unesco

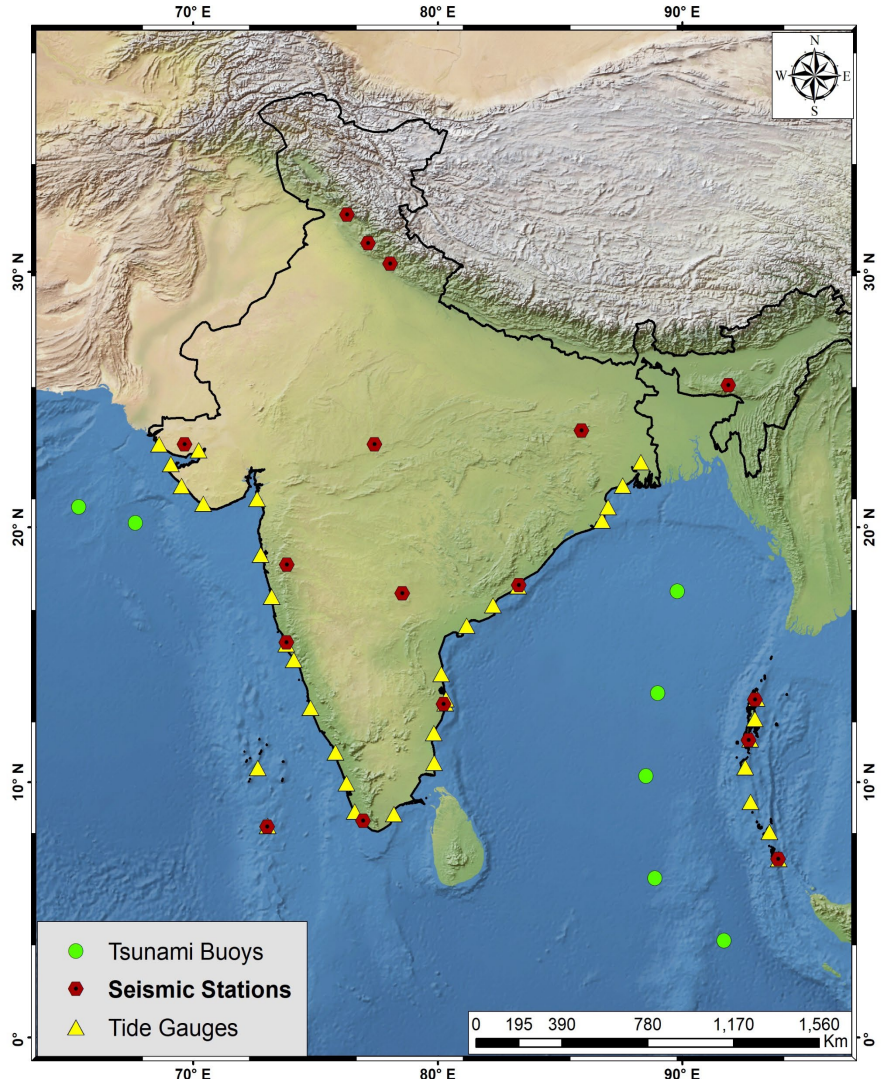
Intergovernmental
Oceanographic
Commission

