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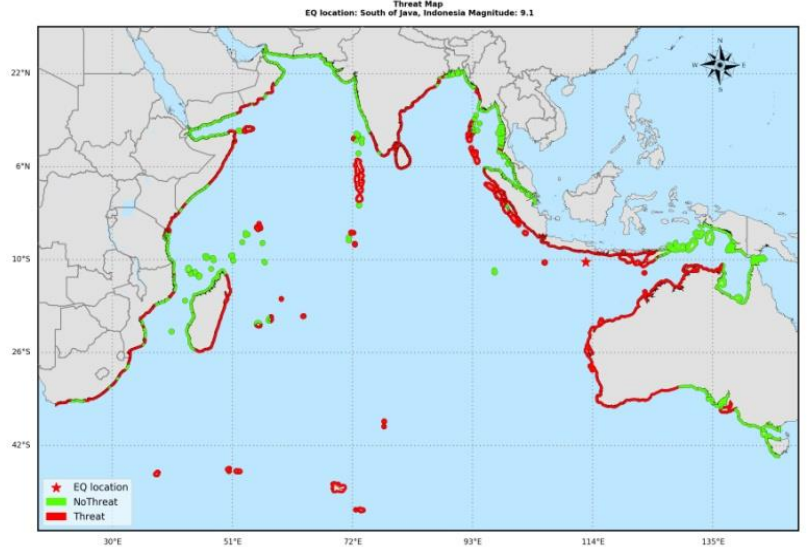
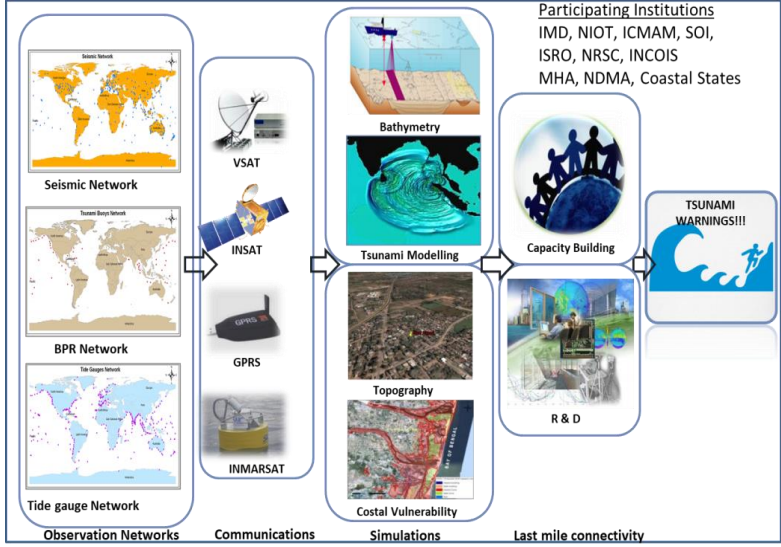
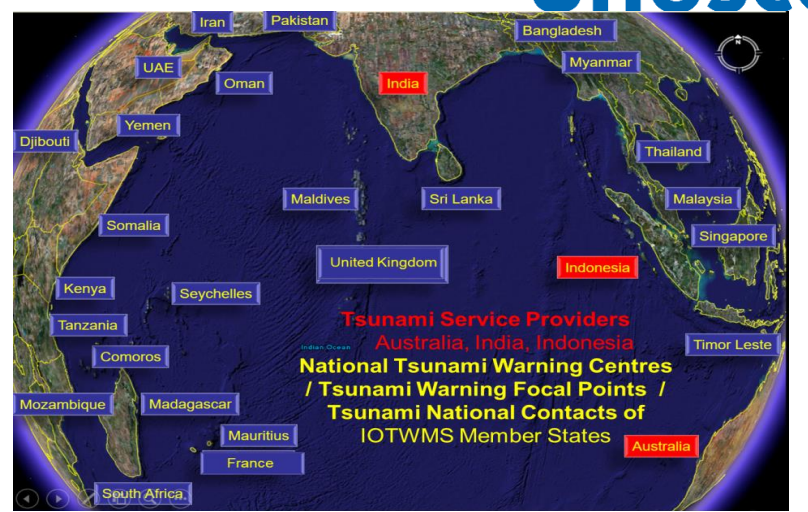
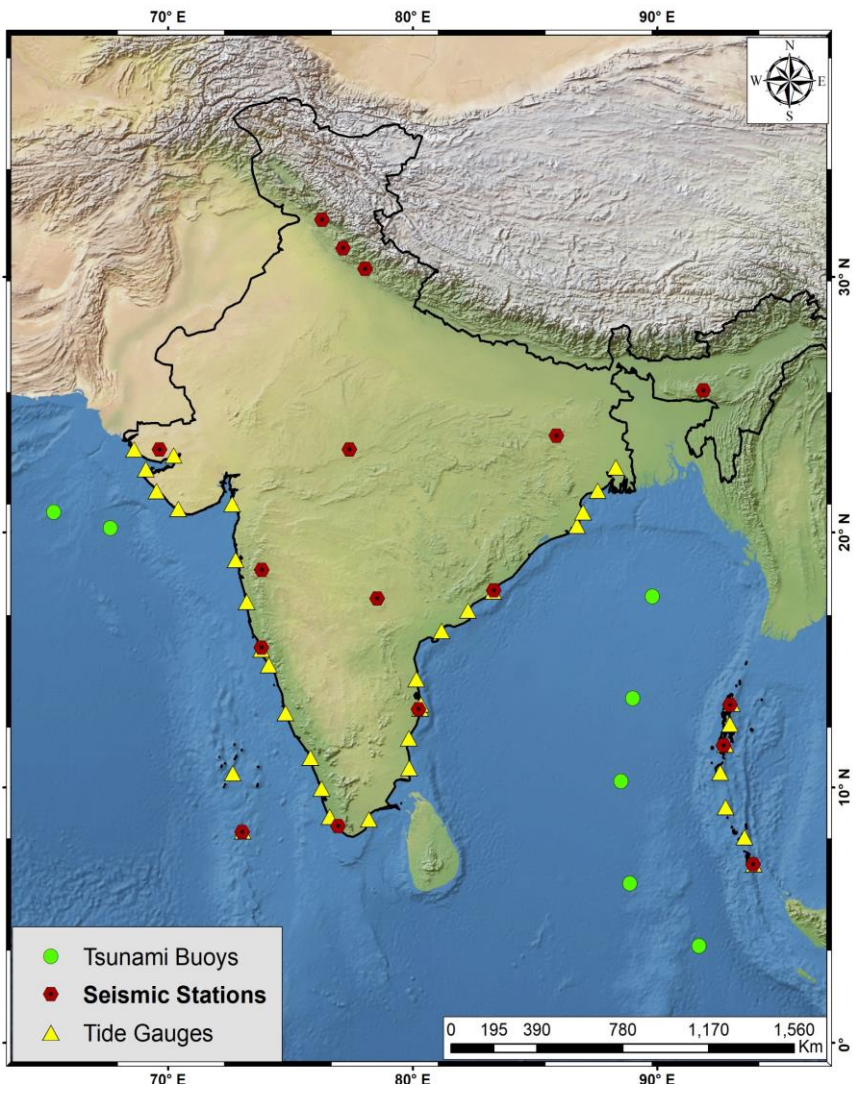
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## 2.4 TSP India Status Report

