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INTERGOVERNMENTAL COORDINATION GROUP (ICG)

INDIAN OCEAN TSUNAMI WARNING & MITIGATION SYSTEM (IOTWMS)

Sub-regional Working Group for the North-West Indian Ocean

08 October 2025

Meeting Report

Figure 1. Participants at the ICG/IOTWMS Sub-regional Working Group for the North-West Indian Ocean meeting held online during 08 October 2025.

1. OPENING

The first intersessional meeting of the ICG/IOTWMS Sub-regional Working Group for the Northwest Indian Ocean (WG-NWIO) was held online on 8 October 2025. The meeting brought together representatives from Member States, invited experts, and colleagues from the Intergovernmental Coordination Group for the Indian Ocean Tsunami Warning and Mitigation System (ICG/IOTWMS) Steering Group to discuss regional priorities, ongoing initiatives, and future plans for tsunami warning and mitigation in the Northwest Indian Ocean region.

1.1 INTRODUCTIONS, WELCOME AND OPENING REMARKS

Dr Srinivasa Kumar Tummala, Head of the ICG/IOTWMS Secretariat, welcomed participants and acknowledged the importance of the WG-NWIO in addressing the near-field tsunami threat posed by the Makran Subduction Zone. He noted that the working group was established during the ICG/IOTWMS session in Muscat in 2015 and has since played a vital role in strengthening regional coordination, hazard assessment, and early warning capabilities.

Ms Sunanda Manneela, Chair of WG-NWIO, expressed appreciation to all participants and emphasized the group's unique role as a "mini ICG/IOTWMS," enabling focused collaboration among six countries in the region. She thanked the previous Chairs Dr Juma Al Maskari (Oman) and Prof Mohammad Mokhtari (Iran) for their leadership and contributions to regional coordination and data sharing. Ms Manneela also acknowledged the support of the IOTWMS Secretariat, particularly Dr Tummala and Ms Nora Gale, and welcomed her Vice Chair, Mr Nasser Al Ismaili (Oman), for his continued support in preparing the agenda and background materials.

Ms Manneela highlighted the group's strategic priorities, including enhanced data sharing, implementation of tsunami ready programmes, and leveraging opportunities such as the UNESCAP project and IOWave25 exercise. She invited participants to introduce themselves, after which representatives from India, Iran, Oman, UAE, and other invited experts provided brief introductions.

Participants were invited to provide brief introductions. The WG-NWIO intersessional meeting attendees included:

Chair

Ms Sunanda Manneela (India)

Vice-Chairs

Mr Nasser Al Ismaili (Oman)

Members

Dr Ajay Kumar Bandela (India)
Mr Padmanabham Jijjavarapu (India)
Dr Sudheer Joseph (India)
Mr M Nagaraja Kumar (India)
Dr Ch Patanjali Kumar (India)
Dr Majid Noranian Esfahani (Iran)
Dr Samad Hamzehei (Iran)
Dr Emad Koochaknejad (Iran)
Dr Amirmahdi Zarboo (Iran)
Mr Zaidi Zainal Abidin (Malaysia)
Mr Abdullah Albusafi (Oman)
Mr Hilal Salim Al Hajari (Oman)
Mr Badar Al Ameri (UAE)
Mr Khalifa Al Ebri (UAE)
Ms Shamma Alneyadi (UAE)
Mr Abdulla AlYammahi (UAE)
Ms Hessa Al Blooshi (UAE)

Invited Experts

Ms Suci Dewi Anugrah (Indonesia, WG3 Chair)
Temily Baker (UNESCAP)
Mr Chathura Liyanaarachchige (Sri Lanka)
Dr Yuelong Miao, ICG/IOTWMS Vice-Chair (Australia)
Dr Mohammad Moktari (Iran, Former Chair WG-NWIO)

Observers

Michel Katrib (UNESCAP)

UNESCO-IOC

Dr Srinivasa Kumar Tummala (ICG/IOTWMS Secretariat)
Mr Ardito Kodijat (IOTIC)
Ms Nora Gale (ICG/IOTWMS Secretariat)

Dr Yuelong Miao, Vice-Chair of the ICG/IOTWMS, welcomed participants and expressed his appreciation for the continued momentum of the WG-NWIO. He noted that the working group has matured significantly since its establishment and is now entering a more advanced phase of collaboration. Dr Miao emphasized the importance of regional cooperation in addressing the unique challenges posed by the Makran Subduction Zone, including near-field tsunami threats and data sharing across borders. He highlighted the value of harmonizing standards and practices across Member States to ensure consistent and high-quality tsunami services, especially for tourists and coastal populations. Dr Miao commended the group's efforts in risk assessment, detection and warning, and community preparedness, and encouraged participants to prioritize tasks and share best practices. He concluded by expressing confidence in the group's ability to set a strong example for other regions and contribute meaningfully to the broader goals of the ICG/IOTWMS and the Ocean Decade Tsunami Programme.