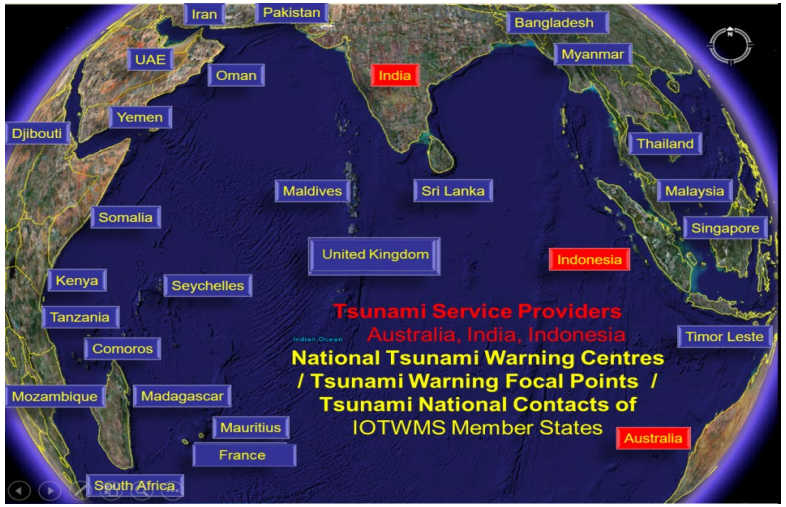
TSP India Status Report

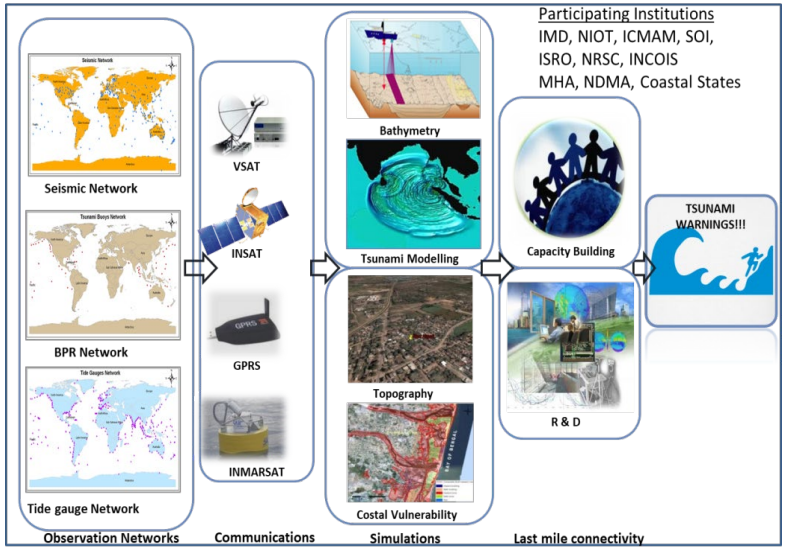
Nagaraja Kumar M
TSP-INDIA
Division Head- Operational Ocean Services
INCOIS- INDIA
raja@incois.gov.in

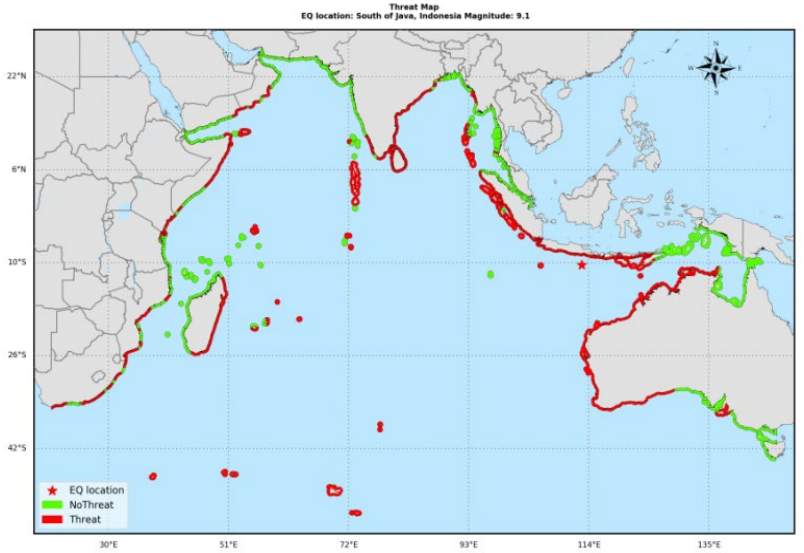
19th Meeting of ICG/IOTWMS Steering Group, Jakarta, 17-19 June 2025

Detection, Observations, Monitoring and Forecasting









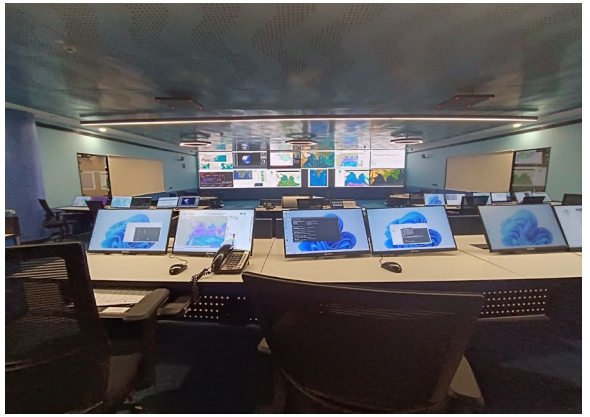
Established col-located GNSS receivers with existing Tide gauges at 15 locations along Indian coast.

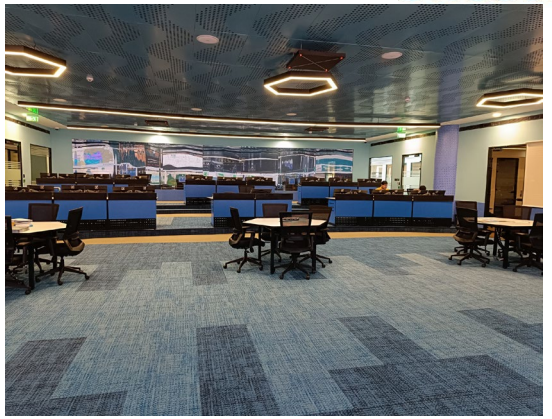
Detection, Observations, Monitoring and Forecasting

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/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.