**J Padmanabham**  
**TSP-India**

*Meeting of Working Group 2 (WG-2) on  
Tsunami Detection, Warning and Dissemination ICG/IOTWMS  
07 August 2024*

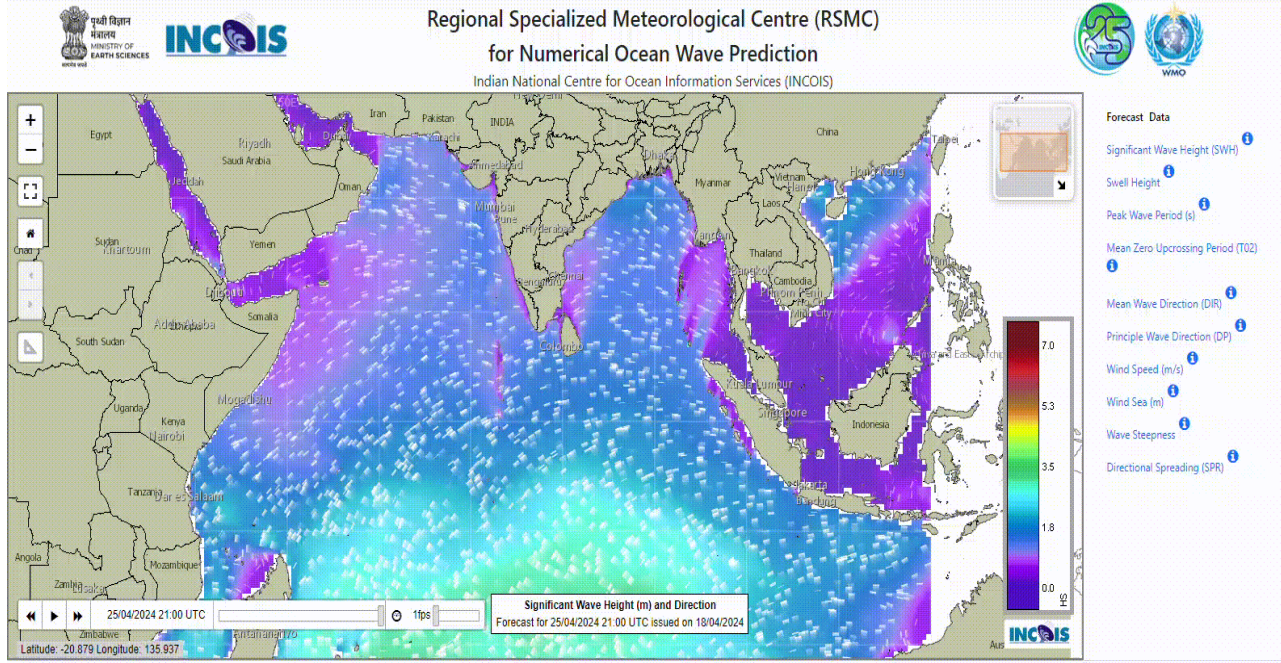
# Detection, Observations, Monitoring and Forecasting



