



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

J. Padmanabham

*Chair-WG2; INCOIS-INDIA
Padmanabham@incois.gov.in*

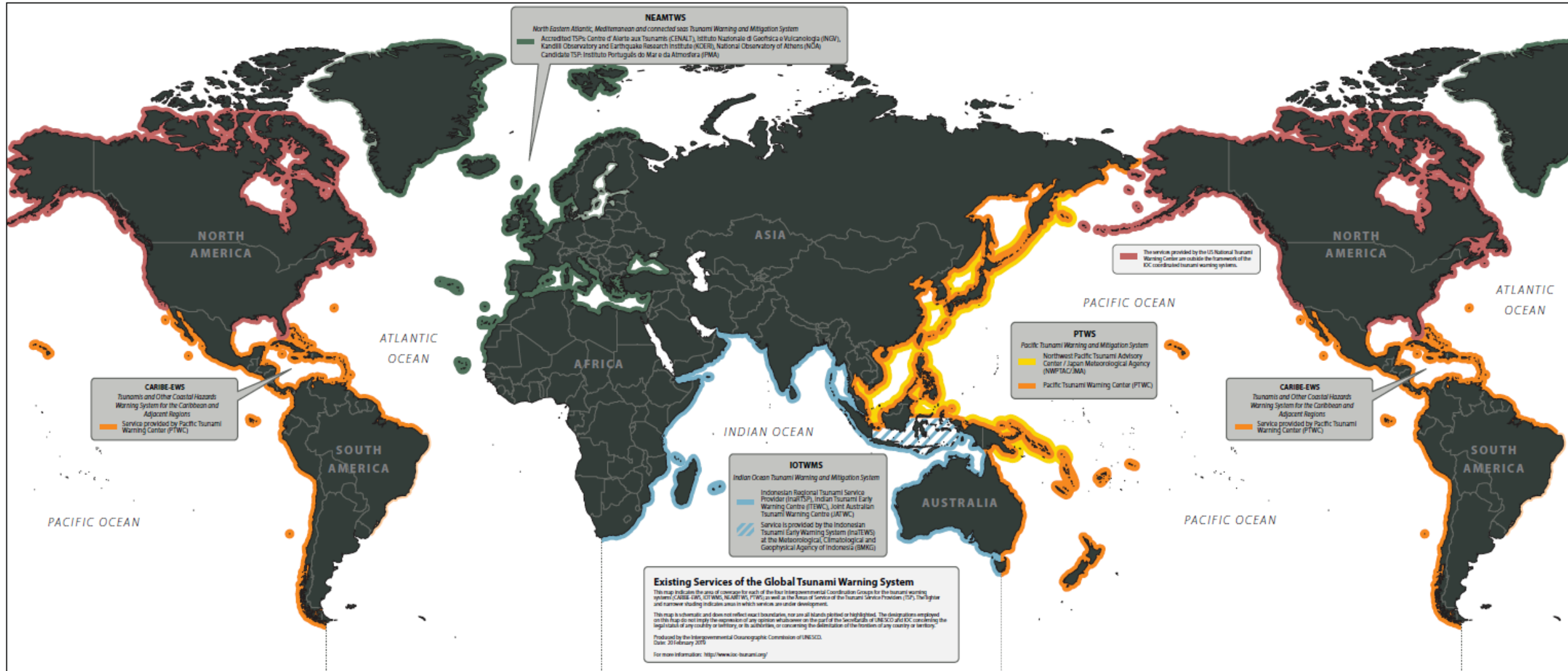
Robert Greenwood, BoM, Australia

*Vice-Chair-WG2; BoM-Australia
robert.greenwood@bom.gov.au*

Session Organization

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

Global Tsunami Warning System

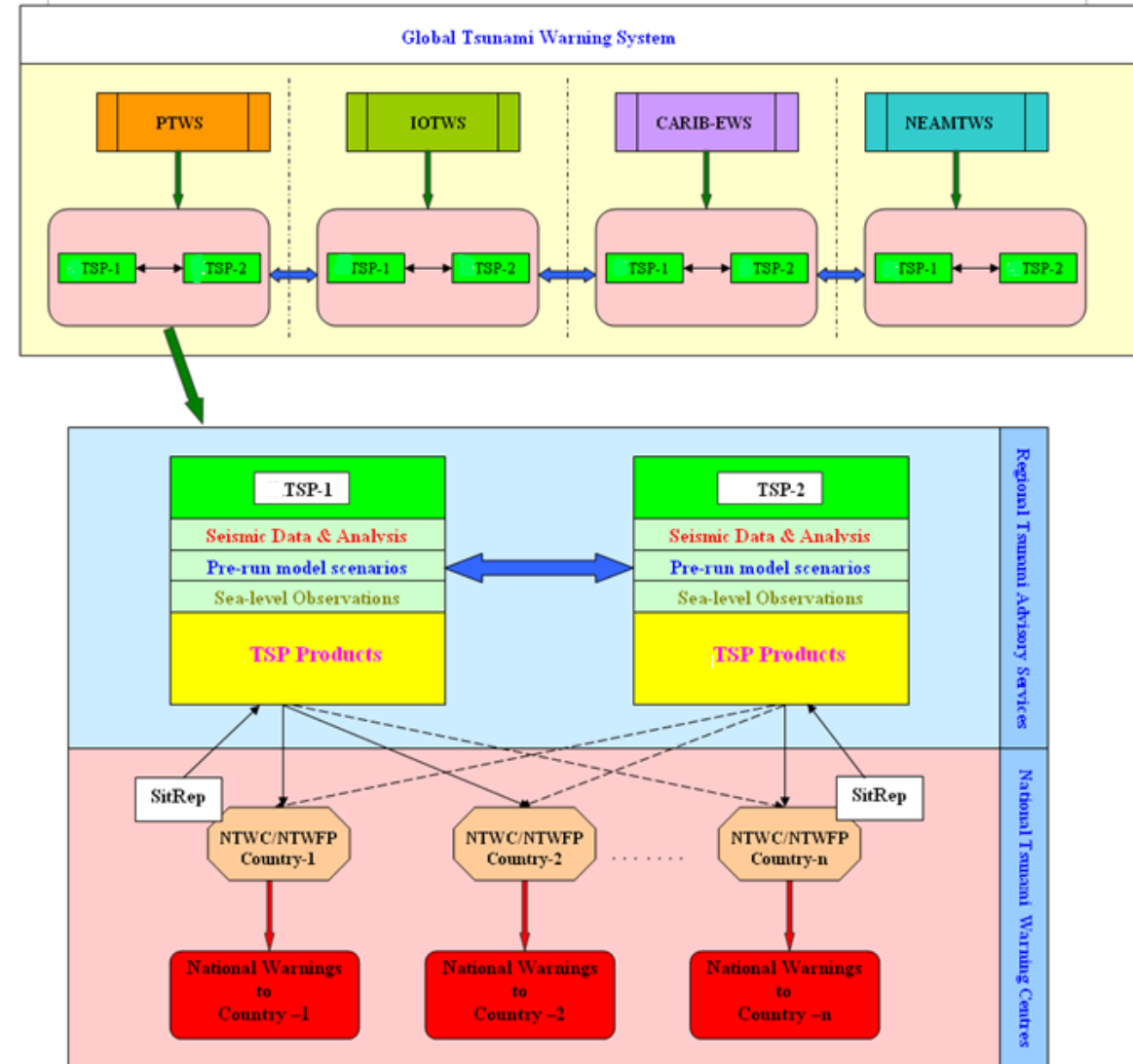


Source: TSUNAMI WATCH OPERATIONS , Global Service Definition Document, IOC Technical series 180

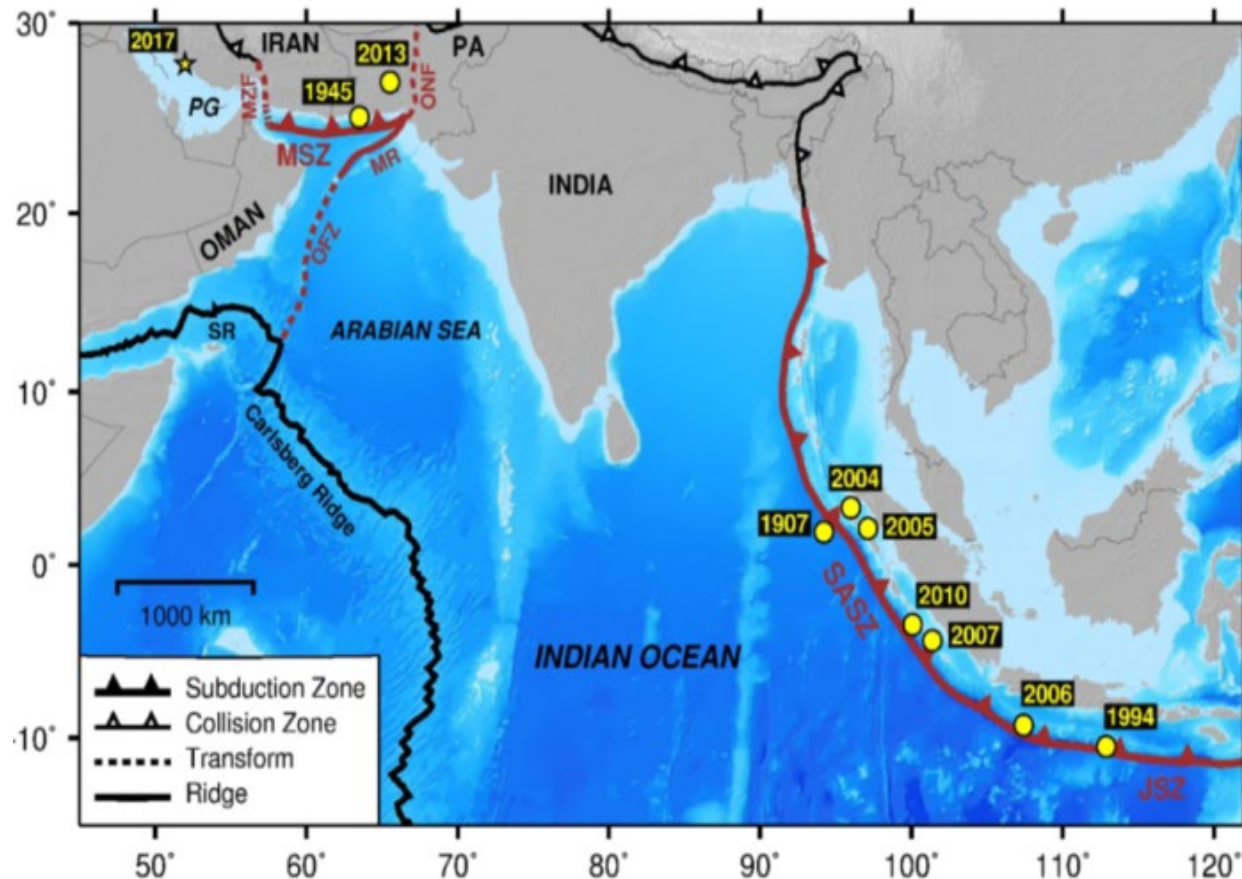
Pre-IOWave25 Workshops on Standard Operating Procedures for NTWCs and DMOs
Hybrid – August 2025

