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Intergovernmental Oceanographic Commission

5.2 ICG/IOTWMS Tsunami Watch Operations status and plans

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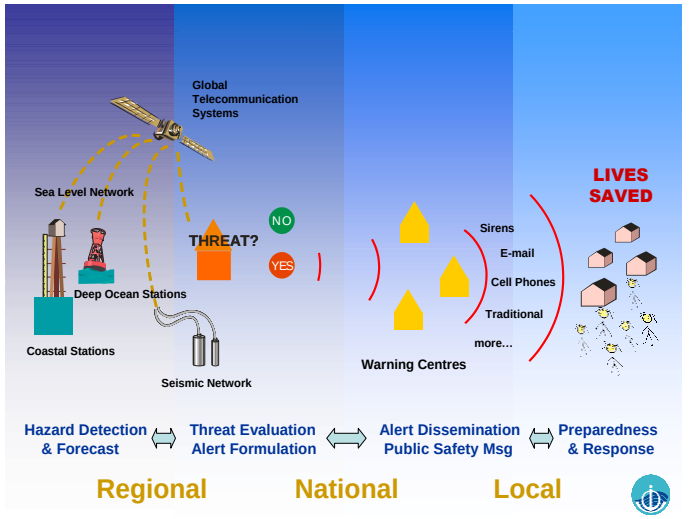
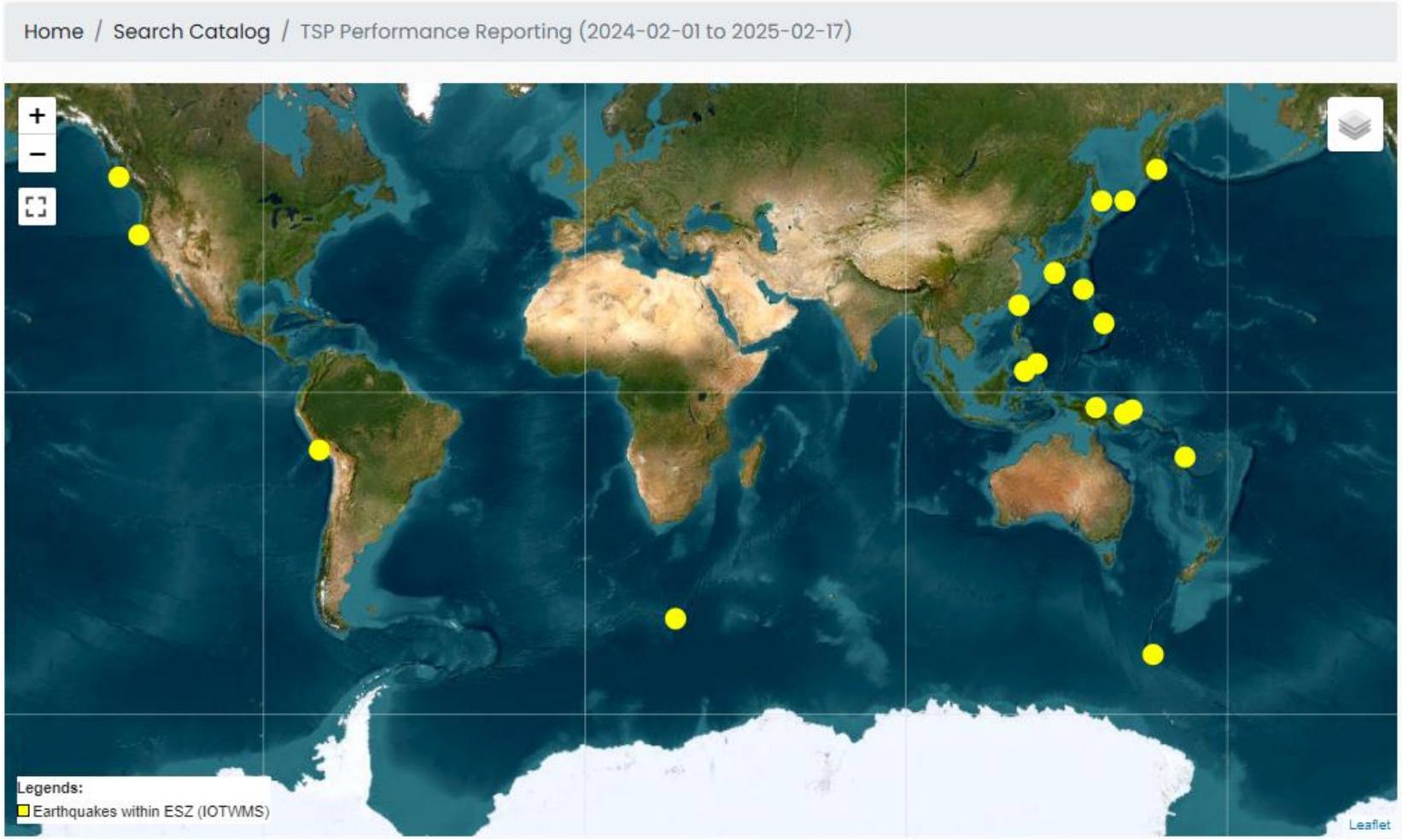
Thanks to Dr Yuelong Miao, Dr Yedi, Dr Robert, Dr. Srinivasa Kumar, Ms.Nora for their inputs

Detection, Warning and Dissemination – Current Status / Highlights

- Under ICG/IOTWMS, there are 3 Tsunami Service Providers (TSPs) (Australia, India, Indonesia) to provide tsunami threat information to National Tsunami Warning Centres (NTWCs)
- During the reporting period, the Indian Ocean witnessed 1 event,
  (i) 2024-07-10 04:55:41 (UTC) with M 6.6 - south of Africa 53.309°S 25.348°E
- NTWCs issue sovereign warnings to their at-risk communities
- NTWCs operate within multi-hazard frameworks.
- Threat information is now being provided for non-seismic source tsunamis, e.g. volcanoes, landslides,… by TSP-Australia. other two TSPs planned to implement.
- Maritime products for NAVAREAs to be trialed and implemented in 2025 by TSPs.
- Competency training framework being developed for NTWCs
- TSP operations are ISO compliant: ISO 9001 (India & Australia), ISO 22328-3 (Indonesia)



