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TSP India Status Report

Nagaraja Kumar M

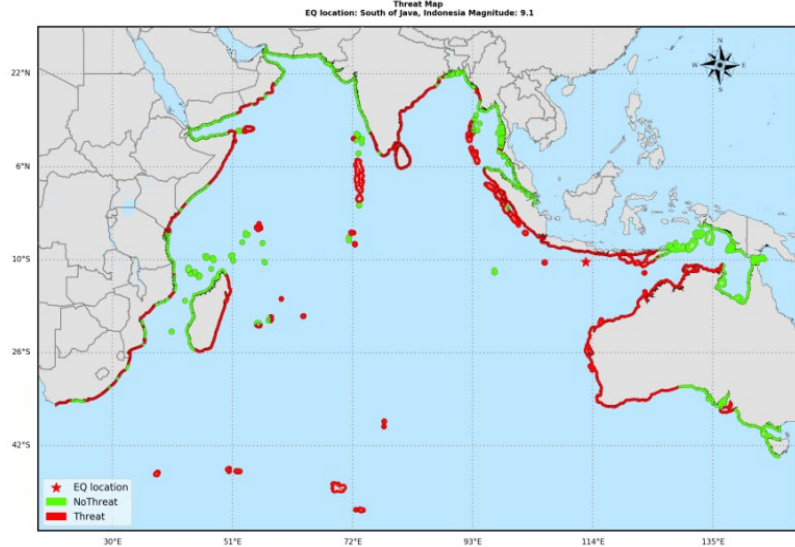
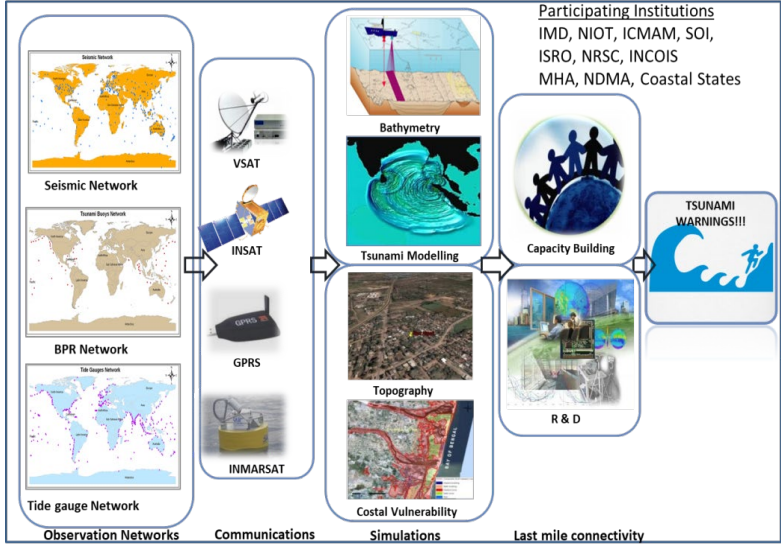
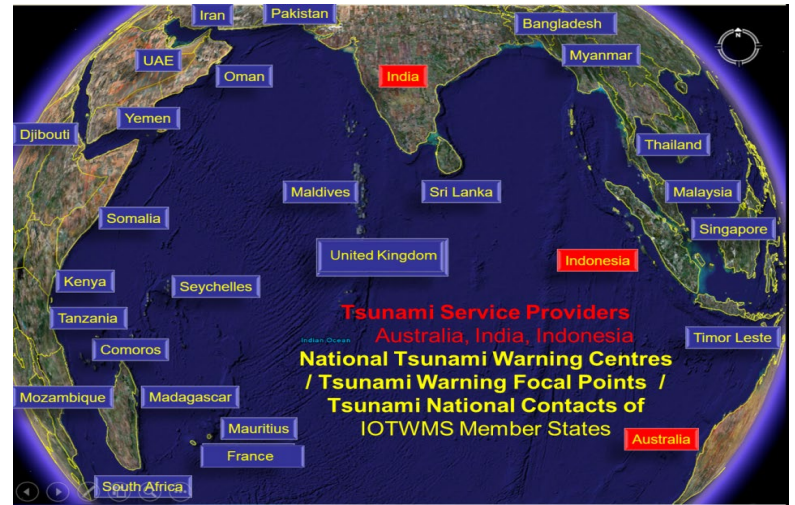
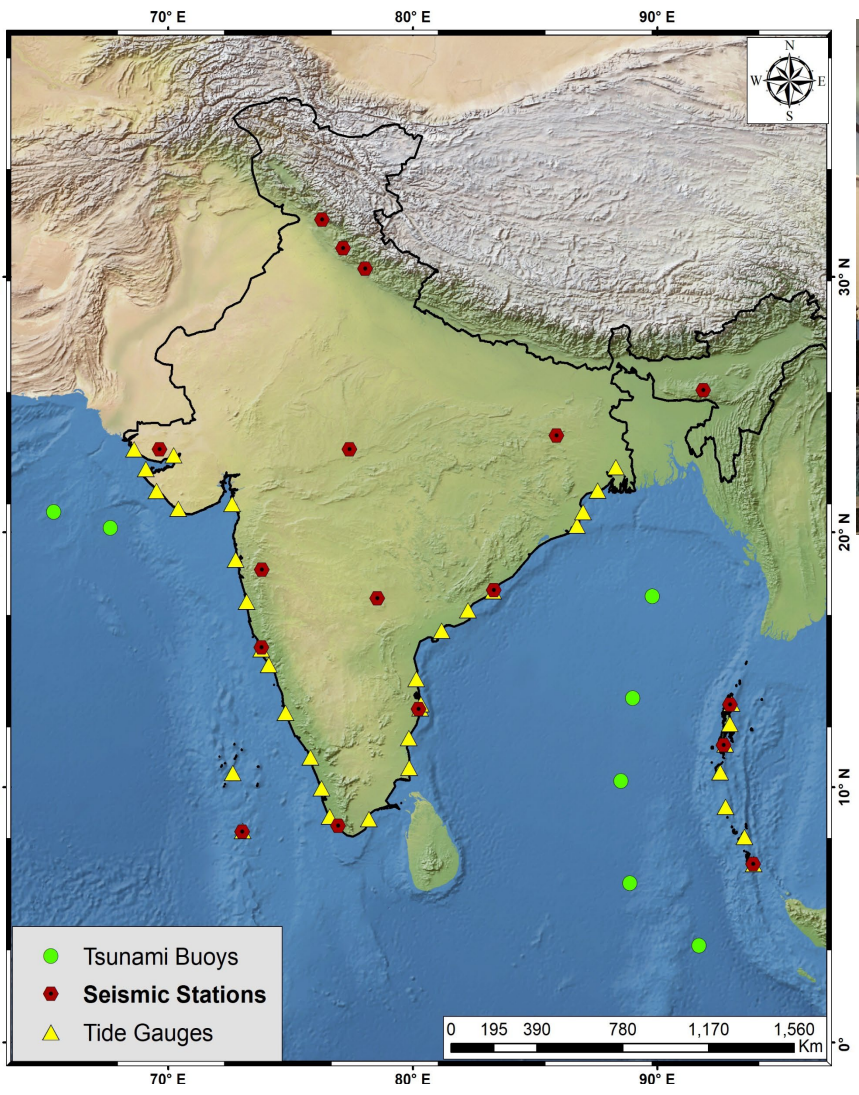
TSP-INDIA