Mr Nasser Al Ismaili, Vice Chair of WG-NWIO, welcomed all participants and thanked Ms Sunanda Manneela for her leadership and coordination. He reflected on the achievements of the WG-NWIO under previous leadership and emphasized the importance of building on those foundations through enhanced collaboration. Mr Al Ismaili noted that the group had already made significant progress in areas such as data sharing, capacity building, and tsunami risk assessment. He expressed optimism that the current session and future activities would further strengthen regional cooperation, particularly through initiatives like the UNESCAP project and the implementation of tsunami ready programmes. He concluded by reaffirming Oman's commitment to the working group and its objectives.

1.2 ADOPTION OF AGENDA AND MEETING LOGISTICS

Ms Nora Gale of the ICG/IOTWMS Secretariat presented the provisional agenda for adoption. She noted that the agenda had been circulated in advance and included key items such as activity updates, Member State reports, ongoing and new initiatives, and the WG-NWIO workplan. No modifications were proposed, and the agenda was adopted without objection. However, the Makran PTHA agenda item was late excluded as the speaker was not available. The final agenda is available in Annex 1.

Ms Gale also provided an overview of meeting logistics, including the availability of an official event page on OceanExpert (https://oceanexpert.org/event/4845), the recording of the session for reporting purposes, and guidance for presenters and participants.

2. ACTIVITY UPDATES

2.1 CHAIR REPORT

Ms Sunanda Manneela, Chair of the Sub-regional Working Group for the Northwest Indian Ocean (WG-NWIO), presented the Chair Report with support from Vice-Chair Mr Nasser Al Ismaili. She began by reaffirming the group's mandate and strategic importance within the broader framework of the ICG/IOTWMS. The WG-NWIO was established to address the unique tsunami risks faced by countries bordering the Makran Subduction Zone and to strengthen regional coordination and preparedness.

The Terms of Reference (TOR) for the WG-NWIO, as endorsed by the ICG/IOTWMS, include the following:

1. Evaluate capabilities and ascertain capacity building requirements of Member States in the region for providing end-to-end tsunami warning and mitigation services within a multi-hazard framework.
2. Facilitate cooperation in the establishment and upgrading of seismic, sea level, and GNSS stations and networks, as well as communication systems in the region.
3. Promote capacity building and the sharing of tsunami-related data and information among Member States.
4. Establish and maintain procedures for National Tsunami Warning Centres (NTWCs) across the region to exchange information on warnings, observations, and impacts during events.

5. Support the implementation of the UNESCO-IOC Tsunami Ready Recognition Programme in the region, in coordination with Working Group 3.

Ms Manneela reviewed recent activities undertaken by the working group, including a virtual meeting held on 22 July 2024 and the regional TEMPP (Tsunami Evacuation Maps, Plans and Procedures) training workshop hosted in Muscat from 21–25 April 2024. These activities supported the development of evacuation maps and community-level preparedness strategies in pilot areas.

She provided an overview of the observational networks currently in place across the region. India, Iran, Oman, Pakistan, and the United Arab Emirates collectively operate dozens of seismic stations, tide gauges, and tsunami buoys. However, data sharing remains uneven, and the Chair emphasized the need to strengthen regional cooperation and ensure timely access to real-time data, particularly for near-field tsunami threats.

The Chair also highlighted progress under the UNESCAP-funded regional project, which is being implemented in three phases:

- Phase 1 focused on hazard and risk assessment and the development of national tsunami warning chains.
- Phase 2 supported inundation and evacuation mapping capacity development.
- Phase 3, now underway, aims to enhance preparedness in at-risk coastal communities.

Ms Manneela noted that several Member States have developed structured warning chains and standard operating procedures (SOPs) that link Tsunami Service Providers (TSPs) to NTWCs, national disaster management authorities (NDMOs), local disaster management offices (LDMOs), and the public. These chains include defined timelines for issuing warnings in near-field scenarios, which are critical for the Makran region.

She reported on the completion of Version 1.0 of the Probabilistic Tsunami Hazard Assessment (PTHA) for the Northwest Indian Ocean and shared that Version 2.0 is under development. The updated version will include hazard curves and refined source models, particularly for the West Coast of India.

Pilot areas for Tsunami Ready implementation have been identified in all participating countries. These include:

- India: Gujarat and Kerala
- Iran: Chabahar and Jask
- Oman: Muscat, Barka, and Sib
- Pakistan: Gwadar and Karachi
- UAE: Dibba, Kalba, and Khor Fakkan

Inundation maps for these pilot areas have been developed and will be tested through community evacuation drills. The Chair emphasized that these efforts are aligned with the goals of the UNESCO-IOC Tsunami Ready Recognition Programme and the Ocean Decade Tsunami Programme.

Ms Manneela also presented findings from the 2024 Capacity Assessment Report, which evaluated Member States across 14 indicators. While most countries demonstrated strong capabilities in hazard assessment, policy frameworks, and awareness, gaps were noted in tsunami emergency response, evacuation infrastructure, and community-level capacity in some areas.

