

Intergovernmental Oceanographic Commission
Reports of Meetings of Experts and Equivalent Bodies



unesco

Working Group on Tsunamis and Other Hazards Related to Sea-Level Warning and Mitigation Systems (TOWS-WG)

Sixteenth Meeting

Paris, France

2–3 March 2023

UNESCO

Intergovernmental Oceanographic Commission
Reports of Meetings of Experts and Equivalent Bodies

**Working Group on Tsunamis
and Other Hazards Related
to Sea-Level Warning
and Mitigation Systems
(TOWS-WG)**

Sixteenth Meeting
Paris, France
2–3 March 2023

UNESCO 2023

IOC/TOWS-WG-XVI/3
Paris, May 2023
Original: English¹

¹ This document contains the Executive Summary in English, French, Spanish and Russian.

TABLE OF CONTENTS

	page
<i>Executive Summary</i>	(iii)
<i>Résumé analytique</i>	(vii)
<i>Resumen</i>	(xi)
<i>Рабочее Резюме</i>	(xvi)
1. OPENING AND WELCOME	1
1.1 OPENING	1
1.2 ADOPTION OF AGENDA	2
1.3 WORKING ARRANGEMENTS	3
2. REPORTS FROM PARTICIPANT BODIES	3
2.1 REPORT FROM IOC BODIES.....	3
2.1.1 Tsunami And Other Coastal Hazards Warning System For The Caribbean And Adjacent Regions (CARIBE-EWS)	3
2.1.2 Indian Ocean Tsunami Warning And Mitigation System (IOTWMS).....	4
2.1.3 Tsunami Early Warning And Mitigation System In The North-Eastern Atlantic, The Mediterranean And Connected Seas (NEAMTWS)	6
2.1.4 Pacific Tsunami Warning And Mitigation System (PTWS).....	7
2.1.5 International Oceanographic Data And Information Exchange (IODE).....	10
2.2 REPORT OF NON-IOC BODIES.....	12
2.2.1 World Tsunami Awareness Day (UNDRR)	12
2.2.2 World Meteorological Organization (WMO).....	14
2.2.3 International Union Of Geodesy And Geophysics (IUGG).....	17
2.2.4 International Hydrographic Organization (IHO).....	17
3. REVIEW OF PROGRESS	18
3.1 STATUS OF IMPLEMENTATION OF DECISION IOC-XXXI/3.4.1	18
4. REPORTS OF THE INTER-ICG TASK TEAMS	18
4.1 INTER-ICG TASK TEAM ON DISASTER MANAGEMENT AND PREPAREDNESS (TT-DMP)	18
4.2 INTER-ICG TASK TEAM ON TSUNAMI WATCH OPERATIONS	18
5. UN OCEAN DECADE TSUNAMI PROGRAMME	19
5.1 PRESENTATION AND ENDORSEMENT OF THE DRAFT 10-YEAR SCIENCE PLAN	19
5.2 REPORT ON THE PROGRESS OF THE TSUNAMI READY COALITION	19
5.3 REPORT OF THE DECADE COORDINATION UNIT	21

6.	OTHER ISSUES	22
7.	DATE AND PLACE OF THE NEXT MEETING	23
8.	CLOSURE OF MEETING	23

ANNEXES

I.	AGENDA
II.	DECISIONS AND RECOMMENDATIONS
III.	REPORT OF THE TOWS-WG INTER-ICG TASK TEAM ON DISASTER MANAGEMENT AND PREPAREDNESS
IV.	REPORT OF THE TOWS-WG INTER-ICG TASK TEAM ON TSUNAMI WATCH OPERATIONS
V.	LIST OF PARTICIPANTS
VI.	LIST OF ACRONYMS

Executive Summary

The Sixteenth Meeting of the Working Group on Tsunamis and Other Hazards Related to Sea-Level Warning and Mitigation Systems (TOWS-WG-XVI) was held in Paris, on 2–3 March 2023 under the Chairpersonship of Mr Alexander Frolov (IOC Vice-Chair). The meeting evaluated the progress made in respect to Decision IOC-31/3.4.1 of the IOC Assembly at its Thirty-first session (14–25 June 2021, online).

The Group expressed its solidarity with the people who are affected by the Türkiye-Syria earthquake on 6 February 2023.

The Group reviewed reports by the IOC Intergovernmental Coordination Groups (ICGs) as well as of the Task Team on Disaster Management and Preparedness (TT-DMP) and Task Team on Tsunami Watch Operations (TT-TWO).

The Group noted with appreciation the progress made during the intersessional period, including:

- (i) Wave exercises conducted in the Caribbean (CARIBE WAVE 22) and Pacific (PacWave 22) regions;
- (ii) Work of the *Ad Hoc* Teams on Meteotsunamis and Tsunamis Generated by Volcanoes under the TT TWO;
- (iii) Continuing expansion of capabilities and services of the Tsunami Service Providers (TSPs) for each region, especially with regards to tsunami events, and including development of new products and capabilities, such as for the maritime community and growing capability in response to tsunamis generated by non-seismic and complex events;
- (iv) Enhancements to monitoring and detection capabilities, such as growing use of GNSS data globally and installation of undersea cable systems (SMART) in the North-eastern Atlantic and Southwest Pacific Oceans;
- (v) the appointment of Dr Laura Kong, Director, International Tsunami Information Center (ITIC) as the Chair of the UNESCO/IOC Tsunami Ready Coalition);
- (vi) Continued progress in the implementation of UNESCO/IOC Tsunami Ready in the North-eastern Atlantic, the Mediterranean and connected seas, Indian Ocean, Pacific Ocean, and Caribbean and Adjacent regions;
- (vii) Efforts of the [Indian Ocean Tsunami Information Centre \(IOTIC\)](#) and [International Tsunami Information Centre \(ITIC\)](#) in preparing Tsunami Awareness, UNESCO/IOC Tsunami Ready and Tsunami Evacuation Maps, Plans and Procedures (TEMPP) training through the [Ocean Teacher Global Academy \(OTGA\)](#) platform and hybrid training workshops and training videos;
- (viii) Initiatives like [Hotel Resilient](#), as a benchmarking and certification of hotels and resorts for disaster risk management (multi-hazard including tsunami) and climate change adaptation, as well as the example for a major hotel in Waikiki, Hawaii, United States;
- (ix) Work of the Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System (ICG/PTWS) to develop a [National Tsunami Warning Centre \(NTWC\) Competency Framework](#) (2019), and the ITIC's leadership to pilot training courses based on the Framework;
- (x) Activities undertaken by the respective regions for [World Tsunami Awareness Day \(WTAD\)](#) 2022, and as part of this, the strong engagement in the

- [#GetToHighGround](#) Initiative, and the success achieved through United Nations Office of Disaster Risk Reduction (UNDRR) and IOC collaboration;
- (xi) Efforts of the Intergovernmental Coordination Group for the Tsunami and other Coastal Hazards Warning System for the Caribbean and Adjacent Regions (ICG/CARIBE-EWS) and the IOC Secretariat to coordinate and contribute to global initiatives related to Multi-Hazard Early Warning Systems (MHEWS);
 - (xii) Continuing collaboration with the International Union of Geodesy and Geophysics (IUGG), World Meteorological Organization (WMO), United Nations Office of Disaster Risk Reduction (UNDRR), International Hydrographic Organization (IHO), and International Maritime Organization (IMO);
 - (xiii) The ICG/PTWS for quick implementation of the Interim Hunga Tonga – Hunga Ha’apai (HTHH) Volcano Tsunami Response Procedures by 15 March 2022 ([Circular Letter 2882](#)).

The Group recommended continued collaboration between the UNESCO-IOC and the UNDRR, **noting** the 2023 WTAD theme will highlight the importance of fighting inequality for a resilient future and activities will include continuing the [#GetToHighGround](#) initiative and the [#TsunamiReady](#) to engage citizens on tsunami awareness. The theme aligns closely with the current focus of the TOWS-WG in the context of the UN Ocean Decade, The Mid-Term Review of the Sendai Framework, and action to accelerate the implementation of the [UN Early Warnings for All \(EW4All\) initiative](#) to ensure everyone on earth is covered by MHEWS in the next four years, prioritizing the most at-risk communities. **The Group requested** the UNDRR to strengthen collaboration with respective ICGs and corresponding Tsunami Information Centres (TICs).

The Group recommended the continued collaboration between the UNESCO-IOC and the World Meteorological Organization (WMO), highlighting the role that many National Meteorological and Hydrological Services (NMHS) have in tsunami early warning and the role that WMO plays in supporting the NMHS in this regard, especially as linked to infrastructure and communications.

The Group decided warning systems for tsunamis generated by volcanoes should be considered and coordinated as part of the UNESCO-IOC UNESCO/IOC Global tsunami and other Ocean-related Hazards Warning and Mitigation System (GOHWMS), and also when possible be part of a MHEWS.

The Group decided to organize a Scientific Symposium and recommended an Organizing Committee be composed of two Co-chairs nominated by the TT-TWO and TT-DMP, the Chair of the ODTP Scientific Committee, a representative from the Indonesian Agency for Meteorology, Climatology and Geophysics (BMKG), a representative of the IUGG-Joint Tsunami Commission, and a representative of each of the TICs. **The Group accepted** with appreciation the offer of the Government of the Republic of Indonesia to host the symposium in December 2024 as part of the plans by the Intergovernmental Coordination Group for the Indian Ocean Tsunami Warning and Mitigation System (ICG/IOTWMS) to commemorate the 20th Anniversary of the Indian Ocean Tsunami of 2004.

The Group decided to continue the *Ad Hoc* Team on Meteotsunamis to finalise its report; **recommended** that WMO experts be engaged to assist in this task; and **also acknowledged** that WMO requests the WMO-IOC Joint Collaborative Board to discuss tsunami related issues with respect to meteotsunami, to clarify the roles and responsibilities for the WMO and UNESCO/IOC, and how best to strengthen collaboration for supporting Member States.

The Group recommended that the IOC Assembly, at its 32nd Session in 2023, **endorse** the 10-Year Research, Development and Implementation Plan of the Ocean Decade Tsunami

Programme with the proposed modifications, including those proposed by the inter ICG Task Teams.