INCOIS- INDIA

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*Meeting of ICG/IOTWMS Working Group 2- Tsunami Detection, Warning and Dissemination
25th August 2025 (online)*

Detection, Observations, Monitoring and Forecasting



Established co-located GNSS receivers with existing Tide gauges at 15 locations along Indian coast.

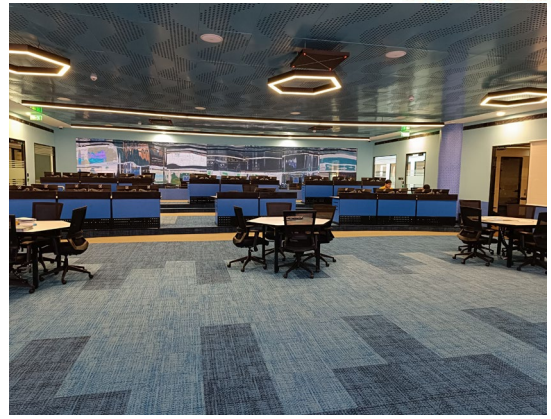
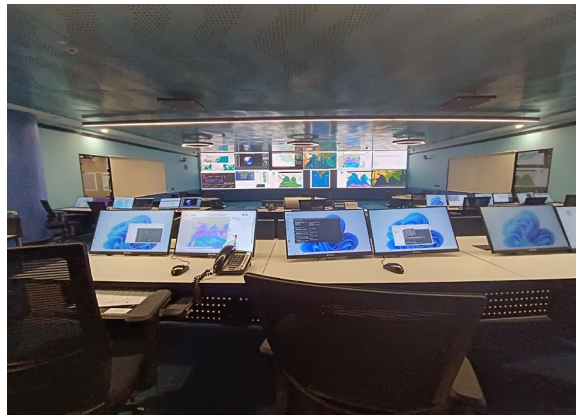
Detection, Observations, Monitoring and Forecasting



