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

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Pre-IOWAVE25 Workshop on Standard Operating Procedures for NTWCs and DMOs
Hybrid – August 2025

Session Organization

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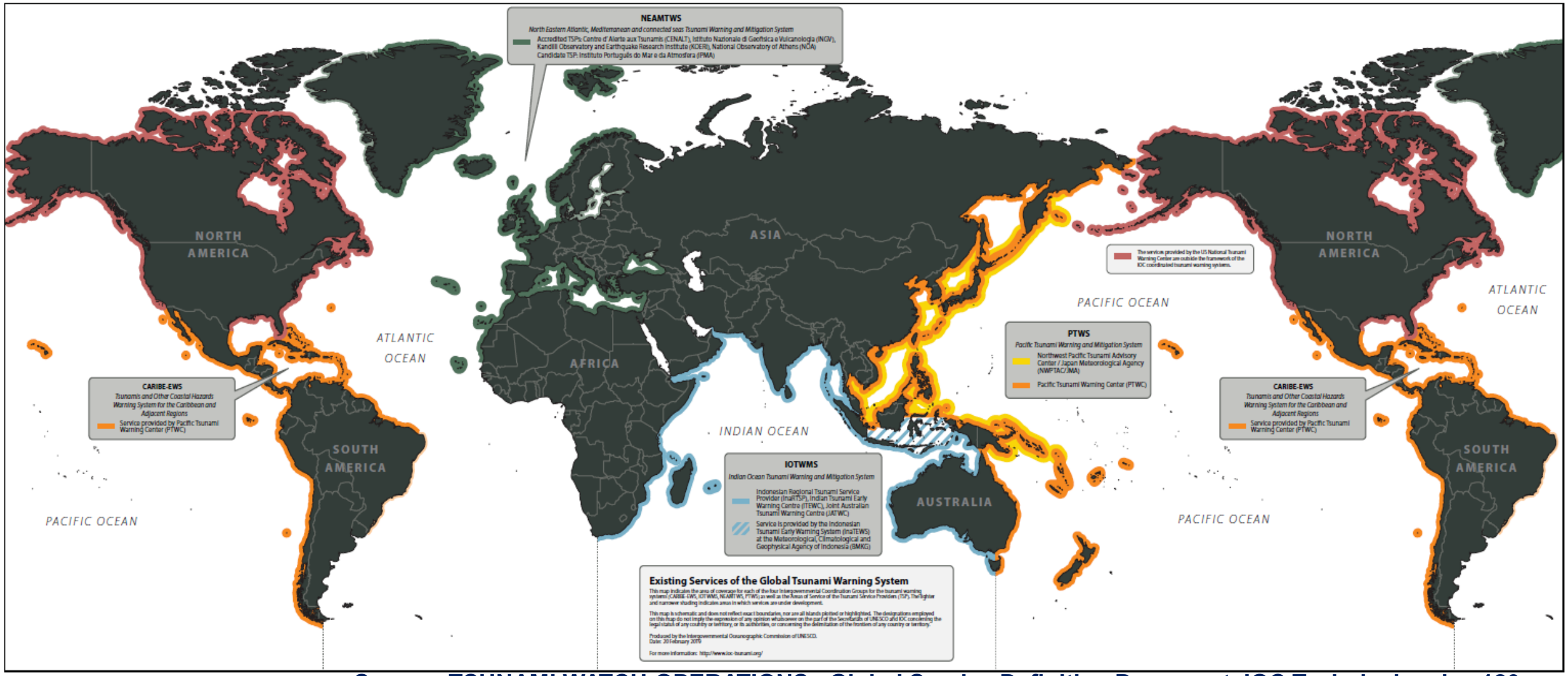
- **Introduction to TSP Services and Products , NAVAREA Service**
- **Tsunamis generated by non-seismic and complex sources, associated products**

Global Tsunami Warning System



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

Structure of Each Regional Tsunami Warning System

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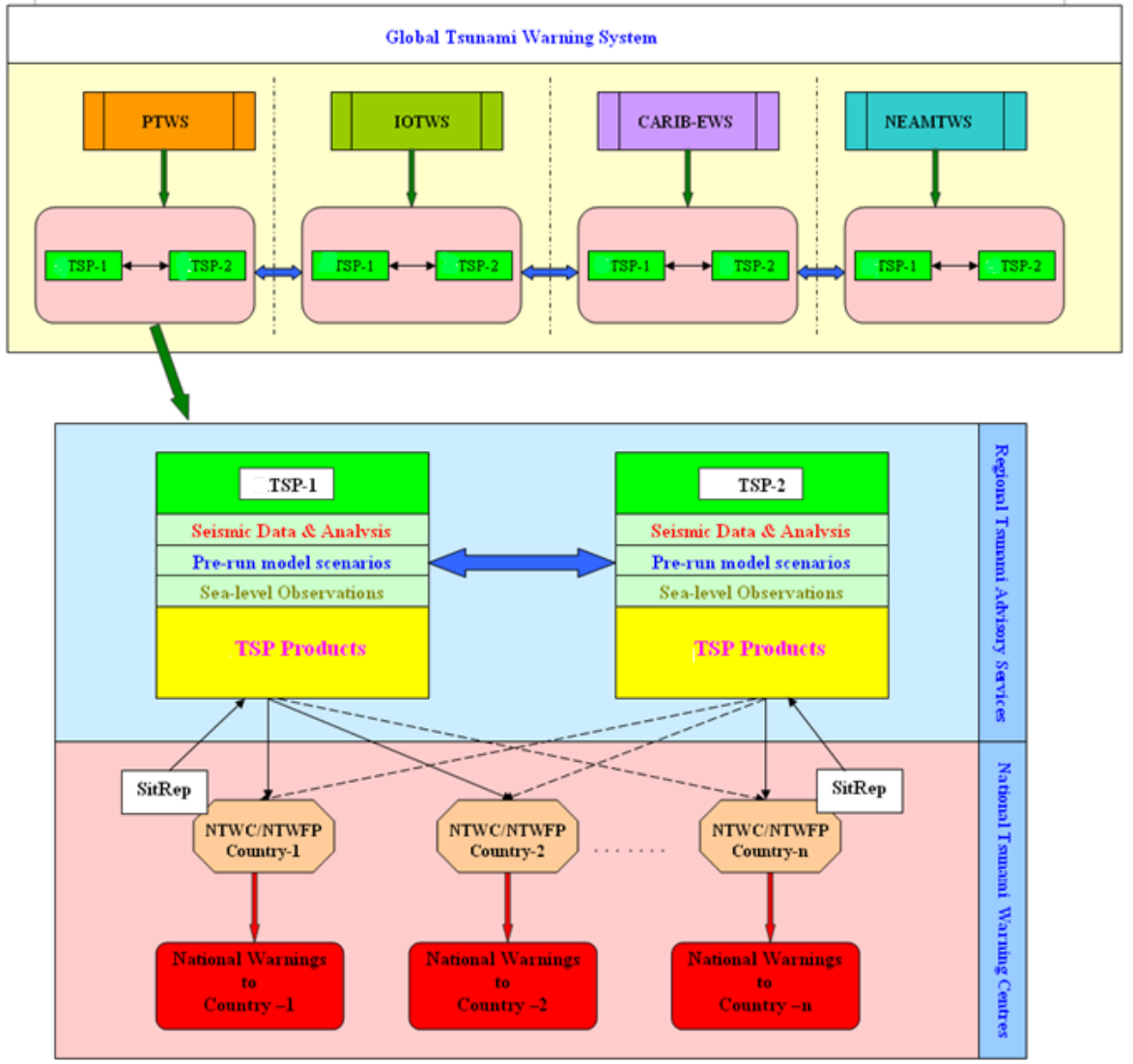
- Regional Tsunami Warning Systems operating in each Intergovernmental Coordination Group (viz. IOTWMS, PTWS, NEAMTWS, CARIBE-EWS) are the building blocks of a global TWS.
- Each TWS consists of one or more Tsunami Service Providers (TSPs) and multiple National Tsunami Warning Centres (NTWCs) e.g. IOTWMS 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

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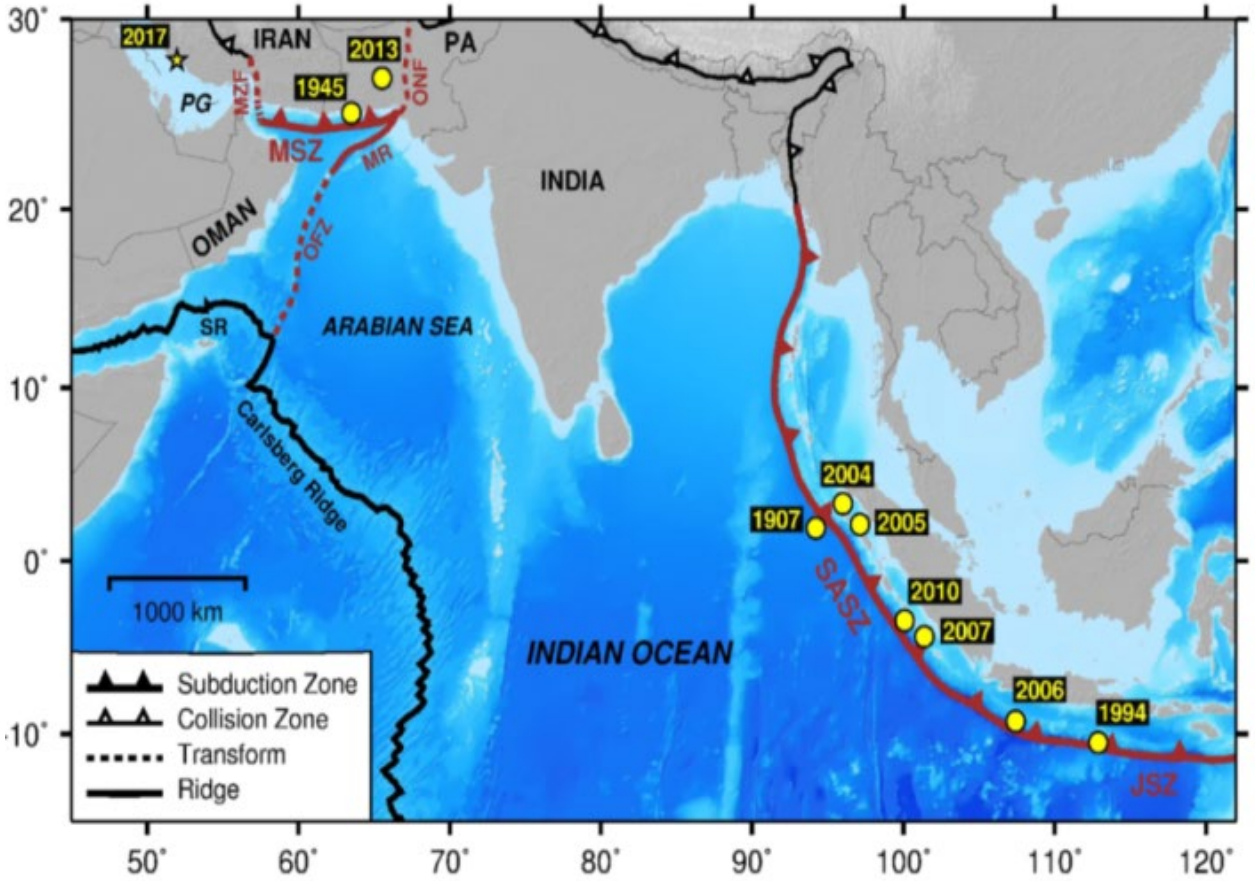