The Group recommended that the IOC Assembly at its 32nd session in 2023 instruct the regional ICGs to:

- (i) Encourage sea level data is sampled at one second intervals and with the highest available accuracy and transmitted in real-time as a matter of priority, given the critical need to resolve and understand the near-field threat to high at-risk communities where a tsunami generated by non-subduction earthquake sources as well as non-seismic sources (e.g. generated by volcanoes) may arrive in minutes;
- (ii) Encourage sea-level network operators to undertake regular and routine calibration of their sea-level monitoring instrumentation, following recommendations of IOC Manuals & Guides 3 and 14 (Volumes I–V);
- (iii) Routinely monitor the status of seismic and sea level related observing networks to identify and better help rectify gaps in coverage and free and open data exchange;
- (iv) Consider and implement the recommendations of the *Ad Hoc* Team on Tsunamis Generated by Volcanoes with respect to the hazard assessment, monitoring and warning requirements, including costs of deploying and maintaining such systems. Where identified tsunamis generated by volcanoes may impact multiple Member States, TSPs for the relevant ocean basin tsunami warning and mitigation systems should consider if they need to be involved in monitoring and provision of threat advice;
- (v) TSPs in collaboration with NAVAREA operators of the International Hydrographic Organization (IHO) test the tsunami maritime safety products in 2023/24, with a view to operationally implementing in 2024/25;
- (vi) Add the task to the Terms of Reference of the ICGs and TICs to facilitate the implementation and functioning of the UNESCO-IOC Tsunami Ready Recognition Programme;
- (vii) Add the role of ICGs in their Terms of Reference as regional Steering Committees for the ODTP;
- (viii) Undertake sub-regional exercises as part of WAVE Exercises as an efficient way to further engage Member States on exercises as appropriate;
- (ix) Follow the initiative of ICG/PTWS to enable sub-regional live information sharing during tsunami events to inform neighbouring country decision-making;
- (x) Explore and inform the TOWS-WG TT-DMP on mechanisms for recognition of UNESCO-IOC Tsunami Ready similar standards which are already in place in some countries;
- (xi) Caribbean Tsunami Information Centre (CTIC) to share UNESCO/IOC Tsunami Ready survey questionnaire and feedback forms on implementation process to receive information from the UNESCO/IOC Tsunami Ready communities;
- (xii) Encourage the standard text in the UNESCO-IOC Tsunami Ready signage for vertical evacuation, such as “Go to the designated building for vertical evacuation”;
- (xiii) Properly inform the public on the validity of the recognition, as indicated on the UNESCO-IOC Tsunami Ready signage and certificate under the UNESCO-IOC Tsunami Ready logo; and instructs;

- (xiv) ITIC to pilot the Draft PTWS [National Tsunami Warning Centre \(NTWC\) Competency Framework](#) (2019) for endorsement by ICG/PTWS with the goal to develop a global framework for all ICGs to use.

The Group recommended that the IOC Assembly at its 32nd session in 2023 **request** the IOC Secretariat to:

- (i) Provide a timelier update of the UNESCO-IOC Tsunami Ready database;
- (ii) Explore how to develop an automated application system for UNESCO-IOC Tsunami Ready application and renewal;
- (iii) Enhance the renewal process of UNESCO-IOC Tsunami Ready and learning about the renewal experience in the United States TsunamiReady® program;
- (iv) Facilitate the finalization of the OTGA basic tsunami training materials as soon as possible to support the UNESCO-IOC Tsunami Ready programme;
- (v) Develop a paper on the tsunami threat on coasts along the Southern Atlantic Ocean to assist concerned Member States of IOC on the decision to be part of the global Tsunami Warning and Mitigation System;
- (vi) Help inform Member States widely on the potential tsunami hazard from volcanoes:
 - Publish the Tsunamis Generated by Volcanoes Report as an UNESCO-IOC publication in 2023;
 - Distribute the Tsunamis Generated by Volcanoes Report, including the List of Tsunamigenic Volcanoes to Volcano Observatories;
 - Distribute the Tsunamis Generated by Volcanoes Report, including the List of Tsunamigenic Volcanoes to UNESCO-IOC Member States.

Résumé analytique

La 16^e réunion du Groupe de travail sur les systèmes d'alerte aux tsunamis et autres aléas liés au niveau de la mer, et de mitigation (TOWS-WG-XVI) s'est tenue à Paris les 2 et 3 mars 2023, sous la présidence de M. Alexander Frolov (Vice-Président de la COI). Les participants à la réunion ont évalué les progrès réalisés concernant la décision IOC-31/3.4.1 adoptée par l'Assemblée de la COI à sa 31^e session (14-25 juin 2021, en ligne).

Le Groupe a exprimé sa solidarité à l'égard des personnes frappées par le séisme survenu en Türkiye et en Syrie le 6 février 2023.

Le Groupe a examiné les rapports des groupes intergouvernementaux de coordination (GIC) de la COI ainsi que ceux des Équipes spéciales sur la gestion et la préparation en cas de catastrophe (TT-DMP) et sur les opérations de veille aux tsunamis (TT-TWO).

Le Groupe a pris note avec satisfaction des progrès accomplis au cours de la période intersessions, notamment :

- (i) les exercices de préparation aux tsunamis menés dans les régions des Caraïbes (CARIBE WAVE 22) et du Pacifique (PacWave 22) ;
- (ii) les travaux de deux équipes ad hoc sur les tsunamis météorologiques et les tsunamis d'origine volcanique dans le cadre de la TT-TWO ;
- (iii) la poursuite de l'élargissement des compétences et des services des prestataires de services relatifs aux tsunamis (TSP) de chaque région, en particulier en ce qui concerne la survenue de tsunamis, et notamment l'élaboration de nouveaux produits et l'enseignement de nouvelles compétences, par exemple au profit du secteur maritime et du renforcement des capacités de réaction aux tsunamis générés par des phénomènes complexes et non sismiques ;
- (iv) l'amélioration des capacités de surveillance et de détection, par exemple l'utilisation croissante des données du Système mondial de navigation par satellite (GNSS) à l'échelle mondiale et l'installation de systèmes de câbles sous-marins de surveillance scientifique et de télécommunication fiable (SMART) dans l'Atlantique du Nord-Ouest et le Pacifique Sud-Ouest ;
- (v) la nomination de Mme Laura Kong, Directrice du Centre international d'information sur les tsunamis (CIIT) en tant que Présidente de la coalition Tsunami Ready de la COI ;
- (vi) la poursuite de la mise en œuvre du programme Tsunami Ready de la COI dans les régions de l'Atlantique du Nord-Est, de la Méditerranée et des mers adjacentes, de l'océan Indien, de l'océan Pacifique ainsi que de la mer des Caraïbes et des régions adjacentes ;
- (vii) les efforts déployés par le [Centre d'information sur les tsunamis dans l'océan Indien \(IOTIC\)](#) et le [CIIT](#) pour préparer une formation sur la sensibilisation aux tsunamis, le programme Tsunami Ready et les cartes, plans et procédures d'évacuation en cas de tsunami par le biais de la plate-forme [Académie mondiale OceanTeacher](#) et pour proposer des formations et des ateliers hybrides ainsi que des vidéos de formation ;
- (viii) des initiatives telles que « [Hotel Resilient](#) », un outil d'évaluation comparative et de certification des hôtels et des centres de villégiature portant sur la gestion des risques de catastrophe (multialéas, y compris les tsunamis) et l'adaptation au changement climatique, ainsi que l'exemple donné par un grand hôtel situé à Waikiki, à Hawaï (États-Unis) ;
- (ix) les travaux menés par le GIC du Système d'alerte aux tsunamis et de mitigation dans le Pacifique (GIC/PTWS) en vue de mettre en place un [référentiel de](#)

compétences destiné aux centres nationaux d'alerte aux tsunamis (NTWC) (2019) et le rôle de chef de file joué par le CIIT dans la mise à l'essai des cours de formation basés sur ce référentiel ;

- (x) les activités entreprises par les différentes régions à l'occasion de la [Journée mondiale de sensibilisation aux tsunamis 2022](#), et dans ce cadre, la forte participation à l'initiative [#GetToHighGround](#) ([#RéfugiezVousEnHauteur](#)) et les résultats obtenus grâce à la collaboration entre le Bureau des Nations Unies pour la prévention des catastrophes (UNDRR) et la COI ;
- (xi) les efforts déployés par le GIC du Système d'alerte aux tsunamis et autres risques côtiers dans la mer des Caraïbes et les régions adjacentes (GIC/CARIBE-EWS) et le Secrétariat de la COI pour coordonner les initiatives mondiales relatives aux systèmes d'alerte précoce multidangères (MHEWS) et y contribuer ;
- (xii) la poursuite de la collaboration avec l'Union géodésique et géophysique internationale (UGGI), l'Organisation météorologique mondiale (OMM), l'UNDRR, l'Organisation hydrographique internationale (OHI) et l'Organisation maritime internationale (OMI) ;
- (xiii) la mise en œuvre rapide par le GIC/PTWS des procédures provisoires d'intervention en cas de tsunami consécutif à l'éruption du volcan Hunga Tonga – Hunga Ha'apai à compter du 15 mars 2022 ([lettre circulaire n° 2882](#)).

Le Groupe a recommandé de poursuivre la collaboration entre la COI et l'UNDRR, **notant** que le thème de la Journée mondiale de sensibilisation aux tsunamis 2023 soulignerait l'importance de lutter contre les inégalités pour assurer un avenir résilient et que les activités comprendraient la poursuite des campagnes [#GetToHighGround](#) et [#TsunamiReady](#), dont l'objectif était d'interagir avec les citoyens sur la sensibilisation aux tsunamis. Ce thème coïncide étroitement avec l'objectif actuel du TOWS-WG dans le contexte de la Décennie des Nations Unies pour les sciences océaniques au service du développement durable, de l'examen à mi-parcours du Cadre de Sendai et des actions visant à accélérer la mise en œuvre de [l'initiative des Nations Unies « Alertes précoces pour tous »](#) afin de veiller à ce que tous les habitants de la planète soient couverts par un MHEWS au cours des quatre prochaines années, en accordant la priorité aux populations les plus à risque. **Le Groupe a prié l'UNDRR** de renforcer la collaboration avec les GIC concernés et les centres d'information sur les tsunamis (CIT) correspondants.