SynOPS Lab

The state-of-the-art Synergistic Ocean Observations Prediction and Services Lab (SynOPS) inaugurated on 14 February 2024

- To' enables immersive 2D/3D 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



TARANG - High Performance Computing (HPC) Facility

System Overview

- 4.64-bit machine, capable of supporting multi-tasking, multi-programming, multi-user and time-sharing environment, of a proven architecture with scalable processing elements, scalable high performance I/O, scalable interconnection network and a balanced design to have 99.9% uptime with adequate redundancies and to avoid single point of failure so as to meet the operational requirements.
- The compute capacity is about 1 Peta FLOPS, with 2 Peta Byte storage and 3 Peta Byte archival storage.
- Additionally, there is a dedicated standalone system for Artificial Intelligence (AI) and Machine Learning (ML) applications with a capacity of 15.5 Peta FLOPS.

System Configuration

Workload	Qty	Model	CPU	RAM	Network	Storage
Server	40	2 x AMD MI300X	2 x AMD MI300X	256 GB	100 Gbps InfiniBand	100 TB SSD
GPU Nodes	195	8 x NVIDIA A100	8 x NVIDIA A100	256 GB	100 Gbps InfiniBand	100 TB SSD
Admin Node	2	DL 380 C10	7315, 32C, 2.66GHz	256 GB	100 Gbps InfiniBand	100 TB SSD
Log Node	2	DL 380 C10	7315, 32C, 2.66GHz	256 GB	100 Gbps InfiniBand	100 TB SSD
Utility Node	2	DL 380 C10	7315, 32C, 2.66GHz	256 GB	100 Gbps InfiniBand	100 TB SSD
DB Node	1	DL 380 C10	7315, 32C, 2.66GHz	256 GB	100 Gbps InfiniBand	100 TB SSD
DB Node (S)	1	DL 380 C10	7315, 32C, 2.66GHz	256 GB	100 Gbps InfiniBand	100 TB SSD
DB Node (M)	1	DL 380 C10	7315, 32C, 2.66GHz	256 GB	100 Gbps InfiniBand	100 TB SSD
DB Node (A)	1	DL 380 C10	7315, 32C, 2.66GHz	256 GB	100 Gbps InfiniBand	100 TB SSD
DB Node (I)	1	DL 380 C10	7315, 32C, 2.66GHz	256 GB	100 Gbps InfiniBand	100 TB SSD

Technical Support Facilities

- Transformers (designed with N+1 redundancy)
- Uninterrupted Power Supply (UPS) (designed with N+1 redundancy)
- Batteries (designed for 15 min Battery Backup of individual UPS load)
- Multiple entry/exits (designed for fire safety)
- Lighting system (designed to provide correct lux level for different working areas)
- Adequate fire fighting provisions (designed for fire safety)
- Tables (to ensure proper distribution of load keeping voltage drop within acceptable limits)
- Chillers with pumps and 2 thermal storage tanks for 15 min emergency backup

Workloads

- Operational models for providing Tsunami Early Warnings for India and other 24 countries on the Indian Ocean rim
- Next generation Ocean State Forecast system with more accurate representation of physical processes, non-hydrostatic dynamics, high resolution nests for local forecasts and advanced data assimilation techniques
- Developing/improving sophisticated models such as MOM, ROMS, HYCOM, Vflow, Wav3, SWAN, Tsumani N2, ADCIRC leveraging advanced technologies such as Artificial Intelligence and Machine Learning

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

- It has 1 Peta FLOPS 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

Warning Dissemination and Communication



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

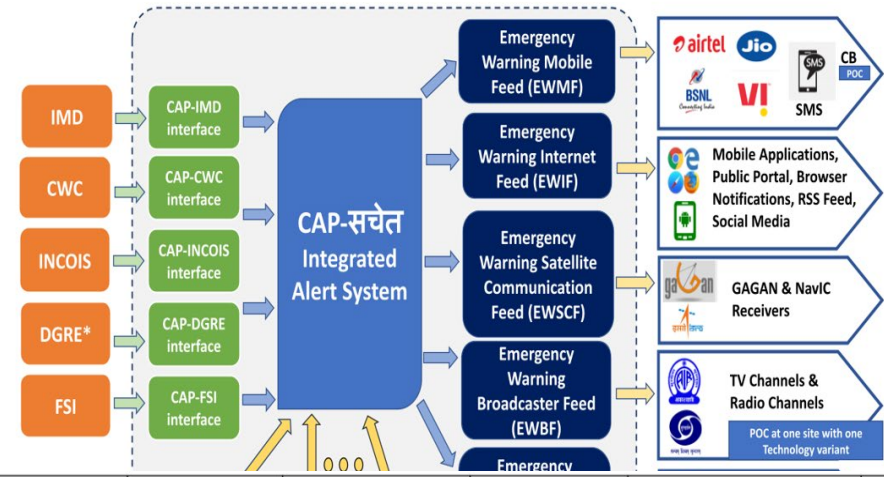
Tsunami Advisories and bulletins at <https://tsunami.incois.gov.in>

