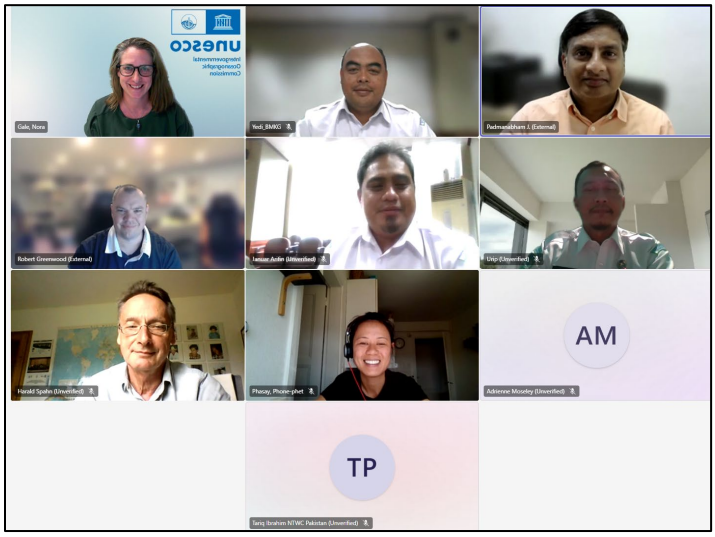
INTERGOVERNMENTAL COORDINATION GROUP (ICG)

INDIAN OCEAN TSUNAMI WARNING & MITIGATION SYSTEM (IOTWMS)

Working Group 2 on Tsunami Detection, Warning and Dissemination

7 August 2024



Participants at the intersessional meeting of ICG/IOTWMS Working Group 2, 7 August 2024.

Members

Mr Jijjavarapu Padmanabham (India),
WG-2 Chair

Dr Robert Greenwood (Australia),
WG-2 Vice-Chair

Mr Yedi Dermadi (Indonesia)
WG-2 Vice-Chair

Ms Adrienne Mosely (Australia)

Mr Tariq Ibrahim (Pakistan)

Mr Urip Setiyono (Indonesia)

Invited Experts

Dr Yuelong Miao (Australia),
Vice-Chair ICG/IOTMWS

Mr Harald Spahn (Germany)

Observer

Mr Januar Arifin (Indonesia)

UNESCO-IOC

Ms Nora Gale (ICG/IOTWMS Secretariat)

Ms Phone-Phet Phasay (Tsunami Resilience Section)

1. OPENING

1.1 Welcome and Opening Remarks

Dr Yuelong Miao, Vice-Chair of the Intergovernmental Coordination Group for the Indian Ocean Tsunami Warning and Mitigation System (ICG/IOTWMS) welcomed everyone to the intersessional meeting of Working Group 2 (WG-2) on Tsunami Detection, Warning and Dissemination. Dr Miao expressed the closeness of the Working Group to his heart and its importance within the IOTWMS. Tsunami detection, warning and dissemination is a cornerstone to the tsunami warning and mitigation system. He noted that there will be a lot of interesting discussion in today's meeting that will go a long way towards meeting the Working Group's targets. With the upcoming 14th session of ICG/IOTWMS (Jakarta, November 2024) it is useful to reflect on what has been achieved and what can be done, particularly in relationship to the UN Decade of Ocean Science for Sustainable Development. In conclusion, Dr Miao wished the meeting much success.

Mr Jijjavarapu Padmanabham, Chair of WG-2, thanked Dr Miao for his inspiration. He welcomed the members, invited experts, observers and the Secretariat to the WG-2 meeting on tsunami detection, warning and dissemination. Mr Padmanabham is honoured to be dedicated to this team of experts using the latest technology for tsunami warning. He encouraged the Working Group members to actively engage, share insights, and collaborate to advance the timeliness of tsunami detection and dissemination. He further encouraged the adoption of new technologies such as smart cable and optimizing the sea level network and seismic networks in the Indian Ocean region.

1.2 Adoption of Agenda

Mr Jijjavarapu Padmanabham reviewed the provisional agenda, which was adopted by the Working Group without modification (refer to Annex 1).

1.3 Terms of Reference and Membership

The terms of reference and membership for the WG-2 were reviewed as noted below.

Liaise with other working group(s) and task team(s) within the ICG/IOTWMS and with working groups from the other ocean basins through the TOWS-WG to:

1 Coordinate and strengthen the operational implementation of tsunami detection, warning and dissemination, including for tsunamis generated by non-seismic and complex sources.

2 Support the Tsunami Service Providers (TSPs) delivery of interoperable regional tsunami threat information products to Member States.

3 Support Member States in the development of their national tsunami warning capabilities.

4 Monitor the performance of key observational, warning and communication system components.

5 Support implementation of IOWave Exercises.

6 Identify areas of priority for action following assessments, communications tests, exercises, and real tsunami events.

7 Provide advice on further development of IOC-UNESCO TRRP.

8 Provide advice to the Indian Ocean Tsunami Information Centre (IOTIC) on educational materials about the warning systems and services.