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



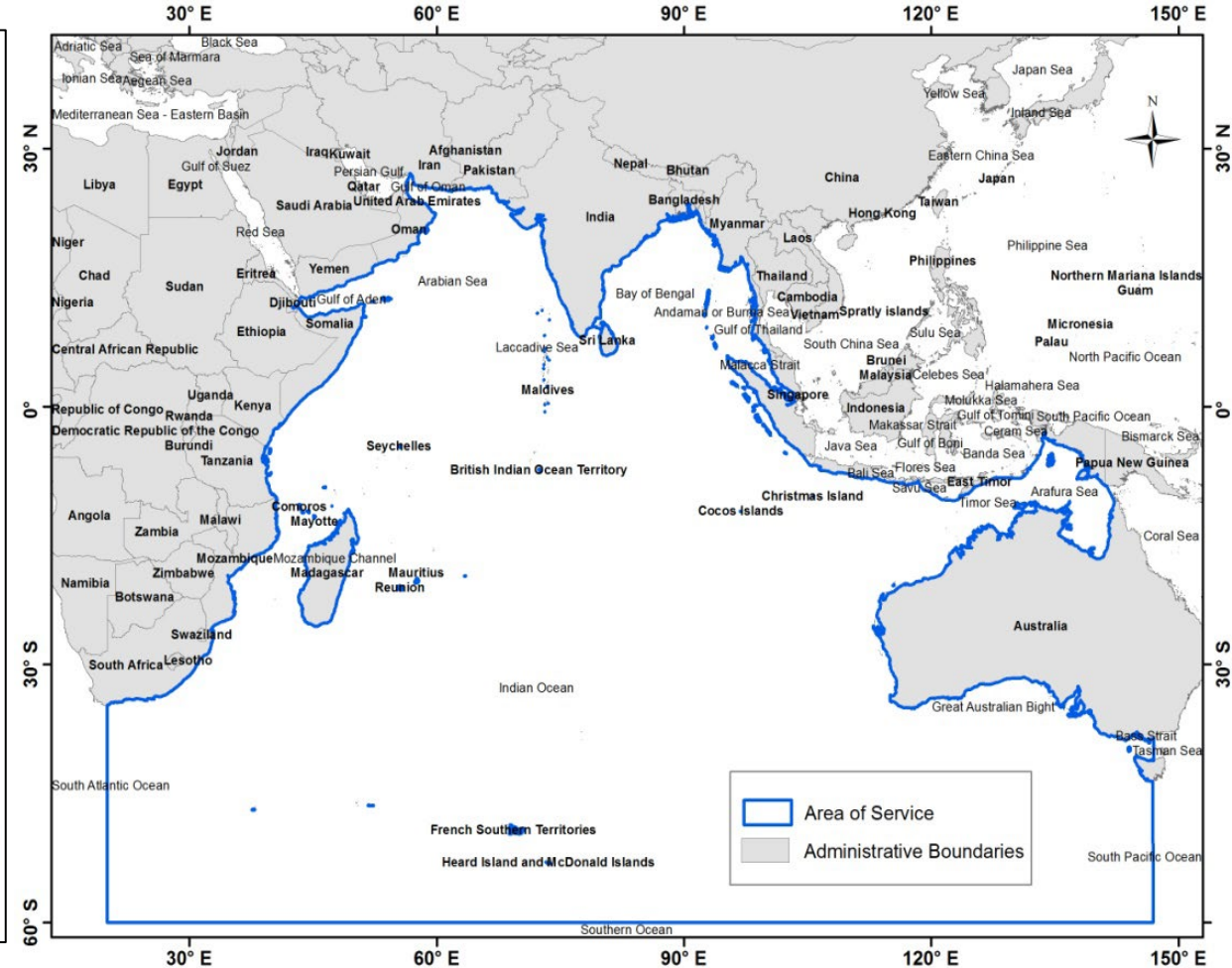
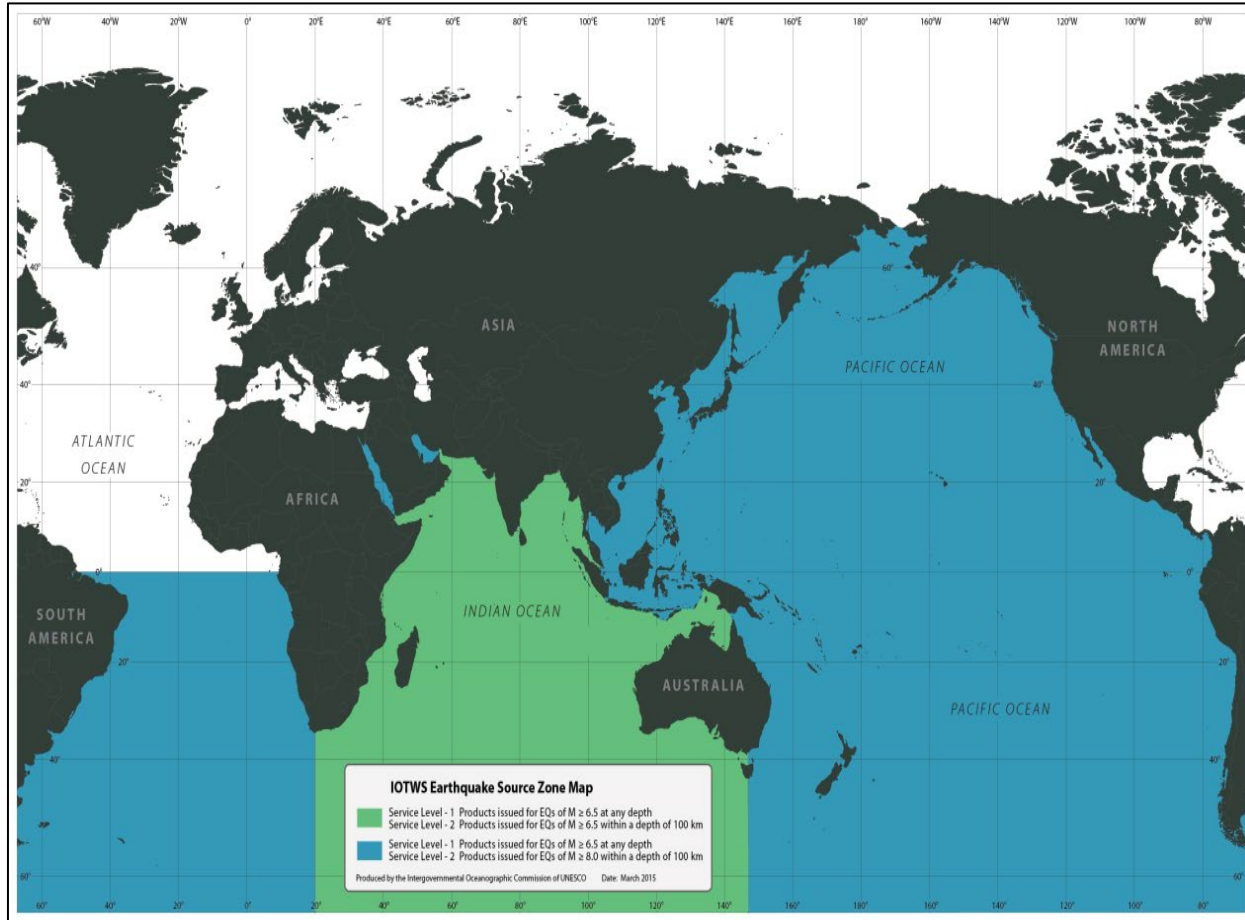
- Subduction Zone: Indian and Australian plates are moving north and eastward relative to Eurasian plate forming a convergent boundary
- Major Subduction Zones
 - Sumatra Andaman Subduction Zone ~6000 km
 - Makran Subduction Zone ~900 km
- Sumatra Andaman Subduction Zone (SASZ) – From Himalayan front 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