Earthquakes Monitored in ESZ(IOTWMS) – Current Status

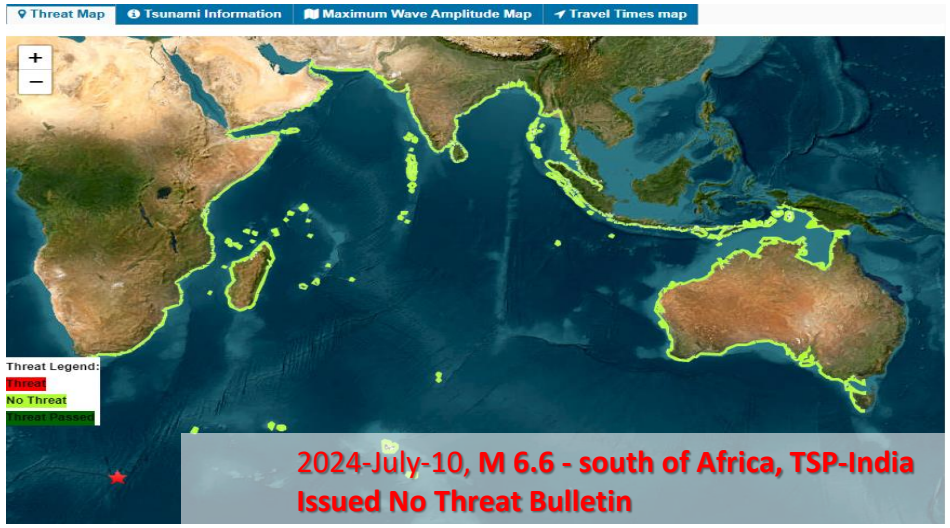


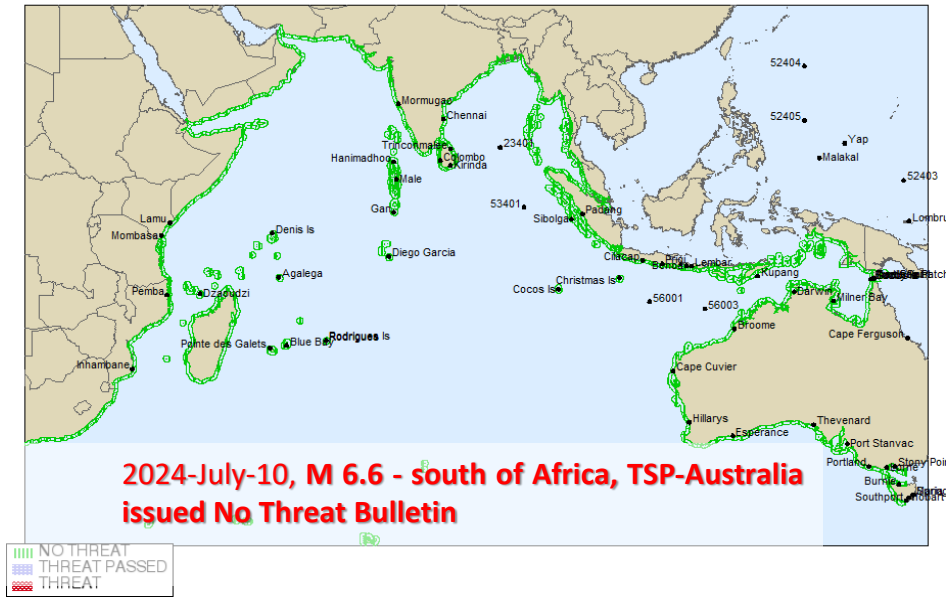
- During the reporting period, the Total number of Earthquakes (M>=6.5) monitored and issued bulletins to IO Member states = 22
- Indian Ocean Events – 01; Global Ocean (Pacific & South Atlantic)- 21
- Indian Ocean events,

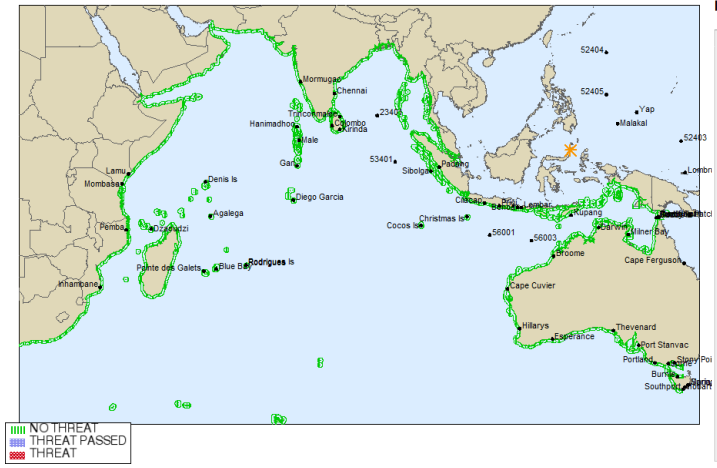
(i) 10-August-2024 M6.6 at south of Africa

TSP-Australia also exercised the issue of TGV SOP and issued no threat bulletin for the

Seismic & Non-Seismic Events







INFORMATION FOR BULLETIN 1.No Threat Bulletin 2109UTC 29 Apr 2024

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

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TSUNAMI BULLETIN NUMBER 1 (TYPE-II THREAT ASSESSMENT BULLETIN)
IOTWMS TSUNAMI SERVICE PROVIDER AUSTRALIA (JATWC)
ISSUED AT 2109 UTC Monday 29 April 2024
---------------------------------------------------------------------------

... 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. TSUNAMI SOURCE INFORMATION
IOTWMS-TSP AUSTRALIA has detected a volcanic eruption at Ruang with the following
details:

Date:        29 Apr 2024
Origin Time: 1835 UTC
Latitude:    2.31N
Longitude:   125.36E
Location:    TALAUD ISLANDS, INDONESIA

2. EVALUATION
Based on 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.
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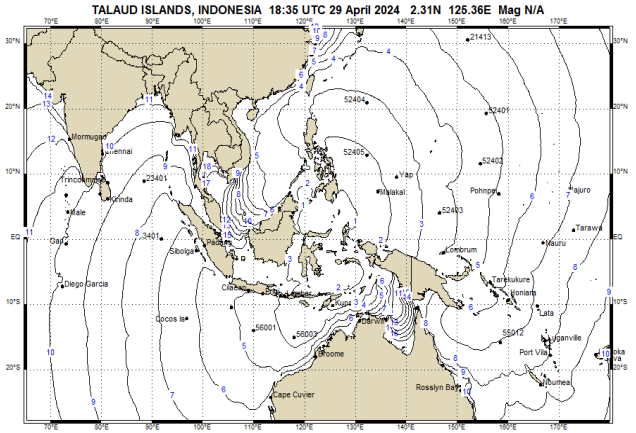


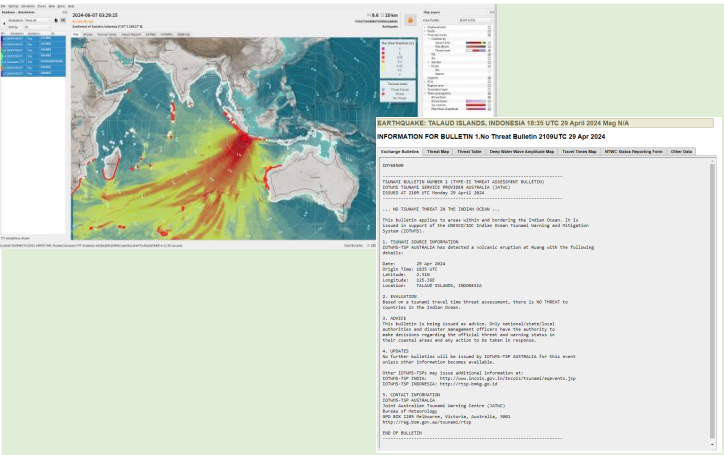
Non-Seismic (TGV) – No Threat bulletin issued by TSP-Australia for the Volcanic eruption of Mt. Ruang