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

Tsunami Updates

Location	Magnitude	Latest Updated Time (UTC)	View Latest Bulletin
Southern Sumatra, Indonesia	6.5M	19 Aug 2020 04:18:31	Public Exchange
Southern Sumatra, Indonesia	6.9M	19 Aug 2020 04:09:30	Public Exchange

6.5M, Southern Sumatra, Indonesia
Origin Time (UTC): 19 Aug 2020 03:53:00
Location: 4.41S, 101.00E
Depth: 10.0 km
[View Bulletin](#)



Fax

Email

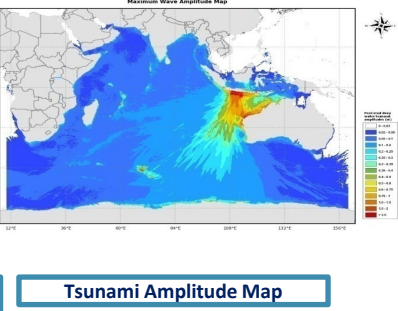
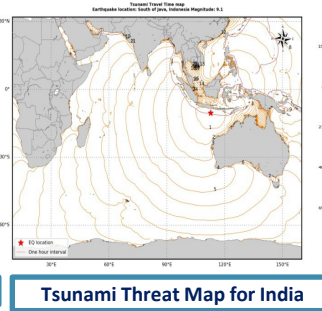
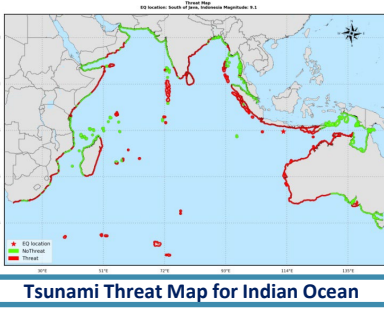
SMS

Web

GTS

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 sufficient caution. Ships/boats flowing against current in open sea to be very 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 m (Be Prepared) There is a possibility of surging of waves, boats to ply with utmost vigilance, recreation with due care.	1.0 ≤ Currents ≤ 2.0 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 ≤ 1.0 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)



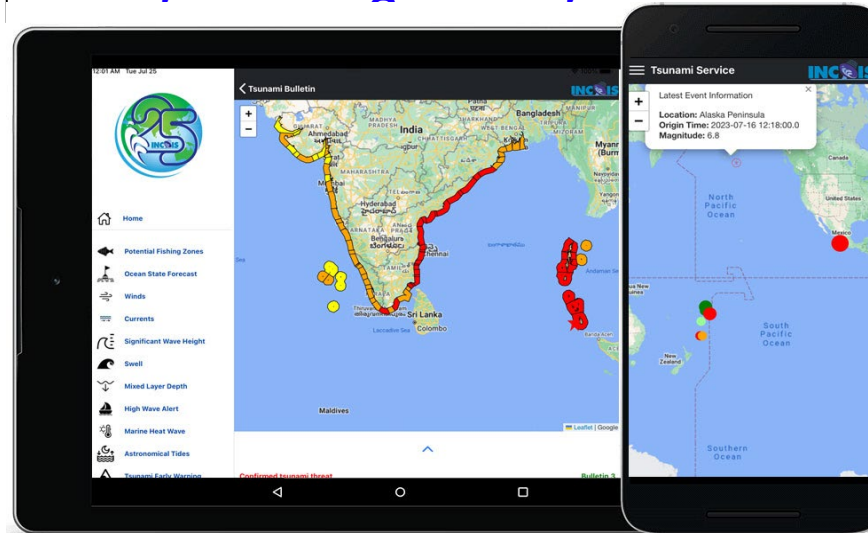
Warning Dissemination and Communication

Multichannel, **Multilingual**, Geo-located, Social Media, Regular tests and Clear & Concise Messages

"SAMUDRA" (Smart Access to Marine Users for ocean Data Resources and Advisories) The mobile app empowers users with real-time updates and critical alerts on oceanic disasters such as tsunamis, storm surges, high waves, swell surge alerts, etc.