9 In collaboration with IOC-UNESCO IOTIC and IOC-UNESCO Secretariat for ICG/IOTWMS, help strengthen the capacity and capability of Member States.

Activities may include:

1 Help coordinate and facilitate the development and operational implementation of tsunami detection, warning and dissemination systems and procedures within Multi-Hazard Early Warning System (MHEWS) frameworks and systems.

2 Monitor, assess and routinely report to the Steering Group and ICG on the performance of Tsunami Service Providers (TSPs), observational seismic and sea level monitoring networks, communication systems and procedures.

3 Consult with Working Group 1 “Tsunami Risk, Community Awareness and Preparedness” on the requirements and suitability of threat information and warning products.

4 Work closely with Working Group 1 "Tsunami Risk, Community Awareness and Preparedness", Working Group 3 “Tsunami Ready Implementation”, IOC-UNESCO IOTIC and IOC-UNESCO Secretariat for ICG/IOTWMS, to help develop the capacity of Member States across the Indian Ocean to implement the IOC-UNESCO Tsunami Ready Recognition Programme (TRRP) or similar initiatives. 5. Work closely with Working Group 1 "Tsunami Risk, Community Awareness and Preparedness", Working Group 3 “Tsunami Ready Implementation”,

5 IOC-UNESCO IOTIC and IOC-UNESCO Secretariat for ICG/IOTWMS, to develop effective national tsunami warning chains, warning products, services, Standing Operating Procedures, and warning chains.

6 Monitor existing international and national arrangements and provision of real-time data required for tsunami monitoring and warning with regards to seismic, GNSS, sea level and other kinds of measurements and data exchange.

7 Undertake studies to determine warning requirements for seismic and sea level data.

8 Facilitate the ongoing development and benchmarking of tsunami modelling, forecast and verification systems.

9 Contribute to the conduct of regular exercises and communication tests of the IOTWMS.

10 In collaboration with Working Group 1 " Tsunami Risk, Community Awareness and Preparedness ", Working Group 3 “Tsunami Ready Implementation”, IOC-UNESCO IOTIC and IOC-UNESCO Secretariat for ICG/IOTWMS, help to develop, coordinate, and implement training and capacity building programmes for NTWCs, DMOs and Broadcast Media in the Tsunami Warning Services.

11 Develop and maintain relevant documentation, such as the IOTWMS Service Definition and IOTWMS NTWC Users Guide.

The Working Group will be composed of members nominated by Member States, Member State representatives for each ICG-designated TSP, at least two representatives of non-TSP National Tsunami Warning Centres, and invited observers, with a chairperson and one or two vice-chairpersons to be elected by the ICG.

The participant list for the intersessional meeting of Working Group is contained in Annex 2.

1.4 Meeting Logistics

Ms Nora Gale of the ICG/IOTWMS Secretariat provided the participants with logistical information for the meeting. Meeting documents and presentations are available on the event website at https://oceanexpert.net/event/4417.

2. PROGRESS OF ACTIVITIES

2.1 Report of the Chair

Mr Jijjavarapu Padmanabham, Chair of WG-2, provided the Chair's report for the intersessional period 2023-24. The three IOTWMS Tsunami Service Providers (TSPs) provide tsunami threat information to National Tsunami Warning Centres (NTWCs). During the reporting period, there were three events: (i) M7.1 at Southern Sumatra, Indonesia, 24 April 2023, (ii) M6.8 at Prince Edward Island, 21 May 2023, and (iii) M6.6 South of Africa, 10 July 2024. TSP Australia is ready to issue threat information for non-seismic tsunami following testing during Exercise IOWave23. Maritime products for NAVAREAs are to be trialled and implemented in 2024 by the TSPs. Competency training frameworks are being developed for NTWCs. TSP operations are ISO-compliant (9001).

Mr Padmanabham reviewed the work plan items for the intersessional period, noting progress and timelines (refer to Section 3). Key priorities include TSP messages to NAVAREA operators, Capacity Assessment of Tsunami Preparedness, standard operating procedures for non-seismic sources, atlas of tsunami sources, exercises and communication tests, aligning with UN Ocean Decade, and optimal seismic and sea level network coverage. Gaps and challenges include sustaining observing systems, data sharing, inter-agency coordination, integrated multi-hazard warning, and timely and accurate detection and warning to near-field tsunami, and non-seismic and complex tsunami.

Dr Miao congratulated the team on their great work during the reporting period, which included the exercise, communication tests, and updating documents. The ICG/IOTWMS should never forget that this Working Group sustains the operational system through its three Tsunami Service Providers.

Dr Robert Greenwood drew attention to the non-seismic bulletins. He mentioned that TSP Australia issued a no-threat bulletin for an eruption at Mt Ruang, Indonesia in April 2024.