Finally, the Chair reviewed action items from the 14th ICG/IOTWMS session and presented a draft workplan for the intersessional period. Key priorities include strengthening data sharing and observational networks, supporting capacity building and on-the-job training, advancing tsunami ready implementation, developing SOPs for non-seismic tsunami sources, and exploring paleo-tsunami studies and emerging technologies. She encouraged Member States to collaborate closely and take advantage of regional training opportunities and technical support provided through the Secretariat and IOTIC.

2.2 SECRETARIAT REPORT

Ms Nora Gale of the ICG/IOTWMS Secretariat presented the Secretariat Report, providing an overview of the governance structure, operational pillars, and recent activities of the Indian Ocean Tsunami Warning and Mitigation System (IOTWMS). She began by acknowledging the significant progress made since the 2004 Indian Ocean tsunami, which led to the establishment of four regional systems coordinated by UNESCO-IOC: the Pacific (PTWS), Indian Ocean (IOTWMS), Caribbean (CARIBE-EWS), and North-Eastern Atlantic, Mediterranean and Connected Seas (NEAMTWS). These systems operate as an interoperable "system-of-systems," with Member States receiving forecast information from designated Tsunami Service Providers (TSPs) and maintaining sovereign responsibility for issuing warnings to their citizens.

Ms Gale outlined the three foundational pillars of the IOTWMS:

1. Risk Assessment and Reduction – This includes the systematic collection of data, hazard modelling, and the publication of probabilistic tsunami hazard maps. She highlighted recent advances in seismic modelling and the development of regional hazard assessments, including those focused on the Makran Subduction Zone.
2. Detection, Warning and Dissemination – The IOTWMS is supported by three TSPs (Australia, India, and Indonesia), a network of National Tsunami Warning Centres (NTWCs), and expanded seismic and sea-level monitoring systems. Ms Gale emphasized the importance of harmonized threat information, robust SOPs, and ongoing work to address non-seismic tsunami sources such as volcanic eruptions and landslides. She noted that webinars on volcanic tsunami monitoring were held in April 2025 and that TSP Australia has begun issuing products for such events.
3. Awareness and Response – Ms Gale stressed that effective warnings must be matched by public awareness and response capabilities. She highlighted the role of the Indian Ocean Tsunami Information Centre (IOTIC), the Tsunami Ready Recognition Programme (TRRP), and regional capacity-building efforts such as the TEMPP and SOP trainings. She also noted commemorative events marking the 70th anniversary of the 1945 Makran tsunami and the 20th anniversary of the 2004 Indian Ocean tsunami.

The Secretariat has supported Member States through regional and national workshops, including the TEMPP training held in Hyderabad in April 2025, which brought together 35 participants from 17 countries. Additional national trainings were conducted in Maldives, Seychelles, and Timor Leste. Ms Gale also reviewed the structure of early warning chains and SOPs across the region, noting that Member States have refined their procedures in preparation for Exercise IOWave25.

Regarding IOWave25, Ms Gale reported that the exercise is taking place from 25 September to 5 November 2025 and includes four scenarios: three earthquake-based and one volcanic. She encouraged Member States to ensure participation from Tsunami Ready communities and noted that pre-exercise workshops engaged over 400 participants from 23 countries. She also shared that communication tests are conducted every six months, with email proving the most reliable method of message delivery.

Ms Gale presented findings from the 2024 Capacity Assessment of Tsunami Preparedness, which showed strong progress in governance, hazard assessment, and awareness. However, gaps remain in community-level planning, dissemination systems, and preparedness for non-seismic tsunami sources. She referenced the Banda Aceh Statement from the Global Tsunami Symposium, which calls for 100% Tsunami Ready communities worldwide by 2030.

Finally, Ms Gale summarized key decisions from the 14th ICG/IOTWMS session in Banten and the 19th Steering Group meeting in Jakarta. These included the endorsement of new projects such as the Flanders UNESCO Science Trust Fund initiative for SIDS and Africa, and Phase 3 of the UNESCAP Trust Fund Project for the Northwest Indian Ocean. She concluded by outlining the roadmap for 2025–2026 and reaffirmed the Secretariat's commitment to supporting Member States in building tsunami-resilient communities.

2.3 EXERCISE IOWAVE25

Dr Ajay Kumar Bandela, Chair of the IOWave25 Task Team, presented an overview of the ongoing Indian Ocean-wide tsunami exercise, IOWave25, scheduled from 25 September to 5 November 2025. The exercise is coordinated by the ICG/IOTWMS to evaluate the effectiveness of tsunami warning and response systems across the region. It builds on a legacy of previous exercises held since 2009, with increasing participation and complexity over time. IOWave25 includes four scenarios—three earthquake-generated and one volcanic—designed to test end-to-end tsunami warning and mitigation systems.