Le Groupe a recommandé la poursuite de la collaboration entre la COI et l'OMM, en mettant l'accent sur le rôle que de nombreux services météorologiques et hydrologiques nationaux (SMHN) jouaient dans l'alerte rapide aux tsunamis, ainsi que sur l'aide que leur apportait l'OMM dans ce domaine, notamment concernant les infrastructures et les communications.

Le Groupe a décidé que les systèmes d'alerte aux tsunamis d'origine volcanique devraient être étudiés et coordonnés dans le cadre du Système mondial d'alerte rapide aux tsunamis et autres aléas liés aux océans de la COI ainsi que, dans la mesure du possible, être intégrés à un MHEWS.

Le Groupe a décidé d'organiser un colloque scientifique et a recommandé de constituer un comité d'organisation composé de deux co-Présidents nommés par la TT-TWO et la TT-DMP, du Président du Comité scientifique du Programme relatif aux tsunamis de la Décennie de l'Océan, d'un représentant de la Commission mixte sur les tsunamis de l'UGGI et d'un représentant de chacun des CIT. **Le Groupe a accepté** avec gratitude la proposition du Gouvernement de la République d'Indonésie d'accueillir le colloque en décembre 2024, dans le cadre du projet du GIC du Système d'alerte aux tsunamis et de mitigation dans l'océan Indien (GIC/IOTWMS) de commémorer les 20 ans du tsunami survenu dans l'océan Indien en 2004.

Le Groupe a décidé que l'équipe ad hoc sur les tsunamis météorologiques poursuivrait ses travaux afin de finaliser son rapport ; **a recommandé** de faire appel à des experts de l'OMM pour l'épauler dans cette tâche ; et **a également pris acte** de la demande de l'OMM au Conseil collaboratif mixte OMM-COI d'examiner les questions liées aux tsunamis que posaient les tsunamis météorologiques, de clarifier les rôles et les responsabilités de l'OMM et de la COI et de déterminer la meilleure façon de renforcer la collaboration au service des États membres.

Le Groupe a recommandé que l'Assemblée de la COI, à sa 32^e session en 2023, **approuve** le plan décennal de recherche, de développement et de mise en œuvre du Programme relatif aux tsunamis de la Décennie de l'Océan ainsi que les modifications proposées, y compris celles suggérées par les équipes spéciales inter-GIC.

Le Groupe a également recommandé que l'Assemblée de la COI, à sa 32^e session en 2023, donne instruction aux GIC régionaux :

- (i) d'encourager le relevé de données sur le niveau de la mer à intervalles d'une seconde, avec la plus grande précision possible, et leur transmission prioritaire en temps réel, compte tenu de la nécessité impérieuse de résoudre et de comprendre la menace en champ proche planant sur les populations à haut risque d'être frappées en quelques minutes par un tsunami d'origine sismique hors subduction ou par un tsunami d'origine non sismique (par exemple, consécutif à une éruption volcanique) ;
- (ii) d'encourager les opérateurs des réseaux d'observation du niveau de la mer à procéder à un étalonnage régulier et systématique de leurs instruments de surveillance du niveau de la mer, conformément aux recommandations des Manuels et guides de la COI n° 3 et n° 14 (volume I à V) ;
- (iii) de contrôler régulièrement l'état des réseaux sismiques et d'observation du niveau de la mer afin de repérer les lacunes en matière de couverture et d'échange libre et gratuit de données, et de mieux contribuer à combler ces lacunes ;
- (iv) de prendre en considération et d'appliquer les recommandations formulées par l'équipe ad hoc sur les tsunamis d'origine volcanique concernant les exigences en matière d'évaluation des aléas, de surveillance et d'alerte, y compris les coûts de déploiement et de maintenance de ces systèmes ; lorsqu'un tsunami volcanique détecté est susceptible de frapper plusieurs États membres, il faut que les TSP des systèmes d'alerte aux tsunamis et de mitigation des bassins océaniques concernés déterminent s'ils doivent participer à la surveillance et à la diffusion de consignes de sécurité ;
- (v) de veiller à ce que les TSP, en collaboration avec les opérateurs des zones NAVAREA de l'OHI, contrôlent les produits de sécurité maritime relatifs aux tsunamis en 2023-2024, en vue de leur mise en œuvre opérationnelle en 2024-2025 ;
- (vi) d'ajouter au mandat des GIC et des CIT une disposition sur la facilitation de la mise en œuvre et du fonctionnement du programme de certification Tsunami Ready de la COI ;
- (vii) d'ajouter au mandat des GIC une disposition concernant leur rôle en tant que comités directeurs régionaux du Programme relatif aux tsunamis de la Décennie de l'Océan ;
- (viii) de mener des exercices sous-régionaux dans le cadre des exercices de préparation aux tsunamis afin de renforcer efficacement la participation des États membres à ces exercices, selon que de besoin ;

- (ix) de suivre l'initiative du GIC/PTWS sur la diffusion sous-régionale d'informations en temps réel lors de tsunamis, laquelle vise à aider les pays voisins à prendre des décisions ;
- (x) d'étudier les mécanismes de certification des normes similaires à celles du programme Tsunami Ready de la COI déjà en place dans certains pays et d'en rendre compte à la TT-DMP du TOWS-WG ;
- (xi) de veiller à ce que le Centre d'information sur les tsunamis dans les Caraïbes (CTIC) diffuse le questionnaire et les formulaires de retour d'information sur le processus de mise en œuvre du programme Tsunami Ready de la COI afin de disposer de données sur les communautés Tsunami Ready de la COI ;
- (xii) d'encourager l'utilisation du texte type sur la signalétique d'évacuation verticale du programme Tsunami Ready de la COI, tel que « Se rendre vers le site d'évacuation verticale désigné à cet effet » ;
- (xiii) d'informer correctement le grand public sur la validité de la certification, indiquée sur la signalétique et le certificat Tsunami Ready de la COI portant le logo Tsunami Ready de la COI ;
- (xiv) et donne instruction à l'ITIC de mettre à l'essai le projet de [référentiel de compétences du PTWS destiné aux NTWC](#) (2019) en vue de son approbation par le GIC/PTWS, dans l'objectif d'élaborer un référentiel mondial qui serait utilisé par tous les GIC.

Le Groupe a recommandé que l'Assemblée de la COI, à sa 32^e session en 2023, **prie** le Secrétariat de la COI :

- (i) d'actualiser la base de données Tsunami Ready de la COI ;
- (ii) d'envisager la conception d'un système automatisé de candidature et de renouvellement pour le programme Tsunami Ready de la COI ;
- (iii) de simplifier le processus de renouvellement de la certification Tsunami Ready de la COI et de s'informer sur la façon dont le renouvellement s'effectue dans le cadre du programme TsunamiReady® des États-Unis ;
- (iv) de faciliter la finalisation dans les plus brefs délais des supports de formation de base sur les tsunamis de l'Académie mondiale OceanTeacher afin de venir appuyer le programme Tsunami Ready de la COI ;
- (v) de rédiger un document sur la menace de tsunami qui pèse sur les côtes de l'Atlantique Sud afin d'aider les États membres de la COI concernés à statuer sur leur adhésion au système mondial d'alerte aux tsunamis et de mitigation ;
- (vi) de contribuer à informer amplement les États membres sur l'aléa tsunami d'origine volcanique :
 - de publier en 2023 le rapport sur les tsunamis d'origine volcanique en tant que publication de la COI ;
 - de communiquer aux observatoires des volcans le rapport sur les tsunamis d'origine volcanique, dont la liste des volcans tsunamigènes ;
 - de communiquer aux États membres de la COI le rapport sur les tsunamis d'origine volcanique, dont la liste des volcans tsunamigènes.

Resumen

La 16ª reunión del Grupo de Trabajo sobre los Sistemas de Alerta contra los Tsunamis y Otros Peligros relacionados con el Nivel del Mar y Atenuación de sus Efectos (TOWS-WG-XVI) se celebró en París los días 2 y 3 de marzo de 2023, bajo la presidencia del Sr. Alexander Frolov (Vicepresidente de la COI). En la reunión se evaluaron los progresos realizados con respecto a la decisión IOC-31/3.4.1, adoptada por la Asamblea de la COI en su 31ª reunión (celebrada en línea del 14 al 25 de junio de 2021).

El Grupo expresó su solidaridad con las personas afectadas por el terremoto de Türkiye y Siria del 6 de febrero de 2023.

El Grupo examinó informes de los grupos intergubernamentales de coordinación de la COI, así como del Equipo de Trabajo sobre Gestión de Desastres y Preparación (TT-DMP) y el Equipo de Trabajo sobre Operaciones de Vigilancia de los Tsunamis (TT-TWO).

El Grupo tomó nota con aprecio de los progresos realizados durante el periodo entre reuniones, a saber:

- i) los ejercicios de preparación para los tsunamis efectuados en las regiones del Caribe (CARIBE WAVE 22) y del Pacífico (PacWave 22);
- ii) la labor de los equipos especiales sobre tsunamis meteorológicos y sobre tsunamis generados por volcanes en el marco del TT-TWO;
- iii) el aumento continuo de las capacidades y servicios de los proveedores de servicios sobre tsunamis (TSP) para cada región, especialmente en lo que respecta a los casos de tsunami, incluida la creación de nuevos productos y capacidades, como por ejemplo para la comunidad marítima, y la capacidad reforzada de respuesta a tsunamis generados por fuentes no sísmicas y complejas;
- iv) la mejora de las capacidades de vigilancia y detección, como el uso cada vez mayor de datos de GNSS a escala mundial y la instalación de sistemas de cables submarinos (SMART) en el Atlántico Nororiental y el Pacífico Sudoccidental;
- v) el nombramiento de la Dra. Laura Kong, Directora del Centro Internacional de Información sobre los Tsunamis (ITIC), Presidenta de la Coalición Tsunami Ready de la COI/UNESCO;
- vi) los progresos constantes en la ejecución de Tsunami Ready de la COI/UNESCO en las regiones del Atlántico Nororiental, el Mediterráneo y los mares adyacentes, el Océano Índico, el Océano Pacífico, y el Caribe y las regiones adyacentes;
- vii) los esfuerzos del [Centro de Información sobre los Tsunamis en el Océano Índico \(IOTIC\)](#) y del [Centro Internacional de Información sobre los Tsunamis \(ITIC\)](#) para preparar formación acerca de la concienciación sobre los tsunamis, Tsunami Ready de la COI/UNESCO, y los mapas, planes y procedimientos de evacuación en caso de tsunami (TEMPP) por conducto de la plataforma de la [Academia Mundial OceanTeacher](#), así como talleres de formación híbridos y vídeos de formación;
- viii) iniciativas como [Hotel Resilient](#) para la evaluación comparativa y la certificación de hoteles y complejos turísticos en cuanto a la gestión del riesgo de desastres (peligros múltiples, incluidos tsunamis) y la adaptación al cambio climático, así como el ejemplo de un gran hotel en Waikiki, Hawai (Estados Unidos);