National Observation Network of Seismometer (17), Accelerometer (32), GNSS (32), Tide Gauge (36), Bottom Pressure Recorders (17)

24X7 monitoring centre

# Detection, Observations, Monitoring and Forecasting



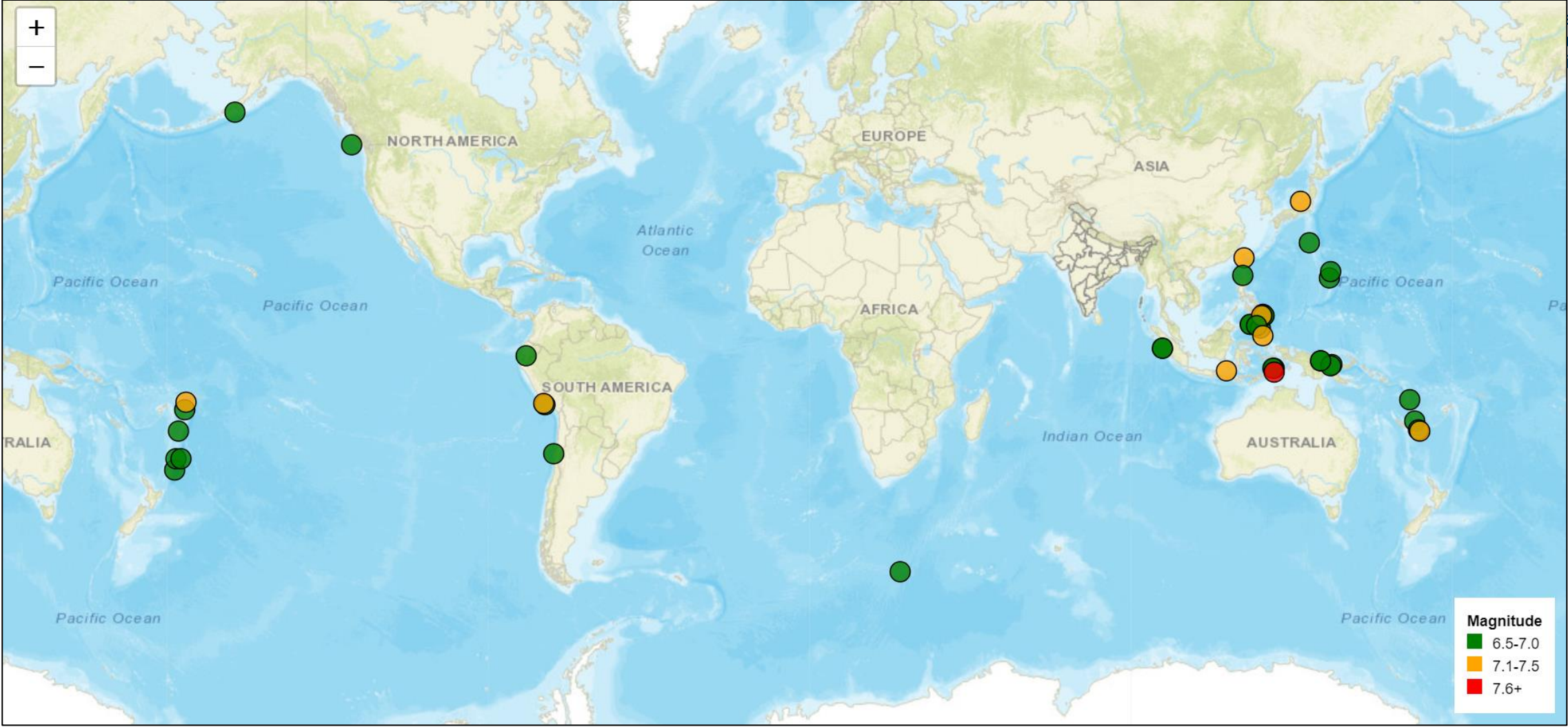
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- Honorable Minister of Earth Sciences inaugurated the state-of-the-art Synergistic Ocean Observations Prediction and Services Lab (SynOPS) on 14 February 2024
- Secretary, MoES inaugurated the WMO RSMC Service for the Indian Ocean on 23 August 2023
  - Global Numerical Ocean Prediction
  - Numerical Ocean Wave Prediction
  - Marine Emergency Response (underway)

# Events Monitoring and Issuance within the ESZ of ICG/IOTWMS



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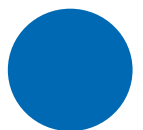
Environmental  
Graphic  
Information

# Maritime products for NAVAREAs

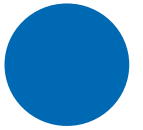


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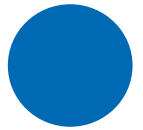
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As a TSP, India is now generating the NAVAREA messages as per the service definition document version 5.0 and is ready for trial.