Dr Greenwood recalled that the ICG/PTWS has an ITIC programme that is looking into trialling a minimum competency development framework. The findings will be requested to be reflected in other ocean basins, including the Indian Ocean.

2.2 Report of the Secretariat

Ms Nora Gale provided the report of the ICG/IOTWMS Secretariat. The terms of reference for the Secretariat are:

1 Support meetings of the Intergovernmental Coordination Group for the Indian Ocean Tsunami Warning & Mitigation System (ICG/IOTWMS).

2 Facilitate the liaison among the various national contact points and national tsunami warning centres.

3 Maintain a current list of operational national contact points and facilities and make it available on request to all Member States.

4 Organize the liaison between ICG/IOTWMS and the ICG/ITSU, with the PTWC and with other tsunami warning centres to facilitate best practices in tsunami warning.

5 Initiate and support training activities and enhance and enrich tsunami warning in the Indian Ocean.

Ms Gale presented the activities held over the prior 12 months (July 2023 to June 2024) and upcoming activities. A meeting of the four ICG/IOTWMS Working Groups are being organised for July and August 2024. The Capacity Assessment of Tsunami Preparedness is underway with a meeting of the team planned for 4-6 September 2024 in Bangkok. The 2nd UNESCO-IOC Global Symposium will be held during 11-14 November 2024 in Banda Aceh prior to the 14th session of the ICG/IOTWMS to be held during 16-19 November 2024 in Jakarta. It is hoped that Indian Ocean Member State representatives will be able to attend both events.

2.3 TOWS-WG Task Team on Tsunami Watch Operations Report

Mr Jijjavarapu Padmanabham provided the report of the Working Group on Tsunamis and Other Hazards Related to Sea-Level Warning and Mitigation Systems (TOWS-WG) Task Team on Tsunami Watch Operations (Sendai, February 2024). The key recommendations from the 17th meeting of TOWS-WG are provided below (Table 1).

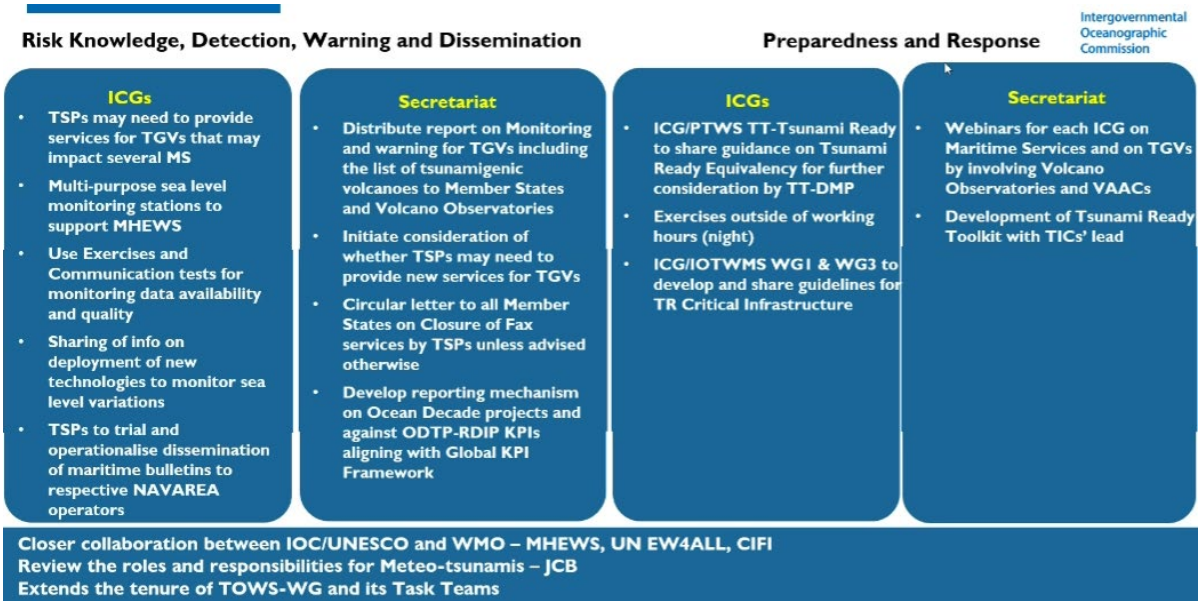


Table 1. Key recommendations from TOWS-WG XVII (Sendai, February 2024).

Mr Padmanabham reviewed the recommendations from the TOWS-WG Task Team on Tsunami Watch Operations, which are available at https://oceanexpert.org/document/34310.

Dr Greenwood enquired about the procedure for including data availability in the comms test reporting. Mr Padmanabham noted that this was practised in the CARIB-EWS in their recent communication test. The availability of the network stations can be one point of reporting in the communication test.

The discussion on the reliability and substantial delays observed in fax was noted in terms of reducing our reliance on Fax. Mr Padmanabham replied that Fax is an old technology, and many times TSP India has observed that the fax does not respond. The mechanism to cease this service and look for new technologies to adopt is well noted. Mr Yedi Dermadi recalled the action assigned to the Secretariat action to notify that fax will cease.