unesco

Intergovernmental
Oceanographic
Commission



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



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**

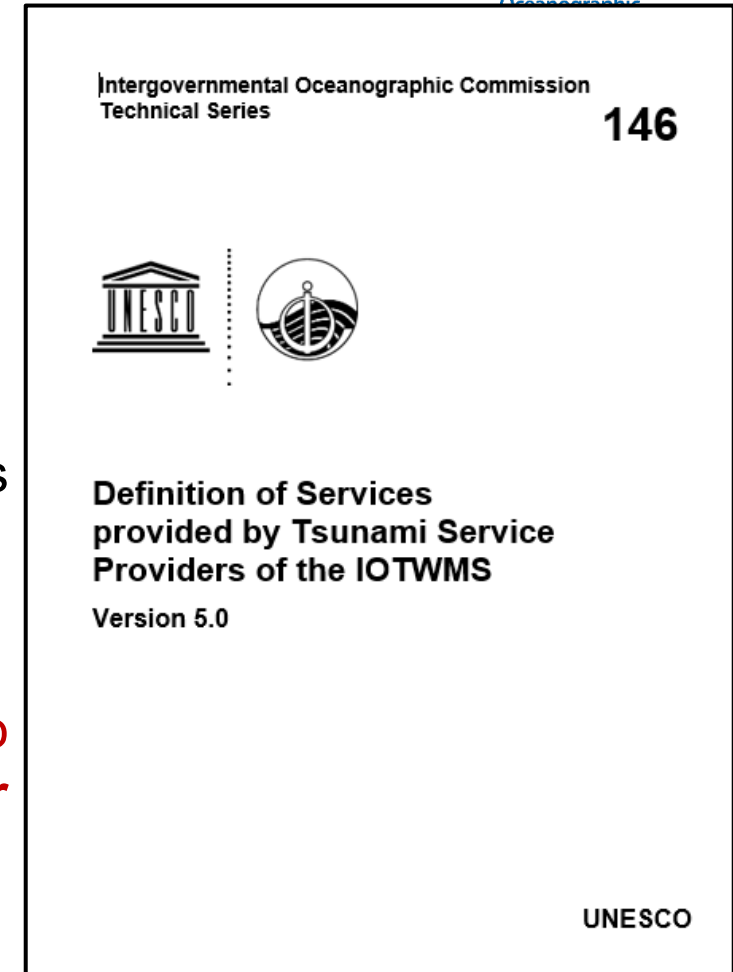
- Service Level-I (EQ Information)
- Service Level –II (Tsunami Threat Bulletins and Threat Maps)

Harmonize the TSP Products to have

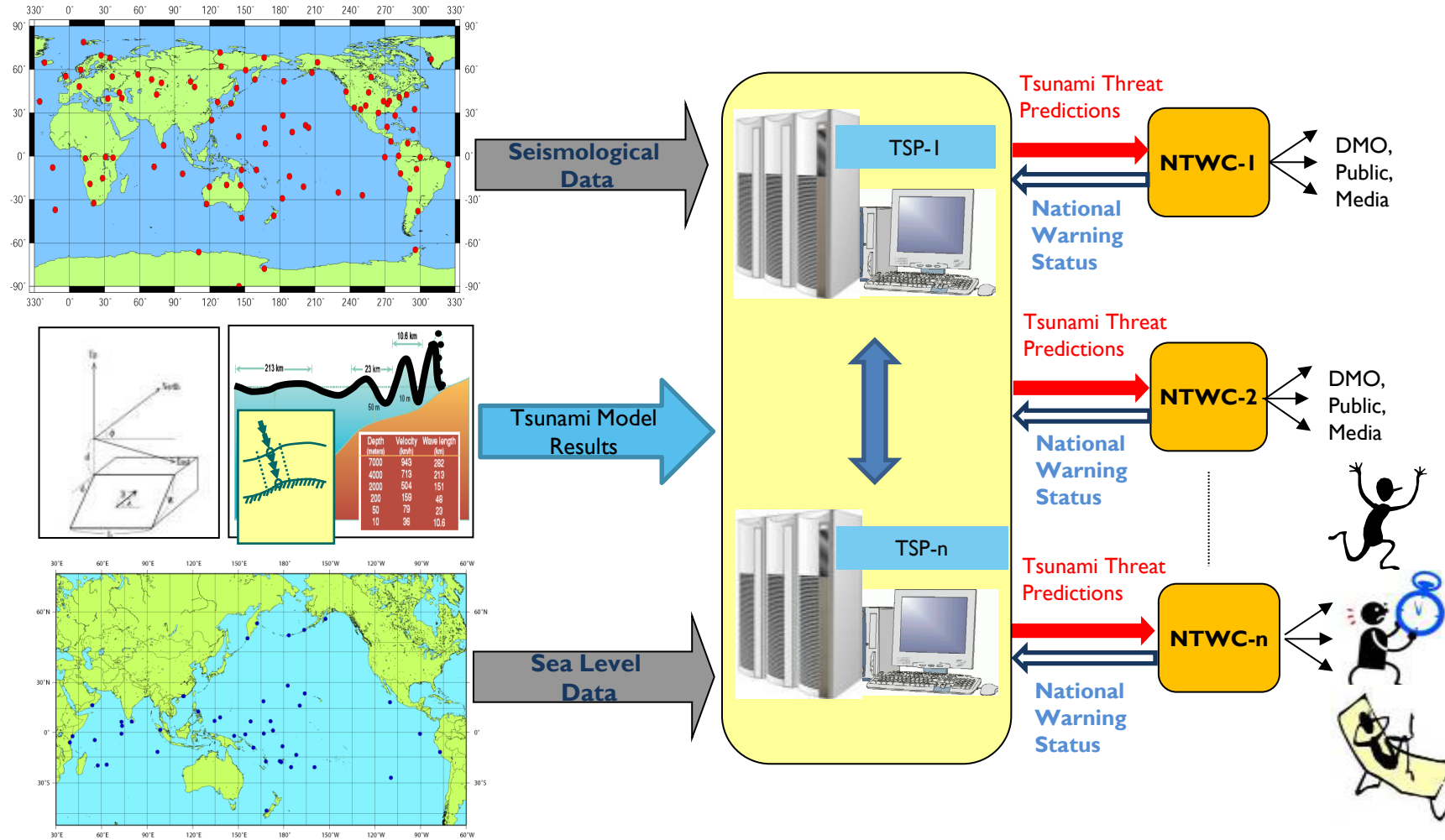
- Consistent bulletin types, formats, information content and terminology
- Consistent tsunami wave threat threshold and coastal zone definitions for the Indian Ocean
- Consistent content in TSP websites

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**.