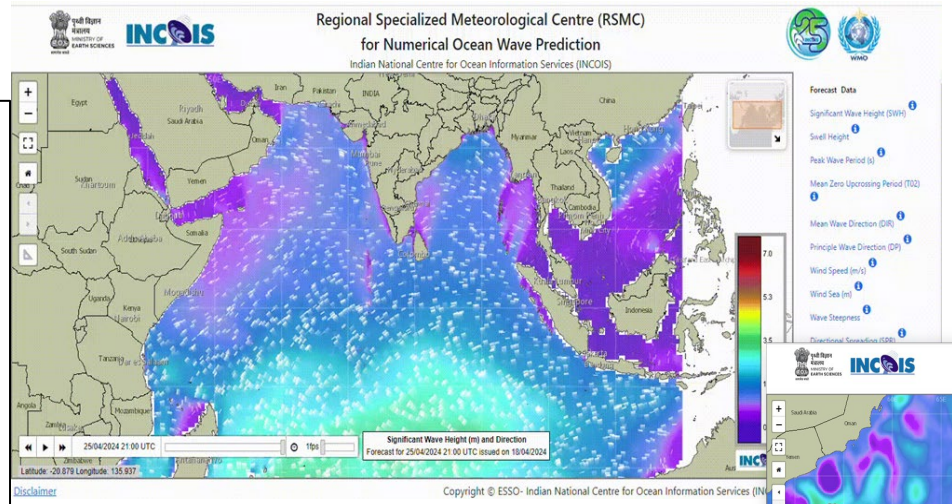
HPC for Numerical Modelling

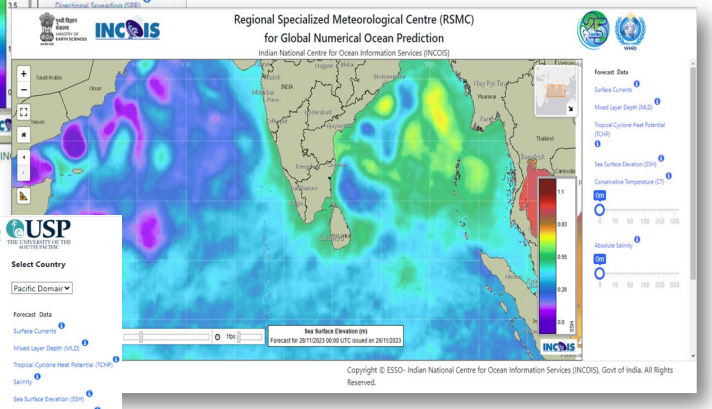
Recently, INCOIS established a High-Performing Computing (HPC) Facility called TARANG.

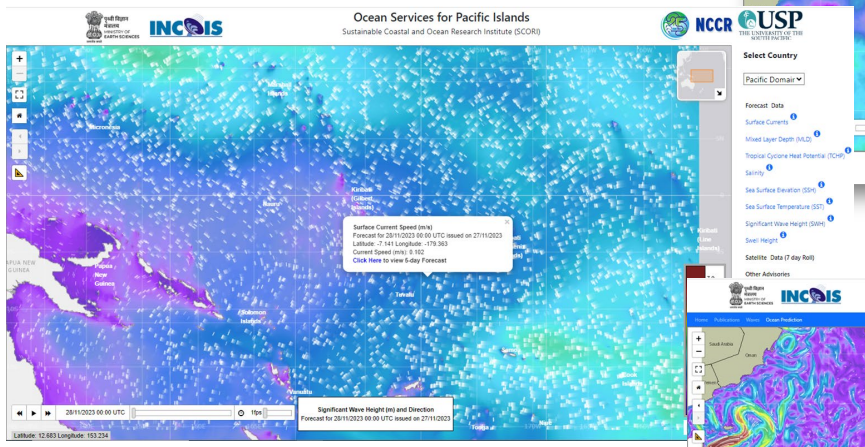
- It has 1 Peta FLOPS of compute power, 2 PB of storage, and 3 PB of archival capacity.
- It also includes an impressive 15.5 Peta FLOPS dedicated to AI and machine learning applications, marking a significant advancement in oceanographic research and data processing

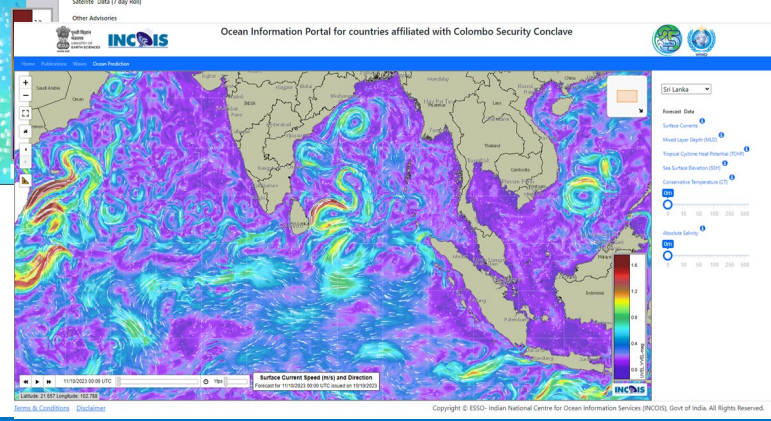
Ocean Services for International Users

- Tsunami Services for Indian Ocean region as part of UNESCO-IOC
- World Meteorological Organisation (WMO) recognised INCOIS as Regional Specialised Meteorological Centre (RSMC) for Ocean Services for Indian Ocean. Providing (I))Global Numerical Ocean Prediction, (ii) Numerical Ocean Wave Prediction
- Ocean Services for 14 Pacific Island Countries (PICs)
- Ocean Services for RIMES member states and South Asia Hydromet Forum (SAHF)
- Ocean Information services under the regional framework of Colombo Security Conclave (CSC)