TT-TWO & TOWS-WG Recommendations and it's Status in ICG/IOTWMS

Recommendation	Status
TSPs to trial and operationalise dissemination of maritime bulletins to respective NAVAREA operators	TSP-Australia and TSP-India have implemented **NAVAREA product issuance**, set to be tested in the upcoming COMMS test.
TSPs may need to provide services for TGVs that may impact several MS	TSP-Australia is **operationally issuing bulletins**, while TSP-India and TSP-Indonesia are **in development**.
Use Exercises and Communication tests for monitoring data availability and quality	will **utilize and assess** sea level monitoring stations for **data availability and quality during the upcoming COMMS and WAVE exercises.**
Sharing of info on deployment of new technologies to monitor sea level variations	On going
Multi-purpose sea level monitoring stations to support MHEWS	On going
Circular letter to all Member States on Closure of Fax services by TSPs unless advised otherwise	IOC CL 3006 issued by ICG. The fax transmissions of tsunami information products by the Tsunami Service Providers will stop on 31 March 2025, unless Member States advise before 31 December 2024 that fax transmission is essential for the functions of their NTWC.

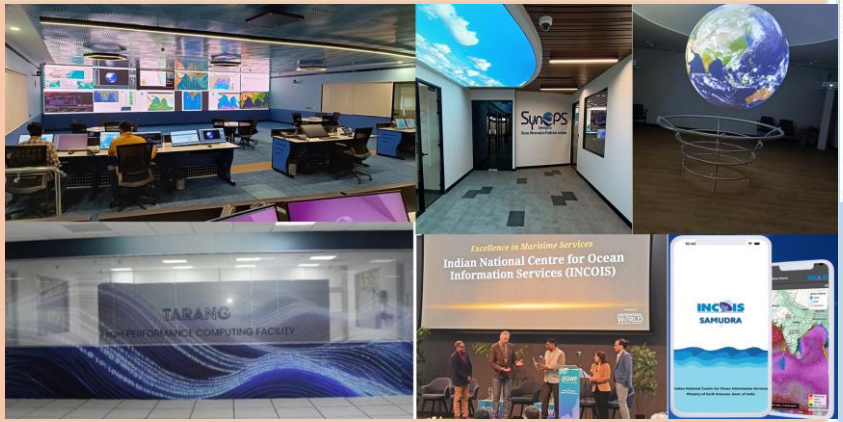
TSP Progress Report

TSP Australia



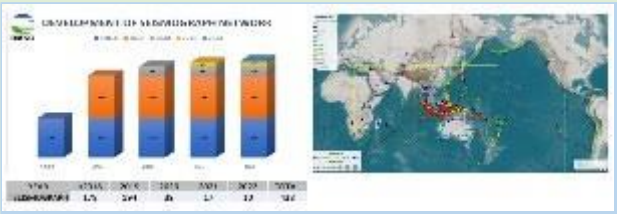
- Capability to produce Indian Ocean products for Non-Seismic events.
- Capability to deliver NAVAREA maritime products.
- Bureau-Joint Australia Tsunami Warning Center in progress with ISO 9001 recertification
- Non-seismic tsunami source SOPs
- No threat Bulletin for the IO was issued in response to the eruption of Ruang on the 29th of April 2024.
- Bureau-JATWC has replaced the current tsunami Decision Support Tool with TOAST on 15 Oct 2024.

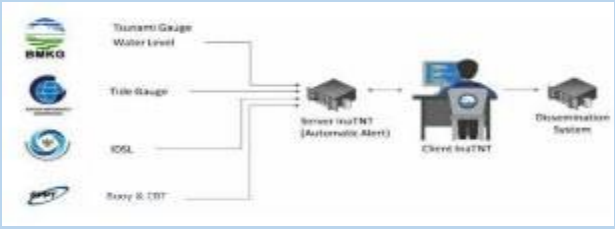
TSP India



- Maintaining CFZs Layers for IOTWMS
- **Capability to deliver NAVAREA maritime products**
- **SAMUDRA Mobile App**. It is a comprehensive **multi-hazard early warning app** to the coastal communities about oceanic threats.
- **Established SynOPS Lab:** A cutting-edge facility advancing ocean monitoring and predictive capabilities.
- **HPC facility "TARANG" at INCOIS -** Dedicated to real-time tsunami inundation modeling, operational oceanography, and advanced simulations.
- Working towards implementation of SOP for the Non-Seismic (TGV) events.

TSP Indonesia





- Integration of the New 4000 TsunAWI Scenarios Into TOAST
- Progressive deployment of the seismometers (535 in 2024)
- Indonesia Tsunami Non- Tectonic monitoring system (InaTNT) to monitor the sea-level anomalies
- Multi-Hazard Platform (InfoBMKG mobile App)
- Establishment of the National Consortium of the EQ and Tsunami Experts
- Developed impact based real time system of InaTEWS supported by National Consortium

TSP KPIs – M6.8+

TSPs KPIs Report for Mag 6.8 and above in Earthquake source zones of IOTWMS (20Feb2024-06Feb2025)

