIDER AUSTRALIA [JATWC] ISSUED AT 1046 UTC THURSDAY 13 FEBRUARY 2020

TO: INDIAN OCEAN NATIONAL TSUNAMI WARNING CENTRES [NTWCs]
FROM: IOTWMS-TSP AUSTRALIA

NOTIFICATION:

IOTWMS-TSP AUSTRALIA HAS JUST ISSUED TSUNAMI BULLETIN NUMBER 1 FOR THE INDIAN OCEAN, BASED ON THE FOLLOWING EVENT:

TYPE: LANDSLIDE
DATE: 13 FEB 2020
ORIGIN TIME: 1033 UTC
LATITUDE: 45.65N
LONGITUDE: 148.99E
LOCATION: KURIL ISLANDS



TO VIEW THE BULLETIN GO TO THE IOTWMS-TSP AUSTRALIA WEBSITE AT:

<http://reg.bom.gov.au/tsunami/rtsp/index.shtml>

NOTE: THIS IS A RESTRICTED-ACCESS WEBSITE CONTAINING TECHNICAL DATA FOR NATIONAL TSUNAMI WARNING CENTRES ONLY. IT IS NOT FOR GENERAL PUBLIC ACCESS.

GENERAL PUBLIC INFORMATION FOR THIS EVENT IS AVAILABLE FROM:

JOINT AUSTRALIAN TSUNAMI WARNING CENTRE [JATWC] BUREAU OF METEOROLOGY MELBOURNE, AUSTRALIA <http://www.bom.gov.au/tsunami>

END OF NOTIFICATION MESSAGE

TSP Australia Bulletin Examples: Type 2 No Threat Bulletin

-
TSUNAMI BULLETIN NUMBER 1 (TYPE-II THREAT ASSESSMENT BULLETIN)
IOTWMS TSUNAMI SERVICE PROVIDER AUSTRALIA (JATWC)
ISSUED AT 1214 UTC Friday 02 August 2019

-

... NO TSUNAMI THREAT IN THE INDIAN OCEAN ...

This bulletin applies to areas within and bordering the Indian Ocean. It is issued in support of the UNESCO/IOC Indian Ocean Tsunami Warning and Mitigation System (IOTWMS).

1. ~~EARTHQUAKE~~-TSUNAMI SOURCE INFORMATION

IOTWMS-TSP AUSTRALIA has detected ~~an earthquake~~ ~~a landslide~~ with the following details:

Magnitude: 7.1 Mwp
Depth: 69km
Date: 02 Aug 2019
Origin Time: 1203 UTC
Latitude: 7.47S
Longitude: 104.58E
Location: Southwest of Sumatra, Indonesia

2. EVALUATION

Based on ~~pre-run model scenarios~~ ~~a tsunami travel time threat assessment~~, there is NO THREAT to countries in the Indian Ocean.

3. ADVICE

This bulletin is being issued as advice. Only national/state/local authorities and disaster management officers have the authority to make decisions regarding the official threat and warning status in their coastal areas and any action to be taken in response.

4. UPDATES

No further bulletins will be issued by IOTWMS-TSP AUSTRALIA for this event unless other information becomes available.

Other IOTWMS-TSPs may issue additional information at:

IOTWMS-TSP INDIA:

<http://www.incois.gov.in/Incois/tsunami/eqevents.jsp>

IOTWMS-TSP INDONESIA: <http://rtsp.bmkg.go.id>

5. CONTACT INFORMATION

IOTWMS-TSP AUSTRALIA

Joint Australian Tsunami Warning Centre (JATWC)

Bureau of Meteorology

GPO BOX 1289 Melbourne, Victoria, Australia, 3001

<http://reg.bom.gov.au/tsunami/rtsp>

END OF BULLETIN

TSP Australia Bulletin Examples: Type 2 Potential Threat Bulletin

-
TSUNAMI BULLETIN NUMBER 1 (TYPE-II THREAT ASSESSMENT BULLETIN)
IOTWMS TSUNAMI SERVICE PROVIDER AUSTRALIA (JATWC)
ISSUED AT 1509 UTC Sunday 19 August 2018

-
... POTENTIAL TSUNAMI THREAT IN THE INDIAN OCEAN ...