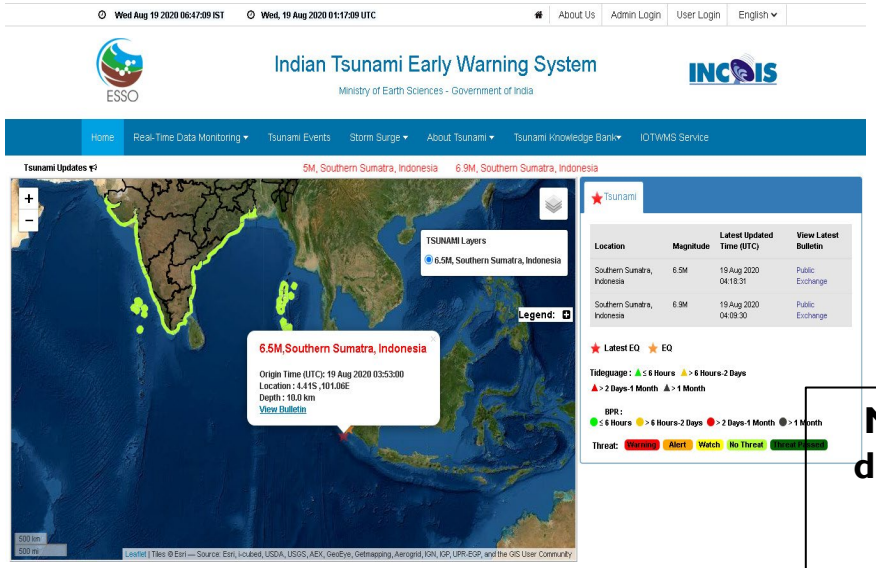




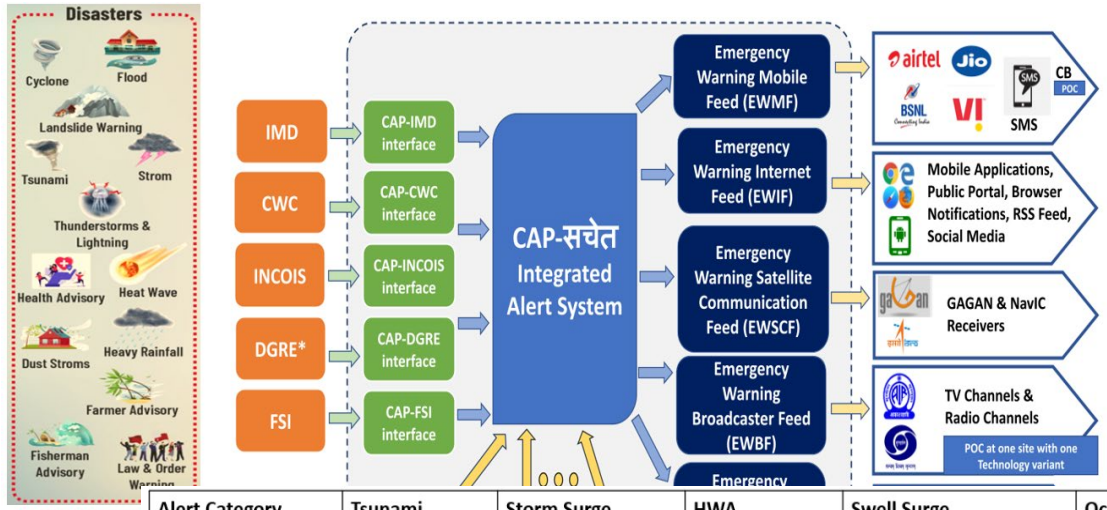
Warning Dissemination and Communication

unesco
Intergovernmental Oceanographic Commission

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

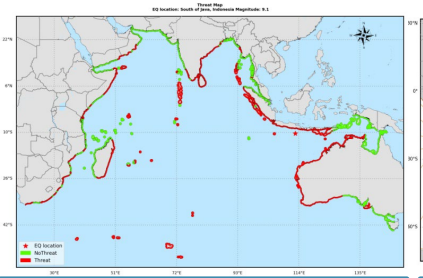


Common Alerting Protocol (CAP) for MHWS – implemented through SACHET platform

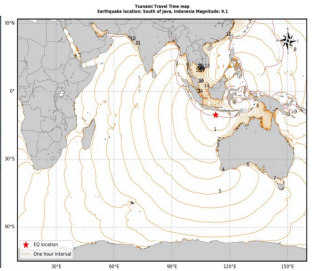


Multi-hazard dissemination and Alerts criteria

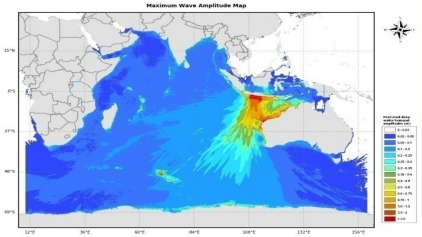
Alert Category	Tsunami	Storm Surge	HWA	Swell Surge	Ocean Currents
Warning	EWA >2.0 m (Take Action) Public advised to move in-land towards higher grounds. Vessels should move into deep ocean.	SSH >2.0 m OR Inundation extent more than 500m (Take Action) The public is advised to avoid low-lying areas. Follow 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 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 pubic 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 ≤ 2.0 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)