- Subduction Zone: Indian and Australian plates are moving north and eastward relative to Eurasian plate forming a convergent boundary
- Major Subduction Zones
  - Sumatra Andaman Subduction Zone ~6000 km
  - Makran Subduction Zone ~900 km
- Sumatra Andaman Subduction Zone (SASZ) – From Himalayan front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

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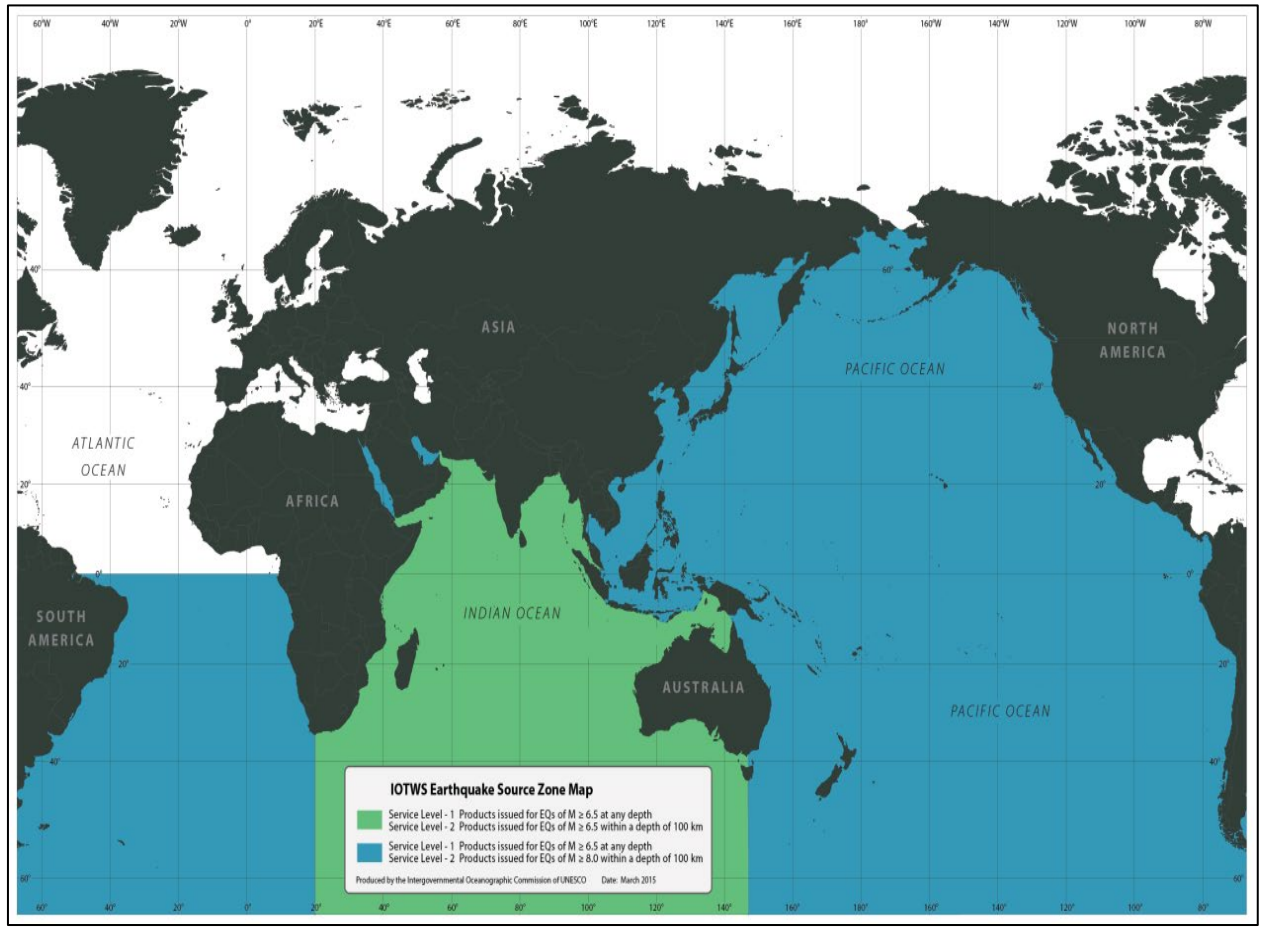
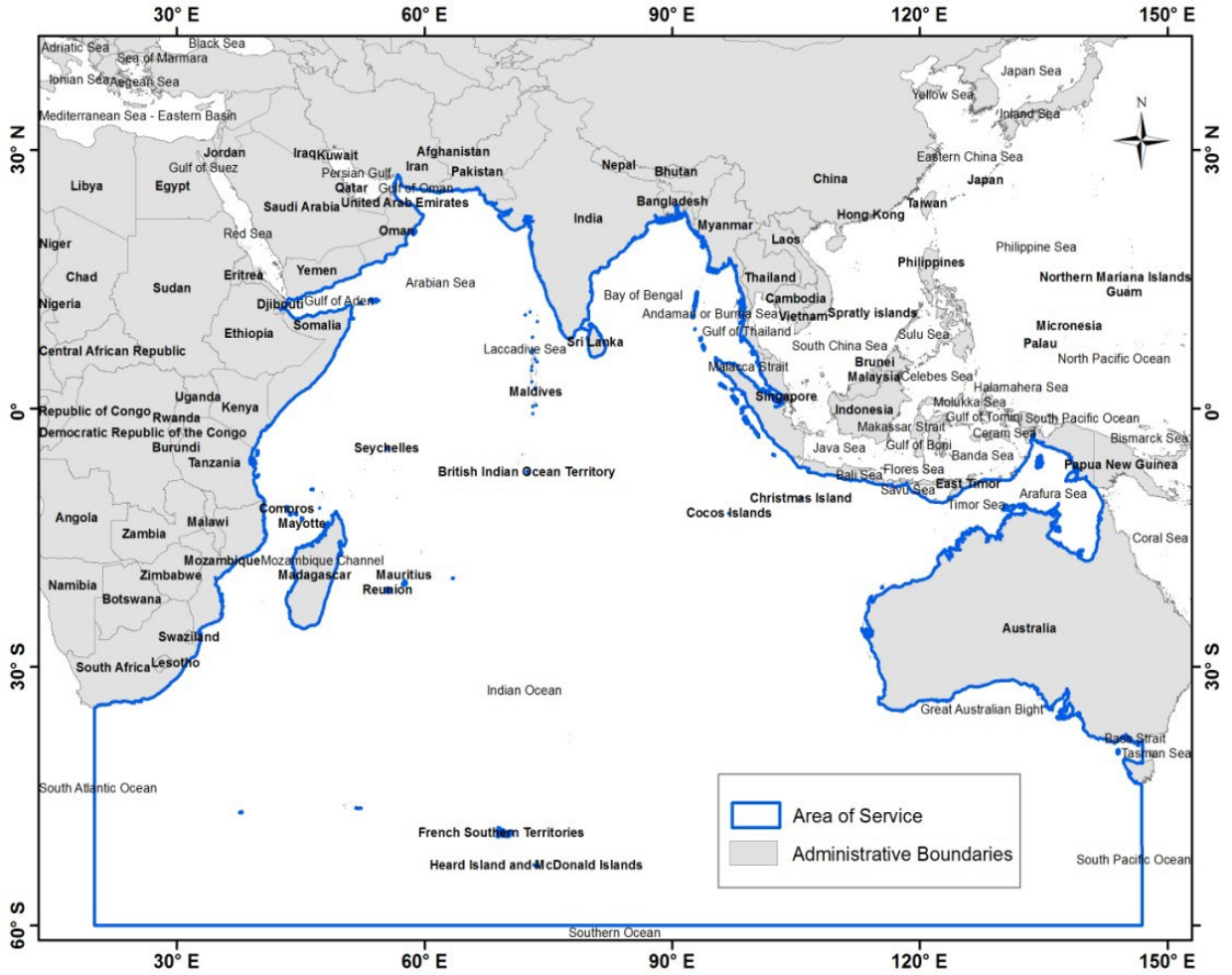