This bulletin applies to areas within and bordering the Indian Ocean. It is issued in support of the UNESCO/IOC Indian Ocean Tsunami Warning and Mitigation System (IOTWMS).

1. EARTHQUAKE TSUNAMI SOURCE INFORMATION

IOTWMS-TSP AUSTRALIA has detected ~~an earthquake~~ ~~a volcanic eruption at Mt Rumble~~ with the following details:

Magnitude: 7.0 Mwp

Depth: 12km

Date: 19 Aug 2018

Origin Time: 1456 UTC

Latitude: 8.47S

Longitude: 116.69E

Location: Sumbawa Region, Indonesia

2. EVALUATION

~~Earthquakes of this size are capable of generating tsunamis. However, so far there is no confirmation about the triggering of a tsunami.~~

An investigation is under way to determine if a tsunami has been triggered. This TSP will monitor sea level gauges and report if any tsunami wave activity has occurred.

Based on ~~pre-run model scenarios~~ ~~a tsunami travel time threat assessment~~, the zones listed below are POTENTIALLY UNDER THREAT.

3. TSUNAMI THREAT FOR THE INDIAN OCEAN

~~For this event all locations within 3 hours are considered under Threat.~~

~~The list below shows the forecast arrival time of the first wave estimated to exceed 0.5m amplitude at the beach in each zone, and The amplitude of the maximum beach wave predicted for the zone. Zones where the estimated wave amplitudes are less than 0.5m at the Beach are not shown.~~

~~The list is grouped by country (alphabetic order) and ordered according to the earliest estimated times of arrival at the beach.~~

Please be aware that actual wave arrival times may differ from those below, and the initial wave may not be the largest. A tsunami is a series of waves and the time between successive waves can be five minutes to one hour.

The threat is deemed to have passed two hours after the forecast time for last exceedance of the 0.5m threat threshold for a zone. ~~Dangerous conditions should be expected to continue for a minimum of 5 hours after the predicted arrival time.~~ As local conditions can cause a wide variation in tsunami wave action, CANCELLATION of national warnings and ALL CLEAR determination must be made by national/state/local authorities.

INDONESIA

NTB SUMBAWA B	1512Z 19Aug2018	0.51m
NTB LOMBOK-TIMUR S	1527Z 19Aug2018	0.51m
NTB LOMBOK-TENGAH	1542Z 19Aug2018	0.51m
NTB SUMBAWA S	1545Z 19Aug2018	0.51m
NTB LOMBOK-BARAT S	1546Z 19Aug2018	0.51m
BALI KLUNGKUNG P.NUSA PENIDA	1549Z 19Aug2018	0.51m
BALI DENPASAR PANTAI-SANUR	1555Z 19Aug2018	0.51m
BALI BADUNG PANTAI-KUTA	1555Z 19Aug2018	0.51m

4. ADVICE

This bulletin is being issued as advice. Only national/state/local authorities and disaster management officers have the authority to make decisions regarding the official threat and warning status in their coastal areas and any action to be taken in response.

5. UPDATES

Additional bulletins will be issued by IOTWMS-TSP AUSTRALIA for this event as more information becomes available.

Other IOTWMS-TSPs may issue additional information at:

TSP INDIA: <http://www.incois.gov.in/Incois/tsunami/eqevents.jsp>

TSP INDONESIA: <http://rtsp.bmkg.go.id>

6. CONTACT INFORMATION

IOTWMS-TSP AUSTRALIA

Joint Australian Tsunami Warning Centre (JATWC)

Bureau of Meteorology

GPO BOX 1289 Melbourne, Victoria, Australia, 3001

<http://reg.bom.gov.au/tsunami/rtsp>

END OF BULLETIN

TSP Australia Bulletin Examples: Type 3 Confirmed Threat Bulletin

-
TSUNAMI BULLETIN NUMBER 2 (TYPE-III CONFIRMED THREAT BULLETIN)
IOTWMS TSUNAMI SERVICE PROVIDER AUSTRALIA (JATWC)
ISSUED AT 1345 UTC Sunday 05 August 2018

-
... CONFIRMED TSUNAMI THREAT IN THE INDIAN OCEAN...