Tsunami Threat Map for Indian Ocean

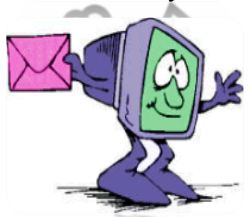


Tsunami Threat Map for India



Tsunami Amplitude Map

Fax



Email

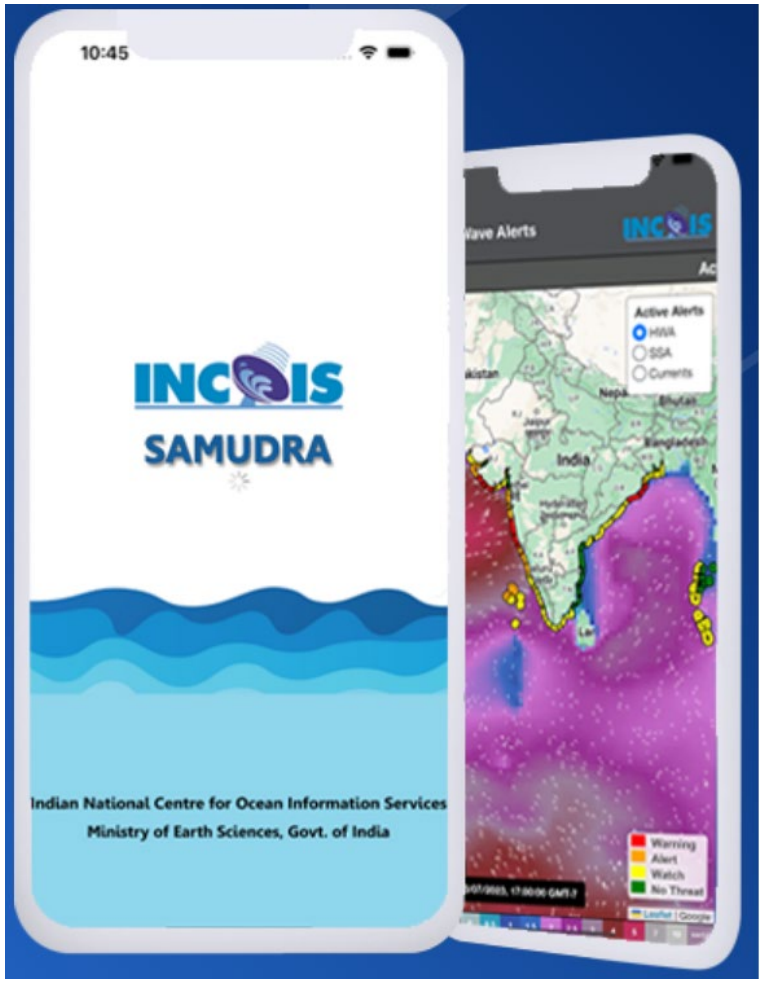
SMS

Web

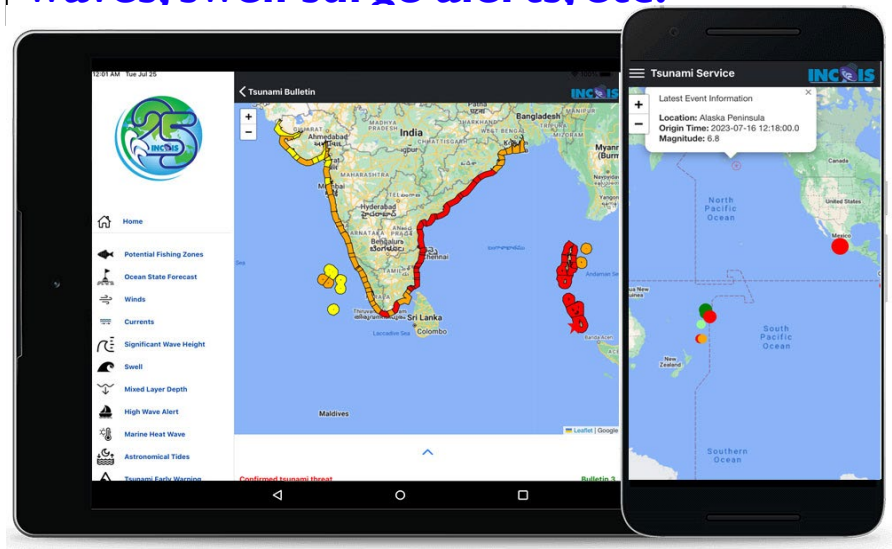
GTS

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

Download on the App Store

GET IT ON Google Play

TSP KPIs 2024 & 2025 – M6.8+

	Service Level 1 EQ Bulletins					Service Level 2 Threat / No Threat Bulletins			General
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	KPI 9 False/ incorrect Bulletins Issued Target: 0
2024	10.3	85%	0.13	42.4	18.6	n/a	n/a	n/a	0
2025	10.7	85%	0.1	8.25	11.7	n/a	n/a	n/a	0