Operational Elements of TSPs



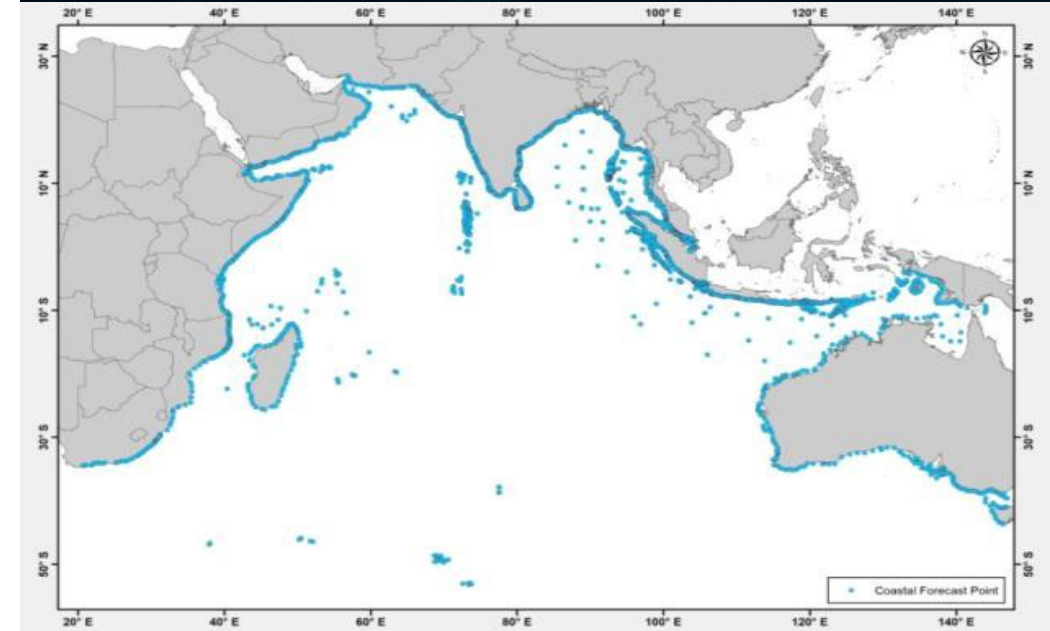
Roles and Responsibilities of TSPs

- **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

IOTWMS Coastal Forecast Zones

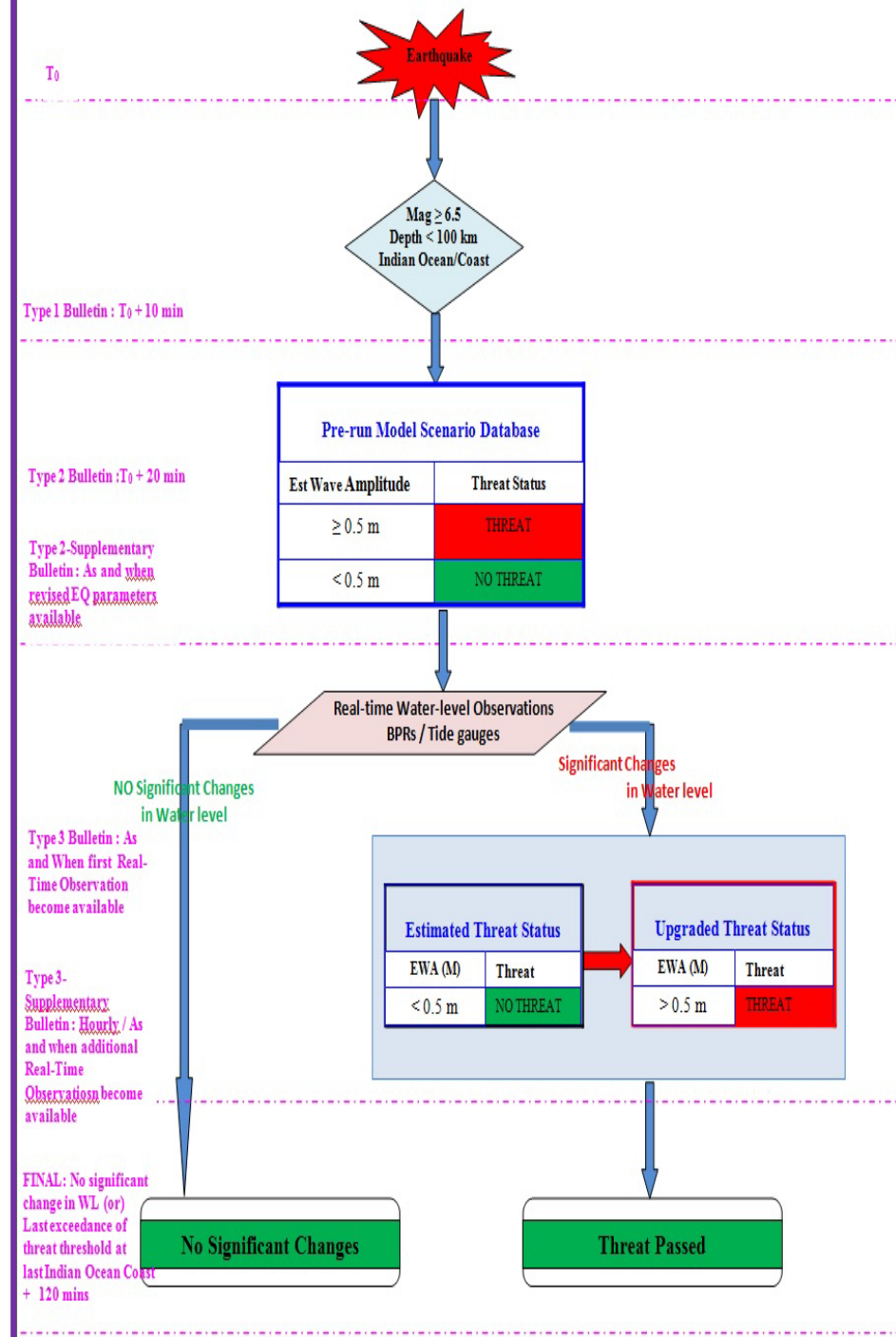
- Total Coastal Forecast Zones (CFZs) are 581.
- Total Coastal Forecast Points (CFPs) are 2251.
- Each coastal forecast zone is represented by a seamless buffer zone along the coast and 50 km in width across the coast.
- The zone starts from the coastal district administrative boundary instead of 30 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.) with in ESZ that may have probability/likely to generate tsunami in the Indian Ocean Basin



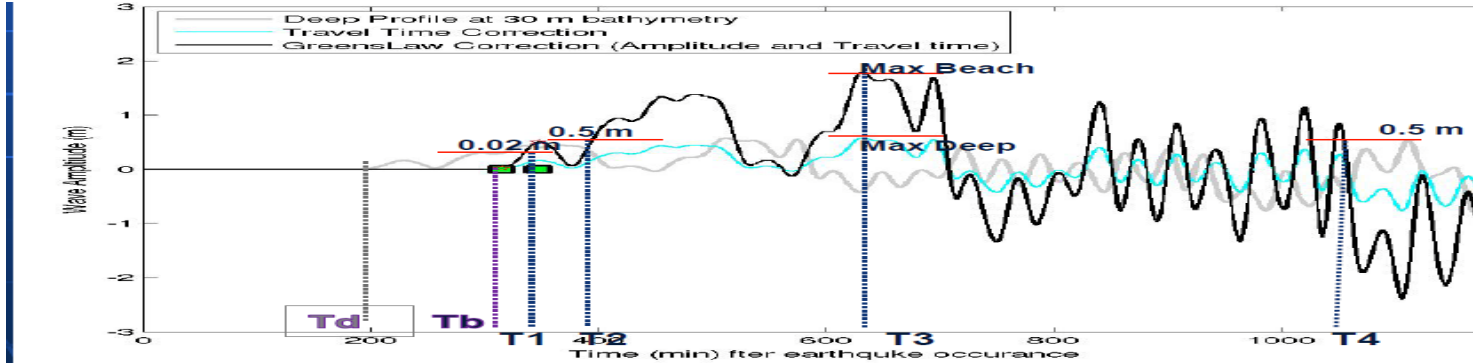
TSP Bulletins- Bulletin Types and Content

- **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 | Target: within 20 minutes |
| | Potential Threat Bulletin , based on assessment using wave models. Contains specific threat information for each Indian Ocean coastal zone. | |
| 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 |

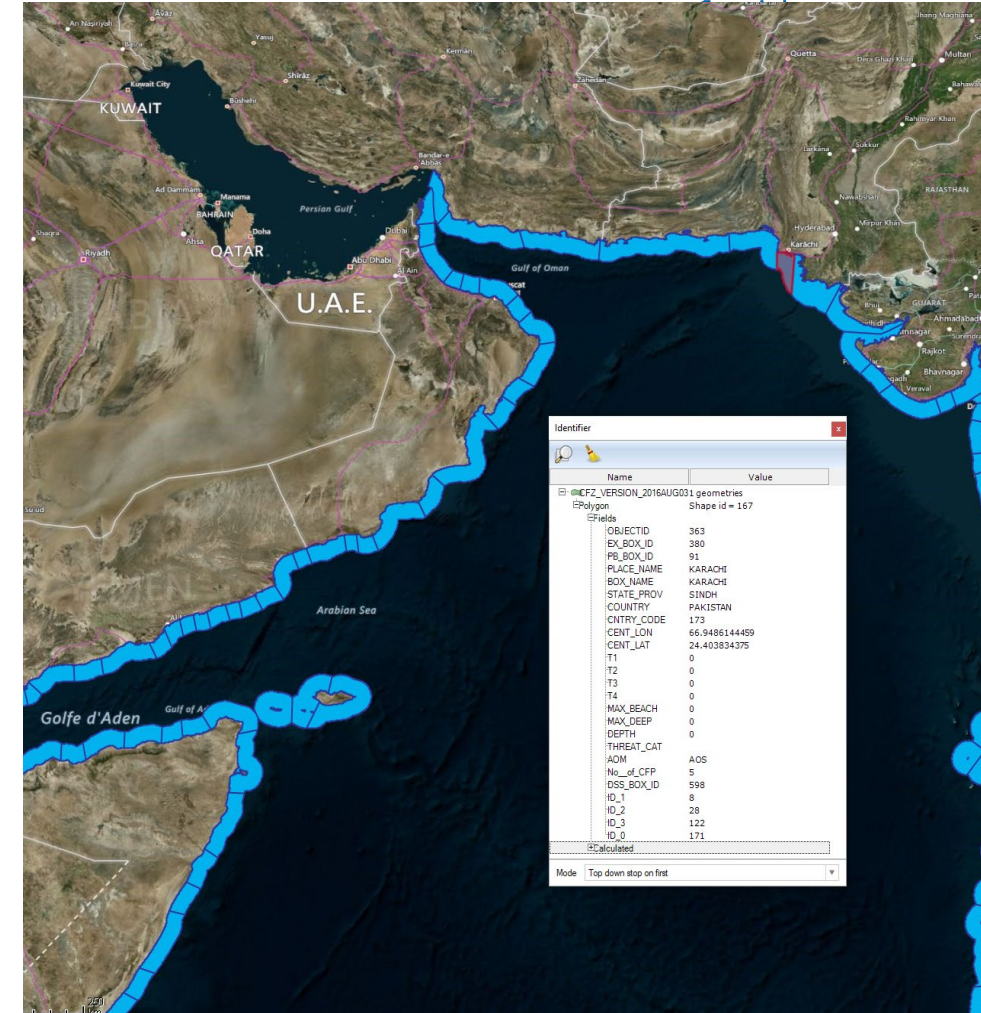
Tsunami Prediction Information

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



Predicted Wave Arrival Times:


- **T_1** : Time of arrival of first amplitude $> +2\text{cm}$
- **T_2** : Time of arrival of first wave over $+50\text{cm}$ amplitude on the beach
- **T_3** : Time of arrival of largest wave (“max beach”)
- **T_4** : 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 Password-Protected Websites containing all the generated tsunami bulletins, threat maps and threat tables, plus the NTVWC Warning Status Reporting Form.


Tue Jul 04 2023 15:17:14 IST
Tue, 04 Jul 2023 09:47:14 UTC

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Indian Tsunami Early Warning System


Ministry of Earth Sciences - Government of India




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Seismic Activity for past 90 days with magnitude > 5.5M




| Origin Time(UTC) | Region Name | Latitude(Deg) | Longitude(Deg) | Depth(km) | Magnitude | Regional Bulletins |
|----------------------|------------------------------|---------------|----------------|-----------|-----------|--------------------|
| 02 Jul 2023 10:27:00 | Tonga Islands | 17.79S | 175.17W | 243.0 | 6.5M | Public Exchange |
| 15 Jun 2023 18:06:00 | South of Fiji Islands | 23.09S | 176.96W | 193.0 | 6.0M | Public Exchange |
| 20 May 2023 01:50:00 | Southeast of Loyalty Islands | 22.94S | 170.51E | 10.0 | 7.0M | Public Exchange |
| 19 May 2023 02:57:00 | Southeast of Loyalty Islands | 23.17S | 170.75E | 10.0 | 7.4M | Public Exchange |
| 10 May 2023 16:02:00 | Tonga Islands | 15.65S | 174.56W | 220.0 | 7.1M | Public Exchange |
| 24 Apr 2023 20:00:00 | Southern Sumatra, Indonesia | .69S | 98.71E | 10.0 | 6.9M | Public Exchange |



AGENCY FOR METEOROLOGICAL CLIMATOLOGY AND GEOPHYSICS

Indonesia Tsunami Service Provider



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Earthquake Event List

Earthquake Event List
[Earthquake Event Map](#)