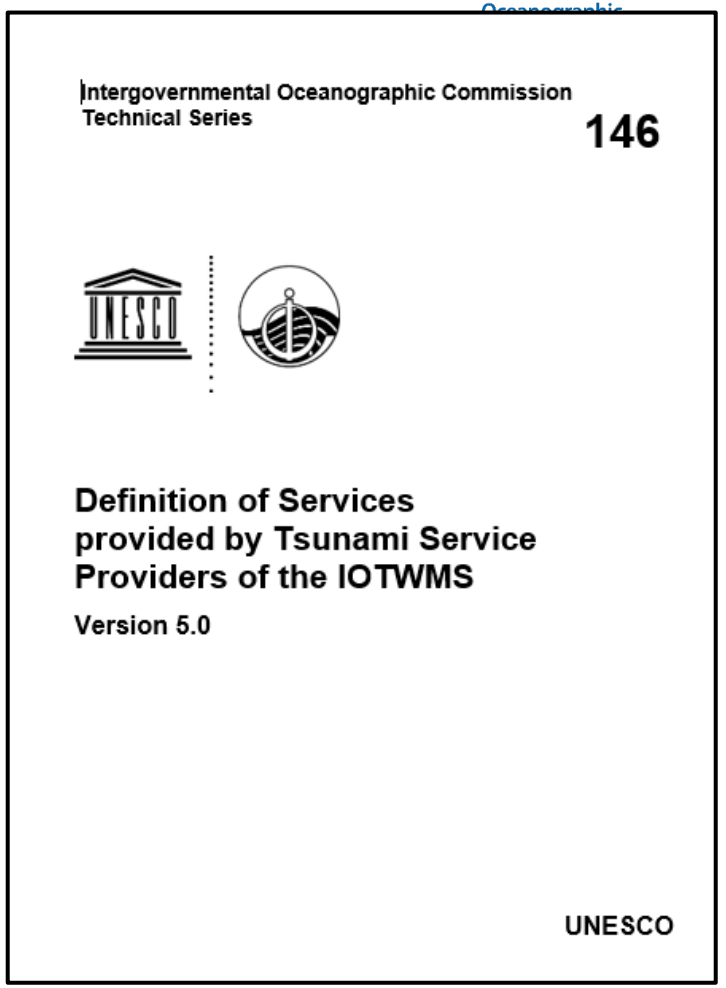
TSP Service Definition Document

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

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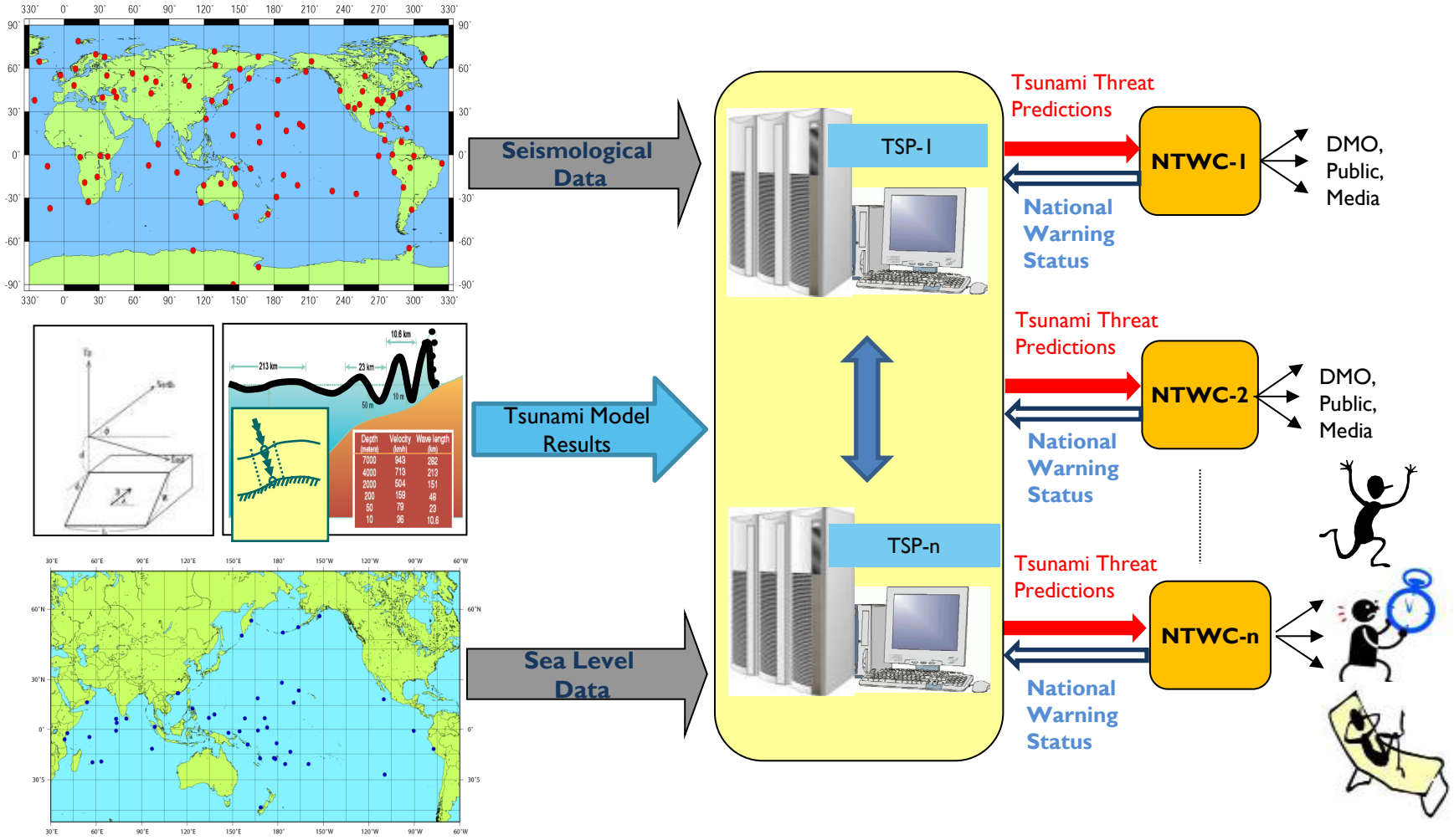

Roles and Responsibilities of TSPs

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- 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

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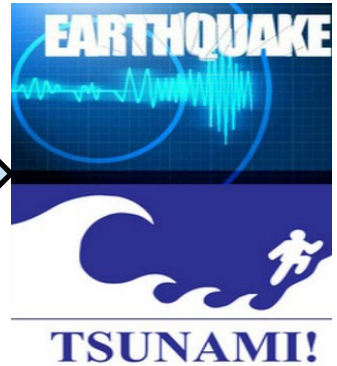
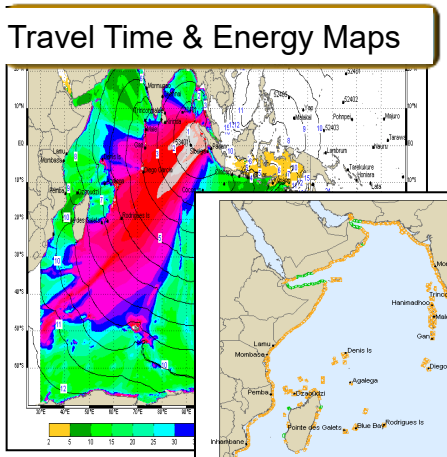
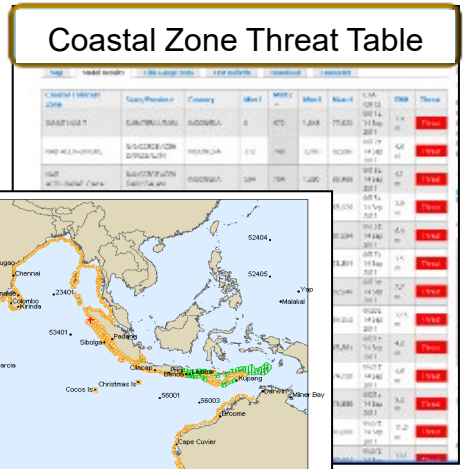
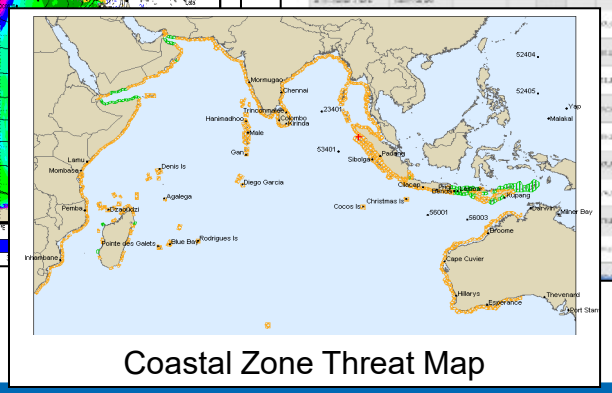
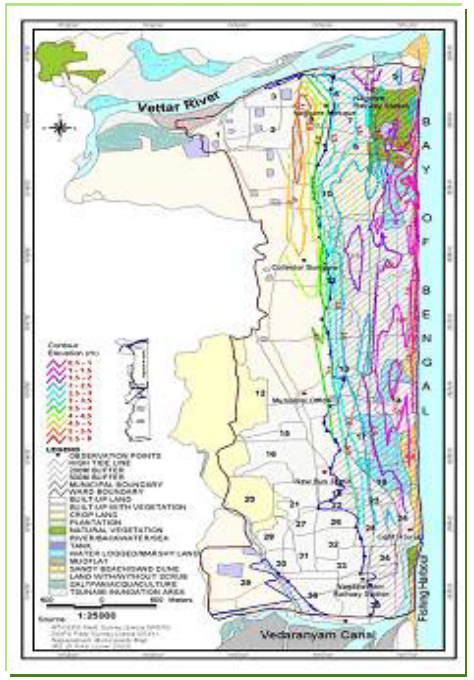
- **Service Level 1** – Earthquake Bulletins (in operation since 2009)
- **Service Level 2** – Tsunami Threat Bulletins and Threat Maps (in operation since 2011)
- **Service Level 3** – Inundation Mapping (not yet in operation)