2.4 TSP Reports on Service Updates

TSP Australia

Dr Robert Greenwood reported on the status of TSP Australia including current developments and future activities. TSP Australia is comprised of Geosciences Australia (GA), which monitors earthquakes, and the Bureau of Meteorology (the Bureau), which monitors sea levels and produces tsunami warnings. Dr Greenwood provided examples of the tsunami monitoring software TOAST, which will go live at the Bureau in September 2024. In parallel, GA will upgrade to SeisComP6 in 2024.

TSP Indonesia

Mr Yedi Dermadi reported on the status of TSP Indonesia (InaTEWS), including KPIs in 2023-24, developments since ICG/IOTWMS-XIII (Bali, November 2022), and the developmental and innovation plans. He mentioned that Indonesia has Installed monitoring equipment, including 533 seismic sensors and 211 tide gauges, with plans for 100 additional tsunami gauge stations. InaTEWS utilised TOAST in conjunction with SeisComP6. Development of the Ina TNT (Indonesia Tsunami Non-Tectonic) Application for Indian Ocean Region, an integrated system that functions to detect sea level change anomalies that indicate tsunami, is underway (see Figure 1).

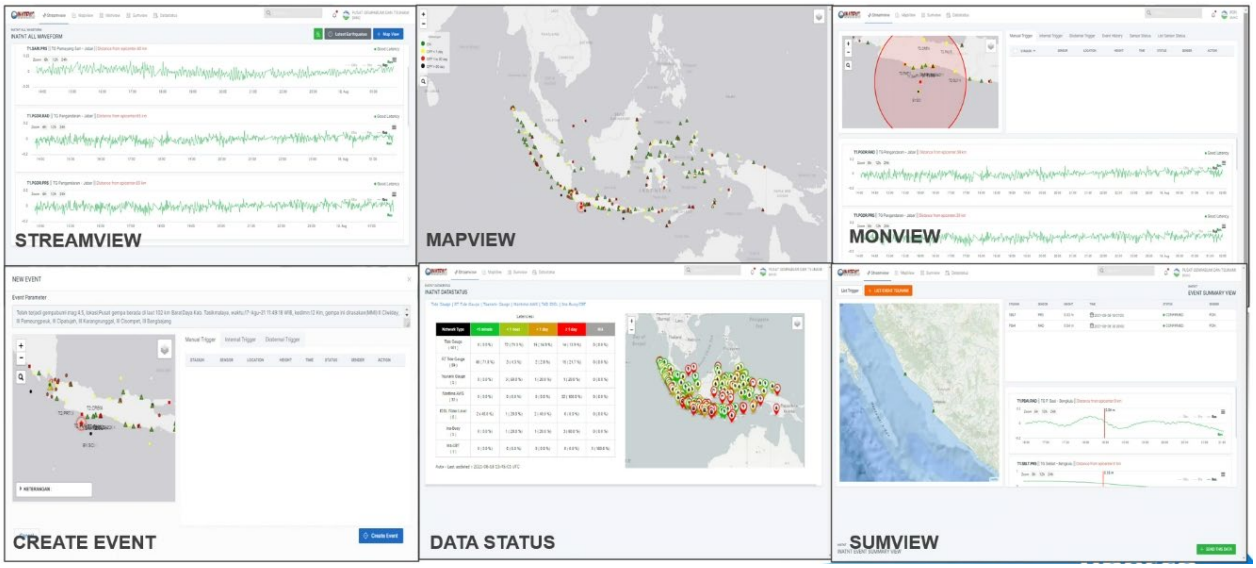


Figure 1. InaTNT (Indonesia Tsunami Non-Tectonic) application's graphical interface.

TSP Indonesia undertake community education activities on Tsunami Ready with 10 communities receiving UNESCO-IOC Tsunami Ready recognition. Additional activities are earthquake field school, verification of tsunami evacuation routes and mapping for tsunami hazards. On-job training of Oman was conducted in Indonesia in May 2024. The development plans include additional tsunami gauge stations, utilization of GNSS data into the earthquake processing system (currently in test phase), products for tsunamis generated by non-seismic and complex sources, and products for NAVAREA coordinators.

Dr Greenwood enquired if the planned tsunami gauges will be shared with the international tsunami community. Mr Dermadi replied that the stations can be shared with other Member States through bilateral agreements. He further commented that the sampling rate will be 1 second.

TSP India

Mr. Jijjavarapu Padmanabham reported on the status of TSP India, highlighting its performance, activities, and development plans. As part of the Indian Tsunami Early Warning Centre (ITEWC), INCOIS operates 17 seismometers for tsunami monitoring, 22 accelerometers along the Andaman and Nicobar Islands, 32 GNSS stations, 36 tide gauges, and 5 bottom pressure recorders for tsunami detection and monitoring.