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| Origin Time (UTC) | Mag | Depth (Kms) | Latitude | Longitude | Location | Type | Bulletin Number | Bulletin Type | Event Group |
|----------------------|-----|----------------|----------|-----------|---|------------|-----------------|----------------------------|-----------------|
| 2023-07-02 10:27:27 | 7.2 | 82 | 17.97S | 174.57W | 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 08:00:00 | 9.0 | 0 | 7.2N | 92.9E | Nicobar Islands, India Region (CommTEST-Jun-2023) | TEST EVENT | 4 | FINAL BULLETIN | 202306070800COM |
| 2023-06-07 08:00:00 | 9.0 | 0 | 7.2N | 92.9E | Nicobar Islands, India Region (CommTEST-Jun-2023) | TEST EVENT | 3, 1 | CONFIRMED THREAT BULLETIN | 202306070800COM |
| 2023-06-07 08:00:00 | 9.0 | 0 | 7.2N | 92.9E | Nicobar Islands, India Region (CommTEST-Jun-2023) | TEST EVENT | 2 | THREAT ASSESSMENT BULLETIN | 202306070800COM |
| 2023-06-07 08:00:00 | 9.0 | 0 | 7.2N | 92.9E | Nicobar Islands, India Region (CommTEST-Jun-2023) | TEST EVENT | 1 | EARTHQUAKE BULLETIN | 202306070800COM |
| 2023-05-20 1:50:59 | 7.5 | 17 | 22.96S | 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 | 174.40W | Tonga Islands | REAL EVENT | 1 | EARTHQUAKE BULLETIN | 202305101602 |
| 2023-04-28 03:13:36 | 6.5 | 589 | 24.95S | 179.64E | South of Fiji Islands | REAL EVENT | 1 | EARTHQUAKE BULLETIN | 202304280313 |
| 2023-04-24 20:00:57 | 6.9 | 84 | 0.93S | 98.39E | Southern Sumatra, Indonesia | REAL EVENT | 2 | THREAT ASSESSMENT BULLETIN | 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 | 29.95S | 177.29W | Kermadec Islands, New Zealand | REAL EVENT | 1 | EARTHQUAKE BULLETIN | 202304240041 |
| 2023-04-14 09:55:46 | 6.5 | 604 | 6.12S | 111E | 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 BULLETIN | 202304030306 |

Current Time (UTC)

Jul 04, 2023
09:44:46

Miscellaneous

- [Earthquake Event List](#)
- [Earthquake Event Map](#)
- [Performance Indicator](#)

Links

- [NTWC Status Reporting Form \(Index\)](#)
- [TSP Australia Website](#)
- [TSP India Website](#)
- [IOC-UNESCO Website](#)
- [IGC/IOTWS Secretariat Website](#)
- [PTWC Website](#)
- [JMA Website](#)

Documentation

- [TSP Indonesia User Manual](#)
- [TSP Australia User Manual](#)
- [TSP India User Manual](#)

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

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

<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

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NSW VIC QLD WA SA TAS ACT NT AUSTRALIA GLOBAL ANTARCTICA

Bureau Home > Joint Australian Tsunami Warning Centre > Status of Tsunami Warnings in the Indian Ocean
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

About | FAQ | Latest Public Bulletin

Warning Status

| Country | Status |
|-----------------------------------|---------|
| Australia | Level 1 |
| France (Indian Ocean Territories) | Level 1 |
| Kenya | Level 1 |
| Mauritius | Level 1 |
| Maldives | Level 1 |
| Myanmar | Level 1 |
| Oman | Level 1 |
| Palau | Level 1 |
| Seychelles | Level 1 |
| Singapore | Level 1 |
| Somalia | Level 1 |
| South Africa | Level 1 |
| Sri Lanka | Level 1 |
| Tanzania | Level 1 |
| Thailand | Level 1 |
| Timor-Leste | Level 1 |
| UAE | Level 1 |
| UK (Indian Ocean Territories) | Level 1 |
| Yemen | Level 1 |

Earthquakes

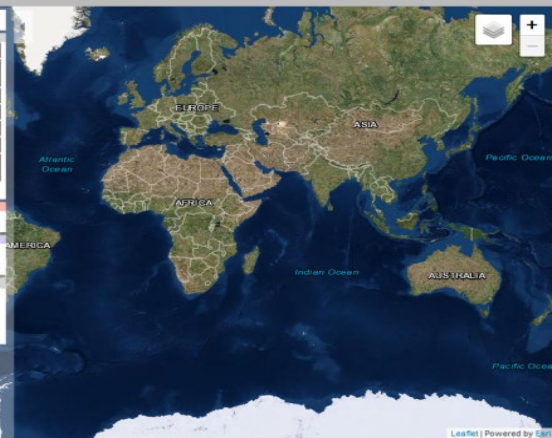
Event Date Mag. Location

Tsunami Wave Observations

Location MAX Date Ev.

National Tsunami Warning Centres

Australia: Bureau of Meteorology, Fremantle (Indian Ocean Territories), India: Indian Ocean Tsunami Warning Centre, Indonesia: Kema, Madagascari, Malaysia: Malaysian Meteorological Department, Mauritius: Mauritius Meteorological Service, Myanmar: Myanmar Meteorological Department, Oman: Oman Meteorological Service, Seychelles: Seychelles Meteorological Service, Sri Lanka: Sri Lanka Meteorological Service, Thailand: Thai Meteorological Service, Timor-Leste: Timor-Leste Meteorological Service, UAE: UAE Meteorological Service, UK (Indian Ocean Territories): UK Meteorological Service, Yemen: Yemen Meteorological Service



TSP- Australia

Indian Tsunami Early Warning System
Ministry of Earth Sciences - Government of India

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Home / Tsunami Early Warnings / NTWCs Feedback Summary

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 (close of 0700 hrs, bulletin by 0730 hrs). If no further NTWC feedback is received, the page will be cleared to indicate no warnings.

Legend

- Threat Level 1: No impact expected, no flooding, no damage.
- Threat Level 2: There is a potential for impact, but given the latest time, no response of the public is necessary at the moment.
- Threat Level 3: Threat of tsunami is high and the public should be alerted to take necessary precautions and evacuate to safe areas.
- Threat Level 4: Threat of tsunami is high and the public should be alerted to take necessary precautions and evacuate to safe areas.
- Threat Level 5: Threat of tsunami is high and the public should be alerted to take necessary precautions and evacuate to safe areas.

Show 50 rows - entries

| Country | Threat Status | Comments | Sender | Sender Time |
|-----------------------------------|---------------|----------|--------|-------------|
| Australia | - | - | - | - |
| Bangladesh | - | - | - | - |
| Comoros | - | - | - | - |
| Qibouti | - | - | - | - |
| France (Indian Ocean Territories) | - | - | - | - |
| India | - | - | - | - |
| Kenya | - | - | - | - |
| Maldives | - | - | - | - |
| Malaysia | - | - | - | - |
| Maldives | - | - | - | - |
| Mauritius | - | - | - | - |
| Myanmar | - | - | - | - |
| Oman | - | - | - | - |
| Palau | - | - | - | - |
| Seychelles | - | - | - | - |
| Singapore | - | - | - | - |
| Somalia | - | - | - | - |
| South Africa | - | - | - | - |
| Sri Lanka | - | - | - | - |
| Thailand | - | - | - | - |
| Timor-Leste | - | - | - | - |
| UAE | - | - | - | - |
| UK (Indian Ocean Territories) | - | - | - | - |
| Yemen | - | - | - | - |

Showing 1 to 20 of 20 entries

TSP- India

AGENCY FOR METEOROLOGY CLIMATOLOGY AND GEOPHYSICS
Indonesia Tsunami Service Provider