This bulletin applies to areas within and bordering the Indian Ocean. It is issued in support of the UNESCO/IOC Indian Ocean Tsunami Warning and Mitigation System (IOTWMS).

1. EARTHQUAKE TSUNAMI SOURCE INFORMATION

IOTWMS-TSP AUSTRALIA has detected ~~an earthquake~~ ~~a volcanic eruption at Mt Rumble~~ with the following details:

Magnitude: 7.0 Mwp

Depth: 25km

Date: 05 Aug 2018

Origin Time: 1146 UTC

Latitude: 8.56S

Longitude: 116.49E

Location: Sumbawa Region, Indonesia

2. EVALUATION

Sea level observations have confirmed that a TSUNAMI WAS GENERATED. Maximum wave amplitudes observed so far:

Benoa	INDONESIA	8.83S 115.33E	0.01m	05 Aug 12:45 UTC
Lembar	INDONESIA	8.70S 116.07E	0.13m	05 Aug 13:08 UTC

Based on ~~pre-run model scenarios~~ ~~a tsunami travel time threat assessment~~, the zones listed below are POTENTIALLY UNDER THREAT.

3. TSUNAMI THREAT FOR THE INDIAN OCEAN

~~For this event all locations within 3 hours are considered under Threat.~~

The list below shows the forecast arrival time of the first wave estimated to exceed 0.5m amplitude at the beach in each zone, and the amplitude of the maximum beach wave predicted for the zone. Zones where the estimated wave amplitudes are less than 0.5m at the beach are not shown.

The list is grouped by country (alphabetic order) and ordered according to the earliest estimated times of arrival at the beach.

Please be aware that actual wave arrival times may differ from those below, and the initial wave may not be the largest. A tsunami is a series of waves and the time between successive waves can be five minutes to one hour.

The threat is deemed to have passed two hours after the forecast time for last exceedance of the 0.5m threat threshold for a zone. ~~Dangerous conditions should be expected to continue for a minimum of 5 hours after the predicted arrival time.~~ As local conditions can cause a wide variation in tsunami wave action, CANCELLATION of national warnings and ALL CLEAR determination must be made by national/state/local authorities.

INDONESIA

NTB SUMBAWA B	1202Z 05Aug2018	0.51m
NTB LOMBOK-TIMUR S	1217Z 05Aug2018	0.51m
NTB LOMBOK-TENGAH	1232Z 05Aug2018	0.51m
NTB SUMBAWA S	1235Z 05Aug2018	0.51m
NTB LOMBOK-BARAT S	1236Z 05Aug2018	0.51m
BALI KLUNGKUNG P.NUSAPENIDA	1239Z 05Aug2018	0.51m
BALI DENPASAR PANTAI-SANUR	1245Z 05Aug2018	0.51m
BALI BADUNG PANTAI-KUTA	1245Z 05Aug2018	0.51m

4. ADVICE

This bulletin is being issued as advice. Only national/state/local authorities and disaster management officers have the authority to make decisions regarding the official threat and warning status in their coastal areas and any action to be taken in response.

5. UPDATES

Additional bulletins will be issued by IOTWMS-TSP AUSTRALIA for this event as more information becomes available.

Other IOTWMS-TSPs may issue additional information at:

TSP INDIA: <http://www.incois.gov.in/Incois/tsunami/eqevents.jsp>

TSP INDONESIA: <http://rtsp.bmkg.go.id>

6. CONTACT INFORMATION

IOTWMS-TSP AUSTRALIA

Joint Australian Tsunami Warning Centre (JATWC)

Bureau of Meteorology

GPO BOX 1289 Melbourne, Victoria, Australia, 3001

<http://reg.bom.gov.au/tsunami/rtsp>

END OF BULLETIN

TSP Australia Bulletin Examples: Type 4 Final Bulletin

TSUNAMI BULLETIN NUMBER 5 (TYPE-IV FINAL BULLETIN)
IOTWMS TSUNAMI SERVICE PROVIDER AUSTRALIA (JATWC)
ISSUED AT 1448 UTC Sunday 05 August 2018

... FINAL TSUNAMI BULLETIN FOR THE INDIAN OCEAN ...