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.



TSP INDIA TSUNAMI BULLETIN NUMBER 3 FOR  
NAVAREA VII, VIII, X, XI  
EAST INDIAN OCEAN, NORTH INDIAN OCEAN, SOUTHWEST INDIAN OCEAN, WEST INDIAN OCEAN  
TSUNAMI CONFIRMED THREAT MESSAGE ISSUED BY TSUNAMI SERVICE PROVIDER INDIA IN SUPPORT OF THE UNESCO/IOC INDIAN OCEAN TSUNAMI WARNING AND MITIGATION SYSTEM AT 0629 UTC WEDNESDAY 12 JUNE 2024.  
A TSUNAMI HAS BEEN GENERATED BY A MAGNITUDE 9.0 EARTHQUAKE THAT OCCURRED NEAR SUNDA STRAIT, INDONESIA [-6.94S, 104.70E] AT 0600 UTC 12 JUN 2024.  
HAZARDOUS TSUNAMI WAVES ARE FORECAST FOR SOME COASTS OF AUSTRALIA, BANGLADESH, DJIBOUTI, FRANCE (INDIAN OCEAN TERRITORIES), INDIA, INDONESIA, KENYA, MADAGASCAR, MALDIVES, MAURITIUS, MOZAMBIQUE, MYANMAR, OMAN, SEYCHELLES, SOMALIA, SOUTH AFRICA, SRI LANKA, TANZANIA, THAILAND, TIMOR-LESTE, UNITED KINGDOM, YEMEN 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.



# Warning Dissemination and Communication

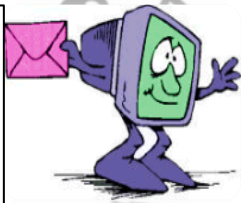


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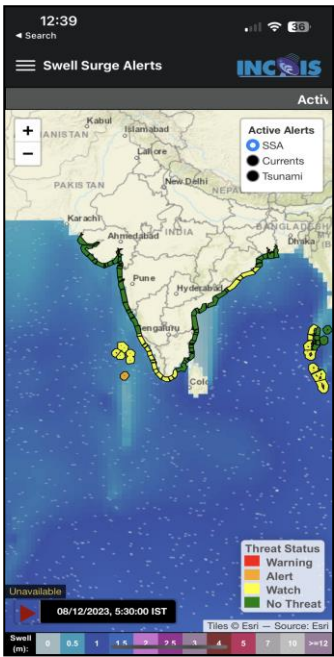
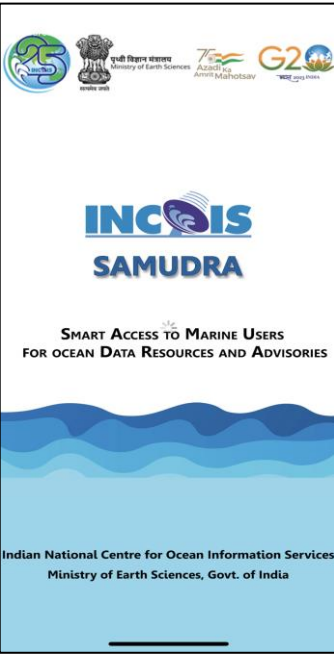
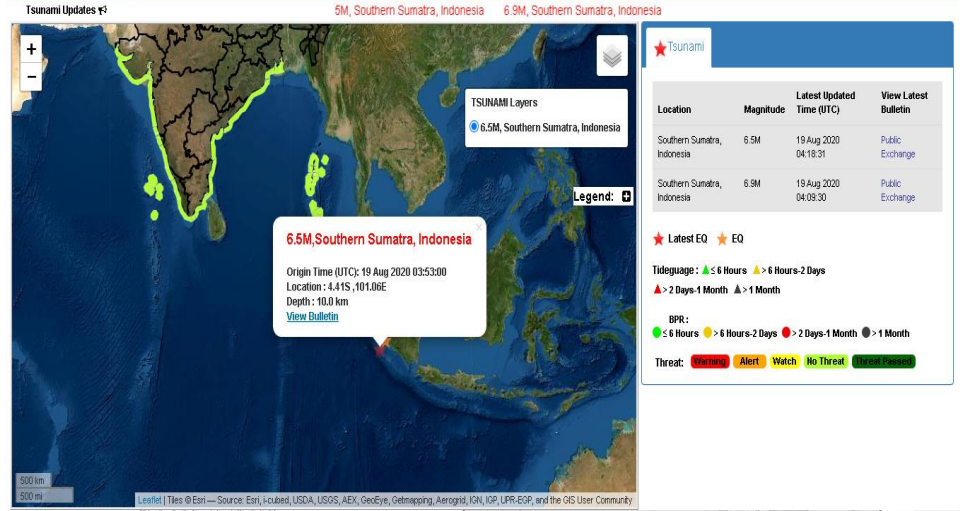
Web