- ix) el trabajo del Grupo Intergubernamental de Coordinación del Sistema de Alerta contra los Tsunamis y Atenuación de sus Efectos en el Pacífico (ICG/PTWS) para elaborar un [marco de competencias para los centros nacionales de alerta contra los tsunamis \(NTWC\)](#) (2019), y el liderazgo del ITIC para organizar cursos de formación basados en ese marco;
- x) las actividades emprendidas por las diferentes regiones para el [Día Mundial de Concienciación sobre los Tsunamis](#) en 2022 y, como parte de ello, el firme compromiso en favor de la iniciativa [#GetToHighGround](#), y los buenos resultados logrados gracias a la colaboración de la Oficina de las Naciones Unidas para la Reducción del Riesgo de Desastres (UNDRR) y la COI;
- xi) los esfuerzos del Grupo Intergubernamental de Coordinación del Sistema de Alerta contra los Tsunamis y otras Amenazas Costeras en el Caribe y Regiones Adyacentes (ICG/CARIBE-EWS) y la Secretaría de la COI para coordinar iniciativas mundiales relacionadas con los sistemas de alerta temprana de peligros múltiples (MHEWS) y contribuir a ellas;
- xii) la colaboración permanente con la Unión Internacional de Geodesia y Geofísica (UIGG), la Organización Meteorológica Mundial (OMM), la Oficina de las Naciones Unidas para la Reducción del Riesgo de Desastres (UNDRR), la Organización Hidrográfica Internacional (OHI) y la Organización Marítima Internacional (OMI);
- xiii) la rápida aplicación por el ICG/PTWS de procedimientos provisionales para responder al tsunami del volcán Hunga Tonga-Hunga Ha'apai (HTHH) el 15 de marzo de 2022 (véase la [circular 2882](#) de la COI).

El Grupo recomendó que se mantuviera la colaboración entre la COI/ UNESCO y la UNDRR, **observando** que el tema del Día Mundial de Concienciación sobre los Tsunamis de 2023 pondría de relieve la importancia de luchar contra la desigualdad para un futuro resiliente y que las actividades incluirían la continuación de la iniciativa [#GetToHighGround](#) y [#TsunamiReady](#) a fin de involucrar a los ciudadanos en la concienciación sobre los tsunamis. El tema está estrechamente vinculado con el enfoque actual del TOWS-WG en el contexto del Decenio del Océano de las Naciones Unidas, el examen de mitad de periodo del Marco de Sendái, y la acción para acelerar la ejecución de la [iniciativa Alertas Tempranas para Todos de las Naciones Unidas](#) con miras a garantizar que todos los habitantes de la Tierra estén cubiertos por MHEWS en los próximos cuatro años, dando prioridad a las comunidades en mayor riesgo. **El Grupo pidió** a la UNDRR que reforzara la colaboración con los grupos intergubernamentales de coordinación respectivos y los centros de información sobre los tsunamis correspondientes.

El Grupo recomendó que se mantuviera la colaboración entre la COI/ UNESCO y la Organización Meteorológica Mundial (OMM) y destacó la función que desempeñan muchos servicios meteorológicos e hidrológicos nacionales (SMHN) en la alerta temprana contra los tsunamis, así como el papel que cumple la OMM en el apoyo a los SMHN en este sentido, especialmente en lo relacionado con las infraestructuras y las comunicaciones.

El Grupo decidió que los sistemas de alerta contra tsunamis generados por volcanes deberían considerarse y coordinarse como parte del sistema mundial de alerta temprana contra los tsunamis y otros peligros oceánicos de la COI/UNESCO (GOHWMS), y también, cuando sea posible, formar parte de un MHEWS.

El Grupo decidió organizar un simposio científico y recomendó que se creara un comité organizador compuesto por dos copresidentes, nombrados por el TT-TWO y el TT-DMP, el Presidente del Comité Científico del Programa de Tsunamis del Decenio del Océano, un representante de la Agencia Indonesia de Meteorología, Climatología y Geofísica (BMKG),

un representante de la Comisión Conjunta sobre Tsunamis de la Unión Internacional de Geodesia y Geofísica (IUGG) y un representante de cada uno de los centros de información sobre tsunamis. **El Grupo aceptó** con reconocimiento la oferta del Gobierno de la República de Indonesia de acoger el simposio en diciembre de 2024 como parte de los planes del Grupo Intergubernamental de Coordinación del Sistema de Alerta contra los Tsunamis y Atenuación de sus Efectos en el Océano Índico (ICG/IOTWMS) para conmemorar el 20º aniversario del tsunami del Océano Índico de 2004.

El Grupo decidió mantener el equipo especial sobre tsunamis meteorológicos para que finalizara su informe; **recomendó** que se involucrara a expertos de la OMM para que prestaran su ayuda en esa labor; y **reconoció además** que la OMM solicitaba a la Junta Mixta de Colaboración OMM/COI que debatiera cuestiones acerca de los tsunamis relativos a los tsunamis meteorológicos, aclarara las funciones y responsabilidades de la OMM y la COI/UNESCO, y definiera la mejor manera de fortalecer la colaboración para apoyar a los Estados Miembros.

El Grupo recomendó que la Asamblea de la COI, en su 32ª reunión en 2023, **aprobara** el plan decenal de investigación, desarrollo y ejecución del Programa de Tsunamis del Decenio del Océano con las modificaciones propuestas, comprendidas las presentadas por los equipos de trabajo de los grupos intergubernamentales de coordinación.

El Grupo recomendó que la Asamblea de la COI, en su 32ª reunión en 2023, encomendara a los grupos intergubernamentales de coordinación regionales lo siguiente:

- i) promover que los datos sobre el nivel del mar se muestreen a intervalos de un segundo y con la mayor precisión posible, y se transmitan en tiempo real con carácter prioritario, dada la necesidad crítica de resolver y comprender la amenaza de origen cercano para las comunidades de alto riesgo, donde un tsunami generado por fuentes sísmicas de no subducción, así como por fuentes no sísmicas (por ejemplo, volcanes), puede llegar en cuestión de minutos;
- ii) alentar a los operadores de la red de medición del nivel del mar a realizar una calibración periódica y rutinaria de sus instrumentos de observación del nivel del mar, siguiendo las recomendaciones formuladas en el nº 3 y el nº 14 (volúmenes I-V) de la colección Manuales y guías de la COI;
- iii) supervisar de forma sistemática el estado de las redes sísmicas y de observación del nivel del mar para detectar las lagunas en materia de cobertura y de intercambio de datos libre y abierto, y contribuir a colmarlas;
- iv) tener en cuenta y aplicar las recomendaciones del equipo especial sobre tsunamis generados por volcanes con respecto a los requisitos de evaluación de los peligros, vigilancia y alerta, incluidos los costos de instalación y mantenimiento de sistemas de ese tipo. Cuando se detecten tsunamis generados por volcanes que puedan afectar a varios Estados Miembros, los proveedores de servicios sobre tsunamis de los sistemas de alerta contra los tsunamis y atenuación de sus efectos de las cuencas oceánicas pertinentes deberán evaluar si es necesario que participen en la vigilancia y el suministro de asesoramiento sobre amenazas;
- v) velar por que los proveedores de servicios sobre tsunamis, en colaboración con los operadores de las zonas NAVAREA de la Organización Hidrográfica Internacional (OHI), prueben los productos de seguridad marítima frente a tsunamis en 2023-2024, con vistas a su aplicación práctica en 2024-2025;
- vi) incluir en el mandato de los grupos de coordinación intergubernamentales y los centros de información sobre los tsunamis la tarea de facilitar la aplicación y el

- funcionamiento del programa de acreditación Tsunami Ready de la COI/UNESCO;
- vii) incluir en los mandatos de los grupos de coordinación intergubernamentales la función de comités de dirección regionales para el Programa de Tsunamis del Decenio del Océano;
 - viii) realizar ejercicios subregionales en el marco de los ejercicios de preparación para los tsunamis, como un medio eficaz de implicar aún más a los Estados Miembros en los ejercicios, según proceda;
 - ix) adoptar la iniciativa del ICG/PTWS de permitir el intercambio subregional de información en directo durante los tsunamis para fundamentar la toma de decisiones de los países vecinos;
 - x) estudiar mecanismos para reconocer programas similares a Tsunami Ready de la COI/UNESCO ya existentes en algunos países, e informar al TT-DMP del TOWS-WG;
 - xi) velar por que el Centro de Información sobre los Tsunamis del Caribe (CTIC) comparta el cuestionario de Tsunami Ready de la COI/UNESCO y los formularios de observaciones sobre el proceso de aplicación para recibir información de las comunidades Tsunami Ready de la COI/UNESCO;
 - xii) promover el texto estándar de la señalización de Tsunami Ready de la COI/UNESCO para la evacuación vertical, como “diríjase al edificio designado para la evacuación vertical”;
 - xiii) informar adecuadamente al público sobre la validez de la acreditación, como se indica en la señalización y el certificado de Tsunami Ready de la COI/UNESCO debajo del logotipo de Tsunami Ready de la COI/UNESCO; y encargó que:
 - xiv) el ITIC pusiera a prueba el proyecto de [marco de competencias para los centros nacionales de alerta contra los tsunamis \(NTWC\)](#) (2019) del PTWS para que el ICG/PTWS lo apruebe, con el objetivo de elaborar un marco global que usen todos los grupos de coordinación intergubernamentales.