The objectives of IOWave25 are comprehensive and span community-level preparedness, national SOP validation, and technical coordination between Tsunami Service Providers (TSPs) and National Tsunami Warning Centres (NTWCs). Specifically, the exercise aims to:

- Validate that tsunami warnings reach all segments of the community, including persons with disabilities, youth, and the elderly.
- Assess community awareness, preparedness, and response.
- Test SOPs for generating and disseminating warnings, issuing public safety messages, and coordinating evacuations.
- Confirm the reception and use of TSP bulletins by NTWCs and NAVAREA stakeholders.
- Evaluate NTWC reporting and understanding of new TSP services for non-seismic and complex tsunami sources.

Four scenarios were developed for IOWave25:

1. Sunda Trench (25 September 2025) – A magnitude 9.0 earthquake in the Sunda Strait, Indonesia.
2. Makran Trench (15 October 2025) – A magnitude 9.0 earthquake off the coast of Pakistan, particularly relevant to WG-NWIO Member States.
3. Fani Maore Volcano (25 October 2025) – A volcanic eruption in the Mozambique Channel.
4. Sumatra Trench (5 November 2025) – A magnitude 9.2 earthquake in Northern Sumatra, coinciding with World Tsunami Awareness Day.

Dr Bandela emphasized the importance of Member State participation, particularly in scenarios relevant to their region. For the Makran Trench scenario, seven countries are participating, including India, Oman, Pakistan, UAE, Madagascar, Mauritius, and Mozambique. Community-level evacuation drills are planned in India, Oman, UAE, and Mauritius.

Pre-exercise workshops were held in August 2025 to support SOP refinement and coordination. These hybrid workshops engaged over 400 participants from 25 Member States and were organized in collaboration with IOTIC and the IOTWMS Secretariat. The workshops focused on SOPs for NTWCs and DMOs and encouraged Member States to align their preparations with the UNESCO-IOC Tsunami Ready indicators.

Dr Bandela also presented the IOWave25 checklist and timeline, which includes key milestones such as national coordination committee formation, SOP updates, media engagement, and post-exercise evaluations. The IOWave25 Exercise Manual has been finalized, and supplements containing TSP bulletins and products are under preparation. All materials are available on the official exercise website: https://oceanexpert.org/event/4786.

In closing, Dr Bandela encouraged Member States to actively participate in the exercise, conduct community evacuations where feasible, and use the opportunity to strengthen national and regional tsunami preparedness.

During the discussion, Mr. Chathura Liyanaarachchige inquired about the availability of funding to support international observers for the IOWave25 exercise. In response, Dr. Tummala clarified that there is no dedicated budget for international observer participation. Instead, Member States are encouraged to engage existing in-country United Nations offices or national institutions to fulfil observer roles.

3. MEMBER STATE REPORTS

India

Dr Chodavarapu Patanjali Kumar from INCOIS presented India's national report, highlighting significant advancements in observational networks and tsunami preparedness. India operates a robust seismic network comprising 17 national broadband stations and 25 additional stations from the National Centre for Seismology (NCS), supplemented by data from approximately 400 international stations. Three seismic stations are shared in real time.

INCOIS has established a GNSS and Strong Motion Network at 35 locations in the Andaman & Nicobar Islands. The tsunami buoy network includes seven buoys—five in the Bay of Bengal and two in the Arabian Sea—with data shared with NOAA-NDBC. Additionally, India maintains 36 tide gauges, with eight contributing to the IOC Sea Level Monitoring Facility. Fifteen GNSS stations have been co-located with tide gauges, and 14 new tide gauge stations are being established.

India is actively participating in Exercise IOWave25, with involvement in both Scenario 2: Makran Trench and Scenario 4: Sumatra Trench. INCOIS will issue 15 bulletins per scenario over a 12-hour period. West coast states and Lakshadweep Islands are engaged in the Makran scenario, while east coast states and the Andaman & Nicobar Islands are involved in the Sumatra scenario.

India continues to lead in implementing the UNESCO-IOC Tsunami Ready Recognition Programme, with 26 new villages in Odisha recognized in 2024. The programme has expanded to 91 communities across 10 coastal states and union territories.

Future plans include enhancing observational networks, establishing a submarine cable-based multi-parameter observatory near the Andaman subduction zone, and developing SOPs for non-seismic tsunami sources such as volcanogenic and landslide-generated events.

Iran

Dr Majid Noranian from the Iranian National Institute for Oceanography and Atmospheric Sciences (INIOAS) presented Iran's report. Iran's tsunami monitoring infrastructure includes HF radar (under development), tide gauges at seven coastal locations, and seismic stations. These systems support real-time modelling and emergency response, with data shared among national agencies including PMO, IRIMO, and the University of Tehran.

Iran is working toward an integrated multi-sensor framework combining radar, tide gauge, and seismic data. Communication channels are being aligned with IOC/UNESCO standards, although regional data exchange remains challenging.

Iran's participation in Exercise IOWave25 involves a coordinated response led by INIOAS, NDMO, PMO, and other agencies. The exercise scenario simulates a magnitude 9.0 earthquake in the Gulf of Oman. A detailed drill was conducted at Chabahar Port, including siren activation, evacuation of schools and coastal areas, deployment of emergency services, and post-exercise evaluation.