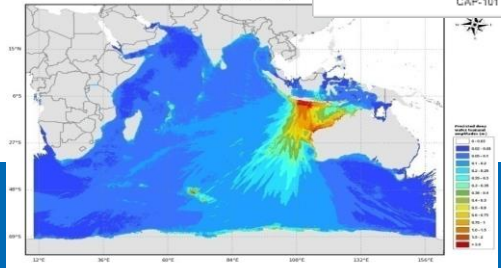
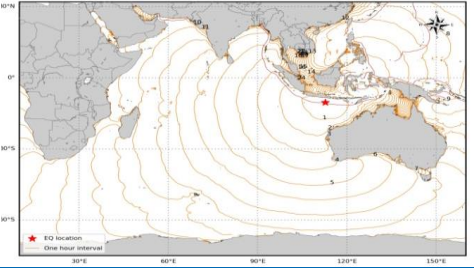
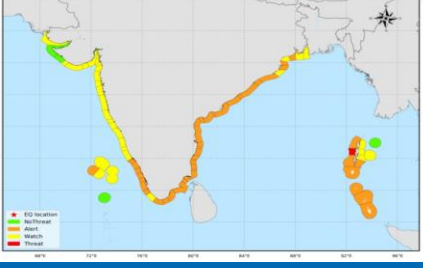
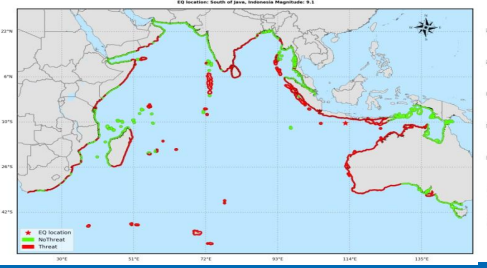
GTS

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

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.



Tsunami Threat Map for Indian Ocean

Tsunami Threat Map for India

Tsunami Travel Time Map

Tsunami Amplitude Map

# TSP KPIs 2023 & 2024 – M6.8+



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	Service Level 1 EQ Bulletins					Service Level 2 Threat / No Threat Bulletins		
Year	KPI 1  ET First EQ Bull  Target: 10 mins (% met)	KPI 2  POD EQs GE M6.8  Target: 100%	KPI 3  EQ Mag  Target: 0.3 (% met)	KPI 4  EQ Depth  Target: 30 km (% met)	KPI 5  EQ Location  Target: 30 km (% met)	KPI 6  ET First Threat Bull  Target: 20 mins (% met)	KPI 7  POD Tsunami Waves  Target: 100%	KPI 8  Tsunami Height Accuracy  Target: Factor of 2
2023	12.0 (47%)	* (83%)	0.25 (74%)	23.9 km (75%)	18.9 (80%)	22.0 (100%)	n/a	n/a
2024	10.5 (50%)	* (86%)	0.1 (100%)	55 km # (83%)	17.9 km (83%)	n/a	n/a	n/a

## NOTES

\* KPI-2: A couple of events in the Pacific Ocean were detected as 6.4 Magnitude, which led to 83% & 86%

# KPI4 – In one event in the Pacific Ocean, we detected a fixed depth solution that resulted in 83%

Meets Target	Near Target	Misses Target
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# Monitoring Tsunamis Generated by Volcanoes