NOTES

* KPI-2: A couple of events outside the Indian Ocean region were detected as 6.4 Magnitude for which TSP-India has not issued the bulletins, which led to 85%

Meets Target	Near Target	Misses Target

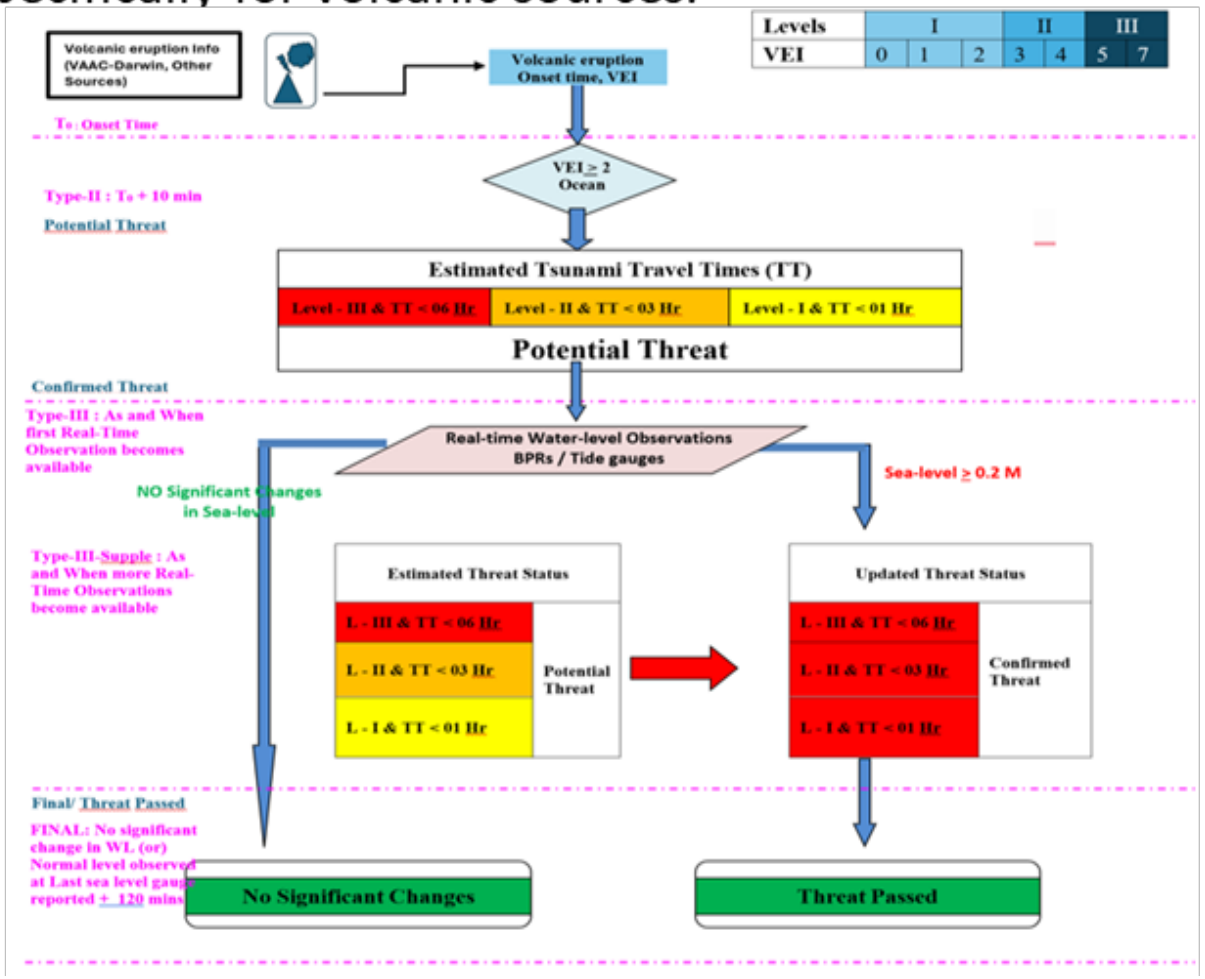
Maritime products for NAVAREAs

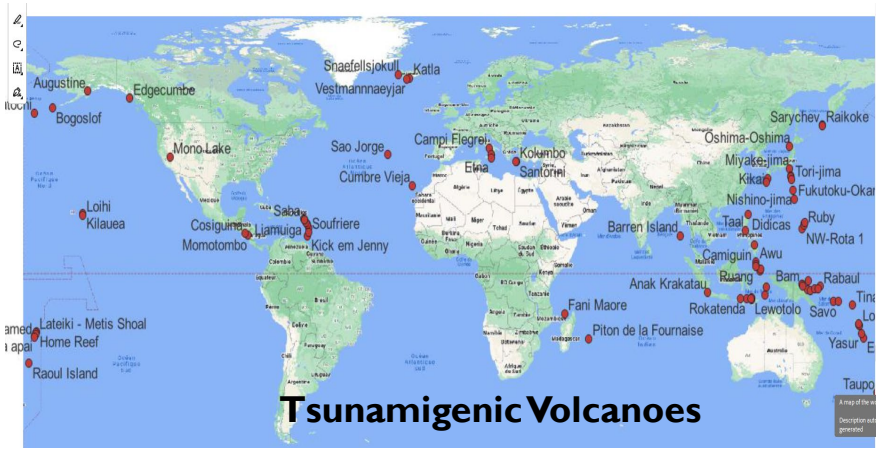
As a TSP, India is now generating the NAVAREA messages as per the service definition document version 5.0.