Inundation and evacuation maps have been developed for Chabahar, and Iran is progressing toward implementing the Tsunami Ready programme in pilot communities through education and coordination meetings.

Oman

Mr Nasser Al Ismaili from the National Multi-Hazard Early Warning Center presented Oman's report. Oman's tsunami warning system includes 26 seismic stations, six wave radars, 10 tide gauge sensors, and 10 GPS stations. The system supports real-time monitoring and feeds into the Multi-Hazard Early Warning System using SeisComp and TOAST software.

Oman has characterized 3,181 tsunami scenarios across 10 seismic zones and magnitudes ranging from 6.5 to 9.25. These scenarios inform risk assessments using high-resolution topographic and bathymetric data.

Standard Operating Procedures (SOPs) are well-defined, with timelines for bulletin issuance and threat evaluation. Dissemination channels include SMS, social media, and cell broadcast technology (CBS), which allows mass alerts without network congestion.

Oman has conducted three national awareness campaigns in North Al Batinah, Dhofar, and South Al Sharqiyah, including lectures, exhibitions, and vertical evacuation drills. Training for system operators has been held in Muscat, Jakarta, and Hyderabad.

For Exercise IOWave25, Oman is participating in Scenario 2: Makran Trench with a functional exercise involving NTWC, NCEM, ROP, and Civil Defense. While no evacuation is planned, coordination and SOP testing are prioritized.

Plans include updating risk maps, acquiring data from 40 GPS stations, continuing awareness campaigns, and exploring implementation of the Tsunami Ready programme or alternative approaches.

Dr. Sudheer Joseph inquired about the planned approach for bathymetry data collection during the exercise, including the expected resolution of the data. In response, Mr. Nasser Al-Shukaili noted that he did not have the specific details at hand but would follow up with the Director to obtain the relevant information.

Dr. Joseph further asked whether any international standards would be applied to the bathymetric data. Mr. Al Ismaili suggested that this topic could be discussed with Dr. Isa El Hussain of Sultan Qaboos University, who may be able to provide guidance on applicable standards and methodologies.

United Arab Emirates

Mr Badr Alameri from the National Center of Meteorology presented the UAE's national report. The UAE maintains a network of seismic and tide stations distributed across key coastal and inland locations, including Abu Dhabi, Dubai, Sharjah, Ras Al Khaimah, and Al Ain. These stations contribute to regional monitoring and support tsunami detection and early warning capabilities.

The UAE shares seismic data in real time with Oman, Pakistan, and other global partners. While data sharing with India is not currently active, the UAE remains committed to strengthening regional cooperation.

The UAE is actively participating in Exercise IOWave25, specifically in Scenario 2: Makran Trench, simulating a magnitude 9.0 earthquake off the coast of Pakistan. The exercise is being conducted as a drill in Al Iqqah, involving hotels, schools, hospitals, and other community institutions. This marks a significant step toward enhancing public preparedness and institutional coordination.

Progress has also been made toward implementing the UNESCO-IOC Tsunami Ready Recognition Programme. The UAE has begun aligning its efforts with the 12 Tsunami Ready indicators, covering hazard assessment, preparedness, and response. These include mapping hazard zones, estimating populations at risk, conducting outreach activities, and ensuring reliable alert dissemination systems.

Looking ahead, the UAE plans to continue building Tsunami Ready communities, expand public awareness initiatives, strengthen SOPs and communication chains, and commemorate World Tsunami Awareness Day 2025 with national-level activities.

4. ONGOING / NEW INITIATIVES

4.1 TSP OBERVING NETWORKS & DATA SHARING

Mr Padmanabham Jijjavarapu (INCOIS, India) presented an overview of the observational networks and data sharing practices of the three Tsunami Service Providers (TSPs) in the Indian Ocean region—India, Australia, and Indonesia. The presentation emphasized the critical role of seismic, sea-level, GNSS, and tsunami buoy networks in enabling timely and accurate tsunami detection and warning.

TSP-India (INCOIS)

The Indian Tsunami Early Warning Centre (ITEWC), operated by INCOIS in Hyderabad, maintains a comprehensive observational network. This includes 17 broadband seismic stations, of which four are shared in real time; 35 tide gauges, with eight contributing data to the IOC Sea Level Monitoring Facility; and five tsunami buoys, all of which share data with the NOAA-NDBC portal. Additionally, INCOIS operates 35 GNSS and Strong Motion Accelerometer stations in the Andaman and Nicobar Islands.

INCOIS is planning to install a submarine cable-based observatory near the Andaman region. This observatory will feature two science nodes equipped with oceanographic and geophysical sensors to enable real-time tsunami detection.

TSP-Australia (JATWC)

The Joint Australian Tsunami Warning Centre (JATWC) is jointly operated by Geoscience Australia and the Australian Bureau of Meteorology. Australia shares open, real-time seismic, GNSS, and sea-level data for tsunami monitoring. The seismic network includes 90 broadband stations, which are all shared via Earthscope IRIS. The GNSS network comprises 20 stations, shared via IGS. The Bureau of Meteorology operates 46 tide gauges, with 44 contributing data to the IOC Sea Level Monitoring Facility, and six tsunami buoys, all of which share data with both NDBC and IOC platforms.