1. EARTHQUAKE TSUNAMI SOURCE INFORMATION

IOTWMS-TSP AUSTRALIA has detected an earthquake with the following details:

Magnitude: 7.0 Mwp

Depth: 25km

Date: 05 Aug 2018

Origin Time: 1146 UTC

Latitude: 8.56S

Longitude: 116.49E

Location: Sumbawa Region, Indonesia

2. EVALUATION

Data from sea-level gauges confirmed that a tsunami was generated.

The expected period of significant tsunami waves is now over for all threatened

Indian Ocean countries, based on IOTWMS-TSP AUSTRALIA modelling.

Because local conditions can cause a wide variation in tsunami wave action,
CANCELLATION of national warnings and ALL CLEAR determination must be made by
national/state/local authorities. Please be aware that dangerous currents can
continue for several hours after the main tsunami waves have passed.

3. TSUNAMI WAVE OBSERVATIONS

Listed below are maximum wave amplitudes recorded at the specified locations.

Note that wave amplitude is measured relative to normal sea level; it is NOT the crest-to-trough wave height.

Benoa	INDONESIA	8.83S 115.33E	0.01m	05 Aug 12:45 UTC
Lembar	INDONESIA	8.70S 116.07E	0.13m	05 Aug 13:08 UTC

4. ADVICE

This bulletin is being issued as advice. Only national/state/local authorities and disaster management officers have the authority to make decisions regarding the official threat and warning status in their coastal areas and any action to be taken in response.

5. UPDATES

No further bulletins will be issued by IOTWMS-TSP AUSTRALIA for this event unless additional information becomes available.

Other IOTWMS-TSPs may issue additional information at:

TSP INDIA: <http://www.incois.gov.in/Incois/tsunami/eqevents.jsp>

TSP INDONESIA: <http://rtsp.bmkg.go.id>

6. CONTACT INFORMATION

IOTWMS-TSP AUSTRALIA

Joint Australian Tsunami Warning Centre (JATWC)