He also highlighted the inauguration of the state-of-the-art *Synergistic Ocean Observation Prediction Services* (SYNOPS) on 14 February 2024. SYNOPS provides 2D/3D visualization of ocean data, including tsunami and storm surge monitoring, ocean state forecasting, satellite remote sensing, and model products. This integrated system supports decision-making for both scientists and policymakers by offering a comprehensive view of ocean hazards.

Mr. Padmanabham presented significant tsunami events that were monitored, and the corresponding bulletins issued. He mentioned that TSP-India is prepared to produce NAVAREA products and introduced a new mobile app called *SAMUDRA* (Smart Access to Marine Users for Ocean Data Resources and Advisories), launched as part of the national early warning dissemination initiative.

Regarding the monitoring of tsunamis generated by volcanoes, he reported that a draft Standard Operating Procedure (SOP) and an atlas are under development, with ten volcanoes identified in the Indian Ocean region as potential tsunami sources. India has also prioritized community preparedness, successfully conducting the IOWave23 exercise, which involved the evacuation of over 40,000 people from 42 coastal villages. INCOIS has further supported capacity-building efforts by providing on-the-job training to NTWC colleagues from Oman.

2.5 TSP Performance against KPIs for 2023/24

Dr Robert Greenwood reported on the TSP performance against Key Performance Indicators (KPIs) for 2023/24. A list of the KPIs for the ICG/IOTWMS TSP are provided in Table 2. Details of the TSPs performance against KPIs 1-8 for 2023 and 2024 is provided in Tables 3 and 4, respectively.

No.	Key Performance Indicator	Target Value
1	Elapsed time from earthquake to issuance of first Earthquake Bulletin	10 minutes
2	Probability of detection of earthquakes with Mw>=6.8 (USGS final value) in the IOTWMS ESZ	100%
3	Accuracy of earthquake magnitude	0.3
4	Accuracy of earthquake hypocenter depth	30 km
5	Accuracy of earthquake hypocenter location	30 km
6	Elapsed time from earthquake to issuance of first Threat Assessment Bulletin	20 minutes
7	Probability of detection of tsunami above threat threshold	100%
8	Accuracy of the tsunami forecast amplitude/height	Factor of 2
9	Number of false or incorrect bulletins issued	0
10	Accuracy of time arrival of tsunami (0.02m amplitude)	Within 5% of travel time
11	Accuracy of time of arrival of 1st significant wave (0.1m)	Within 5% of travel time
12	Accuracy of threat threshold exceedance	Within 5% #
13	Percent of IO countries issued a timely product as defined above	100%
14	Elapsed time from any product issuance to potential receipt by NTWC Contact	5 minutes ##
15	Percent of regular Comms Tests participated in	100%

pert Greenwood (External)

Table 2. IOTWMS Tsunami Service Provider Key Performance Indicators (reference: ICG/IOTWMS Service Definition Document, V5).

	Service Level 1 EQ Bulletins					Service Level 2 Threat / No Threat Bulletins		
TSP	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
Australia	10.6 (54%)	(100%)	0.12 (96%)	13.6 km (88%)	37.8 km (75%)	16.5 (50%)	n/a	n/a
India	12.0 (47%)	(83%)	0.25 (74%)	23.9 km (75%)	18.9 (80%)	22.0 (100%)	n/a	n/a
Indonesia	11.4 (86%)	(92%)	0.22 (76%)	27.9 km (78%)	27.4 km (78%)	16.0 (100%)	n/a	n/a

NOTES

Meets Target	Near Target	Misses Target

Table 3. 2023 Tsunami Service Provider Key Performance Indicators for M6.8+ earthquakes.

	Service Level 1 EQ Bulletins					Service Level 2 Threat / No Threat Bulletins		
TSP	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
Australia	10.1 (86%)	(100%)	0.1 (100%)	14.2 km (86%)	19.0 km (86%)	n/a	n/a	n/a
India	10.5 (50%)	(86%)	0.1 (100%)	55 km (83%)	17.9 km (83%)	n/a	n/a	n/a
Indonesia	9.5 (83%)	(86%)	0.26 (67%)	25.9 km (67%)	21.9 km (83%)	n/a	n/a	n/a

NOTES

Meets Target	Near Target	Misses Target

Table 4. 2024 Tsunami Service Provider Key Performance Indicators for M6.8+ earthquakes.

The Working Group discussed the KPIs. Regarding KPI 1, the difficulty in getting the first earthquake notification bulletin out in ten minutes based on data availability was noted. Regarding KPI 4, the group should consider the merit of the way the depth KPI is assessed.

For marginal events near 6.5, it is very easy to be slow if the magnitude starts lower than the threshold and then upgraded.

Dr Greenwood suggested another metric in the performance report could be how many earthquakes responded to by TSP.

Dr Greenwood suggested a KPI 9 for issuing false or incorrect bulletins should be included for the ICG/IOTWMS-XIV meeting in November 2024. However, the group decided that this is not required.