El Grupo recomendó que la Asamblea de la COI, en su 32ª reunión en 2023, **pidiera** a la Secretaría de la COI lo siguiente:

- i) proporcionar una actualización más oportuna de la base de datos de Tsunami Ready de la COI/UNESCO;
- ii) estudiar cómo elaborar un sistema automatizado de solicitud y renovación de la acreditación Tsunami Ready de la COI/UNESCO;
- iii) mejorar el proceso de renovación de la acreditación Tsunami Ready de la COI/UNESCO e informarse sobre la experiencia en materia de renovación del programa TsunamiReady® en los Estados Unidos;
- iv) facilitar la finalización de los materiales básicos de formación sobre tsunamis de la Academia Mundial OceanTeacher lo antes posible para apoyar el programa Tsunami Ready de la COI/UNESCO;
- v) preparar un documento sobre la amenaza de tsunamis en las costas del Océano Atlántico meridional para ayudar a los Estados Miembros de la COI interesados a tomar la decisión de formar parte del sistema mundial de alerta contra los tsunamis y atenuación de sus efectos;
- vi) ayudar a informar ampliamente a los Estados Miembros sobre el posible riesgo de tsunamis provocados por volcanes de las maneras siguientes:

- publicar el Informe sobre tsunamis generados por volcanes como publicación de la COI/UNESCO en 2023;
- distribuir el Informe sobre tsunamis generados por volcanes, incluida la lista de volcanes tsunamigénicos, a los observatorios de volcanes;
- distribuir el Informe sobre tsunamis generados por volcanes, incluida la lista de volcanes tsunamigénicos, a los Estados Miembros de la COI de la UNESCO.

Рабочее резюме

Шестнадцатое совещание рабочей группы по системам предупреждения и смягчения последствий цунами и других опасных явлений, связанных с изменением уровня моря (РГ-СПЦО-XVI), состоялось 2-3 марта 2023 г. в Париже под председательством г-на Александра Фролова (заместителя председателя МОК). В ходе совещания было проанализировано выполнение решения ЮС-31/3.4.1, принятого Ассамблеей МОК на ее 31-й сессии (14-25 июня 2021 г., онлайн-формат).

Группа выразила солидарность с пострадавшими от землетрясения, произошедшего в Турции и Сирии 6 февраля 2023 г.

Группа рассмотрела доклады межправительственных координационных групп (МКГ) МОК, а также целевой группы по предупреждению и ликвидации последствий бедствий и обеспечению готовности к ним (ЦГЛПГ) и целевой группы по наблюдениям за цунами (ЦГНЦ).

Группа с удовлетворением приняла к сведению информацию о проведенной в межсессионный период работе, в частности о:

- (i) проведении учений в регионах Карибского бассейна («Карибская волна-2022») и Тихого океана («Тихоокеанская волна-2022»);
- (ii) работе специальных групп по цунами метеорологического происхождения и цунами, возникающим в результате извержений вулканов, в рамках целевой группы по наблюдениям за цунами (ЦГНЦ);
- (iii) дальнейшем расширении возможностей и услуг поставщиков данных слежения за цунами (ПДСЦ) для каждого региона, особенно в отношении связанных с цунами событий, включая разработку новых продуктов и технологий, например, для морского сообщества, и укрепление потенциала реагирования на цунами, возникающие в результате несейсмических и комплексных явлений;
- (iv) укреплении потенциала в области мониторинга и обнаружения цунами, например, путем расширения использования на глобальном уровне данных глобальной навигационной спутниковой системы (ГНСС) и установки подводных кабельных систем (SMART) в северо-восточной части Атлантического и юго-западной части Тихого океанов;
- (v) назначении директора Международного центра информации о цунами (МЦИЦ) д-ра Лауры Конг председателем коалиции МОК ЮНЕСКО в поддержку обеспечения готовности к цунами;
- (vi) дальнейшем прогрессе в осуществлении программы МОК ЮНЕСКО по сертификации готовности к цунами в Северо-Восточной части Атлантического океана, Средиземном и прилегающих морях, Индийском океане, Тихом океане, Карибском бассейне и прилегающих регионах;
- (vii) подготовке [Центром информации о цунами в Индийском океане \(ЦИЦИО\)](#) и [Международным центром информации о цунами \(МЦИЦ\)](#) с использованием платформы [Глобальной академии «Океан-инструктор» \(ГАОИ\)](#) учебных курсов по повышению осведомленности о цунами, осуществлению программы МОК ЮНЕСКО по сертификации готовности к цунами и разработке карт, планов и процедур эвакуации в случае цунами (КППЭЦ), а также учебных семинаров в гибридном формате и учебных видеоматериалов;

- (viii) реализации таких инициатив, как «[Устойчивые отели](#)», которая направлена на проведение сравнительного анализа и сертификацию отелей и курортов в интересах управления рисками стихийных бедствий (различных видов, включая цунами) и адаптации к изменению климата, на примере крупного отеля в Вайкики, Гавайи (США);
- (ix) разработке в 2019 г. межправительственной координационной группой по системе предупреждения о цунами и смягчения их последствий в Тихом океане (МКГ/СПЦТО) [рамочных требований к уровню компетентности сотрудников национальных центров предупреждения о цунами \(НЦПЦ\)](#), а также проведение под руководством МЦИЦ экспериментальных учебных курсов на основе этих рамочных требований;
- (x) осуществлении в соответствующих регионах мероприятий по случаю [Всемирного дня распространения информации о проблеме цунами 2022 г.](#), в том числе об активном участии в реализации инициативы [#GetToHighGround](#) («Доберись до высокого места»), и успешном сотрудничестве между Управлением Организации Объединенных Наций по снижению риска бедствий (УСРБ ООН) и МОК;
- (xi) работе межправительственной координационной группы по системе предупреждения о цунами и опасности других бедствий в прибрежных районах Карибского бассейна и прилегающих регионов (МКГ/КАРИБ-СРП) и секретариата МОК по координации и содействию реализации глобальных инициатив, касающихся систем раннего оповещения о многих опасных явлениях (СРОМОЯ);
- (xii) дальнейшем сотрудничестве с Международным геодезическим и геофизическим союзом (МГГС), Всемирной метеорологической организацией (ВМО), Управлением Организации Объединенных Наций по снижению риска бедствий (УСРБ ООН), Международной гидрографической организацией (МГО) и Международной морской организацией (ИМО);
- (xiii) оперативном внедрении МКГ/СПЦТО к 15 марта 2022 г. временных процедур реагирования в связи с цунами, вызванным извержением вулкана Хунга-Тонга-Хунга-Хаапай (ХТХХ) ([циркулярное письмо N°2882](#)).

Группа рекомендовала продолжать сотрудничество между МОК ЮНЕСКО и УСРБ ООН, **отметив**, что тема Всемирного дня распространения информации о проблеме цунами 2023 г. позволит привлечь внимание к значению борьбы с неравенством в интересах устойчивого будущего, а в числе приуроченных мероприятий продолжится осуществление таких инициатив, как [#GetToHighGround](#) и [#TsunamiReady](#) для повышения осведомленности граждан о цунами. Эта тема тесно связана с текущей работой РГ-СПЦО в контексте Десятилетия океана ООН, среднесрочного обзора Сендайской рамочной программы и действий по ускорению осуществления [инициативы ООН «Раннее оповещение для всех»](#) в целях обеспечения в ближайшие четыре года каждому человеку на Земле защиты с помощью СРОМОЯ с приоритетным вниманием к подверженным наибольшему риску общинам. **Группа обратилась** к УСРБ ООН с просьбой активизировать сотрудничество с соответствующими МКГ и центрами информации о цунами (ЦИЦ).

Группа рекомендовала продолжить сотрудничество между ЮНЕСКО/МОК и Всемирной метеорологической организацией (ВМО), подчеркнув роль, которую многие национальные метеорологические и гидрологические службы (НМГС) играют в раннем оповещении о цунами, и роль, которую ВМО играет в оказании поддержки НМГС в этой связи, особенно в области инфраструктуры и коммуникаций.

Группа постановила, что системы оповещения о цунами, возникающих в результате извержений вулканов, должны разрабатываться и координироваться в рамках глобальной системы МОК ЮНЕСКО по предупреждению о цунами и других опасных океанических явлениях и смягчения их последствий (ГСПООЯСП), а также, по возможности, в рамках СРОМОЯ.

Группа постановила организовать научный симпозиум и рекомендовала учредить организационный комитет в составе двух назначенных ЦГНЦ и ЦГЛПГ сопредседателей, председателя научного комитета ПЦДО, представителя Индонезийского агентства по метеорологии, климатологии и геофизике, представителя совместной комиссии МСГГ по цунами и одного представителя от каждого ЦИЦ. **Группа** с признательностью **приняла** предложение правительства Республики Индонезия провести в стране симпозиум в декабре 2024 г. в рамках памятных мероприятий межправительственной координационной группы по системе предупреждения о цунами и смягчения их последствий в Индийском океане (МКГ/СПЦСПИО) по случаю 20-й годовщины цунами в Индийском океане в 2004 г.

Группа постановила продолжить работу специальной группы по цунами метеорологического происхождения для завершения подготовки ее доклада, **рекомендовала** привлечь экспертов ВМО для содействия в этой задаче, **а также приняла к сведению**, что ВМО поручила совместному совету по сотрудничеству между ВМО и МОК обсудить связанные с цунами вопросы в отношении цунами метеорологического происхождения, уточнить роли и обязанности ВМО и МОК ЮНЕСКО, а также определить наиболее эффективные методы укрепления сотрудничества в поддержку государств-членов.

Группа рекомендовала Ассамблее МОК на ее 32-й сессии в 2023 г. **одобрить** десятилетний план исследований, разработок и осуществления программы по цунами в рамках Десятилетия океана с предложенными изменениями, в том числе сформулированными целевыми группами МКГ.

Группа рекомендовала Ассамблее МОК на ее 32-й сессии в 2023 г. поручить региональным МКГ:

- (i) поощрять сбор как можно более точных данных об уровне моря с интервалом в одну секунду и их передачу в режиме реального времени в приоритетном порядке, учитывая острую необходимость выявления и устранения непосредственных угроз для подверженных высокому риску населенных территорий, где цунами, возникающие в результате землетрясений в зонах субдукции, а также несейсмических явлений (например, извержений вулканов), могут произойти в считанные минуты после таких явлений;
- (ii) поощрять операторов сетей наблюдений за уровнем моря к проведению регулярной и плановой калибровки оборудования для мониторинга уровня моря в соответствии с изложенными в сериях № 3 и № 14 справочников и руководств МОК (тома I-V) рекомендациями;
- (iii) проводить регулярный мониторинг состояния сетей наблюдений за сейсмической активностью и уровнем моря для выявления и более эффективного содействия устранению пробелов в охвате, а также свободном и открытом обмене данными;
- (iv) рассмотреть и выполнить рекомендации специальной группы по возникающим в результате извержений вулканов цунами в отношении требований к оценке опасности, мониторингу и предупреждению, включая затраты на развертывание и обеспечение функционирования таких систем.