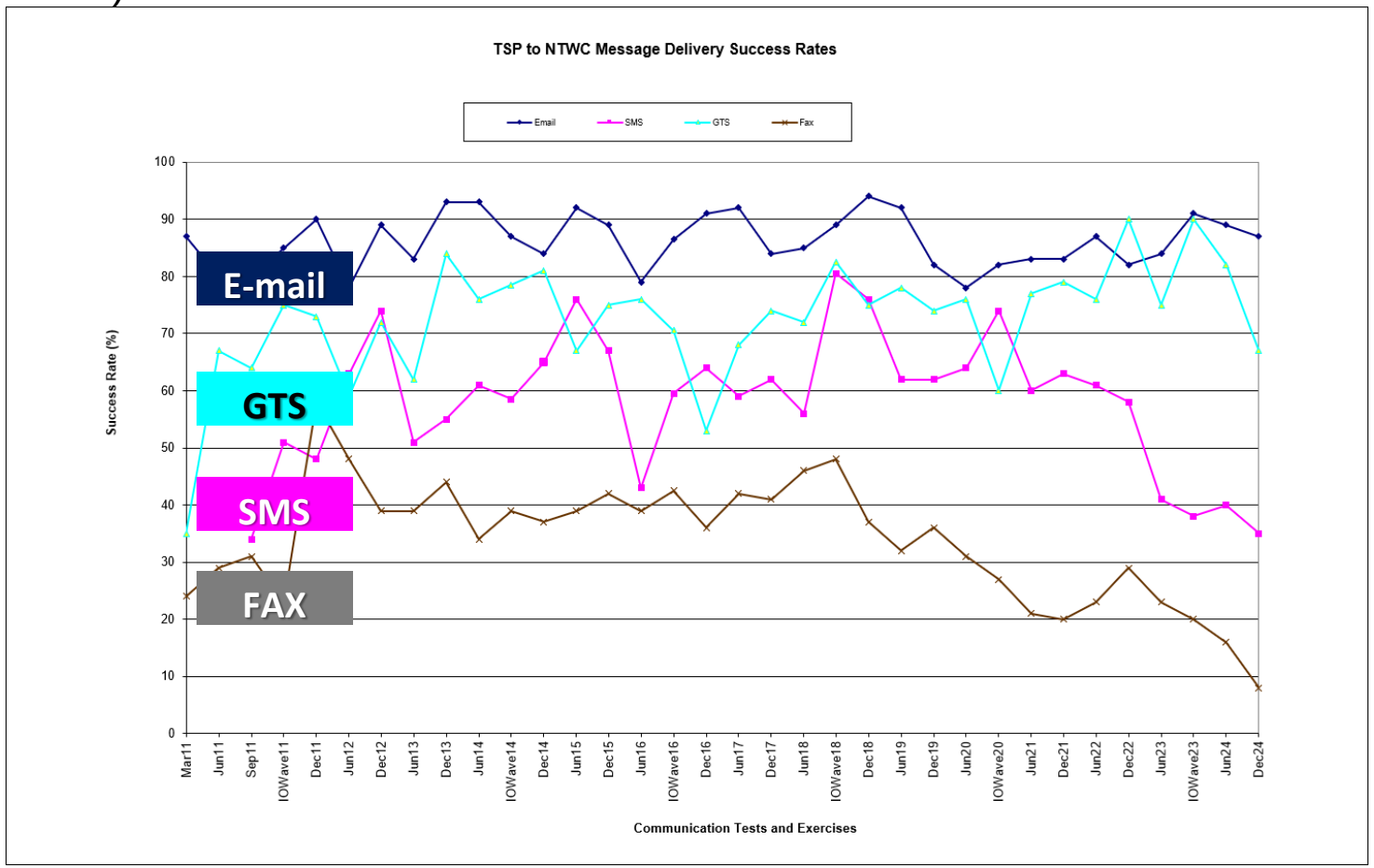
	Service Level 1 EQ Bulletins					Service Level 2 Threat / No Threat Bulletins			General
TSP	**KPI 1** **ET First EQ Bull** **Target: 10 mins**	**KPI 2** **POD EQs GE M6.8 in ESZ** **Target: 100%**	**KPI 3** **EQ Mag** **Target: 0.3**	**KPI 4** **EQ Depth** **Target: 30 km**	**KPI 5** **EQ Location** **Target: 30 km**	**KPI 6** **ET First Threat Bull** **Target: 20 mins**	**KPI 7** **POD Tsunami Waves** **Target: 100%**	**KPI 8** **Tsunami Height Accuracy** **Target: Factor of 2**	**KPI 9** **False / Incorrect Bulletins Issued** **Target: 0**
Australia	9.6	93%	0.1	17.5	22.3 Km	n/a	n/a	n/a	1#
India	10.3	93%	0.13	42.9 km	18.8 km	n/a	n/a	n/a	0
Indonesia	9.2	93%	0.16	21.3 km	23.5 km	n/a	n/a	n/a	1@

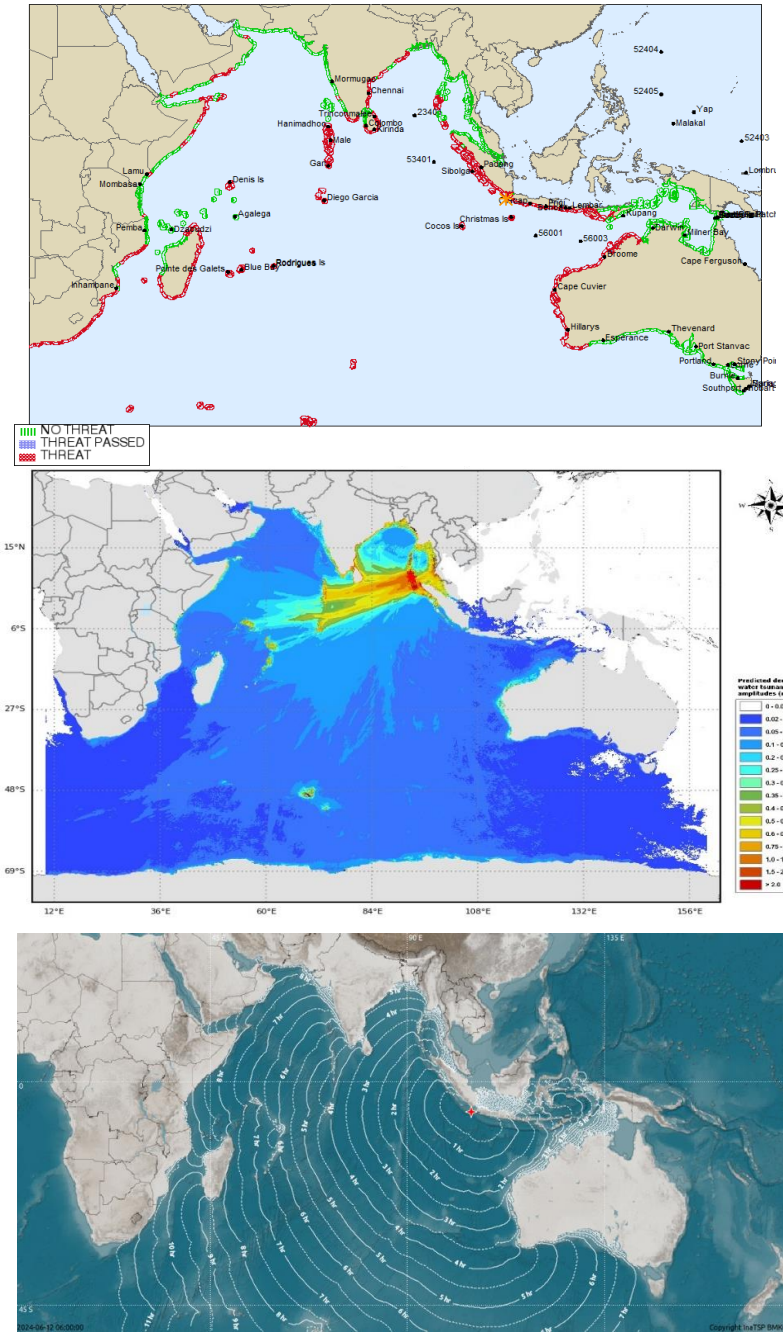
#TSP AUSTRALIA issued a no-threat bulletin for the earthquake outside the ESZ of IOTWMS due to the recent migration of DSS to TOAST.
@TSP-Indonesia issued a no-threat bulletin for a land-based earthquake (Magnitude 6.8) that occurred in Xizang in January 2025, located over 200 km from the coast

Meets Target	Near Target	Misses Target

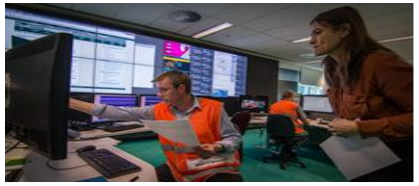
IOTWMS Communication Tests

- As of today, 6 IOWave Exercises and 28 Communication Tests were conducted.
- During the reporting period, 2 COMMS tests were conducted (June & December 2024)





TSP –Australia Recent Developments



JATWC staff located at Geoscience Australia (left) and Bureau of Meteorology (right)

Non-seismic Products (For Volcanic Source)

No threat Bulletins for the Indian Ocean and Australia were issued in response to the eruption of Ruang on the 29th of April 2024. This is the first non-seismic product issued by a TSP for the Indian Ocean.