2.6 IOTWMS Communication Tests 2023/24

Ms Nora Gale reported on the IOTWMS communication tests during the intersessional period. She recalled that the first test was conducted in March 2011 and to date twenty-seven (27) tests have been undertaken. In addition to the communication tests, six (6) Indian Ocean Wave (IOWave) exercises have been conducted. The report on the 7 January 2023 test is published while the report of the 12 June 2024 is in preparation.

Both email and GTS continue to be reliable means of TSP message delivery to NTWCs with success rates around 90% and 80%, respectively. In contrast, SMS and Fax are not reliable means of TSP message delivery with success rates around 40% and 20% respectively. TSP web access by NTWCs sits around 80% while web reporting is around 60%. The TSP Indonesia warning receiver system has a reported accessibility rate of around 90%.

The working group noted the increasing challenges in receipt success and cost concerning the use of fax in disseminating and receiving tsunami threat information from Tsunami Service Providers (TSPs). Following the recommendations of the 17th meeting of TOWS-WG (Sendai, February 2024), it was decided to advise all Member States via Circular Letter that TSP fax transmissions of tsunami information products will cease within 6 months of the Circular Letter date unless Member States advise within three months that fax transmissions of tsunami information products are essential for NTWC functions and there is no other back-up.

The low rates of dissemination via SMS were discussed. Members noted the restrictions of individual mobile service provider's area of coverage resulting in messages from only a subset of the TSPs being able to reach individual countries. The working group decided to investigate new ways to disseminate TSP notification messages to NTWCs (i.e., WhatsApp).

2.7 Status of Warning Chains in the IOTWMS

Mr Harald Spahn reported on the status of warning chains in the IOTWMS. He is part of the Capacity Assessment mission team (Bangkok, September 2004) to review the preliminary results and formulate recommendations for the report and executive summary of the capacity assessment of tsunami preparedness in the Indian Ocean. He noted the IOTWMS training workshops have addressed standard operating procedures in more detail than the Capacity Assessment. Therefore, the results of the training workshops should also be considered when drawing recommendations for future activities.

Most warning chains are robust and redundant. Roles, responsibilities, and standard operating procedures require further clarification in eleven of the twenty-five countries. It is recommended to strengthen the framework and multi-stakeholder processes for effective warning through high-level political dialog. Emphasis should be placed on the development of standard operating procedures for disaster management organisations.

Ms Gale suggested that Mr Spahn's presentation may also be of interest to the ICG/IOTWMS Working Group 1 (WG1) on tsunami risk, community awareness and preparedness. She will speak to the Chair of WG1 on asking Mr Spahn to present in their intersessional meeting scheduled for 19 August 2024.

2.8 NAVAREA Bulletin Implementation

Mr Yedi Dermadi reported on the implementation of NAVAREA bulletins by the Tsunami Service Providers. NAVAREAs are the maritime geographic areas in which specific governments are responsible for broadcasting navigational warnings. In IOTWMS there are 5 NAVAREAs (i.e., VII South Africa, VIII India, IX Pakistan, X Australia, and XI Japan). This issue was first raised in October 2019 the action to implement was adopted. The IOTWMS Service Definition (Version 5.0) notes that "Through agreement with IHO, TSPs are asked to provide NAVAREA products each time Potential Threat, Confirmed Threat, and Final bulletins are issued in the agreed format". Mr Dermadi presented the associated NAVAREA bulletin templates. TSP Australia and India are ready to produce NAVAREA products, while TSP Indonesia is currently implementing.

There was a discussion about using Coastal Forecast Zones (CFZs) for the NAVAREAs. Ideally, these could be included within the TSP shape files.

The working group agreed that this is a priority activity with the December 2024 IOTWMS communications tests a target date for dissemination. Additionally, for an online workshop on NAVAREAs for the maritime community should be organised.

It was noted that Dr Miao is the NAVAREA coordinator for area X Australia and could advise on this activity.

3. WORKPLAN DISCUSSION AND ACTIONS

The Working Group 2 Chair, Vice-Chairs and Secretariat met on 8 August to assess the status and priority of each workplan actions. The priory actions for the coming months in the lead-up to the 14th session of the ICG/IOTWMS (Jakarta, November 2024) include TSP messages to NAVAREA operators, and the 2024 capacity assessment of tsunami preparedness in the Indian Ocean. Other key priorities include standard operating procedures for non-seismic sources, atlas of tsunami sources, exercises and communication tests, aligning with UN Ocean Decade, and optimal seismic and sea level network coverage.

i **TSP Messages to NAVAREA Operators**

Based on the recent TOWS-WG recommendations, a key priority for ICG/IOTWMS TSPs is issuing relevant messages to NAVAREA operators for maritime warnings. A trial run of TSP NAVAREA messages should be planned for the upcoming Communication Test in December 2024. WG2 noted that TSP-Australia and TSP-India are prepared to issue these messages, while TSP-Indonesia is still in the implementation phase. To facilitate this, it is essential to establish and maintain up-to-date contact details for NAVAREA operators and coordinators.