Если от выявленного цунами, возникшего в результате извержения вулкана, могут пострадать сразу несколько государств-членов, ПДСЦ для систем предупреждения о цунами и смягчения их последствий в соответствующих океанических бассейнах следует рассмотреть вопрос о необходимости участия в мониторинге и консультировании относительно угрозы;

- (v) обеспечить тестирование в 2023-2024 гг. поставщиками данных слежения за цунами в сотрудничестве с операторами системы «NAVAREA» Международной гидрографической организации (МГО) инструментов по безопасности на море в случае цунами с целью их практического внедрения в 2024-2025 гг.;
- (vi) включить в круг ведения МКГ и ЦИЦ содействие осуществлению программы МОК ЮНЕСКО по сертификации готовности к цунами;
- (vii) включить в круг ведения МКГ выполнение роли региональных руководящих комитетов по осуществлению ПЦДО;
- (viii) проводить в соответствующих случаях в рамках учений «Волна» субрегиональные учения в качестве эффективного способа расширения участия в них государств-членов;
- (ix) поддерживать инициативу МКГ/СПЦТО по обеспечению обмена информацией в режиме реального времени на субрегиональном уровне в случае цунами в целях содействия принятию соседними странами обоснованных решений;
- (x) изучить и проинформировать РГ-СПЦО и ЦГЛПГ о действующих в некоторых странах механизмах признания стандартов, аналогичных программе МОК ЮНЕСКО по сертификации готовности к цунами;
- (xi) распространить через Карибский центр информации о цунами (КЦИЦ) вопросник по программе МОК ЮНЕСКО по сертификации готовности к цунами и формуляры для отзывов о ходе осуществления программы для сбора информации от получивших сертификат готовности к цунами в рамках программы МОК ЮНЕСКО общин;
- (xii) поощрять использование на применяющихся в рамках программы МОК ЮНЕСКО по сертификации готовности к цунами указателях путей вертикальной эвакуации типовых формулировок, таких как «Направляйтесь в указанное здание для вертикальной эвакуации»;
- (xiii) должным образом информировать население о сроке действия признания готовности к цунами в рамках программы МОК ЮНЕСКО, который обозначается на соответствующих указателях и в сертификатах с логотипом МОК ЮНЕСКО; и поручает;
- (xiv) обеспечить применение Международным центром информации о цунами (МЦИЦ) на экспериментальной основе проекта [рамочных требований СПЦТО \(2019 г.\) к уровню компетентности сотрудников национальных центров предупреждения о цунами \(НЦПЦ\)](#) для последующего утверждения МКГ/СПЦТО с целью разработки глобальных рамок для использования всеми МКГ;

Группа рекомендовала Ассамблее МОК на ее 32-й сессии в 2023 г. **поручить** секретариату МОК:

- (i) обеспечить более своевременное обновление базы данных МОК ЮНЕСКО о готовности к цунами;

- (ii) изучить возможности разработки автоматизированной системы подачи заявок на получение и продление подтверждающего готовность к цунами сертификата МОК ЮНЕСКО;
- (iii) усовершенствовать процедуру продления подтверждающего готовность к цунами сертификата МОК ЮНЕСКО и изучить соответствующие процедуры, используемые в рамках аналогичной программы Соединенных Штатов Америки (TsunamiReady®);
- (iv) содействовать скорейшей доработке посвященных цунами базовых учебных материалов ГАОИ в поддержку осуществления программы МОК ЮНЕСКО по сертификации готовности к цунами;
- (v) подготовить документ об угрозе цунами для побережья южной части Атлантического океана в целях оказания заинтересованным государствам – членам МОК помощи в принятии решения относительно присоединения к глобальной системе предупреждения о цунами и смягчения их последствий;
- (vi) способствовать широкому информированию государств-членов о потенциальной опасности цунами от вулканов:
 - опубликовать доклад о вызываемых извержениями вулканов цунами в качестве публикации МОК ЮНЕСКО в 2023 г.;
 - распространить среди вулканических обсерваторий доклад о вызываемых извержениями вулканов цунами, включая перечень способных вызвать цунами вулканов;
 - распространить доклад о вызываемых извержениями вулканов цунами, включая перечень способных вызвать цунами вулканов среди государств – членов МОК ЮНЕСКО.

1. OPENING AND WELCOME

1.1 OPENING

1. The Chairperson, Mr Alexander Frolov, opened the Sixteenth Meeting of the Working Group on Tsunamis and Other Hazards Related to Sea-Level Warning and Mitigation Systems (TOWS-WG-XVI) and welcomed the participants. In his opening remarks, he recalled that there is currently a strong reliance on seismic data within tsunami early warning. Member States support gathering, sharing, and receiving of seismic data which is critical to assessment of tsunami sources. However, the uncertainty associated with estimating tsunami source parameters only on the basis of seismic data, especially in the short term immediately after an earthquake, can lead to uncertainties in tsunami forecasting. Mr Frolov further noted that there are also further challenges related to detection of tsunamis from non-seismic sources. These sources may not show up in the seismic data. In such cases, direct measurements of tsunami waves near their source are required. Indeed, discussion of risks associated with volcano-generated tsunamis, landslide generated tsunamis and meteo-tsunamis are increasingly at the forefront of tsunami early warning discussions.
2. Mr Frolov also drew attention to the Ocean Decade of Science for Sustainable Development (hereafter, UN Ocean Decade), and specifically to the Ocean Decade Tsunami Programme (ODTP). This programme was approved by the IOC Assembly in June 2021 (Decision IOC-31/3.4.1) and highlights the ambition of the tsunami community to meet key challenges, including relating to data and non-seismic source tsunamis. In 2021, the IOC Assembly also approved the preparation of a Draft 10-Year Research, Development and Implementation Plan (hereafter the Plan) by the Scientific Committee of the Ocean Decade Tsunami Programme (ODTP-SC), as well as the establishment of a Tsunami Ready Coalition. Mr Frolov noted that the second draft of the Plan, along with an overview of the preliminary structure of Tsunami Ready Coalition, would be presented at this meeting of the TOWS-WG (TOWS-WG-XVI).
3. In closing, Mr Frolov recalled that during the 55th Session of the IOC Executive Council, the Terms of Reference of the TOWS-WG were modified to include its role of Steering Committee for the ODTP. As such, TOWS-WG has stronger obligations as well as opportunities for strengthening its contributions to the work of the tsunami community. Finally, Mr Frolov congratulated Mr Bernardo Aliaga on his appointment as Head of the TSR and expressed appreciation for the TSR Secretariat for organization of the meeting.
4. Mr Vladimir Ryabinin, Executive Secretary of IOC, also provided welcoming remarks (through a pre-recorded video). Mr Ryabinin began by noting that this would be his last opportunity to provide opening remarks at a TOWS-WG meeting, as he is scheduled to retire from his position as Executive Secretary of IOC on 21 December 2023. He therefore began by expressing gratitude to the members of TOWS-WG for their active work and dedication, and even despite challenges of the COVID-19 pandemic.
5. Mr Vladimir next drew attention to key milestones which had been reached since he began as Executive Secretary, including the adoption of the Sendai Framework for Disaster Risk Reduction and the UN Agenda 2030. These achievements, amongst others, provided significant momentum for ocean sciences and the tsunami programme specifically.
6. He indicated that the UN Ocean Decade provides an opportunity for growth of ocean science related activities. Currently, it includes 46 Programmes, including the ODTP, and over 200 different activities, with monetary engagements in the order of 1 billion USD. In the context of the UN Ocean Decade, key ocean stakeholders are also bringing together ocean science with its possible applications for sustainable development, thus creating important synergies

with other key players. Highlighting the important role of UNESCO/IOC within the UN Ocean Decade, Mr Ryabinin underlined the important declaration made at the UN Ocean Conference (June 2022) which emphasised the explicit function and role of UNESCO/IOC in coordinating the UN Ocean Decade and encouraged Member States and all ocean stakeholders to support the initiative.

7. Mr Ryabinin recalled that the first UN Ocean Conference was held in 2017 and marked a turning point for awareness of the state of the ocean. This increased awareness was particularly driven by the creation of Sustainable Development Goal (SDG) 14 as well as publishing of the [First World Ocean Assessment](#) in 2015. During the [2022 UN Ocean Conference](#), co-hosted by the Governments of Kenya and Portugal, on 27 June–1 July 2022, in Lisbon, Portugal, over 30 Heads of State were present and voiced their concerns about the state of the ocean, marking an unprecedented political will for and support towards addressing ocean issues and challenges. The next Conference will take place in June 2025 and will be hosted jointly by Costa Rica and France and held in Nice, France.
8. The ocean, and ocean sciences, are increasingly well-reflected across several cross-cutting frameworks, such as the United Nations Framework Convention on Climate Change (UNFCCC) and the Convention on Biological Diversity (specifically based on outputs from the COP15). Despite these achievements, SDG Goal 14 remains the least funded SDG based on an analysis of the implementation of SDG Goals, conducted in 2022. In addition, within the above-mentioned Conventions, oceans are often included only as secondary priorities; this needs to shift to successfully address critical ocean challenges. Mr Ryabinin drew attention to the High-Level Panel for a Sustainable Ocean Economy which produced over 20 seminal papers providing guidance on key ocean issues and demonstrated the strong link between ocean science and sustainable ocean management as well as mitigation and adaptation to climate change. In fact, UNESCO/IOC will be supporting the 17 countries which are represented on the Panel to develop plans and best practice for sustainable management of their Exclusive Economic Zones. Mr Ryabinin expressed his hope that, by the 2025 UN Ocean Conference, the United Nations would be able to provide a strong statement and way forward for sustainable ocean management, coupled with further resources in this area. In this context, tsunami early warning and ocean disaster risk reduction would be a critical element to include in this overarching ocean management approach.
9. Mr Ryabinin congratulated the TOWS-WG for the draft 10-year Research, Development and Implementation Plan developed by the ODTP-SC. He also encouraged the Group to be even more ambitious with their objectives and aspirations in the Plan, especially relating to sections on risk assessment and detection. For instance, relating to the detection of non-seismic source tsunamis, he suggested that stronger aims could support momentum for tackling these detection challenges. More generally, he suggested the Group further develop topics of performance evaluation to identify and address systematic errors. He also encouraged the Group to reflect on how tsunamis can fit into the wider ocean management approach being put forward by UNESCO/IOC to ensure that the tsunami Plan is able to integrate into a holistic framework for the oceans. Lastly, he urged more visibility for the work of the tsunami community, given the important advances being made in this field.
10. In closing, Mr Ryabinin emphasised the importance of engaging Early Career Ocean Professionals in tsunami work and ocean sciences more generally. Sharing knowledge with younger generations is critical to maintaining momentum and ensuring a strong future for ocean sciences.