InaTEWS - Indonesia Tsunami Early Warning System

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Public Bulletin

Event List | Event Map

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Event 1-50 of 685 Events

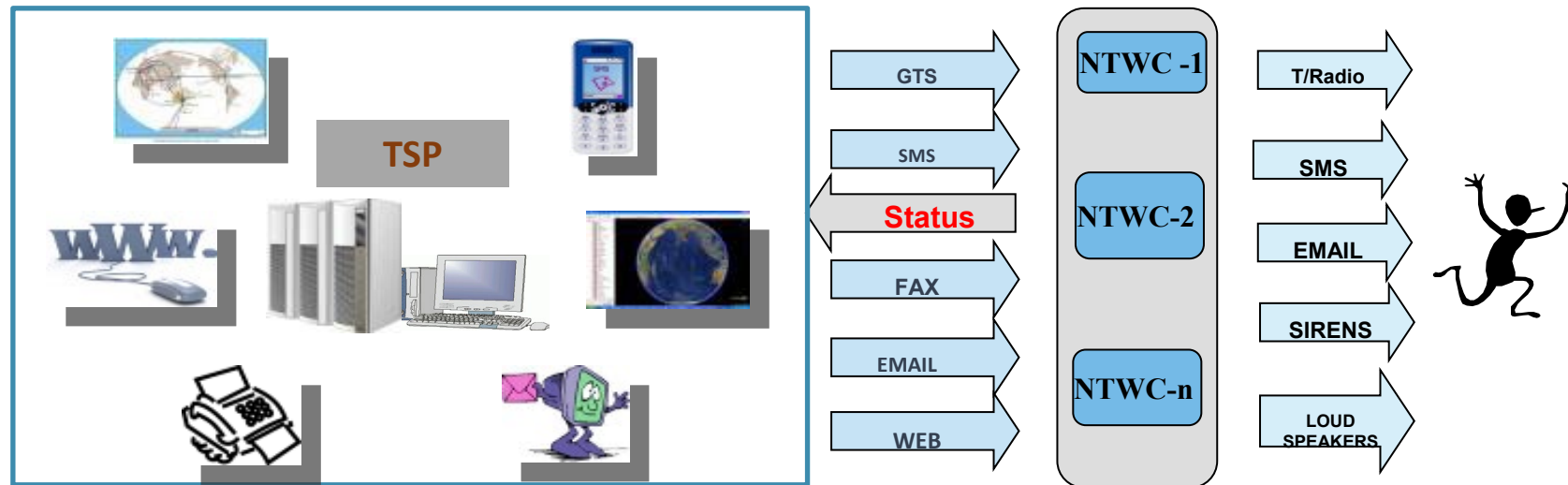
| Date | Time (UTC) | Magnitude | Depth (Km) | Latitude | Longitude | Location | Type | Bulletin Number | Bulletin Type | Event Group |
|------------|------------|-----------|------------|----------|-----------|---|------------|-----------------|----------------------------|-----------------|
| 2025-06-03 | 05:37:55 | 6.8 | 26 | 50.71N | 157.62E | Kuril Islands | REAL EVENT | 1 | EARTHQUAKE BULLETIN | 202506030537 |
| 2025-07-30 | 02:30:36 | 6.8 | 10 | 50.57N | 157.66E | Kuril Islands | REAL EVENT | 1 | EARTHQUAKE BULLETIN | 202507300230 |
| 2025-07-29 | 23:24:54 | 8.6 | 43 | 52.54N | 160.07E | Off East Coast of Kamchatka | REAL EVENT | 2 | THREAT ASSESSMENT BULLETIN | 202507292324 |
| 2025-07-29 | 23:24:50 | 7.6 | 10 | 52.53N | 160.13E | Off East Coast of Kamchatka | REAL EVENT | 1 | EARTHQUAKE BULLETIN | 202507292324 |
| 2025-07-28 | 22:10:31 | 6.7 | 10 | 57.91S | 157.3E | Macquarie Island Region | REAL EVENT | 1 | EARTHQUAKE BULLETIN | 202507282210 |
| 2025-07-20 | 07:07:49 | 6.7 | 55 | 52.9N | 160.63E | Off East Coast of Kamchatka | REAL EVENT | 1 | EARTHQUAKE BULLETIN | 202507200707 |
| 2025-07-20 | 06:49:03 | 6.7 | 10 | 52.87N | 160.61E | Off East Coast of Kamchatka | REAL EVENT | 1 | EARTHQUAKE BULLETIN | 202507200649 |
| 2025-07-20 | 06:28:22 | 6.5 | 49 | 53.17N | 160.28E | Near East Coast of Kamchatka | REAL EVENT | 1 | EARTHQUAKE BULLETIN | 202507200628 |
| 2025-07-16 | 20:37:38 | 7.5 | 10 | 54.82N | 160.60W | Alaska Peninsula | REAL EVENT | 1 | EARTHQUAKE BULLETIN | 202507162037 |
| 2025-07-14 | 05:40:58 | 6.9 | 105 | 6.23S | 131.31E | Taninbar Islands Region, Indonesia | REAL EVENT | 1 | EARTHQUAKE BULLETIN | 202507140548 |
| 2025-06-24 | 01:55:11 | 6.7 | 13 | 7.84N | 129.7E | East of Philippine Islands | REAL EVENT | 1 | EARTHQUAKE BULLETIN | 202506240155 |
| 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 |

User Login
Username:
Password:
Login

TSP- Indonesia

Product Formats & Dissemination

- **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/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

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/rtsp/>

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 | PUSHT | 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 06:06 | 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 KHAIBURAH | 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 |
| OMAN | AL SHARQIYAH | SUR | 11-Oct-2023 06:26 | 11-Oct-2023 06:29 | 11-Oct-2023 06:41 | 12-Oct-2023 07:00 | 6.6 | Threat |
| UNITED ARAB EMIRATES | UAE | KALBA | 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 | AL ASHKHARAH | 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 | MASIRAH | 11-Oct-2023 06:57 | 11-Oct-2023 07:03 | 11-Oct-2023 17:09 | 12-Oct-2023 06:41 | 1.3 | Threat |
| OMAN | AL SHARQIYAH | RAS AR RUWAYS | 11-Oct-2023 07:02 | 11-Oct-2023 07:11 | 11-Oct-2023 12:36 | 12-Oct-2023 06:47 | 1.8 | Threat |
| PAKISTAN | BALUCHISTAN | WINDER | 11-Oct-2023 07:17 | 11-Oct-2023 07:30 | 11-Oct-2023 12:13 | 12-Oct-2023 07:00 | 1.7 | Threat |
| OMAN | AL SHARQIYAH | AD DUQM | 11-Oct-2023 07:24 | 11-Oct-2023 07:31 | 11-Oct-2023 17:41 | 12-Oct-2023 07:00 | 2 | Threat |
| PAKISTAN | SINDH | KARACHI | 11-Oct-2023 07:50 | 11-Oct-2023 08:07 | 11-Oct-2023 17:44 | 12-Oct-2023 06:34 | 2.9 | Threat |
| PAKISTAN | SINDH | SINDH | 11-Oct-2023 07:51 | 11-Oct-2023 08:08 | 11-Oct-2023 18:10 | 12-Oct-2023 07:00 | 1.6 | 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 | HASIK | 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 |



AGENCY FOR METEOROLOGY CLIMATOLOGY AND GEOPHYSICS

Indonesia Tsunami Service Provider




You are logged as: USER

HomePublic BulletinAbout InaTSPSeismic NetworkContact UsLogout

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

Exchange Bulletin

Notification Bulletin

Threat Table

Threat Map

Traveltime Map

SSHMax Map

| Country | Location | T1 (UTC) | T2 (UTC) | T3 (UTC) | T4 (UTC) | EWI | Status |
|----------|-------------|---------------------|---------------------|---------------------|---------------------|------|--------|
| DJIBOUTI | 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 | 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 | 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 | 1.78 | Threat |
| INDIA | JAMNAGAR | 2023-10-11 08:18:15 | 2023-10-11 08:23:30 | 2023-10-11 13:14:00 | 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 | 1.65 | Threat |
| INDIA | HAZIRA, DIU | 2023-10-11 08:35:30 | 2023-10-11 08:42:00 | 2023-10-11 17:18:00 | 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 | 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 | 1.00 | 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 | 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 | 0.91 | Threat |

Current Time (UTC)

Aug 04, 2025

05:37:56

Miscellaneous

Earthquake Event List

Earthquake Event Map

Performance Indicator

Links

NTWC Status Reporting Form (India)