EARTHQUAKE: TALAUD ISLANDS, INDONESIA 18:35 UTC 29 April 2024 Mag N/A

INFORMATION FOR BULLETIN 1.No Threat Bulletin 2109UTC 29 Apr 2024

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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
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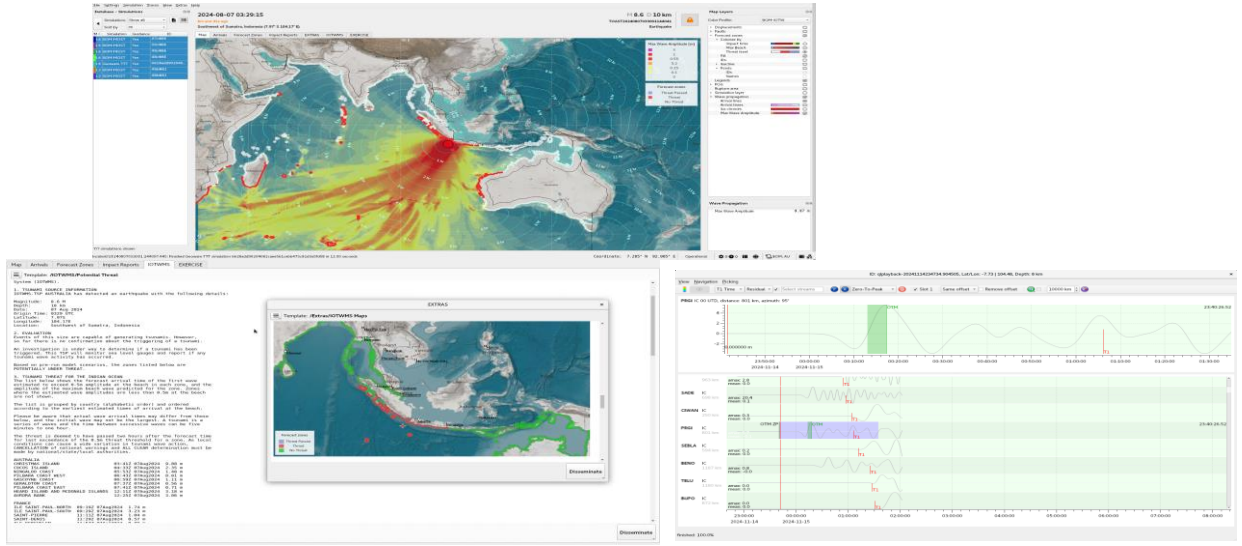
Implemented the NAVAREA capability and will participate in upcoming COMMS Test

The Tsunami Observation and Simulation Terminal (TOAST)

The TOAST system, along with the Product Generation Engine's business release, was implemented on 15 October, replacing the Tsunami Decision Support Tool (DST). The upgrade, driven by IT security enhancements, also brings several short- and long-term benefits.

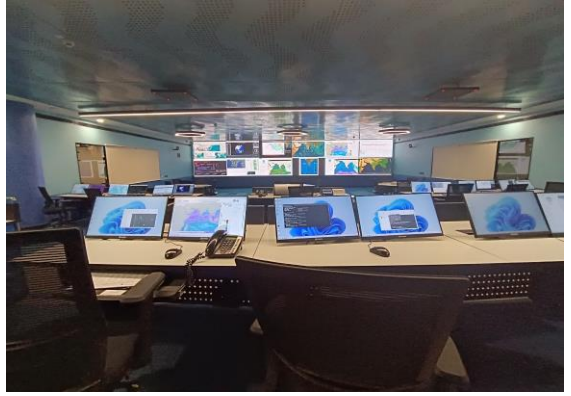


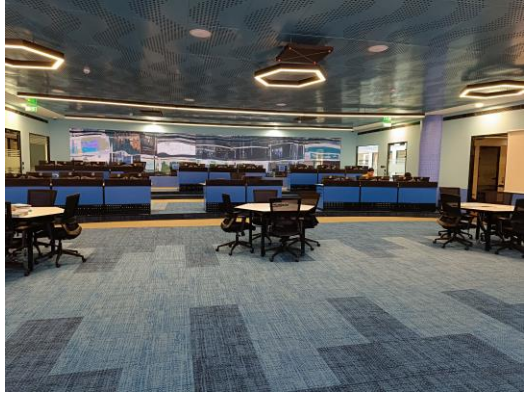
TSP Australia Training and Competency Developments

The Bureau-JATWC has upgraded its training and competency package and implementation guide.

The Bureau and GA have provided support for the NTWC Minimum Staff Competency Training Pilot and WG-PICT Task Team Capacity Development.

TSP –India Recent Developments





SynOPS

- The state-of-the-art Synergistic Ocean Observations Prediction and Services Lab (SynOPS) was inaugurated on 14 February 2024
- To' enable immersive 2D/3D/4D visualization of in-situ data, satellite remote sensing ocean data, model products and decision support products
- SynOPS facility enables better situational awareness and decision making for provision of operational ocean services including Coastal Multi Hazard Early Warning System of Tsunami, Storm Surges, High Waves, Swells, Oil Spills, Marine Search & Rescue, Small Vessel Advisories, etc.

HPC for Numerical Modelling

Recently, INCOIS established a High-Performing Computing (HPC) Facility called TARANG.

- It has 1 PetaFLOPS of compute power, 2 PB of storage, and 3 PB of archival capacity.
- It also includes an impressive 15.5 Peta FLOPS dedicated to AI and machine learning applications, marking a significant advancement in oceanographic research and data processing

TSP –India Recent Developments Cont..

Maritime products for NAVAREAs

As a TSP, India is now generating the NAVAREA messages as per the service definition document version 5.0 and is ready for trial.