TSP-Indonesia (BMKG)

Indonesia's Tsunami Early Warning System (InaTEWS), operated by BMKG in Jakarta, includes 533 seismic stations, with 21 shared internationally. BMKG also operates 106 tsunami gauges, with 21 contributing data to IOC Sea Level. The system is supported by 35 maritime automatic weather stations used as auxiliary water level sensors. Contributions from other Indonesian agencies include 258 tide gauges and 286 GNSS stations (BIG), and seven InaBuoys, one InaCBT, and 11 IDSL units (BRIN).

In 2025, BMKG installed 100 new tsunami gauge stations designed to detect both seismic and non-seismic tsunamis. These stations are equipped with high-frequency sensors, CCTV, and real-time air pressure sensors to detect volcanic meteotsunamis. BMKG has also consolidated all sea-level observations into a single monitoring platform, InaTNT, to streamline access and analysis.

Regional Data Sharing Status – NWIO

The presentation highlighted the status of sea-level data sharing in the Northwest Indian Ocean (NWIO) region. India shares data from eight tide gauges and five tsunami buoys. Oman shares data from nine tide gauges. Pakistan contributes data from one tide gauge in Karachi. Iran and the UAE currently do not share tide gauge data.

Member States were encouraged to identify technical or policy barriers to real-time data sharing and explore bilateral cooperation with TSPs to enhance regional tsunami early warning capabilities.

Action: *Make an inventory of the stations in the Northwest Indian Ocean region and highlight those being shared.*

Recommendation: *Pursue data sharing from Northwest Indian Ocean countries to the IOTWMS Tsunami Service Providers.*

Challenges and ODTP Goals

Mr Padmanabham outlined the challenges in achieving the Ocean Decade Tsunami Programme (ODTP) goal of delivering confirmed tsunami warnings within 10 minutes of origin. These challenges include the proximity of tsunami sources to coastlines, sparse sensor coverage, data latency, and limitations in modelling capabilities.

To address these challenges, the ODTP proposes:

- Deploying dense sensor networks using optimization algorithms to cover high-risk seismic zones.
- Enabling real-time data sharing through interoperable protocols.
- Leveraging new technologies such as SMART subsea cables, GNSS stations, and machine learning.
- Making targeted investments to fill observational gaps and sustain regional collaboration under ICG/IOTWMS.

The overarching goal is to ensure that all at-risk coasts in the Indian Ocean region receive confirmed, actionable tsunami warnings within 10 minutes of origin.

Dr Tummala noted the plans to install 15 tide gauges in East Africa in contribution to a FUST project.

Action: *Create a map of monitoring stations that TSP received data from as a proxy for the regional coverage*.

4.2 NON-SEISMIC TSUNAMI

Dr Mohammad Mokhtari presented findings on the potential for landslide-generated tsunamis in the Makran Subduction Zone. The western Makran margin contains thick, unconsolidated sediments with low cohesion, making it susceptible to submarine landslides triggered by seismic activity. Historical events, including the 1945 tsunami, and recent studies support this risk.

Using seismic-reflection data (PC-2000), bathymetry (GEBCO, PMO), and topography (SRTM), the team applied probabilistic modelling, Gaussian process learning, and numerical simulations based on nonlinear shallow-water equations. Two submarine landslides were identified offshore Chabahar: L1 (~3 km long) and L2 (~6 km long), both composed of silty-sand layers.

Simulations showed wave heights up to 6 meters along Iran's coast and 2–2.5 meters along Pakistan's. Arrival times ranged from 10–15 minutes at Chabahar to 40–50 minutes at Jask and 25–30 minutes at Muscat. Inundation could reach 300 meters inland at Chabahar. A probabilistic model using 2,000 scenarios estimated an 80% chance of waves exceeding 1 meter at Chabahar.

Dr Mokhtari concluded that landslide-generated tsunamis are a credible hazard in the Makran region. He recommended further work using high-resolution bathymetry and 3D seismic data and proposed future simulations using non-hydrostatic models. Integration of AI and geophysical data was suggested to improve hazard identification. Funding opportunities include UNESCO/IOC, UNESCAP, national tsunami programs, and international research grants. Dr Mokhtari encouraged the Working Group to explore the possibility of organising a workshop on landslide generated tsunamis.

Dr Joseph enquired about the approach for a country like India with a broad and diverse coastline. Dr Mokhtari replied that the first step would be to determine the potential for large events.

Dr Tummala noted that for the non-seismic component of the Makran project and group of regional experts can be assembled to conduct a desktop study of potential sources.

4.3 ESCAP MAKRAN PROJECT PHASE 3

Mr Ardito M Kodijat presented the proposed Phase 3 of the UNESCAP-funded project titled Strengthening Tsunami Warning in the North-West Indian Ocean through Regional Cooperation. The initiative builds on the achievements of Phases 1 and 2, which focused on hazard and risk assessment, tsunami warning chain development, and capacity building in inundation and evacuation mapping.