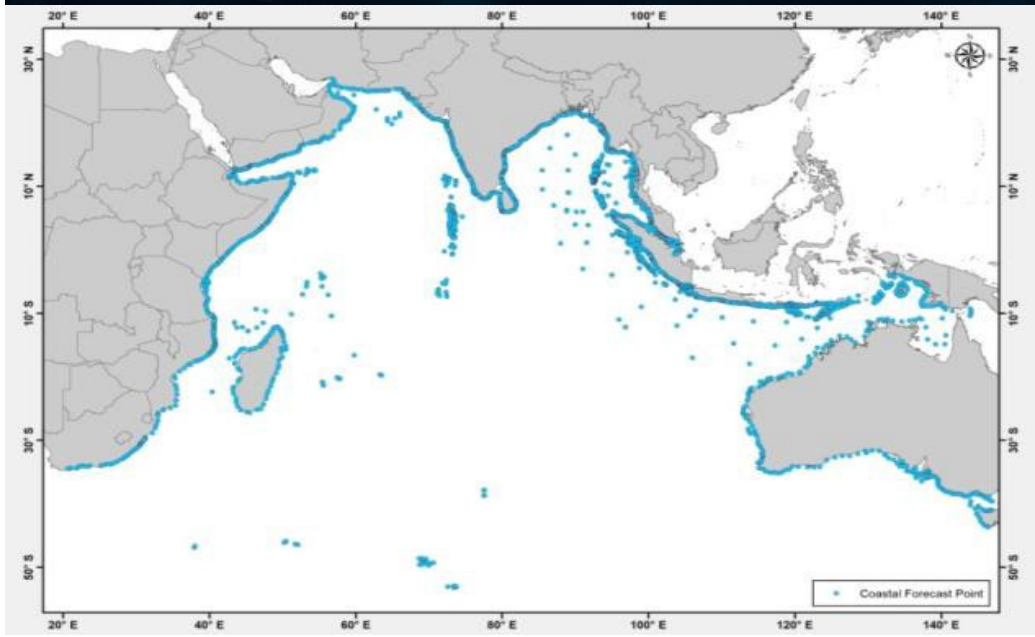




IOTWMS Coastal Forecast Zones

- 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

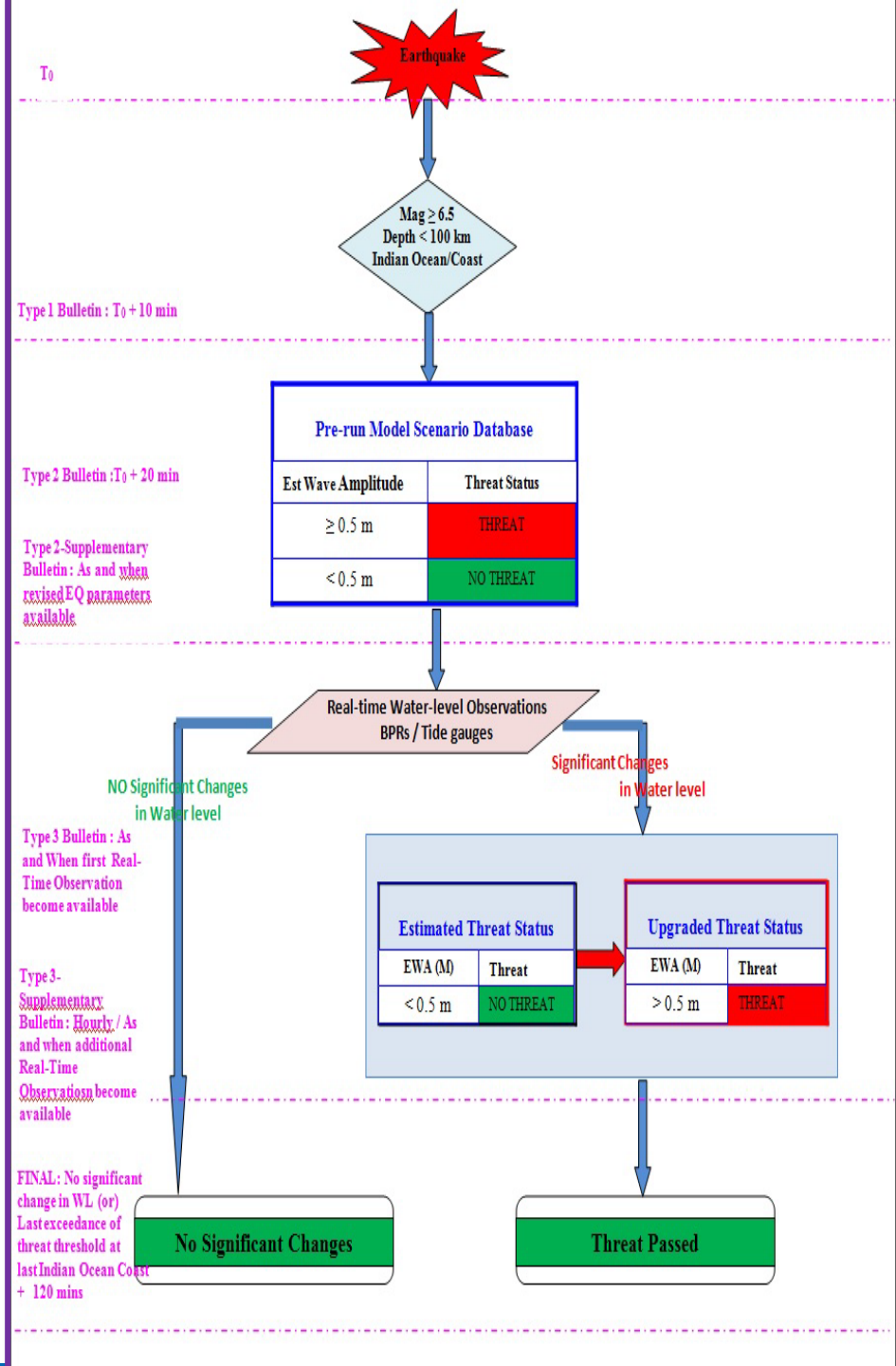
M ≥ 6.5 in the Indian Ocean

[or]

M ≥ 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



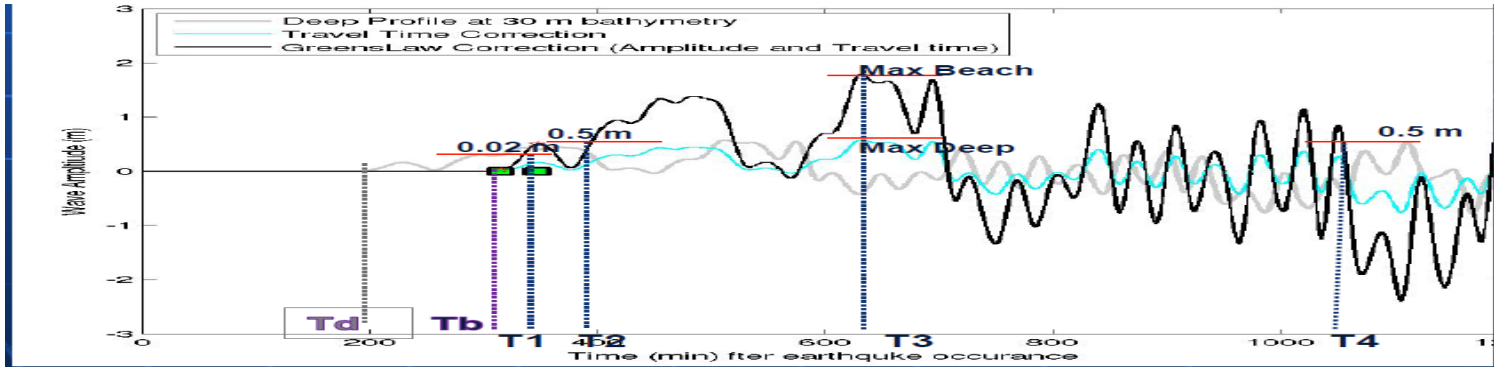
TSP Bulletins- Bulletin Types and Content

- **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.	• 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