TSP INDIA TSUNAMI BULLETIN NUMBER 2 FOR

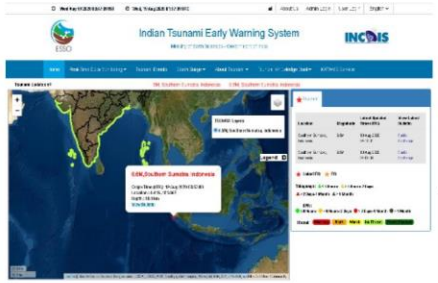
NAVAREA VII, VIII, X, XI

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

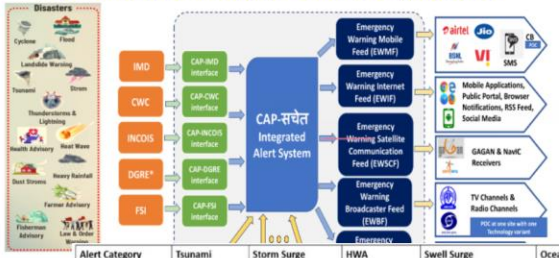
TSUNAMI CANCELLATION MESSAGE ISSUED BY TSUNAMI SERVICE PROVIDER INDIA IN SUPPORT OF THE UNESCO/IOC INDIAN OCEAN TSUNAMI WARNING AND MITIGATION SYSTEM AT 0616 UTC WEDNESDAY 12 JUNE 2024.
THE THREAT HAS NOW LARGELY PASSED FOR THE TSUNAMI GENERATED BY A MAGNITUDE 9.0 EARTHQUAKE THAT OCCURRED NEAR SUNDA STRAIT, INDONESIA [-6.94S, 104.70E] AT 0600 UTC 12 JUN 2024.
HOWEVER, SHIPS APPROACHING THE COAST SHOULD STILL CONSULT LOCAL AUTHORITIES REGARDING LOCAL CONDITIONS AND ADVICES.

Warning Dissemination and Communication

Tsunami Advisories and bulletins at https://tsunami.incois.gov.in

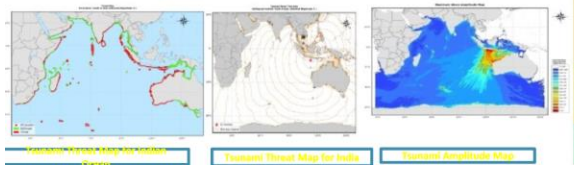


Common Alerting Protocol (CAP) for MHWS – implemented through SACHET platform



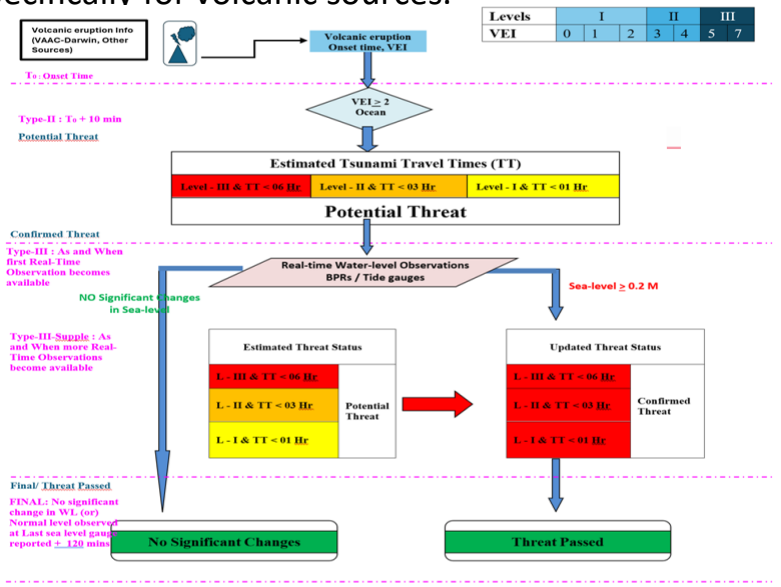
Multi-hazard dissemination and Alerts criteria

Alert Category	Tsunami	Storm Surge	HWA	Swell Surge	Ocean Currents
Warning	EWA >2.0 m (Take Action) Public advised to move in-land towards higher grounds. Vessels should move into deep ocean.	SSH >2.0 m OR Inundation extent more than 500m (Take Action) The public is advised to avoid low-lying areas. Follow local disaster management guidelines.	SWH > 3.5 m (Take Action) Small vessels not to ply. Nearshore recreation activities to be totally suspended.erosion/wave surges possible.	Swell Period > 18 sec + Surge Height > 2.0 m / High Tide (Take Action) Surging of waves nearshore possible, small vessels not to ply, no activities at beach/ nearshore waters as nearshore erosion possible. No exit/entry of small boats at coastline.	Currents > 2.0 m/s (Take Action) Exit/entry at harbours coastline with sufficien caution. Ships/boat flowing against curren in open sea to be ver careful.
Alert	0.5 m ≤ EWA ≤ 2.0 m (Take Action) Public advised to avoid beaches and low-lying coastal areas. Vessels should move into deep ocean.	0.5 m ≤ SSH ≤ 2.0 m OR Inundation extent between 100 to 500m (Take Action) The public is advised to avoid beaches. Follow local disaster management guidelines.	3.0 m ≤ SWH ≤ 3.5 m (Be Prepared) Be careful while doing marine operations and nearshore recreation.	15.0 sec ≤ Swell Period ≤ 18.0 sec + 1.5 m ≤ Surge Height ≤ 2.0 (Be Prepared) There is a possibility of surging of waves, boats to ply with utmost vigilance, recreation with due care.	1.0 ≤ Currents ≤ 2.(m/s (Be Prepared) Harbour/marine operations to be careful
Watch	0.2 m ≤ EWA < 0.5 m (Be Updated) No immediate action is required.	0.2 m ≤ SSH < 0.5 m OR Inundation extent less than 100m (Be Updated) No immediate action is required.	2.0 m ≤ SWH ≤ 3.0 m (Be Updated) No immediate action is required. Check for updates.	12.0 sec ≤ Swell Period ≤ 15.0 sec / 1.0 m ≤ Surge Height ≤ 1.5 m (Be Updated) No immediate action is required. Check for updates.	0.5 ≤ Currents ≤ 1.(m/s (Be Updated) No immediate action is required. Check for updates.
No Threat / Threat Passed	No Significant / No further Tsunami Waves (No Action)	SSH < 0.2 m OR No Inundation (No Action)	SWH < 2.0 m (No Action)	No significant Swell (No Action)	Currents < 0.5 m/s (No Action)



Monitoring Tsunamis Generated by Volcanoes

TSP-India is enhancing its capability to issue non-seismic bulletins, specifically for volcanic sources.