Phase 3 aims to improve community-level tsunami preparedness and response in line with the UNESCO-IOC Tsunami Ready Recognition Programme (TRRP). The objective is to support pilot communities in five participating countries—India, Iran, Oman, Pakistan, and the UAE—to meet the TRRP indicators and apply for official recognition. Additional support will be extended to Sri Lanka and the Maldives for tsunami inundation modelling and mapping.

Key outputs of Phase 3 include:

- Strengthening the capacities of national, local, and community facilitators.
- Supporting pilot communities in meeting TRRP indicators.
- Establishing National Tsunami Ready Boards (NTRBs) or equivalent mechanisms.
- Enhancing local disaster management office (DMO) SOPs and integrating them into multi-hazard frameworks.
- Advancing research on non-seismic and complex tsunami sources in the Makran Subduction Zone.

Pilot sites have been identified in each country, including:

- India: Purakkad and Alappad (Kerala), Okha and Pingleshwar (Gujarat)
- Iran: Chabahar and Jask
- Oman: Alhail North
- Pakistan: Gwadar and Karachi
- UAE: Fujairah
- Sri Lanka: Ambalangoda
- Maldives: Diffushi Island and Fuvahmulah City

The project will also support the development of tsunami inundation and evacuation maps, conduct simulation drills, and provide on-the-job training for national experts. Manuals and guides have been translated into Farsi and Urdu to support local implementation.

A detailed implementation schedule outlines activities over a 24-month period, including training workshops, consultant engagements, SOP reviews, and TRRP application processes. The project is aligned with the IOTWMS Medium-Term Strategy and the four pillars of the UNESCAP Trust Fund for Tsunami, Disaster and Climate Preparedness.

Mr Kodijat emphasized that Phase 3 is designed to be inclusive, science-based, and community-focused, ensuring that vulnerable coastal populations are better prepared to respond to tsunami threats.

Ms Temily Baker noted that ESCAP is pleased to share that the United Nations Secretary-General's report (A/80/333) has formally recognized the collaborative work undertaken in support of tsunami resilience and early warning systems. ESCAP expressed enthusiasm for continuing its partnership with UNESCO-IOC on this initiative over the next two years.

She further highlighted that a side event to officially launch the project is scheduled for 10 November 2025 during the UN Ocean Decade Conference. Dr Tummala added that the initiative has been submitted for endorsement as part of the ODTP.

5. WORKPLAN, ACTIONS, RECOMMENDATIONS, AND CLOSING

Ms Sunanda Manneela presented the updated action items and proposed workplan for the North-West Indian Ocean (NWIO) Regional Working Group, as endorsed during the 19th Meeting of the ICG/IOTWMS Steering Group in Jakarta (June 2025). The workplan builds on priorities identified during ICG/IOTWMS-XIV and reflects ongoing regional collaboration and capacity development efforts.

The action items from the 14th Session of the ICG/IOTWMS (Banten, Indonesia, November 2024) were reviewed including:

1. Data Sharing: While bilateral arrangements exist, regional cooperation with Tsunami Service Providers (TSPs) needs to be strengthened.
2. Paleo-Tsunami Studies: A regional proposal is to be formulated for potential funding and contribution to the UN Ocean Decade Tsunami Programme.
3. Expansion of Mapping: Inundation and evacuation maps developed under the UNESCAP project should be extended to other NWIO areas, supported by TEMPP training.

4. On-the-Job Training: Regional training for NTWC representatives will be facilitated through calls issued by the Secretariat.

The action items from the 19th Meeting of the ICG/IOTWMS Steering Group (Jakarta, Indonesia, June 2025) include:

1. Pursue discussions on real-time seismic and sea level data sharing in the Northwest Indian Ocean region engaging the relevant stakeholders in the region and the TSP representatives [Action: WG-NWIO]

The proposed workplan of the Working Group outlines eight strategic activities:

1. **Gap Assessment**
   A detailed gap analysis will be compiled using results from the 2024 Capacity Assessment to identify country-specific needs.
   Timeline: Q3–Q4 2025
   Partners: Chair / Vice Chair, NTWC Reps, Secretariat

2. **Observation Network Strengthening**
   The existing network inventory will be prepared through a survey of the observation networks in NWIO Member States, data availability and identification of key stations for data sharing with the TSPs
   Timeline: Q4 2025–Q1 2026
   Partners: Chair / Vice Chair, NTWC Reps, TSP Reps, WG-2 Chair

3. **Capacity Building & Knowledge Sharing**
   Support will be provided to IOTIC to develop a knowledge base for the Makran region, including hazard data, training materials, and maps.
   Timeline: Q1–Q2 2026
   Partners: Chair / Vice Chair, NTWC Reps, IOTIC, Secretariat