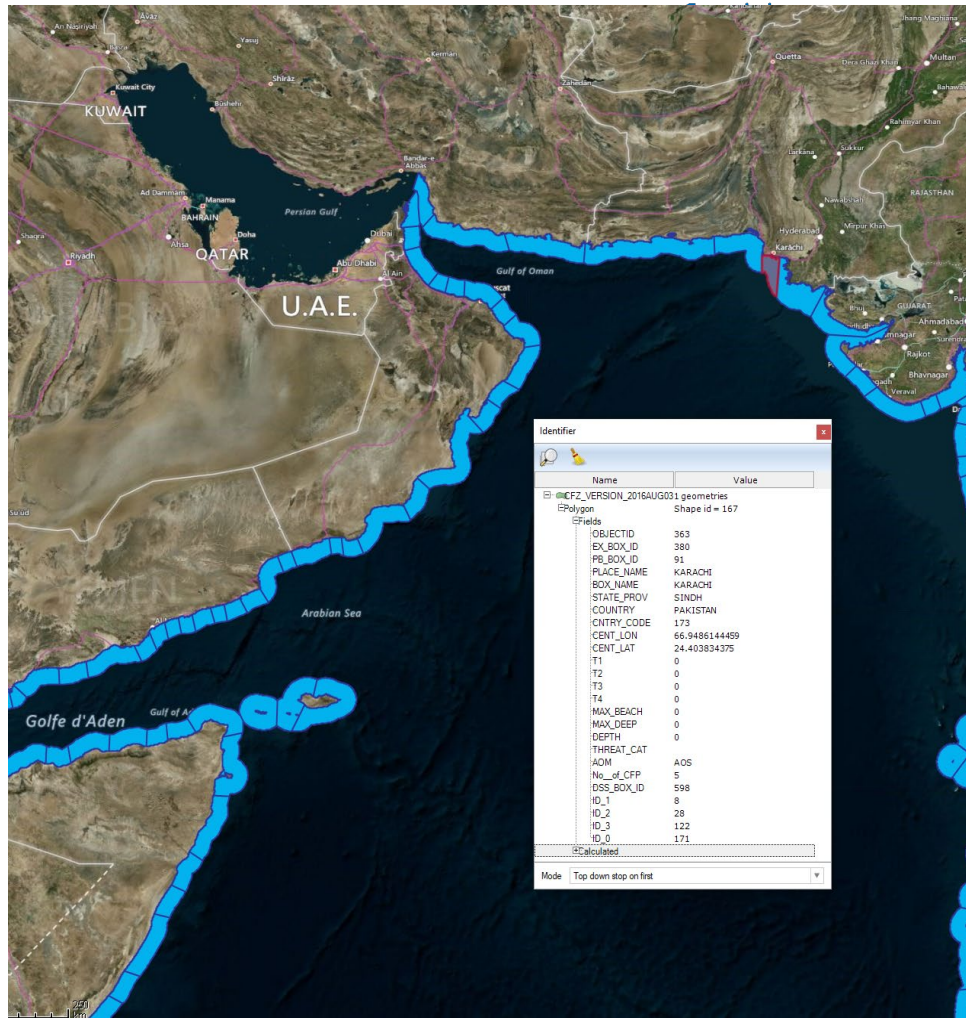
Tsunami Prediction Information

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



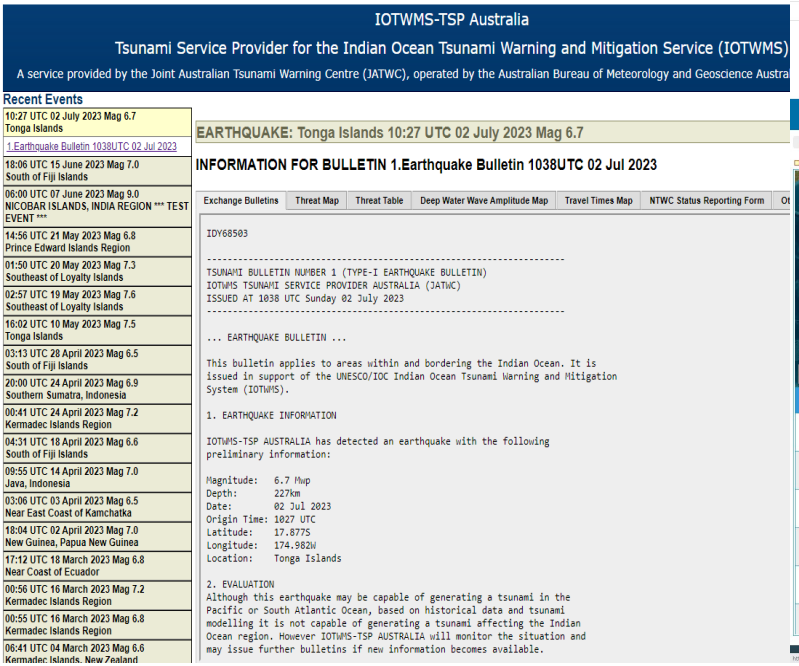
Predicted Wave Arrival Times:

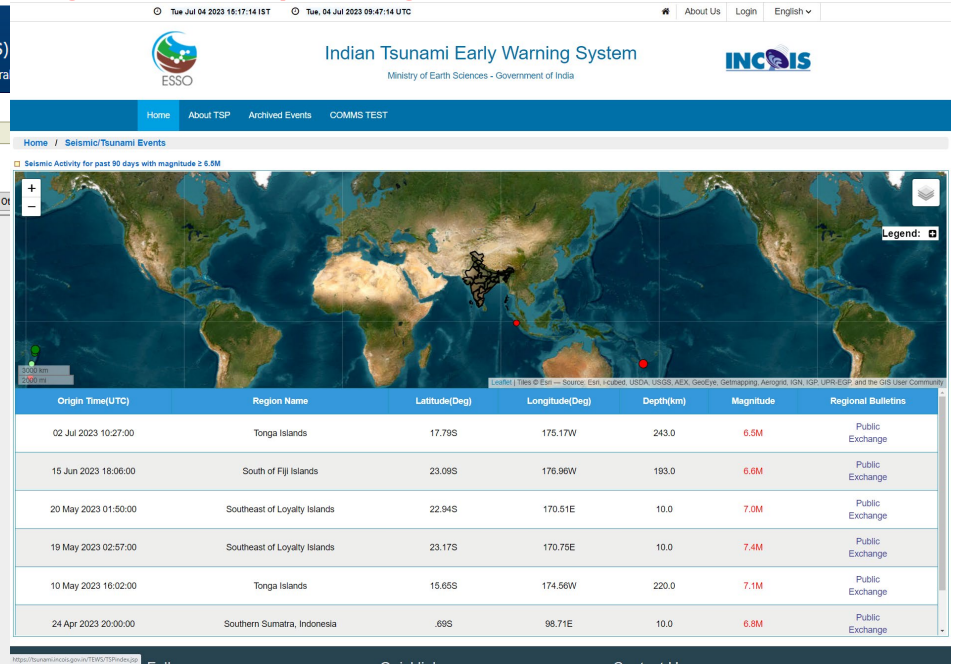
- **T1 :** Time of arrival of first amplitude > +2cm
- **T2 :** Time of arrival of first wave over +50cm amplitude on the beach
- **T3 :** Time of arrival of largest wave ("max beach")
- **T4 :** Time of arrival of last wave over +50cm amplitude
- **MAX_BEACH =** Expected Tsunami Wave Height at beach 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.





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.**

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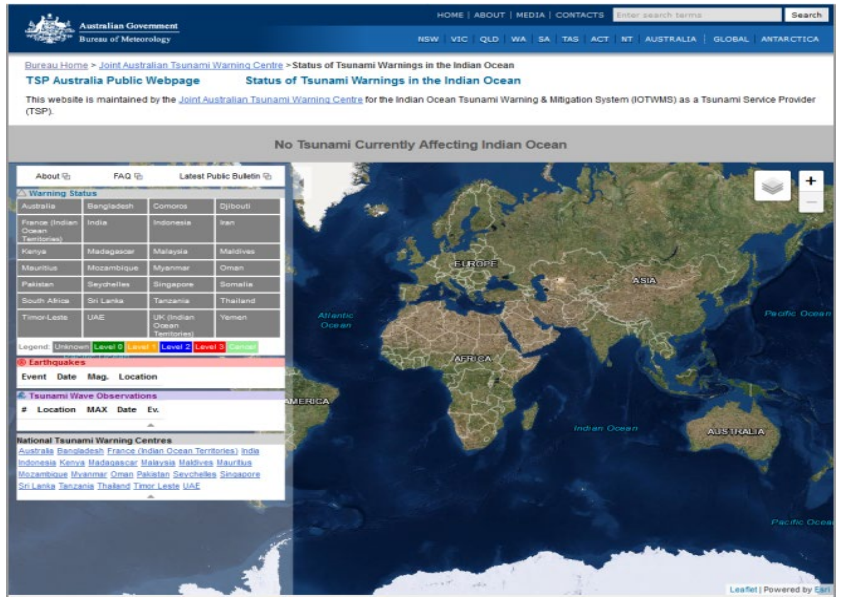
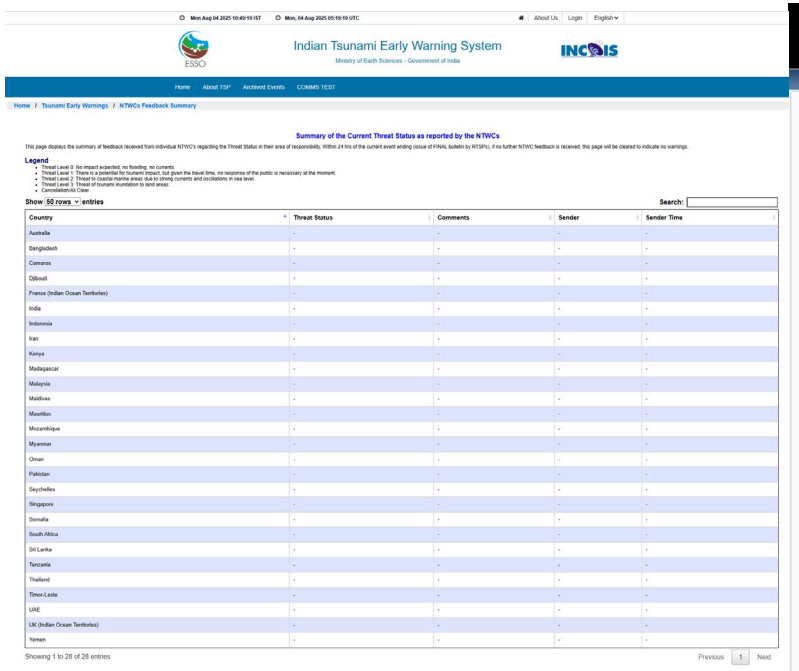
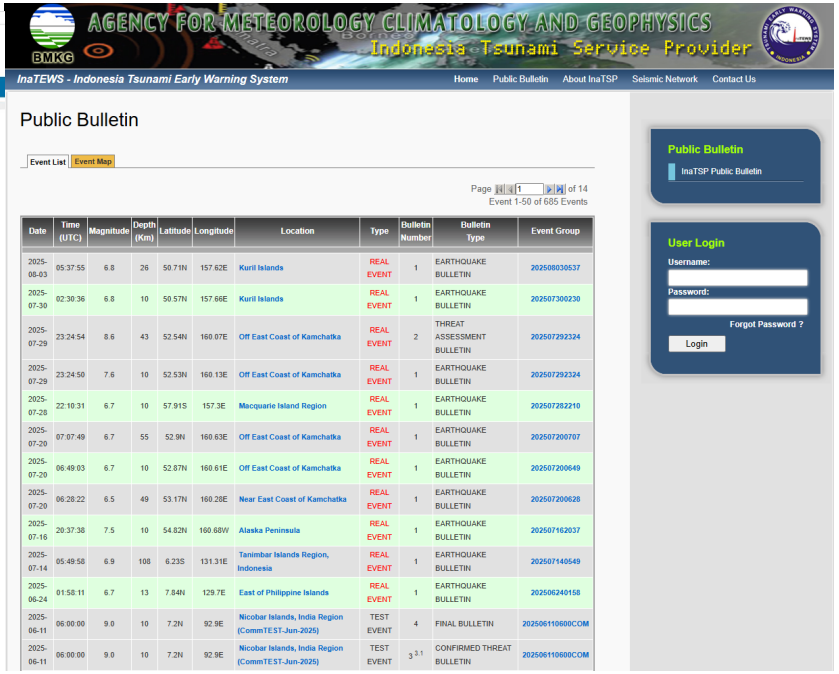