Features:

- Real-time alerts: Tsunamis, high waves, swell surges
- Active alert system on the home page
- PFZ Advisories: Direct fishermen to fish aggregation locations
- Ocean State Forecasts: 5-day advanced predictions for marine activities
- Marine heat wave ,Mixed layer depth & Astronomical tides,
- Interactive Interface: Maps, charts, animations for oceanic data understanding



'SAMUDRA' is web and mobile based app:
Available on both [@GooglePlay](#) Store & Apple [@AppStore](#)

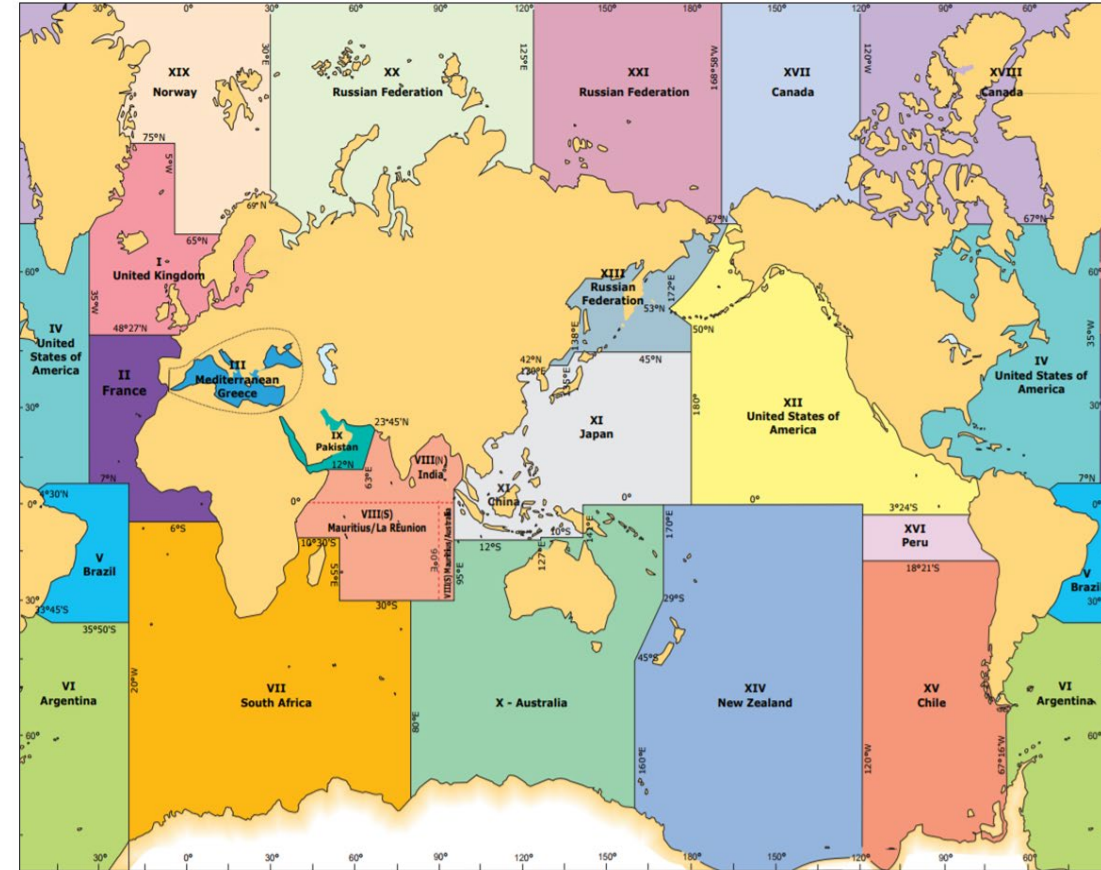


Maritime products for NAVAREAs

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

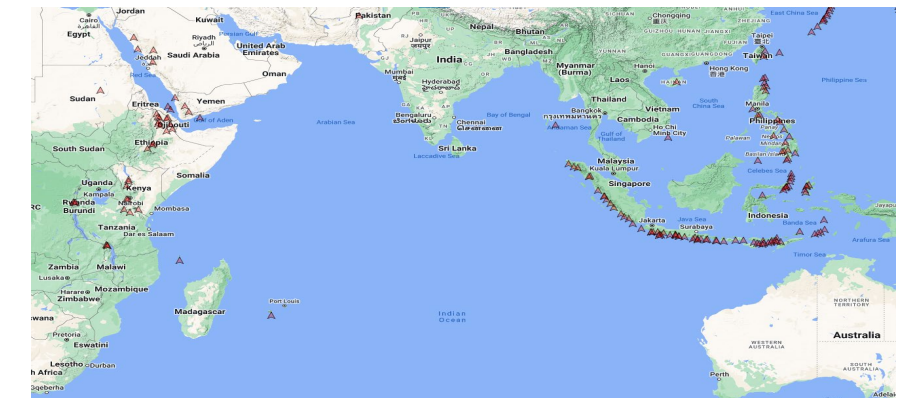
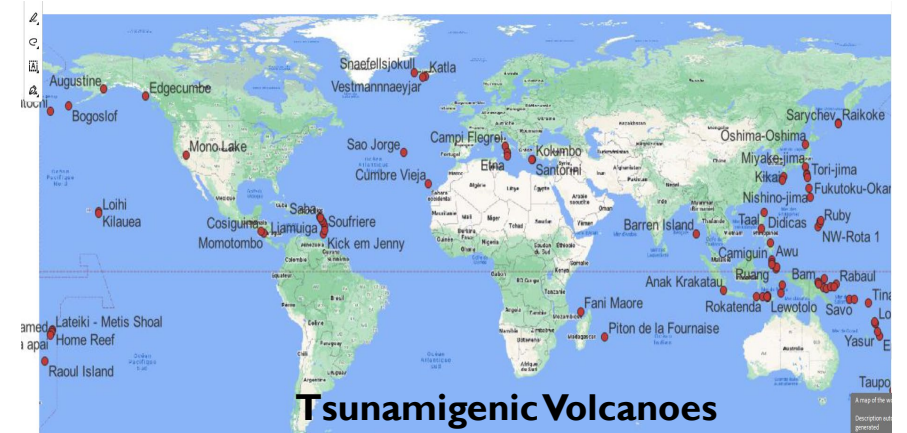
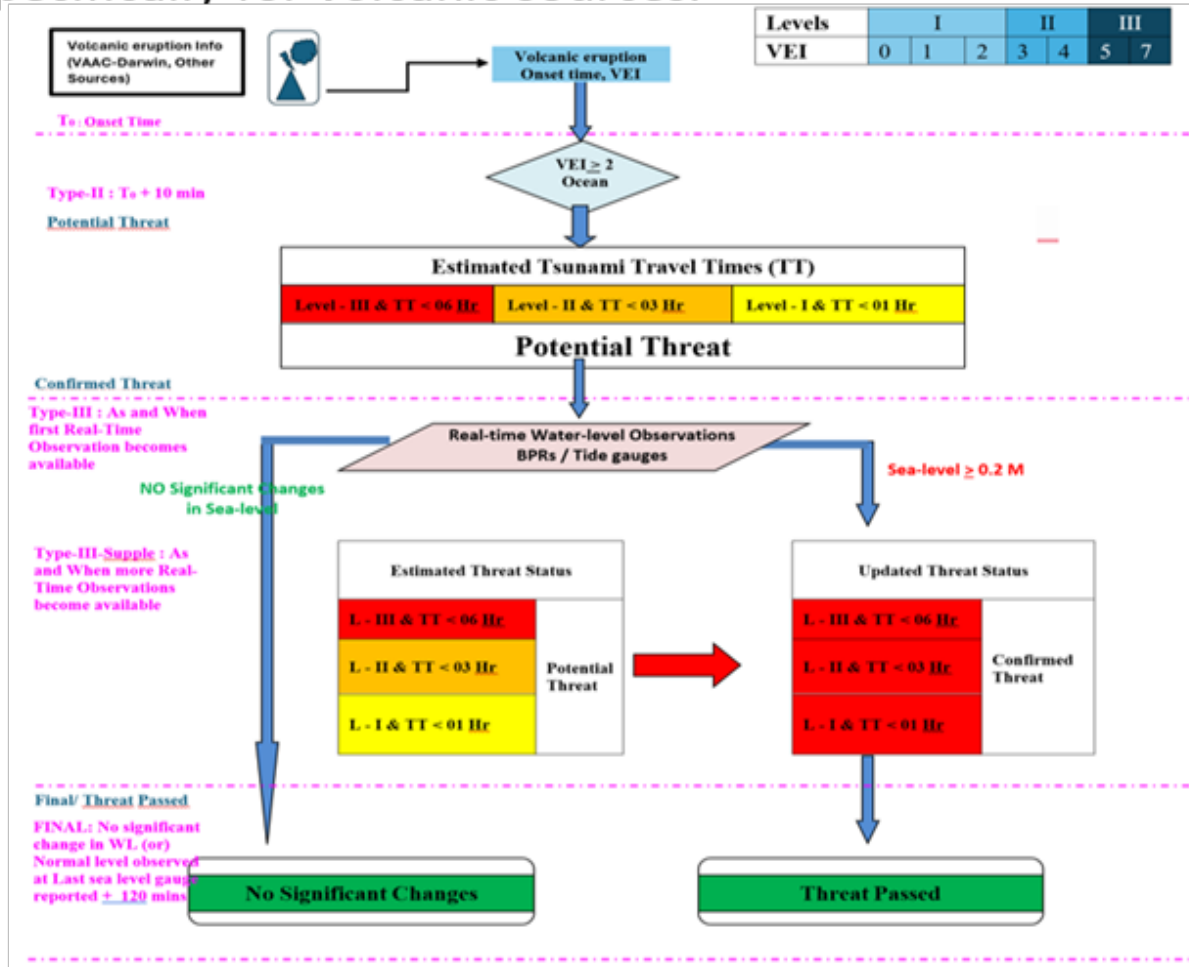
During the COMMS test held on 11th June 2025, TSP-INDIA has tested the dissemination of these alerts to the closed group of emailing list.