TSP Australia Website

TSP India Website

IOC-UNESCO Website

ICG/IOWS Secretariat Website

PTWC Website

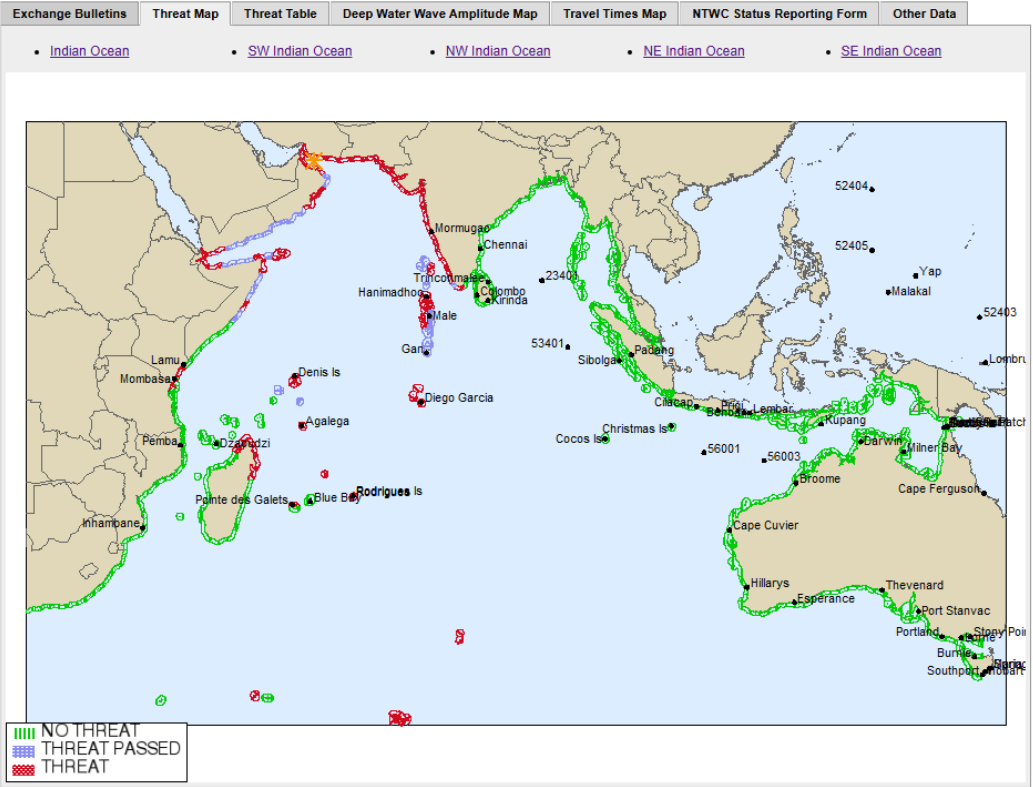
JMA Website

Documentation

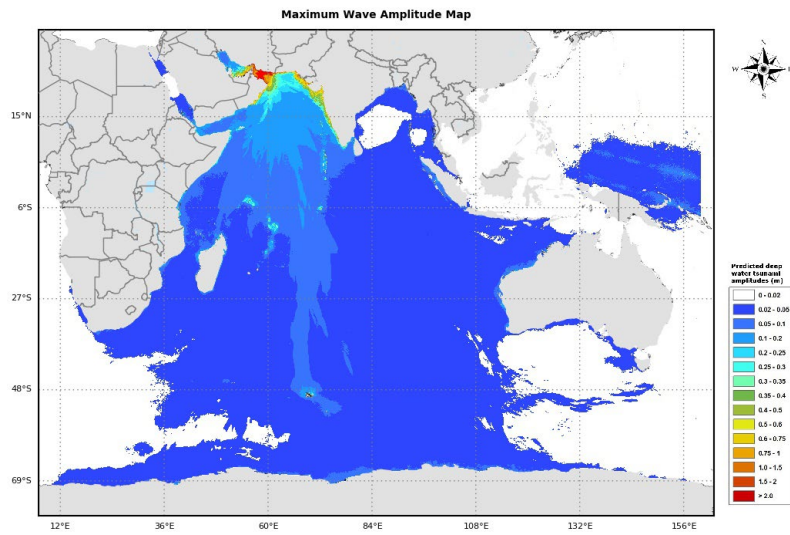
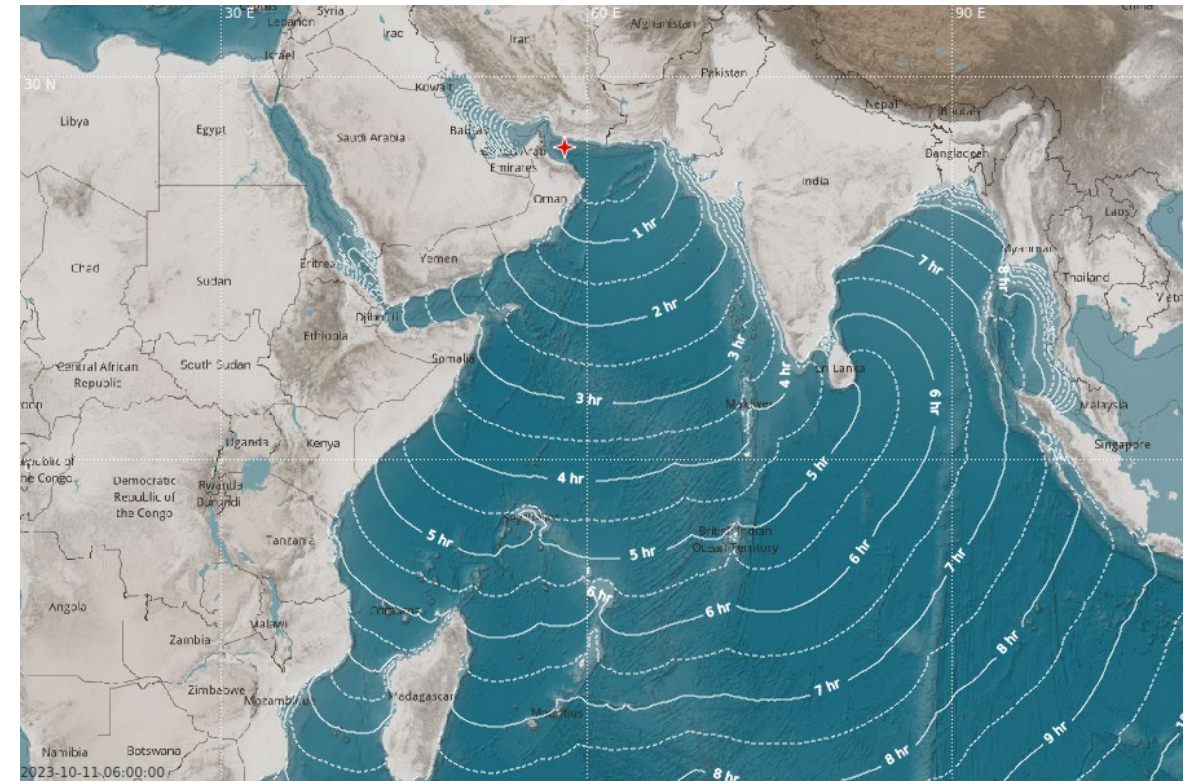
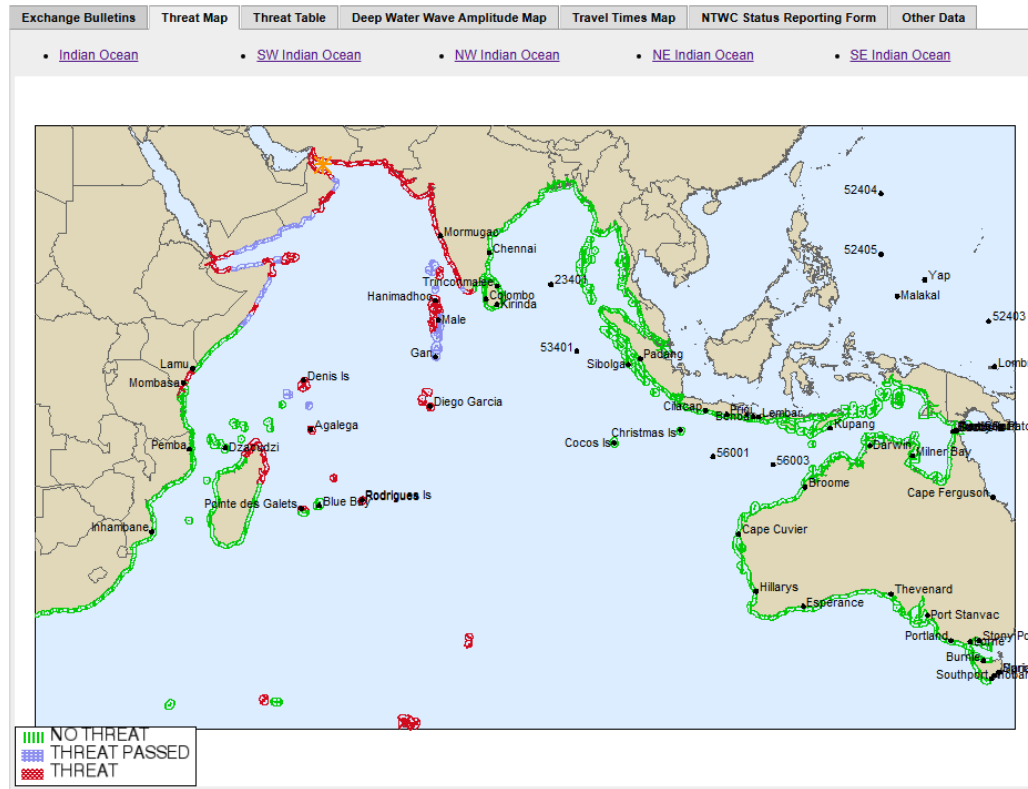
TSP Indonesia User Manual

TSP Australia User Manual

TSP India User Manual



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 | |
| MAURITUS | 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

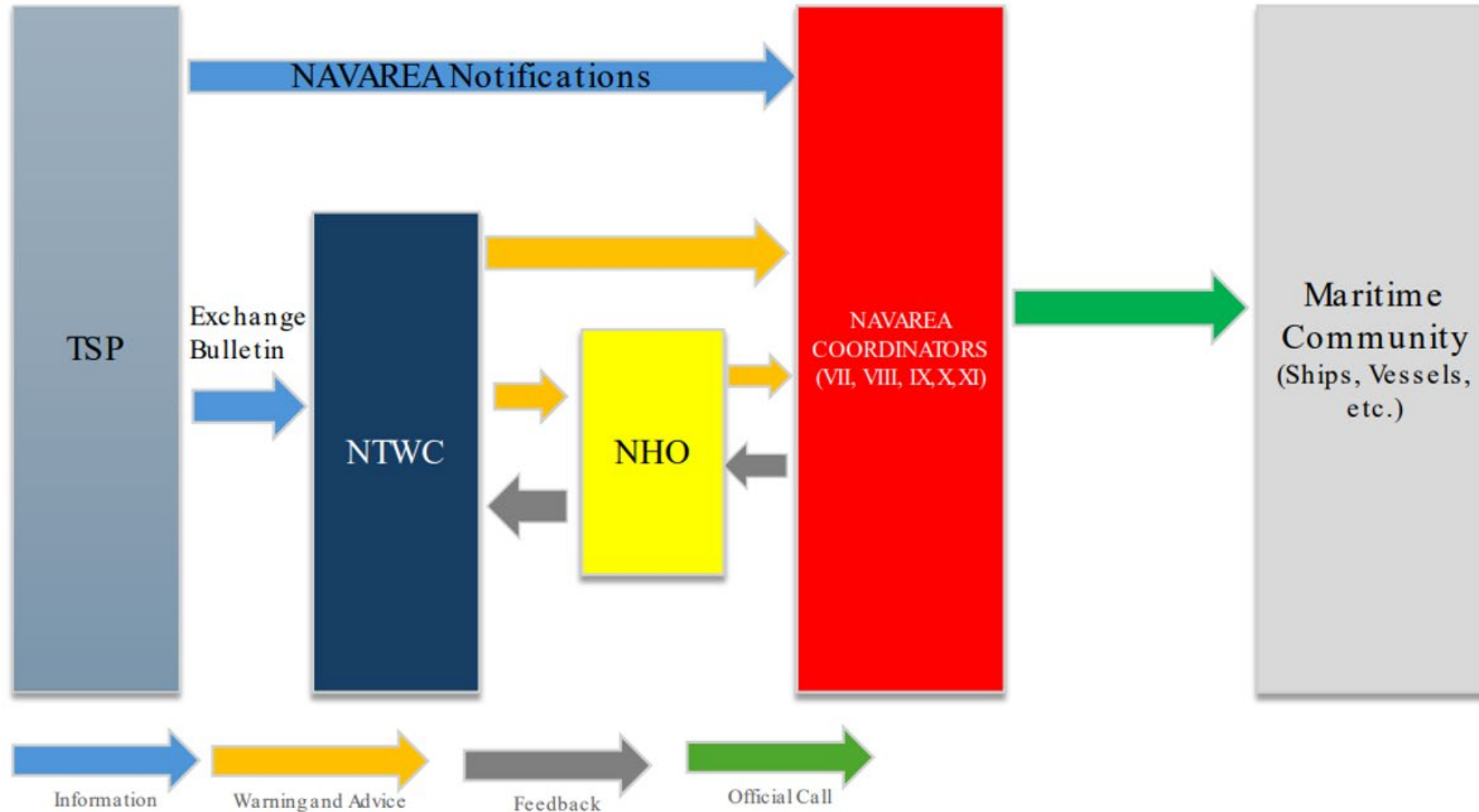
EAST INDIAN OCEAN, NORTH INDIAN OCEAN, SOUTHWEST INDIAN OCEAN, WEST INDIAN OCEAN