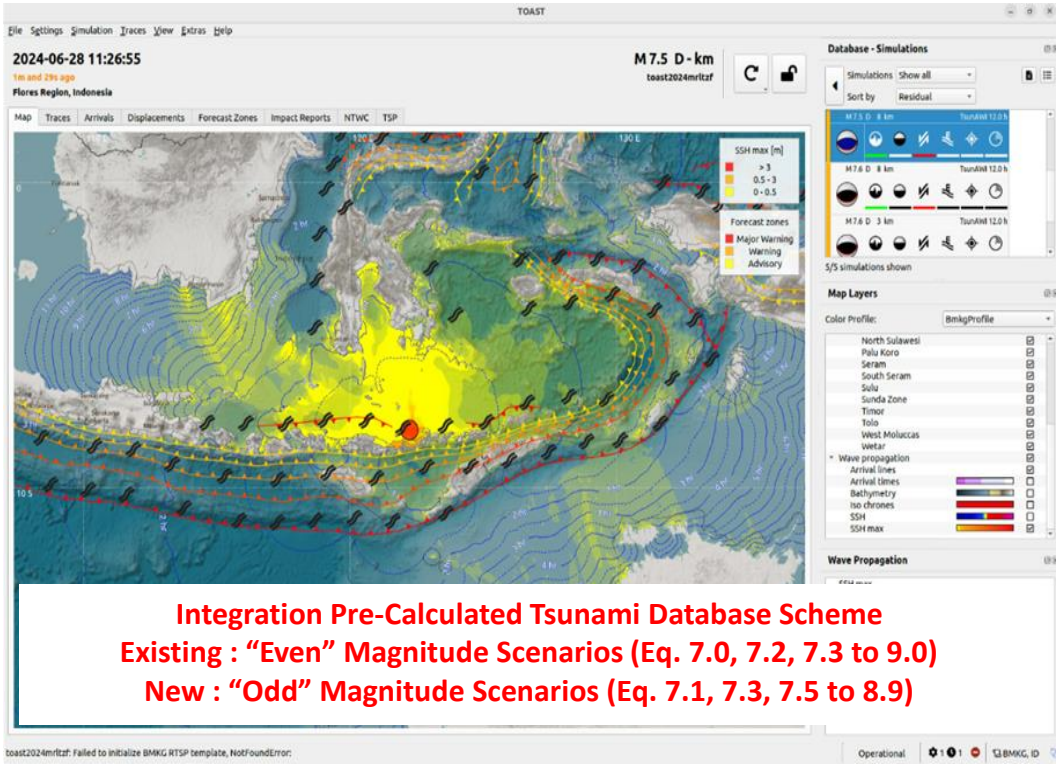


Real-time tsunami propagation and inundation for Indian Ocean Region using ADCIRC (Service Level –III preparation)

- Kolukula SS, Murty PLN, Kumar TS, Ramarao EP, M. V RM. 2025 Tsunami modelling over global oceans. R. Soc. Open Sci. 12: 241128. https://doi.org/10.1098/rsos.241128

TSP –Indonesia Recent Developments

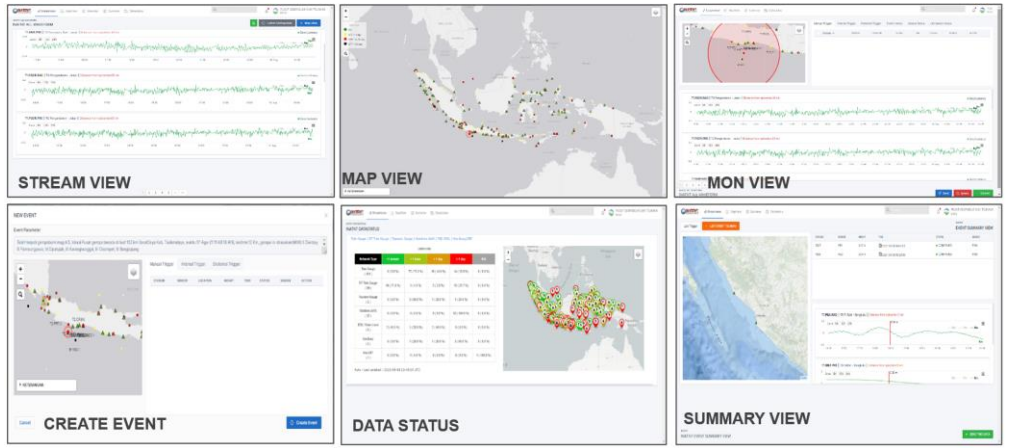
Integration of the New 4000 TsunAWI Scenarios Into TOAST

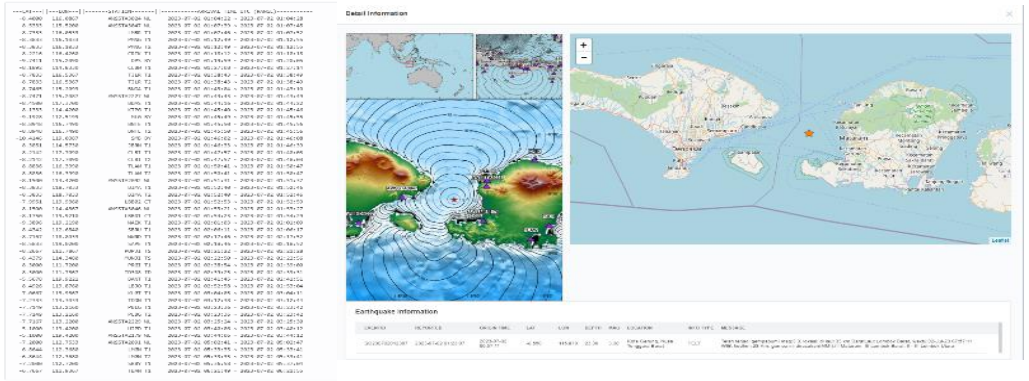


- Progressive deployment of the seismometers (535 in 2024)

InaTNT (Indonesia Tsunami Non-Tectonic) For Indian Ocean Region

- Automatic Sea Level Anomaly Monitoring - InaTNT displays the predicted time travel and arrival time of the tsunami at each water level station for all possible earthquake events.
- Access to IO member states to monitor the sea-level stations



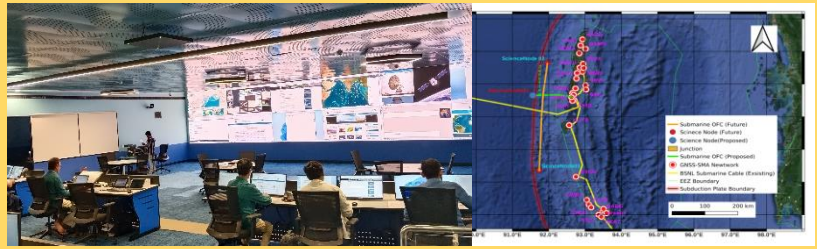


TSP Future Plans

TSP Australia

- GA-JATWC to integrate, test and operationalise seismic array processing as input to rapid earthquake detection and characterization.
- GA-JATWC to commence work towards ISO 9001 accreditation for GA-JATWC systems

TSP India



- Developing SOPs and implementing products for non-seismic tsunamis
- Utilizing GNSS & SMA for precise rupture characterization.
- Establishing the GPS co-located tide Gauges along the Indian coast.
- Archiving Makran source PTHA Data for access to member states.
- Establishing new technologies (Under sea cable) for rapid tsunami detection
- Providing on-the-job trainings for IO member states.

TSP Indonesia

- Deploy 100 Tsunami Gauges
- Utilization of GNSS data for earthquake parameter calculation
- Research on non seismic tsunami
- Provide sea level observation portal for the Indian Ocean area
- Support the On-the-job Training for the IO member states
- Development of processing system for Earthquake Early Warning

International Tsunami Symposium 2025 (India - INCOIS)

INCOIS (India) is hosting the ITS 2025 and the portal will be available for accepting the abstracts and registrations from the participants. The broader objectives and tentative Themes are listed below.