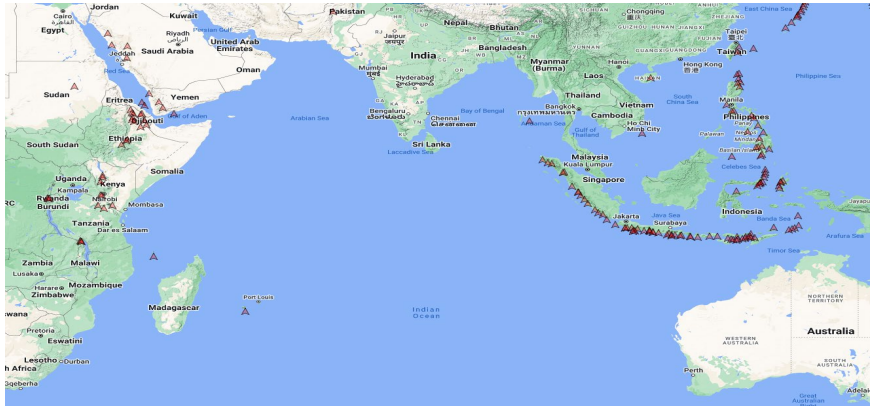
During the COMMS test held on 11th June 2025, TSP-INDIA has tested the dissemination of these alerts to the closed group of emailing list.

Monitoring Tsunamis Generated by Volcanoes

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





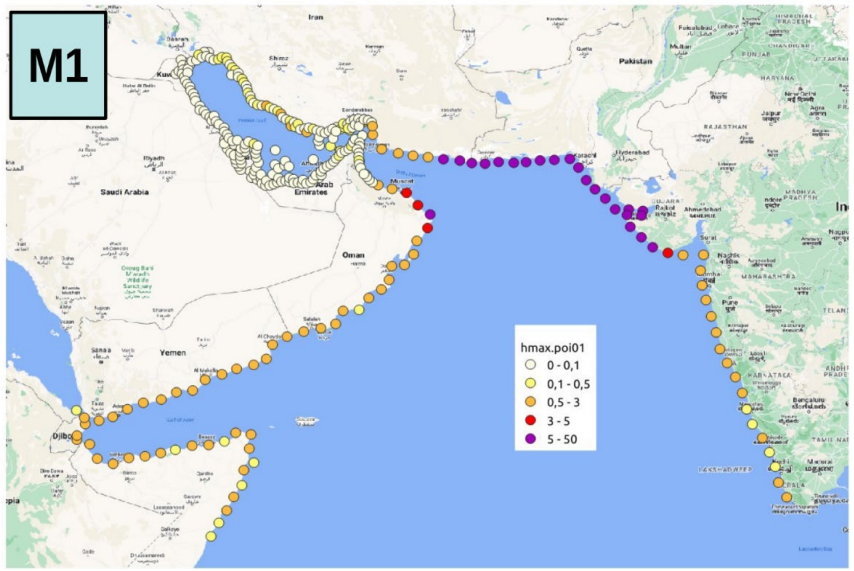


- About 1350 volcanoes are considered active in the past 12,000 years worldwide
- About 50–85 erupting volcanoes each year
- About 70 in the Indian Ocean
- **Tsunamigenic are around 10 in the Indian ocean**