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

JATWC Threat Assessment technique

unesco

- (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.

| | 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) Above crater Above sea level | <0.1 | 0.1-1 | 1-5 | 3-15 | 10-25 | >25 | | | |
| Qualitative Description | "Gentle," | "Effusive" | "Explosive" | "Cataclysmic," "Severe," | "paroxysmal," "violent," | "colossal" | | | |
| Eruption Type | Hawaiian | Strombolian | Vulcanian | Plinian | Ultra-Plinian | | | | |
| Duration (continuous blast) | <1 hour | 1-6 hrs | 6-12 hrs | >12 hrs | | | | | |
| CAVW max explosivity (most explosive activity listed in CAVW) | Lava flow | Phreatic | Explosion or Nuée ardente | | | | | | |
| 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 |

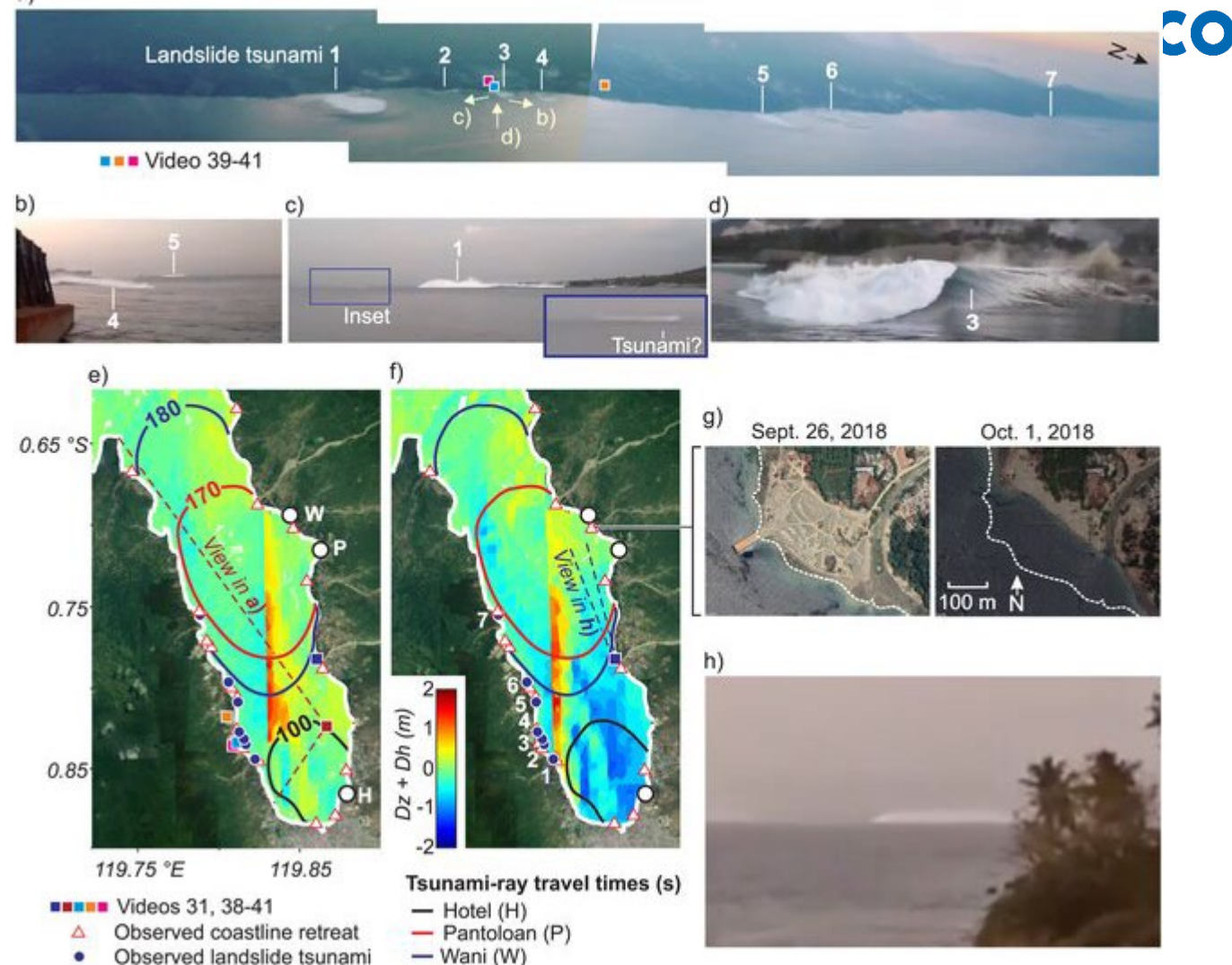
Example Use Case: Hunga Tonga 2022

- 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 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

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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
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TSUNAMI BULLETIN NOTIFICATION MESSAGE NUMBER 1 IOTWMS TSUNAMI SERVICE
PROVIDER AUSTRALIA [JATWC] ISSUED AT 1046 UTC THURSDAY 13 FEBRUARY 2020
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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
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TSP Australia Bulletin Examples: Type 2 No Threat Bulletin

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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: ~~69~~ km
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.NUSAPENIDA | 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

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

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... 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

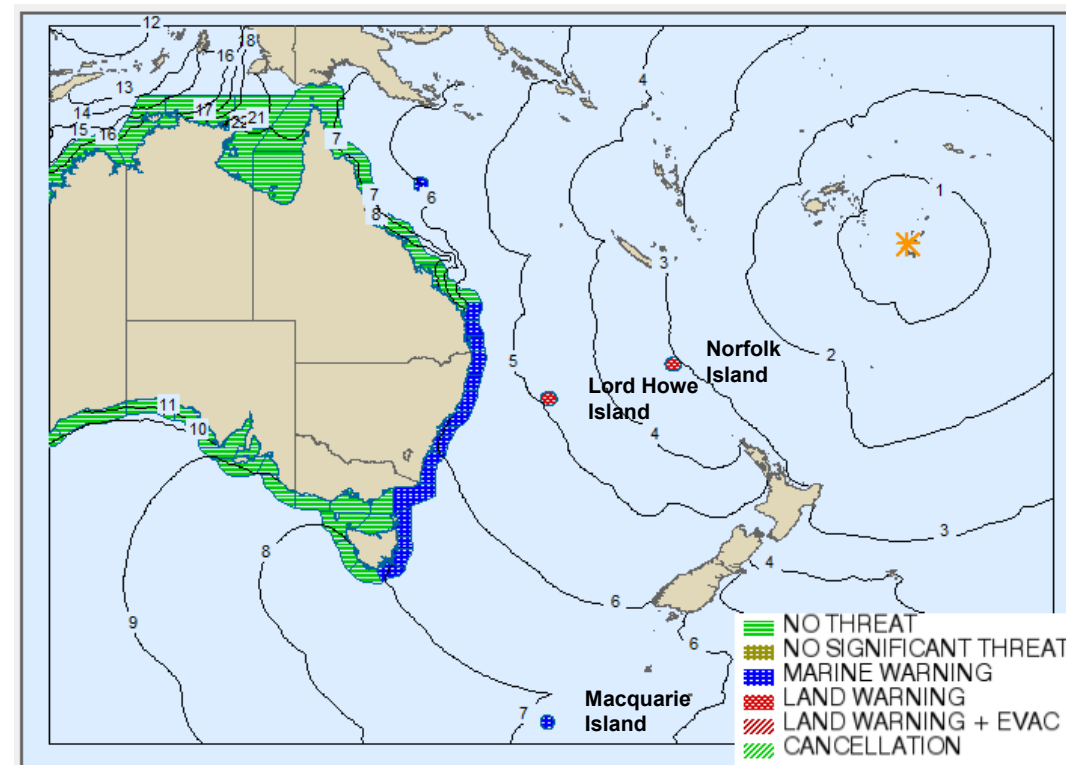
JATWC WARNING TIMELINE

| 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. |

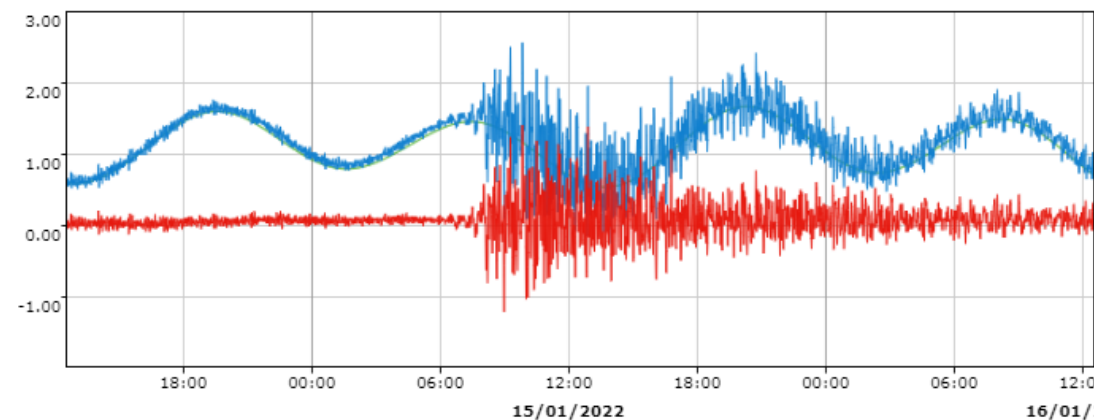
Key Challenges

- 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





unesco

Intergovernmental
Oceanographic
Commission

THANK YOU

Dr Robert Greenwood
robert.greenwood@bom.gov.au