TSP- Australia



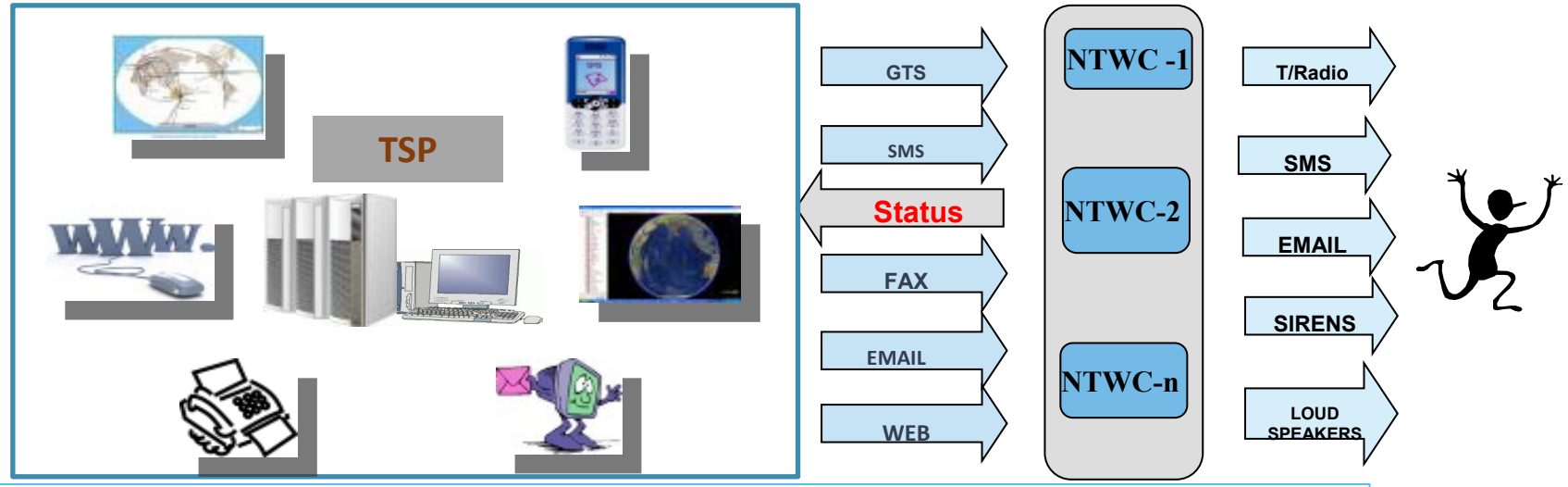
TSP- India



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.

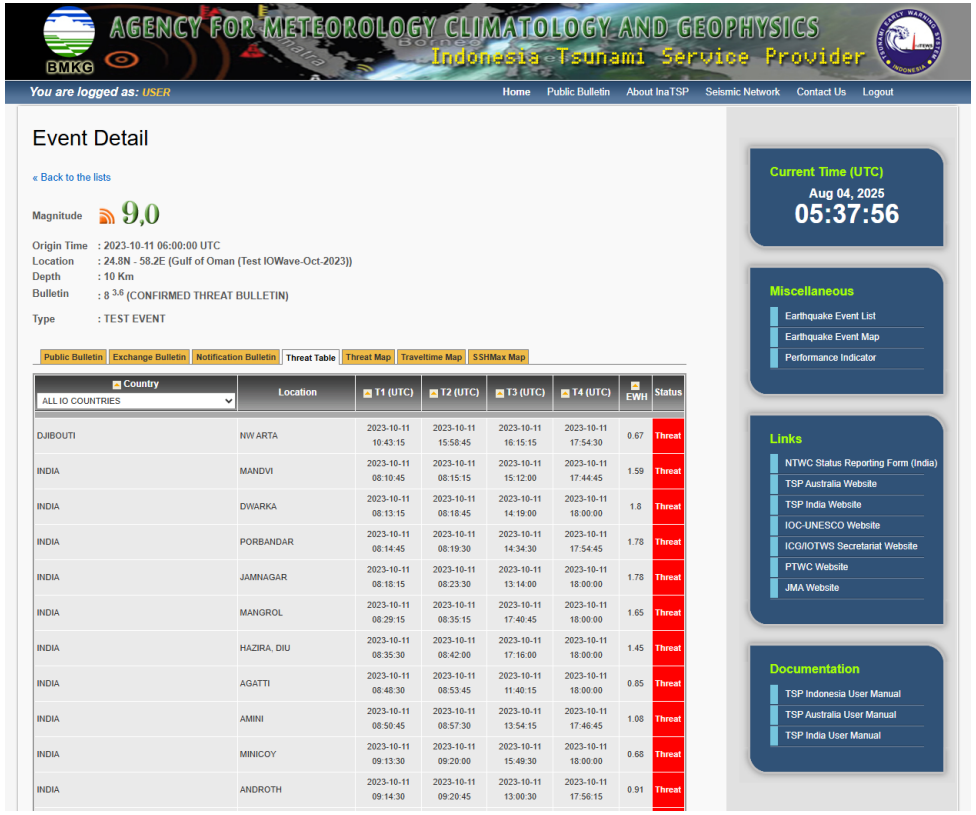
Because local conditions can cause a wide variation in tsunami wave action, **CANCELLATION of national warnings and ALL CLEAR determination must be made by national/state/local authorities**. Please be aware that dangerous currents can continue for several hours after the main tsunami waves have passed.

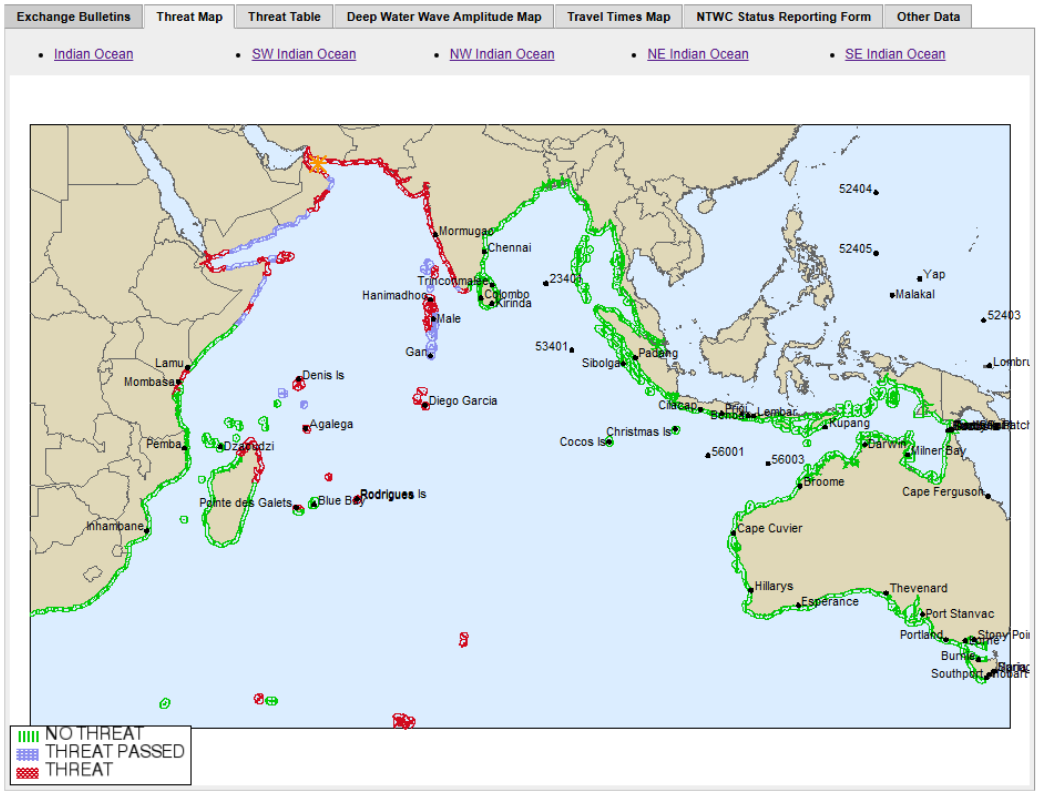
3. TSUNAMI WAVE OBSERVATIONS
Listed below are maximum wave amplitudes recorded at the specified locations. Note that wave amplitude is measured relative to normal sea level: it is NOT the crest-to-trough wave height.