Action:

- Initiating the trial run of TSP messages [At least one TSP] for the maritime community in co-ordination with Secretariat & NAVAREA operators – for the Upcoming Communication Tests
- organise webinars in coordination with IHO for the NAVAREA operators and backup METAREA operators to introduce the new service and products for the maritime community and obtain and advise TSPs of the contact information for their respective NAVAREA and METAREA operators to disseminate the new maritime bulletins.

ii ICG/IOTWMS Service Definition Document V5.0 and NTWC User Guide:

It was agreed to finalise the NTWC User Guide and submit the ICG/IOTWMS SDD Version 5 draft documents and the updated NTWC User Guides for review and formal release during the upcoming ICG meeting.

Action: To complete the NTWC User Guide following the SDD V5.0 – JP

iii **2024 Capacity Assessment of Tsunami Preparedness in the Indian Ocean**
WG2 will contribute to the 2024 Capacity Assessment of Tsunami Preparedness (CATP-2024) among Indian Ocean Member States. The assessment aims to identify both gaps and strengths in current systems, with its findings guiding future preparedness efforts. WG2 will collaborate with WG1 to finalise the capacity assessment report, ensuring it is ready for the upcoming ICG/IOTWMS meeting. This report will provide an overview of regional readiness and serve as a foundation for future improvements. – Ongoing

iv **Standard Operating Procedures (SOPs) for Non-Seismic Tsunami Sources**
As the region faces the threat of tsunamis generated by non-seismic events such as volcanic eruptions and landslides, it is essential to develop Standard Operating Procedures (SOPs) for these sources. WG2 will focus on finalizing these SOPs, providing clear, step-by-step guidance for tsunami warning centres on how to respond to non-seismic tsunami threats.
Action:

- Develop a Standard Operating Procedure (SOP) document specifically for addressing non-seismic tsunami sources, focusing on Tsunami-Generating Volcanic Events (TGVEs). The document will outline clear, step-by-step procedures for TSPs to follow.
- Organize online webinar for ICG/IOTWMS involving relevant Volcano Observatories and Volcanic Ash Advisory Centres (VAACs). These webinars will brief participants on the report *Monitoring and Warning for Tsunamis Generated by Volcanoes* (IOC/2024/TS/183) and its recommendations, highlight the associated hazards and vulnerable Member States, and initiate partnerships between TSPs, NTWCs, Volcano Observatories, and VAACs.

v **Atlas of Known Tsunami Sources**
Developing an atlas of known tsunami sources is essential for strengthening tsunami preparedness. This atlas will provide National Tsunami Warning Centres (NTWCs) with detailed information on non-seismic sources, such as volcanic eruptions, landslides, and their associated tsunami travel times. It will be a crucial reference for probable threat assessment and timely decision-making in response to known non-seismic tsunami risks.
Action: Develop a digital, web-enabled atlas of known TGVEs and other non-seismic tsunami sources, offering easy access and updated information for NTWCs.

vi **Exercises and Communication Tests**
WG 2 continue to support the regular communication tests and Wave exercises to test and improve the performance through various communication modes between Tsunami Service Providers and NTWCs. WG-2 will document the results of these exercises and follow up on any identified issues to ensure continuous improvement. Member States are also encouraged to increase the frequency of tabletop exercises to reduce complacency and ensure their Standard Operating Procedures (SOPs) are regularly tested.
Action: Contribute to the conduct of the regular COMMS test exercises and wav exercises of the IOTWMS. Establish a working mechanism between NTWCs and TSPs to solve any communication issues.

vii Optimal Seismic and Sea Level Network Coverage & Data Sharing
Discussed extensively the need to enhance and share the data within the region of the Indian Ocean for better/timely availability of data from seismic and Sea level networks for tsunami early warning purposes.

Actions:

- WG2 has to take-up to develop an optimal sea level and seismic network design for the Area of Service (AoS) and work with Member States to fill identified gaps, including the strategic and coordinated submission of projects to the UN Ocean Decade and potential funding sources for support.
- TSPs routinely monitor as frequently as possible (at least every 6 months) the status of sea level and seismic observing networks and the quality of the data to meet existing and enhanced tsunami warning requirements in their AoS, including the provision of status summaries for the Secretariat to follow-up with relevant Member States to correct data issues.
- Utilise and promote the use of multi-purpose sea level monitoring stations to support MHEWS in enhancing data coverage and reducing costs.
- sample sea level data at one-second intervals and transmit this in real-time, given the critical need to resolve and understand the near-field threat to high at-risk communities where a tsunami may arrive within 5-30 minutes.

viii **UN Ocean Decade Tsunami Program**

WG-2's action plan will be realigned with the broader objectives of the UN Ocean Decade Tsunami Program. This will involve reviewing WG-2's current roles and responsibilities and adjusting them to ensure they support the UN Ocean Decade's goal of improving tsunami readiness and early warning systems on a global scale.