TSP-india contributed to the preparation of NAVAREA user guide.



Monitoring Tsunamis Generated by Volcanoes

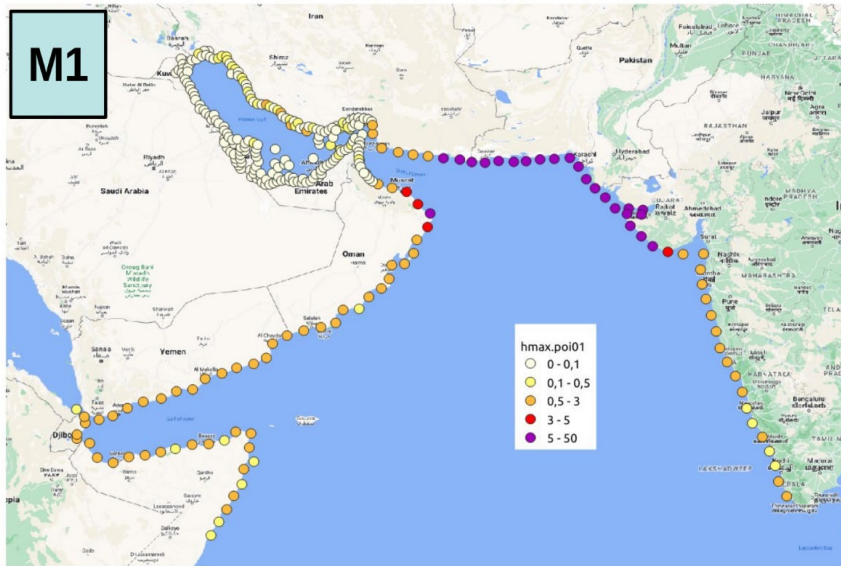
TSP-India is enhancing its capability to issue non-seismic bulletins, specifically for volcanic sources.



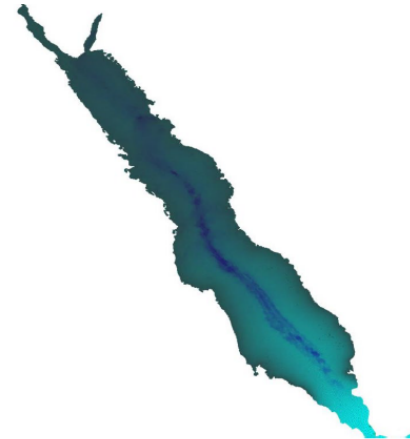
- About 1350 volcanoes are considered active in the past 12,000 years worldwide
- About 50–85 erupting volcanoes each year
- About 70 in the Indian Ocean
- **Tsunamigenic are around 10 in the Indian ocean**

Disaster Risk Knowledge

Probabilistic Tsunami Hazard Assessment

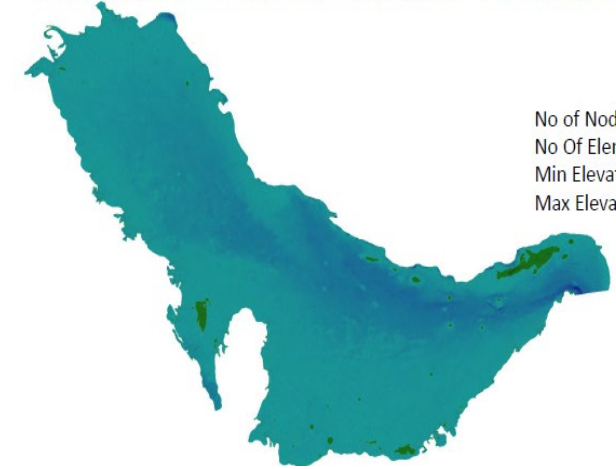


Finite Element Mesh - Red Sea



No of Nodes : 762592
No Of Elements: 1517276
Min Elevation : -2811.5 m
Max Elevation : 405.3 m