1.2 ADOPTION OF AGENDA

11. The agenda was adopted as given in [Annex I](#).

1.3 WORKING ARRANGEMENTS

12. The Technical Secretary, Mr Bernardo Aliaga, provided an overview of logistic details for the meeting. All documents and presentations delivered at this meeting are available from the following website: <https://oceanexpert.org/event/3694>.

2. REPORTS FROM PARTICIPANT BODIES

2.1 REPORT FROM IOC BODIES

2.1.1 Tsunami and Other Coastal Hazards Warning System for the Caribbean and Adjacent Regions (CARIBE-EWS)

13. Ms Chacon Barrantes (Costa Rica), Chair of the Intergovernmental Coordination Group for the Tsunami and other Coastal Hazards Warning System for the Caribbean and Adjacent Regions (ICG/CARIBE-EWS), presented the report on this item (available as a presentation).
14. There has not been a tsunami event in the CARIBE-EWS region during the interseasonal period. However, she noted that the Hunga Tonga – Hunga Ha’apai (HTHH) tsunami, which occurred 15 January 2022, was detected in at least 15 tide gauges in the region. A poster was presented at Meeting of the American Geophysical Union (AGU) in 2022 and a paper is currently under preparation about the impacts of the HTHH event in the CARIBE-EWS region. Ms Chacon highlighted that a key finding has been that the perturbation observed at tide gauges indicated waves were moving from the sea to the land; thus, depending on the orientation of the coast, waves observed corresponded to either odd or even shock waves.
15. Ms Chacon also provided a status update implementation of Tsunami Ready in the region. She shared that two Tsunami Ready renewals have been completed (British Virgin Islands and St. Kitts and Nevis) and one new community had been recognised (Old Harbour, Jamaica). In addition, several other communities are currently under way including Puerto Plata and Sabana Grande de Palenque (Dominican Republic) and St. George (St. Vincent and the Grenadines). Moreover, the Norwegian Agency for Development Cooperation (NORAD) is supporting Tsunami Ready efforts for communities in Barbados, Jamaica, and Trinidad and Tobago. The United States Agency for International Development (USAID) is also financing Tsunami Ready projects in communities in Barbados, Dominica, and St. Lucia, and is working to begin work in the Cayman Islands. The ICG/CARIBE-EWS Task Team (TT) Tsunami Ready Programme also developed a questionnaire on implementation of Tsunami Ready in the region to improve the Tsunami Ready process.
16. The ICG/CARIBE-EWS also contributed to World Tsunami Awareness Day (WTAD) 2022 through the creation of a video showcasing the CARIBE WAVE exercise, created with support from the United Nations Office for Disaster Risk Reduction (UNDRR). CARIBE WAVE 22 took place on 10 March 2022, beginning at 1400 UTC, and was based on two scenarios: (1) Western Muertos Trough and (2) Northern Panama. Forty-eight (48) Member States and Territories participated in the Exercise, with a total of 413,285 people directly engaged. This year, CARIBE WAVE 23 will take place on 23 March 2023 and will utilise two scenarios: (1) Gulf of Honduras and (2) Mount Pelée. This Exercise will be a critical tool for testing products for volcano-generated tsunamis. Finally, Ms Chacon also shared that a paper had been published on the history of CARIBE WAVE in the region ([CARIBE WAVE: A Decade of Exercises for Validating Tsunami Preparedness in the Caribbean and Adjacent Regions](#)).
17. Ms Chacon drew particular attention to the work on volcano-generated tsunamis which has been undertaken by ICG/CARIBE-EWS over the last few years. In fact, some of the work

performed and products created in the region were used to assist with the HTHH event in the Pacific. In addition, and to further build preparedness to volcano-generated tsunamis, specific products will be tested during CARIBE WAVE 23 through a tsunami event generated by a flank collapse at Mount Pelée volcano. Lastly, the Team on Tsunamis Generated by Volcanoes has been working to implement a Memorandum of Understanding (MoU) with the Seismic Research Center (SRC) using the La Soufrière volcano on St. Vincent as a case study.

18. Lastly, Ms Chacon reported that Working Group 2 on Hazard Assessments has also been working on non-seismic sources, and specifically on establishing criteria for choosing sources, identifying possible invited experts, and compiling sources (modeled and not modeled). These updates will then be incorporated into the Caribbean and Adjacent Regions Tsunami Sources and Models (CATSAM).

2.1.2 Indian Ocean Tsunami Warning and Mitigation System (IOTWMS)

19. Mr Yuelong Miao (Australia), Vice-Chair of the Intergovernmental Coordination Group for the Indian Ocean Tsunami Warning and Mitigation System (ICG/IOTWMS) presented the report on this agenda item (available as a [presentation](#)).
20. Mr Miao provided a brief overview of the governance structure of the ICG/IOTWMS, drawing particular attention to the addition of a new Working Group (WG) 3 on Tsunami Ready Implementation, as well as a related Task Team IOWAVE 23. Mr Miao congratulated Ms Suci Dewi Anugrah (Indonesia) and Ms Weniza (Indonesia) for their nominations as Chair of the WG and Chair of the TT, respectively. He also highlighted the two sub-regional WGs which are included within ICG/IOTWMS: one for the Northwest Indian Ocean and the other for the Western Indian Ocean. The creation of other sub-regional Working Groups is also under discussion.
21. Mr Miao also outlined major events of the last intersessional period, notably including the 13th Session of the ICG/IOTWMS in Bali, Indonesia, from 28 November to 1 December 2022. This session was attended by 75 participants from 17 Member States, seven of whom attended in person (Australia, India, Indonesia, Seychelles, Oman, Madagascar, and Bangladesh), and ten others who attended online (Comoros, France, Iran, Pakistan, Kenya, Malaysia, Maldives, Myanmar, Sri Lanka, United Arab Emirates). Key outcomes of the session included the recognised need to establish WG 3 and TT IOWAVE23, to maintain existing WGs and TTs, to establish a Tsunami Ready focal point nominated by each Member State, and to conduct two training workshops on Standard Operating Protocols (SOPs, one for the Western Indian Ocean and one for the Eastern Indian Ocean). In addition, the Session recommended to hold the 14th session of ICG/IOTWMS in late 2024 to coincide with the Tsunami Symposium and the 20th commemoration of the 2004 Indian Ocean Tsunami, accepting with appreciation the offer from the Republic of Indonesia to host.
22. In addition, Mr Miao reported that an Indian Ocean Tsunami Ready hybrid workshop was held in November 2022, which included 84 participants from 12 countries. Regarding progress towards Tsunami Ready recognition, 9 new communities have been recognised (all in Indonesia). Mr Miao also highlighted that the important partnership agreement between UNESCO/IOC and the Indonesian Meteorology, Climatology, and Geophysical Agency (BMKG), had been renewed, thereby ensuring continued running of the Indian Ocean Tsunami Information Centre (IOTIC). Finally, Mr Miao shared that the North-West Indian Ocean Tsunami Project (financed by the Economic and Social Commission for Asia and the Pacific, UNESCAP) has continued successful implementation with specific improvements in data sharing between countries in the region (such as through data exchange agreements).

23. He also noted that there is 25 active Member States in the IOTWMS, and funding has been secured for ICG/IOTWMS until 2027 from the Government of Australia and the Government of Indonesia. The ICG/IOTWMS Secretariat has also provided support for 17 meetings of ICG/IOTWMS and related activities in 2022 and, along with the Indian Ocean Tsunami Information Center (IOTIC), has supported and contributed to several activities such as the implementation of the UNESCO/IOC Tsunami Ready Programme. The latter has also been supported through an Ocean Teacher Global Academy (OTGA) Specialized Training Center [the Tsunami Ready (2021), Tsunami Community Preparedness (2022) and Ocean Forecast System (2021 and 2022)]. Lastly, Mr Miao expressed appreciation for the support of the Indian National Centre for Ocean Information Services (INCOIS) for assessing and archiving Probabilistic Tsunami Hazard Assessments for Northwest Indian Ocean.
24. The IOTWMS has three operational Tsunami Service Providers (TSPs) hosted by Australia, India, and Indonesia, which ensure interoperable tsunami threat information to the National Tsunami Warning Centres (NTWCs). Tsunami detection, warning and dissemination has been strengthened with TSP Australia's implementation of Maritime products for NAVAREA coordinators, renewal of ISO 9001 certification (in progress) of the Joint Australian Tsunami Warning Centre (JATWC) and provisions for non-seismic source tsunamis in the context of the HTHH event. TSP India has also further contributed by updating its coastal forecasting zones, its active participation in the UNESCAP project, and for developing a Key Performance Indicator (KPI) application for IOTWMS TSPs and a Mobile App. TSP Indonesia has undertaken several projects this past year, including the progressive deployment of seismometers (438 in 2022), developing a tsunami non-tectonic monitoring system for Indonesia, establishing the National Consortium of Earthquake and Tsunami Experts, developing an impact-based real time system of InaTEWS by the National Consortium, and developing a new processing system supported by National Consortium. Relating to future plans for TSPs, TSP Australia hopes to integrate, test and operationalise seismic array processing as input to rapid earthquake detection and characterization and replace the current tsunami Decision Support Tool with TOAST. TSP India will work to develop SOPs for non-seismic tsunami sources, utilize global navigation satellite systems (GNSS) and Sismic Margin Assessment (SMA) for rupture characterization, adopt a multi-hazard approach, archive the Makran source PTHA results for Member States, and increase efforts for integrated inversions for tsunami source characterization. TSP Indonesia will plan to use GNSS for earthquake parameter calculation, further research of non-seismic source tsunamis, provide a sea level observation portal for the Indian Ocean area, support on-job training for Member States, and develop a processing system for earthquake early warning.
25. Activities for the next intersessional period will focus on implementing the 10-year Research, Development and Implementation Plan, implementing outcomes from the Multi-Hazard Early Warning Conference (MHEWC) held in Indonesia in May 2022 and translating Words-into-Action in support of the UN Secretary-General call for all communities to have access to early warning systems by 2027. In addition, the ICG/IOTWMS will hold the next IOWAVE Exercise in September–October 2023, support NTWCs in developing SOPs for non-seismic and complex source tsunamis, complete Phase 2c of the UNESCAP project, and conduct a pilot training for Indonesia facilitators (January–February 2023) and Indian Ocean facilitators (April 2023) on the UNESCO/IOC Tsunami Ready programme.
26. ICG/IOTWMS will also plan to hold the ICG/IOTWMS-XIV in late 2024 to coincide with the Tsunami Symposium and the 20th commemoration of the 2004 Indian Ocean Tsunami. Mr Miao shared a draft timeline for organization and holding of these events, noting the following tentative key dates:
- 10–14 December 2024: Symposium and Poster Session (Aceh, Indonesia)
 - 14 December 2024: Commemoration Day for the 20th Anniversary of the 2004 Indian Ocean tsunami, tsunami drill and field trip to the Aceh Tsunami Museum