OBJECTIVES

- To report on and document the achievements in Tsunami Science
- To identify the challenges and gaps in the early warning system and work that still needs to be done
- To enhance interdisciplinary collaboration especially for non-seismic tsunami source detection and tsunami forecasting
- To enhance tsunami detection and warning system through the latest technological advancements like high performance computing and AI/ML etc.
- To promote global tsunami preparedness through UNESCO-IOC Tsunami Ready Recognition Programme and similar programmes/projects
- To leverage on the Ocean Decade Tsunami Programme for improvement

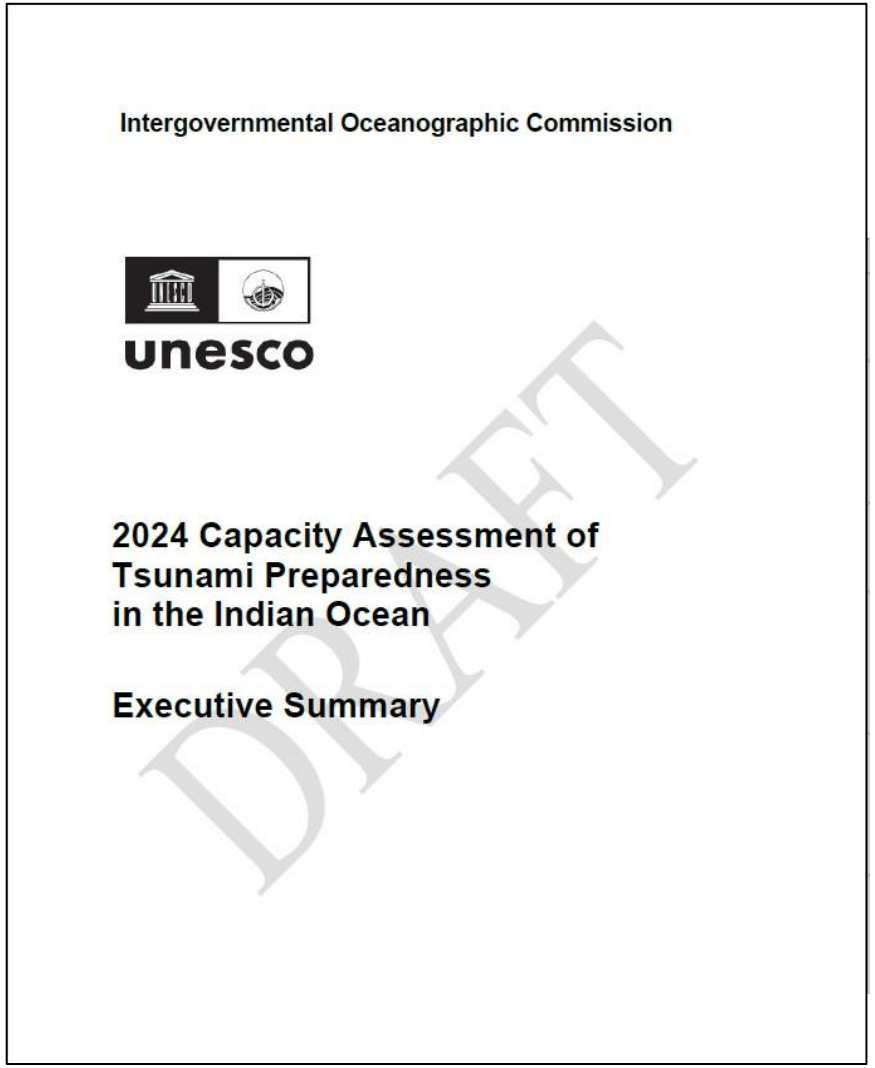
THEMES

- Tsunami hazard, vulnerability and risk assessment
- Paleotsunami Studies
- Instrumentation and observation network
- Tsunamigenic earthquake source mechanisms
- Non-seismic and Complex tsunami Research
- Tsunami modelling (seismic and non-seismic sources)
- Experimental studies
- Advanced Techniques (Real-time inundation modelling, use of high-performance computing, AI/ML etc.)
- Field Surveys
- Tsunami Data Analysis
- Meteotsunamis including 2022 Tonga event
- Communicating Uncertainties
- Tsunami Awareness and Preparedness
- International Cooperation and Private Partnerships

Website is under development and will be available in the next week

ICG/IOTWMS 2024 Capacity Assessment Survey

- ICG/IOTWMS conducted the 2024 UNESCO-IOC Capacity Assessment of Tsunami Preparedness in the Indian Ocean to track regional change and to identify gaps and challenges that could be addressed through future projects and activities.
- Survey responses from twenty-two (22) Member States have been received.
- The University of Huddersfield analysed the data and compared with the results of the 2018 Assessment to produce a draft report.
- The Capacity Assessment Team, supported by the ESCAP Tsunami Trust Fund and the Asian Development Bank, convened a meeting in Bangkok from 4–6 September to formulate recommendations.
- The preliminary draft report is now available for review on the meeting website.



48 IOC-UNESCO Tsunami Ready Communities in the Indian Ocean

36 New communities of India [24] and Indonesia (12) were recognized as Tsunami Ready at the 2nd UNESCO-IOC Global Tsunami Symposium

Major Decisions from the 14th Session of ICG/IOTWMS

(14-19 Nov 2024, Jakarta, Indonesia)

- Include the instructions from 57th Session of the IOC Executive Council, and the recommendations from TOWS-WG XVI and XVII in the work plans of the ICG for the next inter-sessional period;
- ICG/IOTWMS Steering Group released the Service Definition Document version 5.0 that covers templates for NAVAREA and Non-Seismic templates.
- Extend the TSP services to include tsunamis generated by non-seismic and complex sources
- Instructs the Steering Group to finalize the 2024 Capacity Assessment Report and Executive Summary in 4 weeks, for further review by the Member States, incorporate feedback if any, and endorse the final report for publication as UNESCO-IOC Document
- Establish a new intersessional Task Team on Indian Ocean Wave 25 Exercise (IOWave25) reporting to the Steering Group
- Establish a new intersessional Task Team on New/Emerging Technologies for Observations and Forecasting under the WG2
- Establish a new intersessional Task Team on Mid-Term Strategy (MTS) to prepare a draft MTS
- Request the Steering Group to supervise the work of the Task Team and to finalise the MTS 2025-2030 by early half of 2025
- Instructs the Steering Group, Working Groups and Task Teams to consider the recommendations of the ODTP RDIP, IOWave23, 2024 Capacity Assessment and 2nd Global Tsunami Symposium into their work plans.
- Decides to continue the capacity development initiatives related to SOPs, TEMPP, TRRP and on-the-job training for warning center operators by TSPs. TEMPP, hosted by INCOIS, is scheduled to take place in April 2025.
- Request the Steering Group to explore if there is a need of expanding sub-regional working groups to address regional gaps and strengthen collaborations.
- Develop the summary statement of the 2nd UNESCO-IOC Global Tsunami Symposium together with the Program Committee for publication as a UNESCO-IOC document.
- Optimal sea level and seismic network design for the Area of Service (AoS) and work with Member States to fill identified gaps, including the strategic and coordinated submission of projects to the UN Ocean Decade and potential funding sources for support.

Thank You

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