Finite Element Mesh -Persian Gulf



No of Nodes : 408106
No Of Elements: 810988
Min Elevation : -222.7 m
Max Elevation : 237.5 m

- Participating in UNESCAP project of PTHA for Makran Subduction Zone
- Initial benchmark PTHA model simulations run at INCOIS [India] with guidance from GFZ [Germany], INGV and University of Malaga
- Generated Scenarios for tsunami threat in the Persian Gulf and Red Sea
- Agreed to host the results and share with member states
- Arabian Sea tsunami hazard simulations completed (GFZ, Germany/INGV, Italy)
- Red Sea and Persian Gulf tsunami hazard simulations completed (INCOIS/India)
- PTHA2.0 - Hazard curves, maps and non-seismic etc.

Preparedness and Response Capabilities

➤ National Tsunami Mock Exercise:

- Conducted tsunami mock exercise on 05 November 2024 to all coastal provinces of India
- About 27 coastal villages from coastal province participated and evacuated.
- **Tsunami mock drill in Andaman Islands in 2024**

➤ COMMs Tests:

- TSP-India issued bulletins and participated in all COMMs test conducted by IOTWMS

➤ World Tsunami Awareness Day

- Conducted various programmes including mock drill,

➤ Other Workshops:

- Conclave on Commemoration of 20 years of Indian Ocean Tsunami involving various stakeholders including tsunami survivors
- INCOIS conducted workshops/training covering India's East and West coasts
- UNESCO Press Team visit in December 2024 to India and Tsunami Ready Villages



SOP Workshops & Competency Development of NTWCs

- National SOP Workshop in September 2024
 - ✓ INCOIS conducted Tsunami SOP workshop during 25-26 September 2024. Tabletop exercises also conducted for the SOP participant.
- On Job Trainings for Oman NTWC Operators in 2024
 - ✓ INCOIS (TSP-India) conducted " Training course for Oman operators in early warning systems of Tsunami "during 2-6 September 2024. A total of 5 operators were dattended.



- ICG/IOTWMS SG Meeting in Feb 2024
 - ✓ INCOIS hosted ICG/IOTWMS Steering Group at INCOIS, Hyderabad.



- PCTWIN project involving IOTWMS delegates:
 - ✓ INCOIS hosted UKRI-MoES funded project "People-Centered Tsunami Early Warning for the Indian Coastlines (PCTWIN)" from April 8–11, 2025, in Kochi, Kerala
 - ✓ Involved IOTWMS delegates to linkage PCTWIN work packages with IOTWMS Working Groups



- Supported the SOP training workshops organized by IOTWMS:
 - ✓ INCOIS has hosted Tsunami Evacuation Plans, Maps, and Procedures (TEMPP), and UNESCO-IOC Tsunami Ready Recognition Programme (TRRP) training workshop in coordination UNESCO-IOC during 15-23 April 2025
 - ✓ 54 delegates were attending the training workshop from the Indian Ocean Countries



Meeting of ICG/IOTWMS Working Group 2 on 25th August 2025 (online)

Future Plans

- Sustain all observational network of Seismic, GNSS, Tsunami Buoys and Tide gauges
- Establishment of 14 new Tide gauges
- To establish cable based multi-parameter (OBS, BPR, etc.) observatory near to subduction zone off Andaman & Nicobar Islands – Initiated.
- Work on Operational procedures for atypical (non-seismic) tsunami sources - SOP for TGV is drafted and work is under progress.
- Implementation of TRRP in vulnerable areas of all Coastal States/UTs - Extending to other coastal states.
- Continue to contribute strongly to IOTWMS activities in the next intersessional period, including:
 - The planning, conduct and reporting of biennial IOWave exercises
 - The planning, conduct and reporting of 6-monthly Communication Tests
 - Regular NTWC/DMO/Media SOP Training Workshops
 - ICG/IOTWMS Working Groups and Task Teams
- Capacity Building: Training course for Oman operators in early warning systems of Tsunami (Nv 24-28, 2025)
- Hosting of SOP Workshop in September / October 2026



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THANK YOU