4. RECOMMENDATIONS TO THE 14TH SESSION OF ICG/IOTWMS

Working Group 2 has prepared the following recommendations to be presented to the 14th Session of the ICG/IOTWMS.

Recommendations:

- *TSPs to trial dissemination of maritime bulletins to respective NAVAREA operators in the Area of Service (AoS) for the upcoming communication test and for full operational implementation in 2025.*
- *To release the* ICG/IOTWMS SDD Version 5 and NTWC User guides formally for the adoption by TSPs.
- Develop a Standard Operating Procedure (SOP) document specifically for addressing non-seismic tsunami sources, focusing on Tsunami-Generating Volcanic Events (TGVEs).
- Organize online webinar for ICG/IOTWMS involving relevant Volcano Observatories and Volcanic Ash Advisory Centres (VAACs). These webinars will brief participants on the report *Monitoring and Warning for Tsunamis Generated by Volcanoes* (IOC/2024/TS/183) and its recommendations, highlight the associated hazards and vulnerable Member States, and initiate partnerships between TSPs, NTWCs, Volcano Observatories, and VAACs.
- Develop a digital, web-enabled atlas of known TGVs and other non-seismic tsunami sources, offering easy access and information for NTWCs.
- Consider performing exercises outside of working hours, in particular during the night, but being careful to take into consideration difficulties and possible issues of involving the public in night-time drills.
- WG2 has to take up to develop an optimal sea level and seismic network design for the Area of Service (AoS) and work with Member States to fill identified gaps, including the strategic and coordinated submission of projects to the UN Ocean Decade and potential funding sources for support.

- TSPs routinely monitor as frequently as possible (at least every 6 months) the status of sea level and seismic observing networks and the quality of the data to meet existing and enhanced tsunami warning requirements in the AoS.
- sample sea level data at one-second intervals and transmit this in real-time, given the critical need to resolve and understand the near-field threat to high at-risk communities where a tsunami may arrive within 5-30 minutes.
- Utilise and promote the use of multi-purpose sea level monitoring stations to support MHEWS in enhancing data coverage and reducing costs.

5. CLOSING REMARKS

Mr Jijjavarapu Padmanabham provided closing remarks. He thanked the Working Group members, invited experts, observers, and the Secretariat for their participation and contributions in the intersessional meeting of Working Group 2. The Chair, Vice-Chairs and Secretariat will meet on 8 August 2024 to finalise the actions and recommendations arising during the meeting. Mr Padmanabham closed the meeting at

ANNEX 1: AGENDA

Intergovernmental Coordination Group (ICG)

Indian Ocean Tsunami Warning & Mitigation System (IOTWMS)

Working Group 2 on Tsunami Detection, Warning and Dissemination

7 August 2024

Chair: Mr Jijjavarapu Padmanabham (India)
Vice-Chair: Dr Robert Greenwood (Australia)
Vice-Chair: Mr Yedi Dermadi (Indonesia)

Time (UTC)	Agenda	Topic	Speaker
07:00 – 07:30	**1**	**Opening**	
	1.1	Welcome and Opening Remarks	Dr. Yuelong Miao (Vice-chair IOTWMS) & Mr. Padmanabham
	1.2	Adoption of Agenda	Mr. Padmanabham
	1.3	Terms of Reference and Membership	tbc
	1.4	Meeting Logistics	Ms Nora Gale
07:30 – 8:15	**2**	**Activity Updates**	
07:30 – 07:45	2.1	Report of the Chair	Mr. Padmanabham
07:45 – 08:00	2.2	Report of Secretariat	Ms. Nora Gale
08:00 – 08:10	2.3	TOWS TTTWO Report Feb 2024	Mr. Padmanabham
08:10 – 08:25	2.4	TSP Reports on Service Updates	TSP members (Australia, India, and Indonesia)
08:25 - 08:30	2.5	TSP Performance against KPIs for 2023/24	Dr. Robert Greenwood
08:30 – 8:45	**Group Photo & Break**		
08:45 - 08:55	2.6	IOTWMS Communication Tests 2023/24	Ms. Nora Gale

			(*ICG/IOTWMS Secretariat*)
08:55 - 09:10	2.7	Status of warning chains in the IOTWMS and discuss recommendations	Dr. Harald Spahn
09:10 – 09:20	2.8	NAVAREA Bulletin Implementation	Mr. Yedi
09:20 – 09:50	**3**	Workplan discussion and actions	All
09:50 – 09:55	**4**	Recommendations to 14th session of ICG/IOTWMS	All
09:55 – 10:00	**5**	Closing Remarks	Mr Padmanabham

ANNEX 2: PARTICIPANT LIST

Intergovernmental Coordination Group (ICG)

Indian Ocean Tsunami Warning & Mitigation System (IOTWMS)

Working Group 2 on Tsunami Detection, Warning and Dissemination

7 August 2024

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