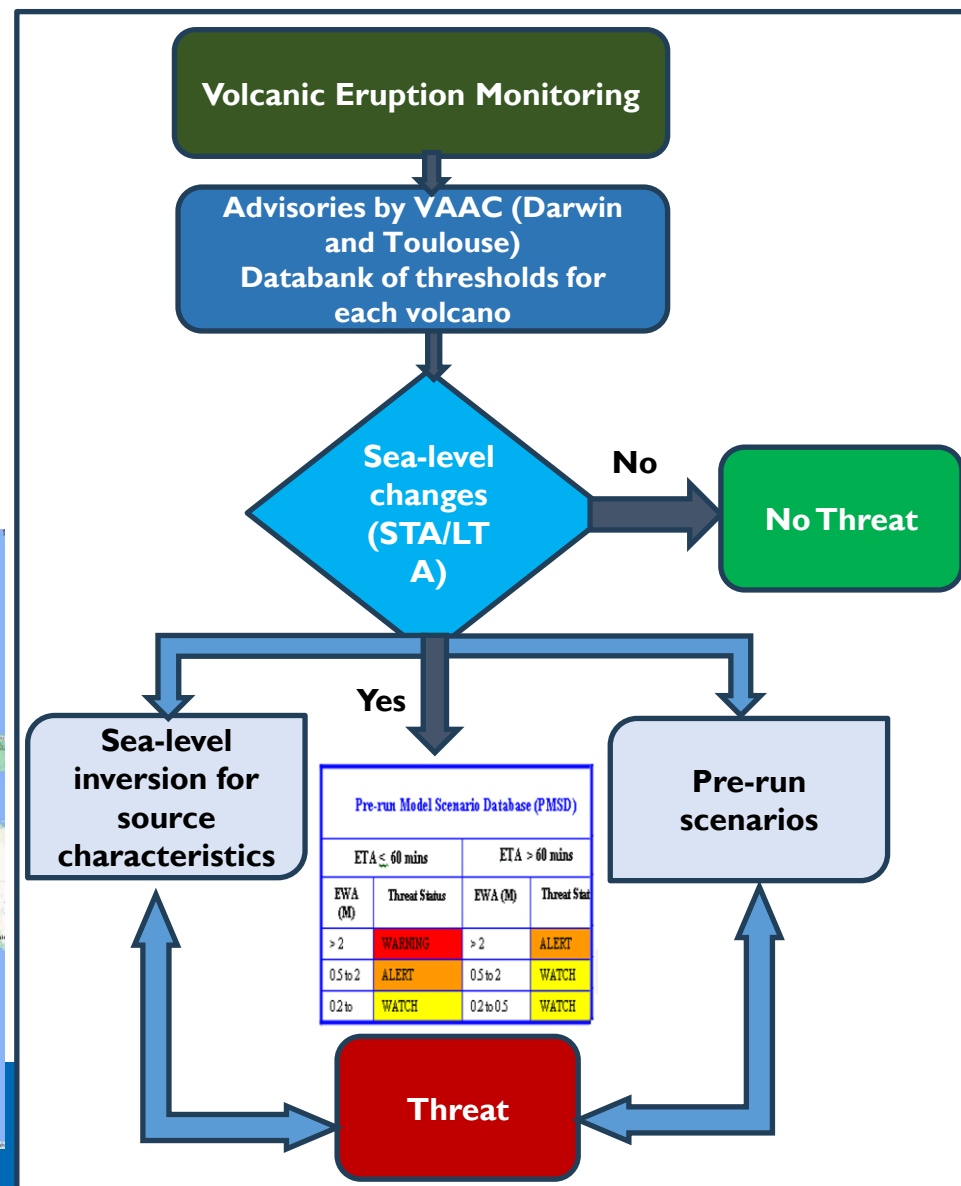
## Monitoring of Volcano

- Volcano Seismicity
- Ground Deformation
- Acoustic Pressure
- Satellite Monitoring

## Volcano Alert levels

Alert Level	Meaning
GREEN/NORMAL	Background
YELLOW/ADVISORY	Above Background
ORANGE/WATCH	Escalation of Parameters
RED/ALERT	Eruption imminent/Ongoing

Volcano Observatory Notice for Aviation (VONL) is used by Volcano Observatory to the Volcanic Ash Advisory Centres (VAAC)

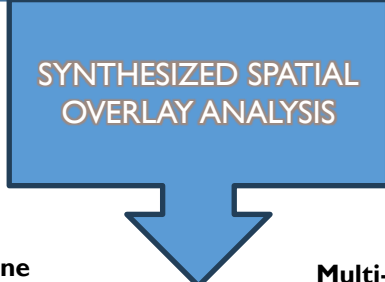
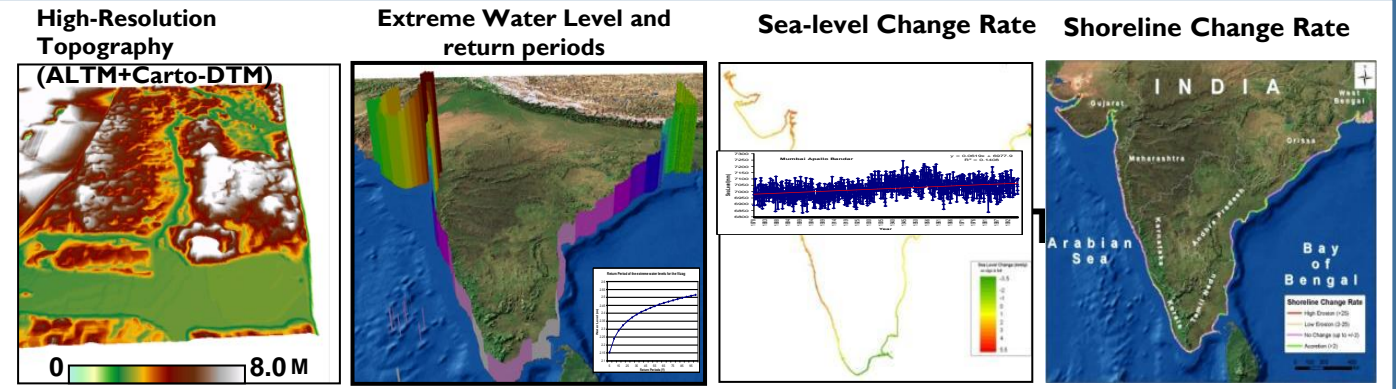




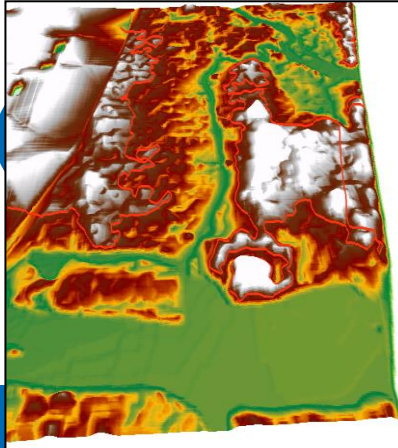
# Coastal Multi-Hazard Vulnerability Assessment