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

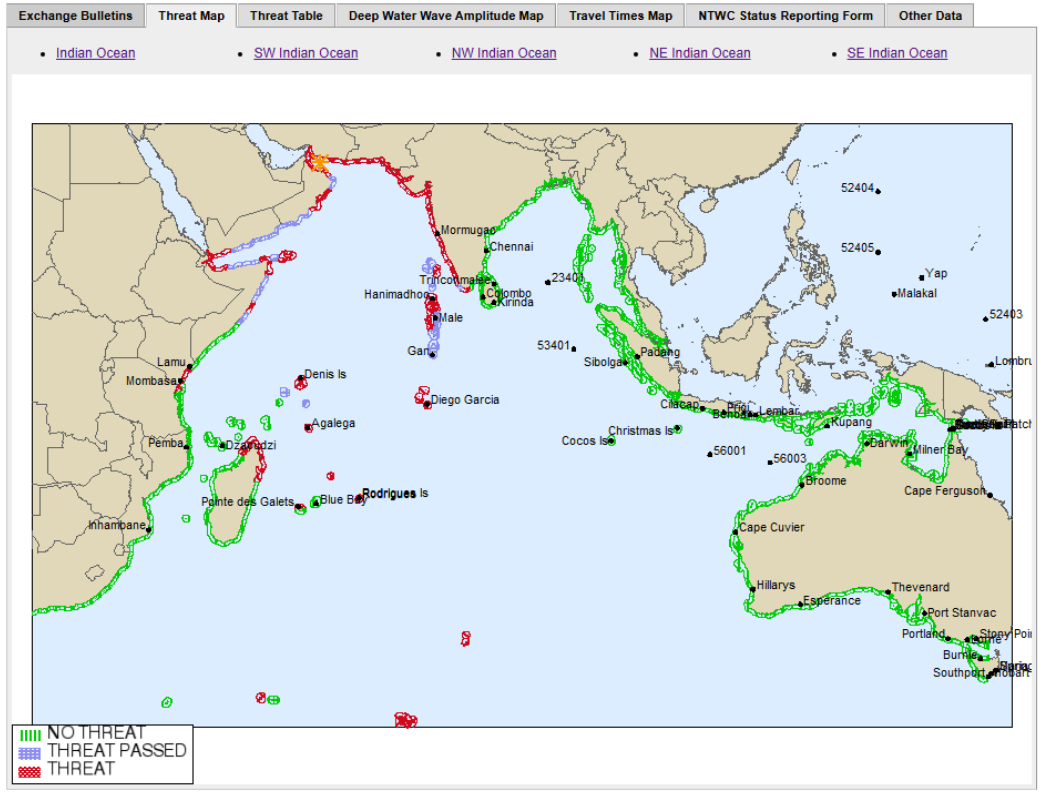
TSP Threat Table - On TSP websites

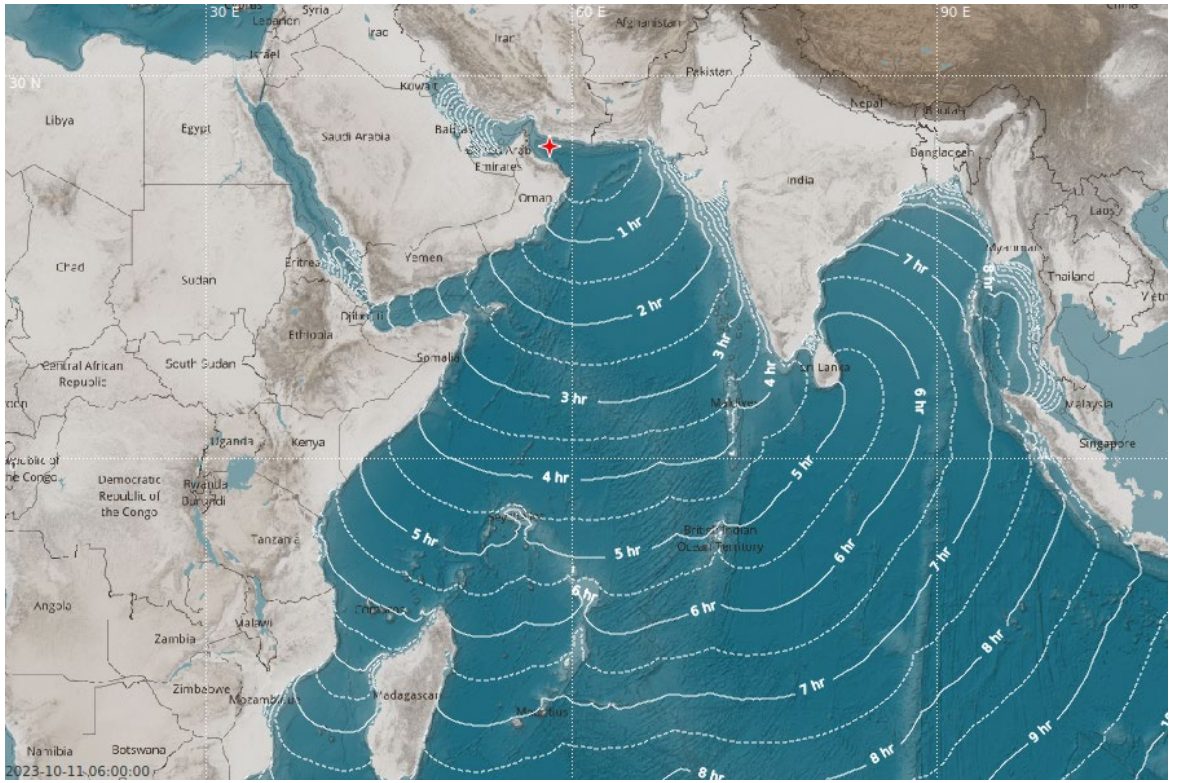
Country	State/Territory	Zone	T1(UTC)	T2(UTC)	T3(UTC)	T4(UTC)	Amplitude(m)	ThreatStatus
IRAN	SISTAN AND BALUCHESTAN	BIR	11-Oct-2023 06:04	11-Oct-2023 06:04	11-Oct-2023 06:06	12-Oct-2023 07:00	6.3	Threat
IRAN	SISTAN AND BALUCHESTAN	PUSHT	11-Oct-2023 06:04	11-Oct-2023 06:04	11-Oct-2023 07:05	12-Oct-2023 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 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
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

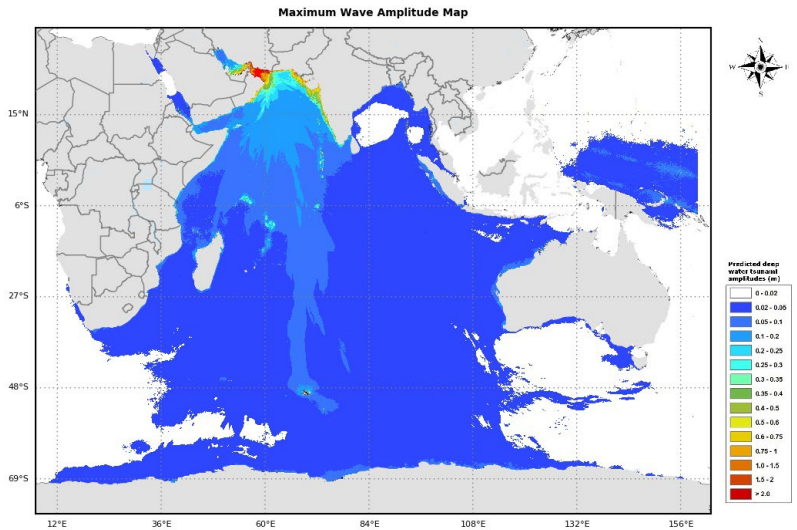




Threat Map, Travel Time Map, Energy Map – On TSP websites







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 sourceevents 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)

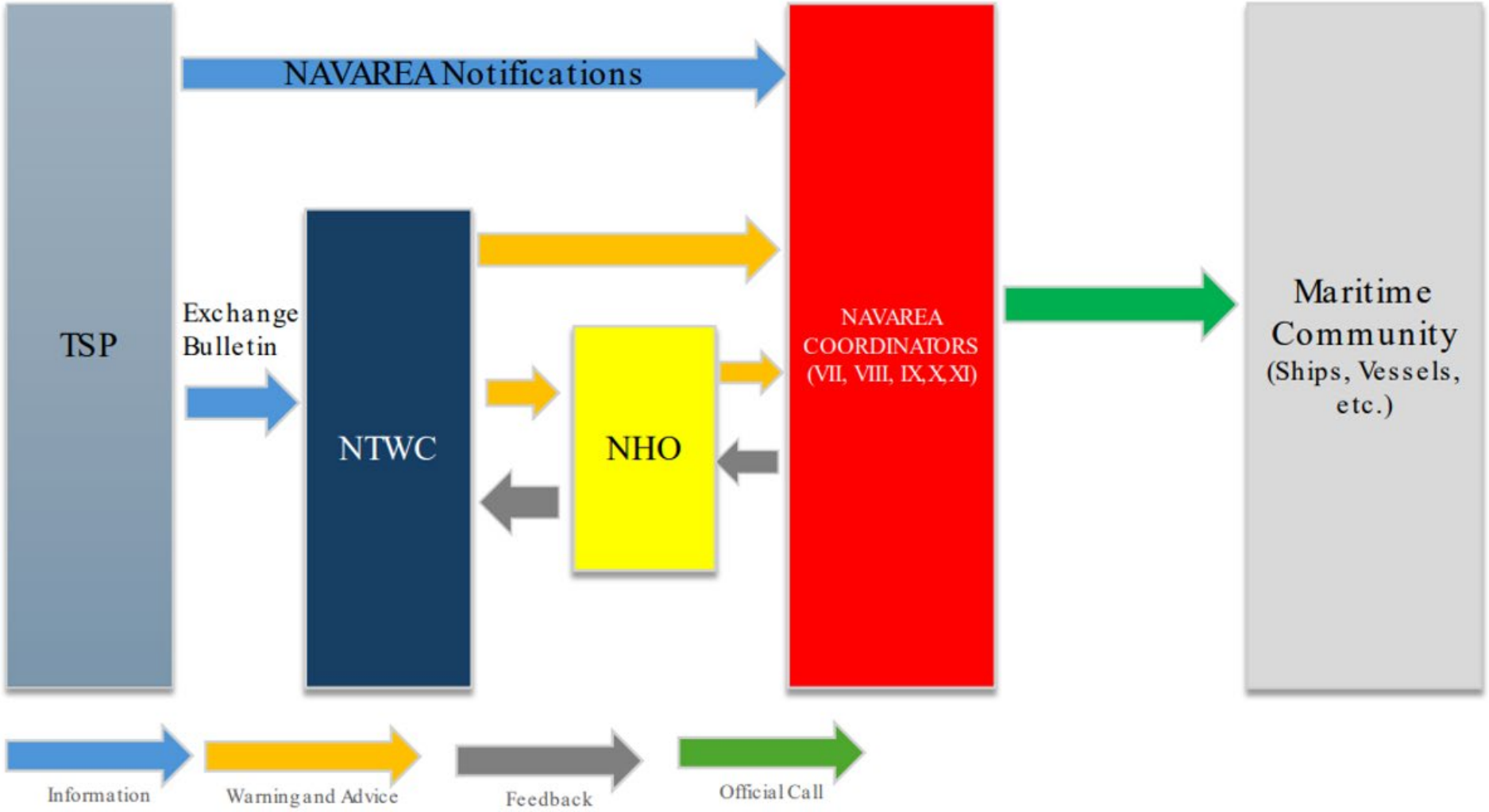
TSP AUSTRALIA TSUNAMI BULLETIN NUMBER 13 FOR

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 OBSERVERED 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)