Bureau of Meteorology

GPO BOX 1289 Melbourne, Victoria, Australia, 3001

<http://reg.bom.gov.au/tsunami/rtsp>

END OF BULLETIN

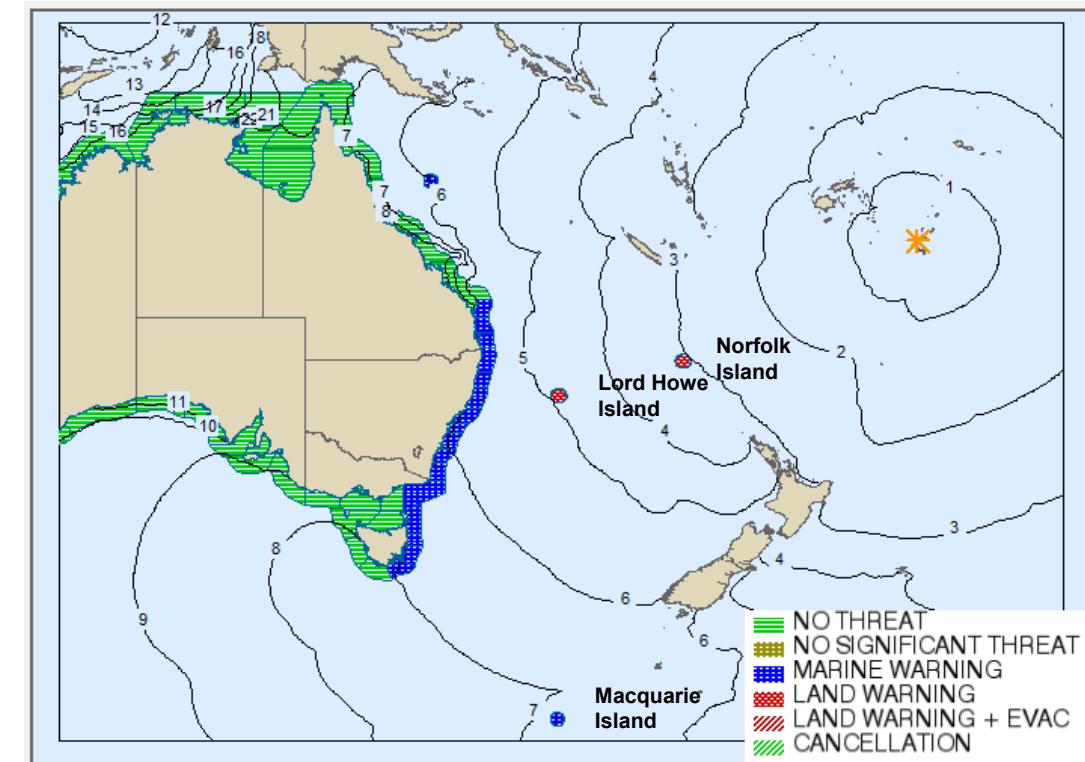
JATWC WARNING TIMELINE

Time (AEDT)	Elapsed Time (hh:mm)	Key Event: 15 January 2022
15:10	00:00	Explosive volcanic eruption of the Hunga Tonga-Hunga Ha'apai volcano (Tonga)
15:30	00:20	Observations confirm a tsunami was generated at 3:30 PM AEDT at Nuku Alofa.
16:58	01:48	No Threat Bulletin issued with additional text to advise that a tsunami had been generated and that the JATWC would continue to monitor observations. Initial assessment based on 3 hours travel time.
19:36	04:26	Marine Warning for Norfolk Island issued after 50 cm wave observed at the tide gauge.
20:00	04:50	Marine Warning issued for Lord Howe Island based on tide gauge measurements increasing at Norfolk Island.
20:37	05:27	Significant observations in NSW and QLD: (40cm at Twofold Bay at 8:10 PM AEDT; 25 cm at Gold Coast at 7:40 PM AEDT) prompts the issuing of Marine Warnings.
20:58	05:48	Norfolk Island Warning upgraded to Land Threat after wave observations exceed 1.0 m at the tide gauge.
21:00	05:50	Marine Warnings extended to Victoria, Tasmania and Macquarie Island using a 7 hours travel time threat assessment.
21:18	06:08	Lord Howe Island Warning upgraded to Land Threat with evacuation order issued at 10:12 PM AEDT.
10:09 +1	18:59	Land warnings for Norfolk Island and Lord Howe Island downgraded to marine.
10:30 to 11:50 +1	19:20 to 20:40	QLD, Macquarie Island, Victoria and Tasmanian marine warnings cancelled.
19:56 to 21:59 +1	28:46 to 30:49	Lord Howe Island, Norfolk Island and NSW warnings cancelled.

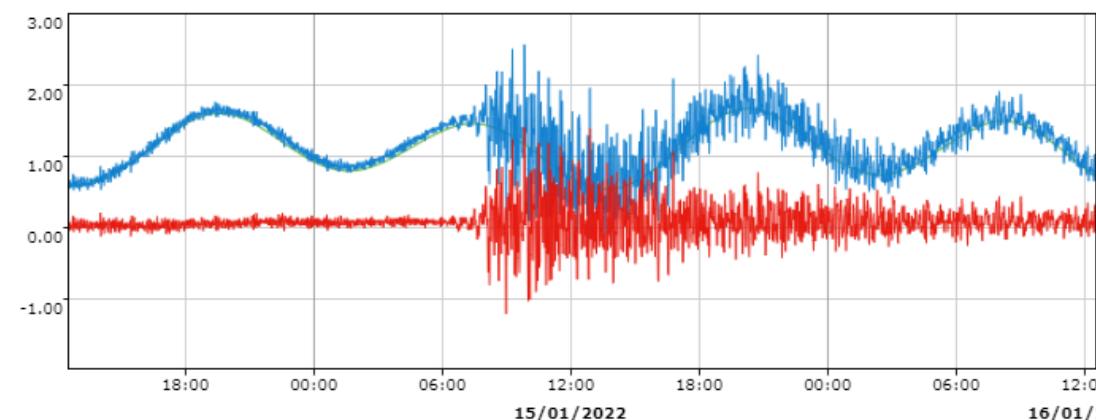
Key Challenges

- Initial detection of the volcanic eruption / tsunami and scale of eruption.
- Lack of event-specific tsunami modelling.
- Lack of a unified sea-level observing tool.

JATWC Tsunami Threat Assessment – Within 7 Hours Travel Time



Norfolk Island – 1.27



THANK YOU

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