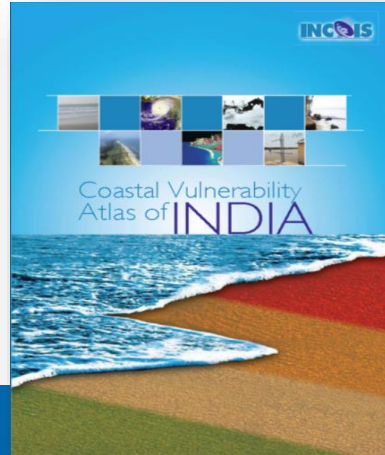
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Composite Multi-hazard Line

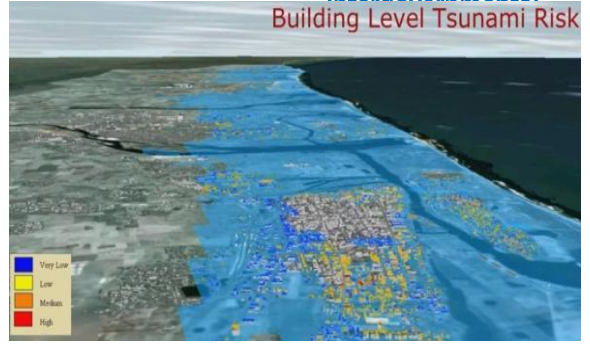


Multi-hazard Vulnerability Maps



## Coastal Inundation – 3D Mapping

- **Coastal Vulnerability Indices Atlas** covering Indian coast comprising 156 maps on 1:0.1 million scale have been prepared
- **The multi-hazard mapping** has been carried out using the parameters sea level change, shoreline change rate, elevation contours, extreme water level from tide gauges and the return periods of extreme events
- **Realistic 3D models** of the buildings along with the attributed details of the owner, address and other socio-demographic details.



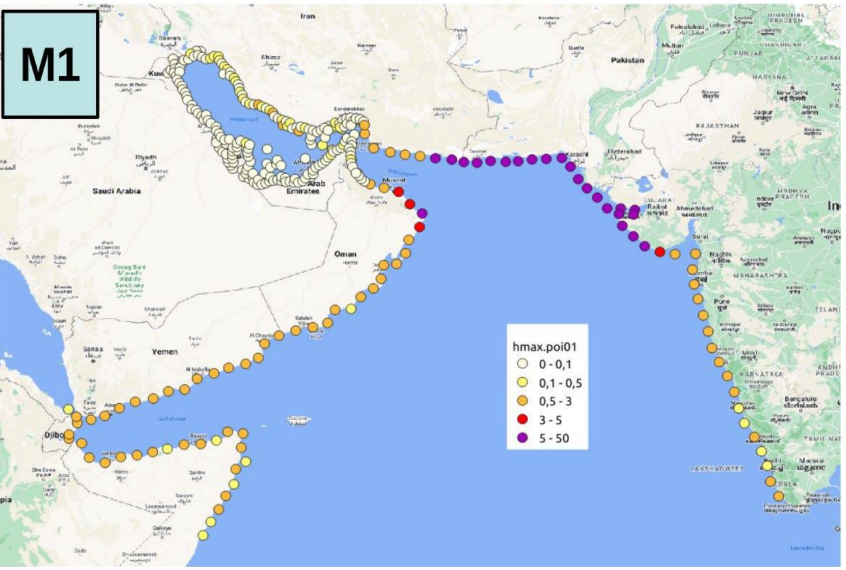
# Disaster Risk Knowledge



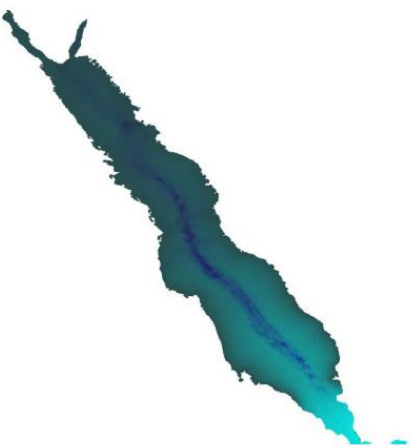
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## Probabilistic Tsunami Hazard Assessment