4. **On-the-Job Training**
   Regional operator training sessions will be conducted to enhance Member State capabilities for seismic and sea level data processing, analysis and data sharing.
   Timeline: Q4 2025 and Q4 2026
   Partners: Chair / Vice Chair, INCOIS, BMKG, Secretariat

5. **Tsunami Ready Implementation**
   IOWave25 will be used to assess progress, support TR recognition applications, and identify new communities for expansion.
   Timeline: Q1–Q2 2026
   Partners: Chair / Vice Chair, TRFP Reps, IOTIC, Secretariat

6. **Paleo-Tsunami Studies**
   A proposal will be prepared and a regional workshop organized to explore historical tsunami events and sources.
   Timeline: Q3–Q4 2025 and Q4 2026
   Partners: Chair / Vice Chair, Invited Experts, Secretariat, IOTIC

7. **Non-Seismic Tsunamis**
   a. SOPs will be developed for monitoring and early warning of non-seismic and complex tsunami events.

   b. Investigate the potential for landslide-induced tsunamis in the Makran region, possibly through the development of a geographical inventory of submarine landslide features.
   Timeline: Q4 2026
   Partners: Chair / Vice Chair, NTWC Reps, Invited Experts, Secretariat

8. **Emerging Technologies**
   NWIO will serve as a platform to test new technologies for observation and forecasting, based on Task Team recommendations.
   Timeline: Q1–Q4 2027
   Partners: Chair / Vice Chair, NTWC Reps, Invited Experts

The first meeting of the North-West Indian Ocean (NWIO) Regional Working Group concluded with a strong sense of regional commitment and collaboration. Chaired by Ms Sunanda Manneela and Vice-Chaired by Dr Nasser Al Ismaili, the meeting brought together Member States, experts, and partners to review progress, share national experiences, and agree on a forward-looking workplan.

Dr Nasser Al Ismaili noted that many goals had already been achieved during the early phases of the UNESCAP regional project. However, he emphasized that in Oman, stakeholders will require further guidance to implement tsunami preparedness measures effectively. He also highlighted the need for acquiring more seismic data in the western Makran Subduction Zone to improve hazard modelling. Importantly, he suggested that methane deposits in the region may have played a role in the 1945 rupture, warranting further investigation.

Dr Srinivasa Kumar Tummala reiterated the importance of forming small, focused groups (identified as partners in the above workplan) to advance specific activities.

Participants acknowledged the progress made under the UNESCAP project, particularly in tsunami hazard assessment, inundation mapping, and the implementation of the Tsunami Ready Recognition Programme. The meeting emphasized the need to sustain momentum through continued capacity building, regional data sharing, and the development of SOPs for non-seismic tsunami sources.

The NWIO Working Group reaffirmed its role as a collaborative platform for testing innovations, sharing best practices, and supporting vulnerable communities. The Chair thanked all participants for their active engagement and encouraged continued collaboration through intersessional activities, upcoming exercises, and regional workshops.

The meeting closed with a shared commitment to building a safer and more resilient NWIO region—one that is better prepared to respond to tsunami threats through science, cooperation, and community empowerment.

Annex 1 – Final Agenda

Meeting of ICG/IOTWMS Sub-regional Working Group

North-West Indian Ocean 08 October 2025 (online)

#	UTC Time	Agenda Item	Lead / Speakers
1	**05:00 – 05:20**	**Opening**	
1.1	05:00 - 05:15	Introductions, Welcome and Opening Remarks	Srinivasa Kumar Sunanda Manneela ICG Chair / Vice-Chairs
1.2	05:15 – 05:20	Adoption of Agenda & Meeting Logistics	Sunanda Manneela Nora Gale
2	**05:20 – 06:00**	**Activity Updates**	
2.1	05:20 - 05:40	Chair Report	Sunanda Manneela Nasser Al Ismaili
2.2	05:40 - 05:50	Secretariat Report	Srinivasa Kumar Nora Gale
2.3	05:50 – 06:00	Exercise IOWave25	B Ajay Kumar
3	**06:00 – 06:50**	**Member State Reports** (10 min each) • India, Iran, Oman, Pakistan, UAE Including: Observing networks, data sharing, Exercise IOWave25 participation, Tsunami Ready implementation in pilot communities, and future plans.	Patanjali Kumar Ali Khoshkholgh Nasser Al Ismaili Ameer Hyder Badr Alameri

#	UTC Time	Agenda Item	Lead / Speakers
4	**06:50 – 08:15**	**Ongoing / New Initiatives**	
4.1	06:50 – 07:10	TSP Observing Networks & Data Sharing	Padmanabham Jijjavarapu
4.2	07:10 – 07:30	Makran PTHA	Andrey Babeyko
4.3	07:10 – 07:25	Non-Seismic Tsunamis	Mohammad Mokhtari
4.4	07:25 – 07:50	ESCAP Makran Project Phase-3	Ardito Kodijat Temily Baker
4.5	07:20 – 08:00	Any Other Items	All
Group Photo			
5	**08:00 – 08:30**	**Workplan, Actions, Recommendations, and Closing**	Sunanda Manneela Srinivasa Kumar