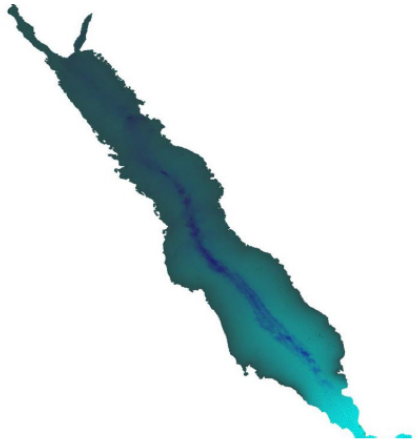
Disaster Risk Knowledge

unesco
Intergovernmental Oceanographic Commission

Probabilistic Tsunami Hazard Assessment

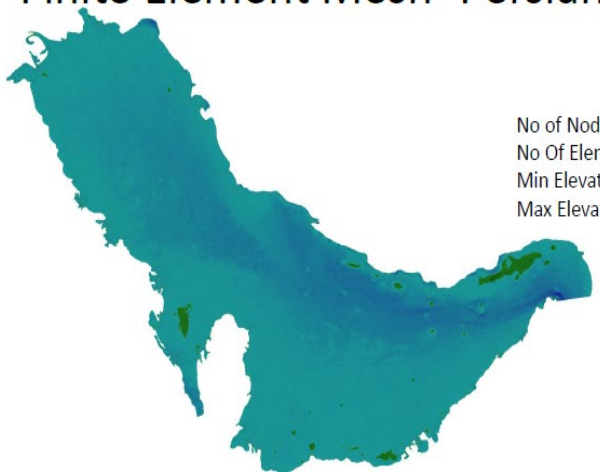


Finite Element Mesh - Red Sea



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

Preparedness and Response Capabilities

- **TRRP implemented in 24 New communities of Odisha and recognized by UNESCO-IOC**
  - After recognition of Venkatraipur and Noliasahi as UNESCO-IOC Tsunami Ready communities in Odisha, OSDMA has implemented TRRP in 24. new villages
  - The National Tsunami Ready Board (NTRB) evaluated indicators and recognised 26 villages (24 new and 2 renewal) of Odisha as Tsunami Ready communities.
  - National recognition certificates presented by Shri. Mohan Charan Majhi, Hon'ble Chief Minister of Odisha on the occasion of Odisha Disaster preparedness day on 29 October 2024
  - UNESCO-IOC recognised all 26 villages as UNESCO-IOC Tsunami Ready Communities and presented certificates on 11 November 2024 as part Global Tsunami at Banda Aceh, Indonesia
- **Implementation of TRRP in other coastal States/UTs**
  - Kerala implementing 9 villages
  - Gujarat 2 villages
  - Tamil Nadu 2 villages
  - Puducherry 2 villages
  - West Bengal 2 villages
  - Andaman & Nicobar 4 villages

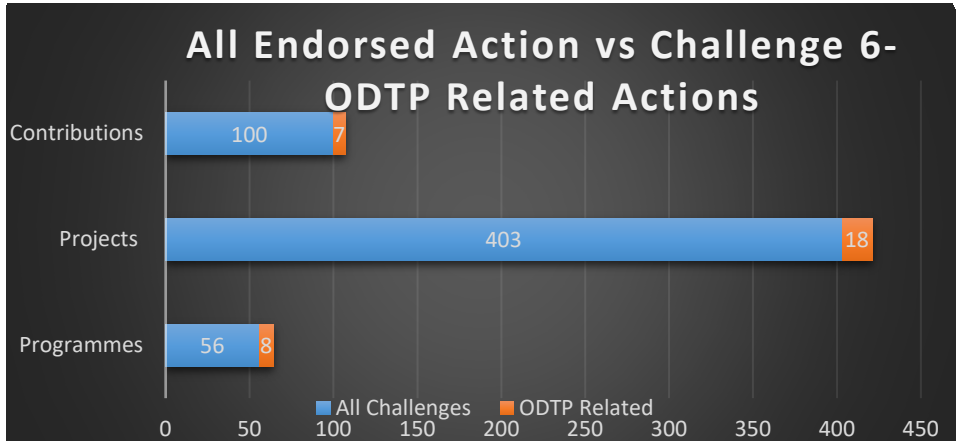
UN Ocean Decade Tsunami Programme

unesco
Intergovernmental Oceanographic Commission

Decade Collaborative Centre for the Indian Ocean Region

Indian Ocean Regional Ocean Decade Conference (IOCon-24)

Ocean Decade Actions



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

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

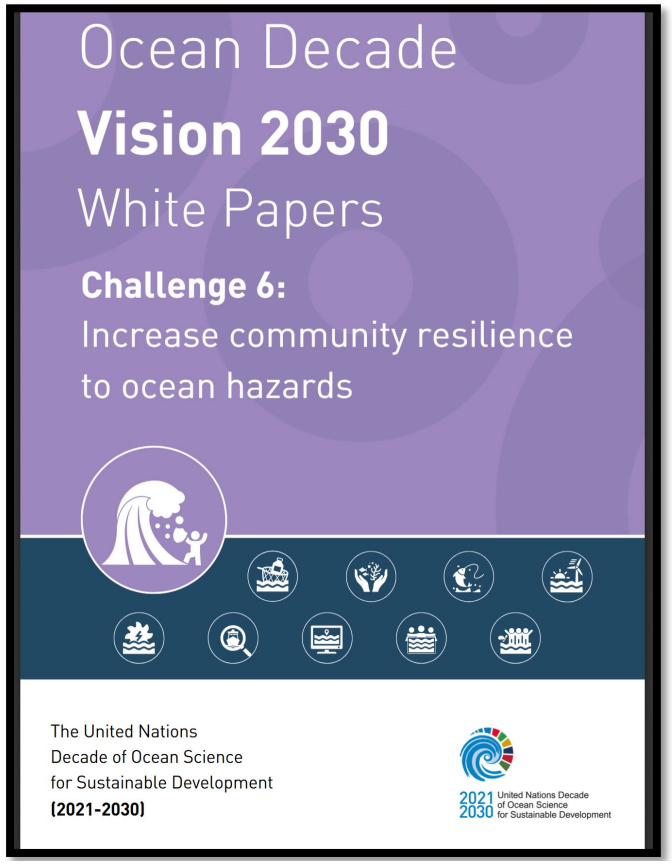
Barcelona Conference

Coastal cities and communities joining Tsunami Ready

Coastal Futures: Charting priorities for Coastal Resilience

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**

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

unesco
Intergovernmental
Oceanographic
Commission

THANK YOU