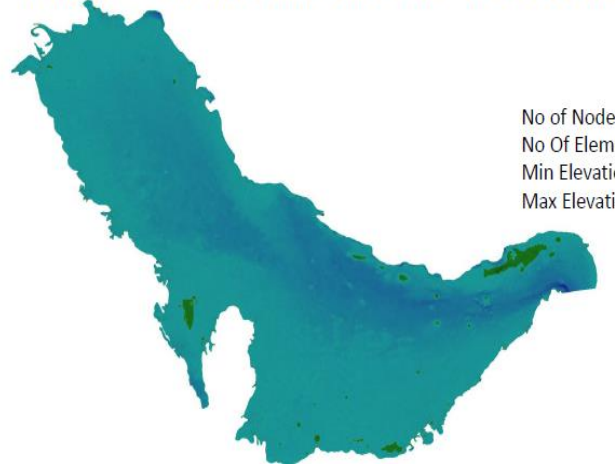


Finite Element Mesh - Red Sea



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

## ➤ **IOWave Exercise 2023:**

- Participated in IOWave23 tsunami exercise on October 4th with an Andaman Trench scenario and on October 11th with a Makran Trench scenario at a national level
- 40,000+ people were evacuated from 42 coastal villages on the east coast

## ➤ **World Tsunami Awareness Day:**

- Hosted an open day, set up a selfie booth,
- Tsunami mock drill in Odisha,
- Science model exhibition, an extempore competition, and drawing/painting competitions for students

## ➤ **Other Workshops:**

- INCOIS conducted five major workshops covering India's East and West coasts under national campaign "Azadi Ka Amrit Mahotsav" in east and west coasts
- A total of 2300 fishermen took part in the mega awareness campaigns across five coastal states



# SOP Workshops & Competency Development of NTWCs



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- On Job Training for NTWC Operators in Indian Ocean Region

✓ INCOIS (TSP-India) conducted "Training course for Oman operators in early warning systems of Tsunami" during 11-22 December 2023. A team of 5 operators were deputed to India to attend this training. It was organized under ITCOOcean Training



- Supported the SOP training workshops organized by IOTWMS:

✓ 03-06 Jul -ICG/IOTWMS : Western IO Member States Training Workshop on SOPs for NTWCs and DMOs (Hybrid)  
✓ 10-13 Jul -ICG/IOTWMS : Eastern IO Member States Training Workshop on SOPs for NTWCs and DMOs(Hybrid)  
✓ 07-08 Aug - ICG/IOTWMS : North-West Indian Ocean SOP Hybrid Training Workshop

# Preparedness and Response Capabilities



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- **Kerala State Disaster Management Authority (KSDMA)**

- Proposed 9 villages from 9 coastal districts
- Orientation workshop for SDMOs and DDMOs completed on May 24, 2024
- Workshops BDMOs and local Gram Panchayat stakeholders is completed 8 villages
- Tsunami Evacuation Plan is under preparation
- By mid of August tsunami mockdrill will be conducted on all 9 villages

- **Gujarat State Disaster Management Authority (GSDMA)**

- Proposed 2 villages
- Meeting with SDMA concluded on July 6, 2024 for planning the TRRP implementation



# UN Ocean Decade Tsunami Programme



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## Decade Collaborative Centre for the Indian Ocean Region

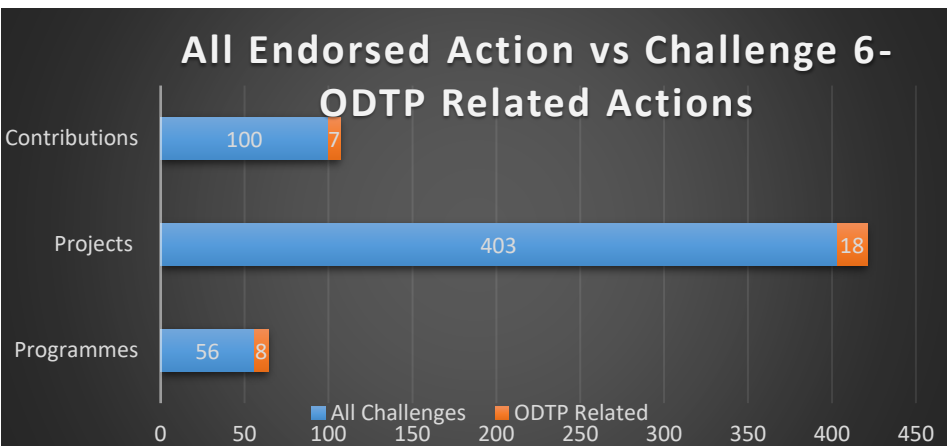
Indian Ocean Regional Ocean Decade Conference (IOCon-24)

## Barcelona Conference



## Ocean Decade Actions

## Coastal cities and communities joining Tsunami Ready



## Coastal Futures: Charting priorities for Coastal Resilience

### Ocean Decade Vision 2030

#### White Papers

**Challenge 6:**  
Increase community resilience to ocean hazards

The United Nations  
Decade of Ocean Science  
for Sustainable Development  
(2021-2030)

**8/56 Programmes; 18/403 Projects;  
7/100 contributions**

**Tsunami Night: 3 Films related to tsunami**

**2630 onsite & 3000+ online participants from 124 countries, 165 satellite events**

**Goal: A safe ocean where life and livelihoods are protected from ocean-related hazards**

- Design people-centred multi-hazard early warning systems
- Design adaptation strategies to increase coastal resilience

Source: <https://oceanexpert.org/document/29188>



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**THANK YOU**