unesco
Intergovernmental
Oceanographic
Commission

Tsunamis generated by non-seismic and complex sources

Atypical event types (Non-Seismic and Complex Sources)

unesco
Intergovernmental Oceanographic Commission

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) 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,"		"terrific"	"colossal" →
Eruption Type		← Strombolian →			← Plinian →				
	← Hawaiian →			← Vulcanian →		← Ultra-Plinian →			
Duration (continuous blast)	← <1 hour →				← >12 hrs →				
			← 1-6 hrs →						
				← 6-12 hrs →					
CAVW max explosivity (most explosive activity listed in CAVW)	Lava flow	← Phreatic →			← Explosion or Nuée ardente →				
	Dome or mudflow								
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.**

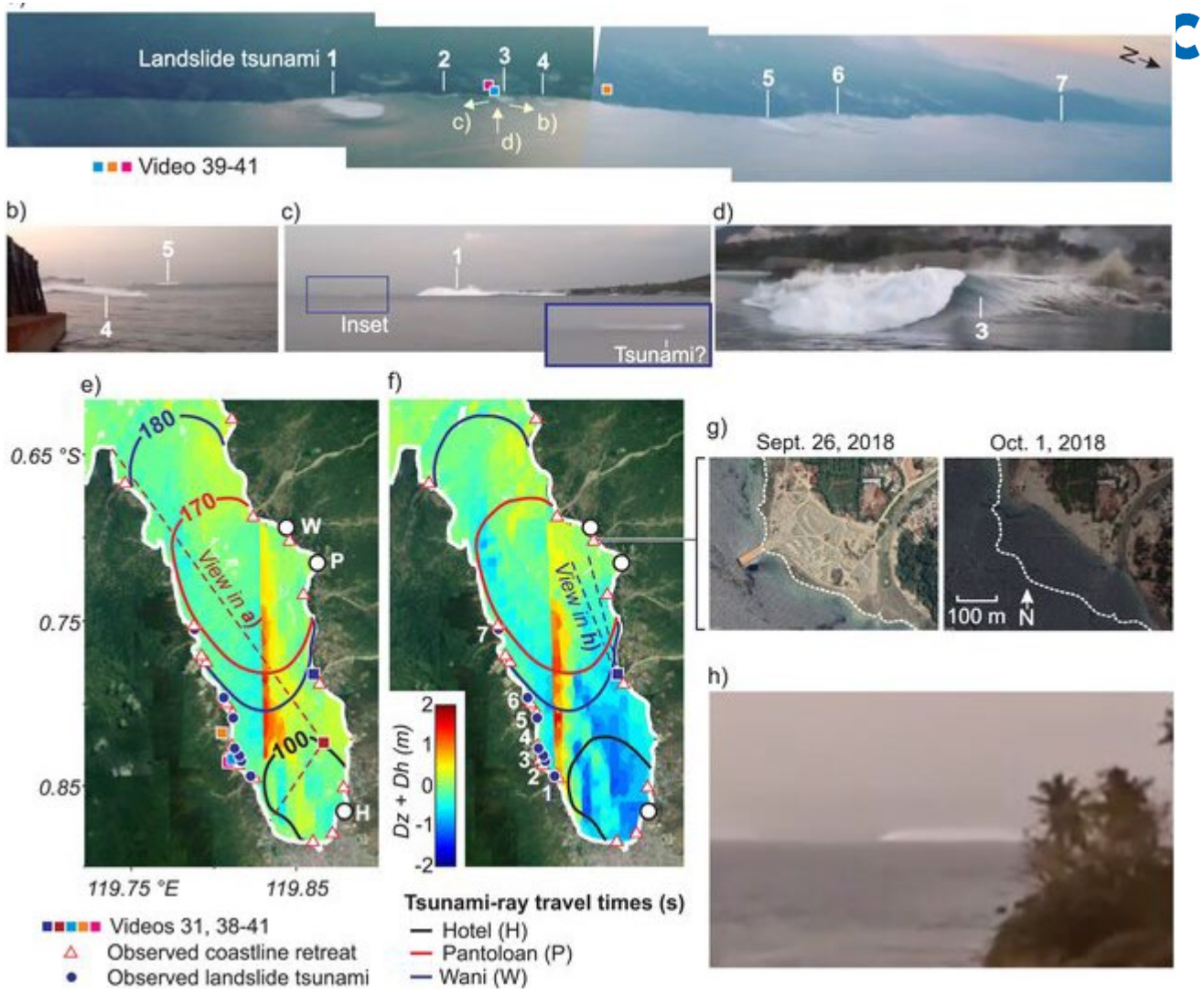
Landslide

(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:

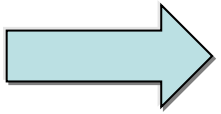
http://reg.bom.gov.au/tsunami/rtsp/index.shtml

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

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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

... 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
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Bureau of Meteorology
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END OF BULLETIN

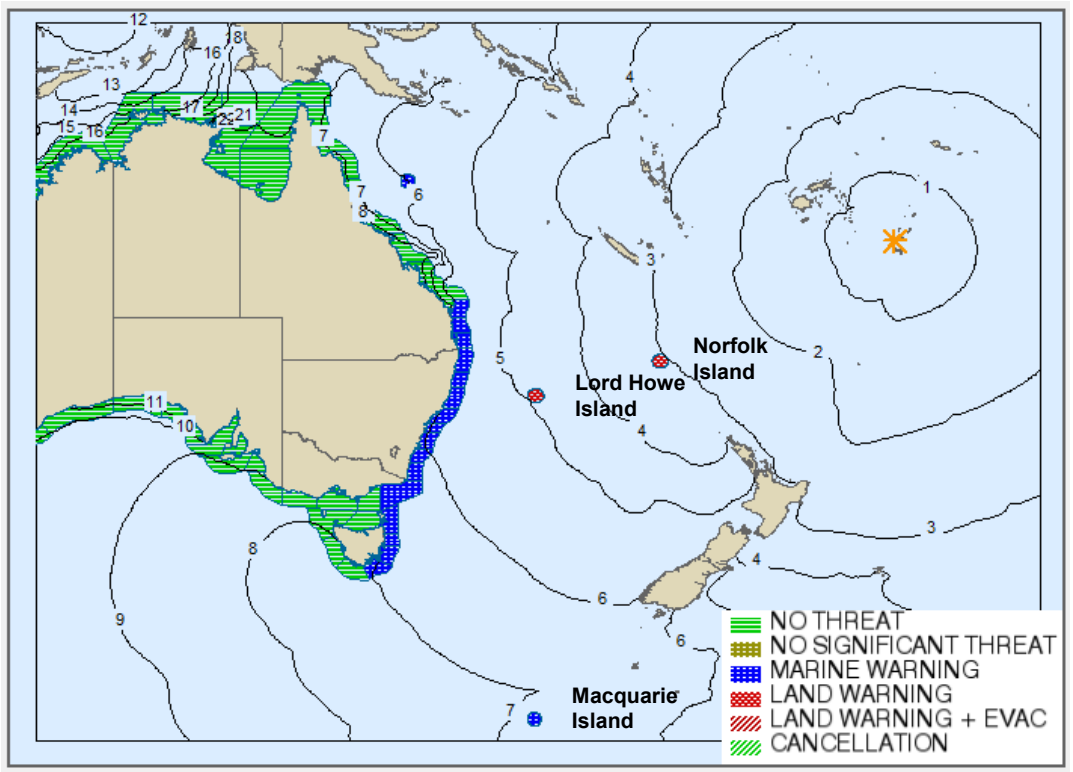
JATWC WARNING TIMELINE

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.

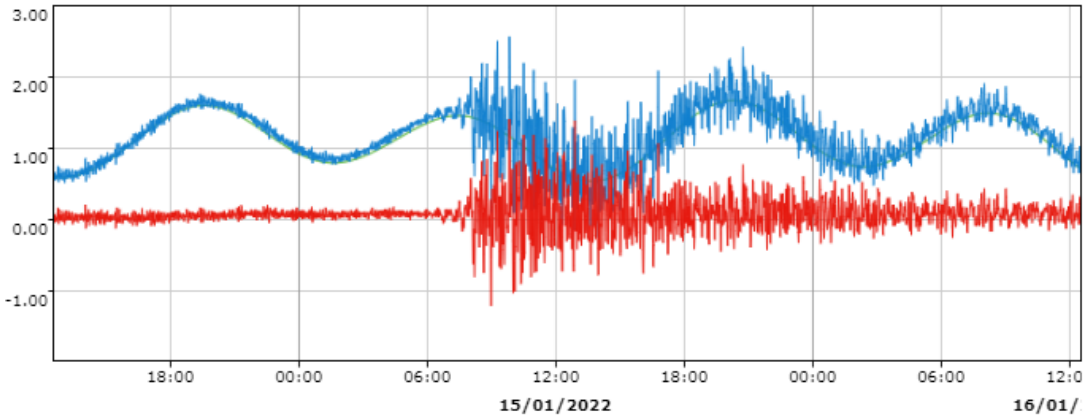
Key Challenges

- 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

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