and Tsunami Ready community village in Aceh, and Tsunami Ready inauguration (Aceh, Indonesia)

- 16–19 December 2024: 14th Session of ICG/IOTWMS (Jakarta, Indonesia)

27. In closing, Mr Miao suggested that TOWS-WG may consider the opportunity to transform the proposed Symposium and Poster Session in Aceh, Indonesia, into a Global Symposium.

2.1.3 Tsunami Early Warning and Mitigation System in the North-Eastern Atlantic, the Mediterranean and Connected Seas (NEAMTWS)

28. Ms Maria Ana Baptista (Portugal), Chair of the Intergovernmental Coordination Group for Tsunami Early Warning and Mitigation System in the North-Eastern Atlantic, the Mediterranean and Connected Seas (ICG/NEAMTWS) presented the report on this item (available as a [presentation](#)).

29. Ms Baptista started by noting that the 18th Session of ICG/NEAMTWS was cancelled due to last-minute administrative obstacles; nonetheless, several other key meetings and activities were held for the region. Notably, a NEAMTIC Workshop on the Multi-Hazard Risk Perception Questionnaire Survey was held on 5 April 2022 (online) and a meeting of the ICG/NEAMTWS Steering Committee was held from 8 to 11 April 2022 (online). In addition, another meeting of the Steering Committee was held on 24 February 2023 to plan for NEAMWave 23, including preparations, scenarios, and potential participation of CoastWAVE project countries. The meeting recommended to hold NEAMWave 23 from 30 to 31 October or 6 to 7 November 2023. In addition, Ms Baptista noted that she had the opportunity to present on key outputs of the ICG/NEAMTWS at the IOC Executive Council in June 2022 in Paris, France.

30. Next, Ms Baptista reported on the UNESCO/IOC-European Union Directorate-General for European Civil Protection and Humanitarian Aid Operations (DG-ECHO) 'CoastWAVE' project (full name: "Strengthening the Resilience of Coastal Communities in the North-East Atlantic and Mediterranean Region to the Impact of Tsunamis and Other Sea Level Related Coastal Hazard"). The project began in September 2021 is due for completion in February 2024, and is being implemented in seven countries: Cyprus, Greece, Egypt, Malta, Morocco, Spain and Turkey. Currently, Component 1 which is focused on adapting global Tsunami Ready standards and guidelines for use in the NEAMTWS region is underway, with Tsunami Ready recognition being pursued. Within the context of the project, a workshop was notably organized on SOP Planning and Implementation for Tsunami Response in the NEAM Region, from 5 to 6 October 2022, in Ispra, Italy. In addition, a training workshop on the Tsunami Ready programme was held online between 16 and 17 February 2023, with the aim to provide knowledge and tools to better implement Tsunami Ready. The workshop involved 30-40 participants, including supporting experts from ICG/IOTWMS and ICG/CARIBE-EWS.

31. The ICG/NEAMTWS Secretariat also organized and supported the Resilient and Safer Coasts side event in the context of the African Conference on Priority Setting and Partnership Development for the UN Decade of Ocean Science for Sustainable Development on 11 May 2022 in Cairo, Egypt. Ms Baptista highlighted several other key activities and events such as the Safe Thessaloniki Conference on Civil Protection (September 2022), the Scientific Workshop for the CENALT anniversary (29-30 September 2022), and the Workshop on Local Tsunami Warning in the Context of Multi-Hazard Disaster Risk Mitigation: Requirements, Challenges, Opportunities (4–5 October 2022, Ispra, Italy). In addition, an ICG/NEAMTWS Experts Meeting was held from 28 to 30 November 2022 in Naples, Italy (hybrid format) on implementing NEAMTWS 2030 Strategy Opportunities and Actions to Explore. The Strategy is based on three key pillars: tsunami hazard and risk Assessment; detection, warning and

dissemination; and awareness and response in the NEAM region. This meeting was co-organized by the National Institute of Geophysics and Volcanology (INGV), University of Napoli “Federico II” and UNESCO/IOC.

32. Ms Baptista next remarked on the devastating 6 February 2023 earthquake at the Türkiye and Syrian Border, highlighting that TSP’s response to the event was discussed by the NEAMTWS Steering Committee. In addition, Ms Baptista noted that in 2017 a tsunami evacuation exercise was conducted by ICG/NEAMTWS in the same location of the 6 February 2022 event, but with a scenario of a lower magnitude. She noted the fact that this event was higher than previous projections.

33. In closing, Ms Baptista shared that the 18th Session of the ICG/NEAMTWS will be held in November 2023 in Egypt.

2.1.4 Pacific Tsunami Warning and Mitigation System (PTWS)

34. Mr Yuji Nishimae (Japan) Chair of the Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System (ICG/PTWS), (Japan), presented the report on this item (available as a [presentation](#)).

35. Mr Nishimae identified the TSPs for the PTWS region, which include the Pacific Tsunami Warning Center (PTWC), the Northwest Pacific Tsunami Advisory Centre (NWPTAC), and the South China Sea Tsunami Advisory Center (SCSTAC). He noted that the Central America Tsunami Advisory Center (CATAC) is not yet fully operational and is currently only providing tsunami information as interim service.

36. Mr Nishimae next highlighted significant events (M>7.0) which have impacted the PTWS region since February 2022, noting that none of the events had resulted in very high tsunami heights. The maximum height was reached during the 19 September 2022 event at 0.79 metres, according to the National Centers for Environmental Information World Data System (NCEI/WDS) Global Historical Tsunami Database.

37. Mr Nishimae spoke about the HTHH volcanic eruption and tsunami event on 15 January 2022. The tsunami waves from this event were observed on tide gauges not only in the Pacific basin, but also across the globe in other oceans. In fact, waves over 1 metre were detected in California (USA), Chile and Japan. In response to this event, the PTWS held three online debrief webinars organized by the International Tsunami Information Center (ITIC) on 20 January, 3 February, and 10 February 2022. The purpose of these meetings was to develop interim volcanic tsunami SOPs and to review what had happened during the HTHH event in relevant TSPs—to share experiences and identify gaps, opportunities, and lessons learned.

38. As a result of these meetings, the ICG/PTWS established a Task Team on Task Team on Tsunami Hazard Response and requested it to prepare a PTWS HTHH Interim Volcano Tsunami Procedures Implementation Plan. These became live on 15 March 2022 and was announced through IOC Circular Letter [2882](#).

39. Based on this work, PTWC developed products for a HTHH volcano-generated tsunami. The IOC Circular Letter [2902](#) announced publishing of the User’s Guide on 17 August 2022. An informational webinar on the ICG/PTWS HTHH Interim Procedures and PTWS Products was held on 6 September 2022. In addition, a Pacific Island Countries and Territories (PICT) sub-regional drill was held on 9 November 2022 within the context of PacWave 22 to test these interim procedures.

40. Mr Nishimae also reported the PTWS Steering Committee had met online in July 2022. The key outcomes of this meeting included the offer by the Kingdom of Tonga to host

ICG/PTWS-XXX in September 2023 which was officially accepted. In addition, the meeting discussed the “HTHH PTWC Interim Procedures and PTWS Products – User’s Guide” and agreed for the Guide to be published on 17 August 2022. The Steering Committee also decided that the next PTWS Steering Committee would be held back-to-back with the TOWS-WG-XVI on 6-9 March 2023.

41. Regarding implementation of the Tsunami Ready programme in the PTWS region, Mr Nishimae noted that there were currently 14 Tsunami Ready communities across seven countries (Costa Rica, Ecuador, El Salvador, Guatemala, Honduras, Panama, and Samoa), with several more under way.
42. The PacWave 22 Exercise was held from October to November 2023. Mr Nishimae outlined the timeline of implementation of the Exercise, noting that PacWave 22 was announced on 23 June 2022 (IOC Circular Letter [2894](#)), the PacWave 22 Manual was published on 31 August 2022 (IOC Circular Letter [2904](#)), and informational webinars about the Exercise were held on 13 September 2022. The Live Communications Test of the Exercise was held on 13 October 2022 at 0000 UTC, conducted by the TSPs. Mr Nishimae noted that test messages were sent by PTWC, NWPTAC, SCSTAC and CATAC. He also added that another tsunami exercise—the PICT regional exercise—was held between 2300 UTC on 9 November 2022 and 0100 UTC on 10 November 2022. An informational webinar about this Exercise was held on 2 November 2022. The Exercise used the 15 January 2022 HTHH volcanic eruption and tsunami, with the aim to test the Interim Procedures.
43. Regarding activities of ICG/PTWS WGs, Mr Nishimae reported the Seventh Meeting of Oceania Regional Seismic Network (ORSNET) was held from 17–19 October 2022 and the Seventh Session of the ICG/PTWS WG2 TT on Seismic Data Sharing in the Southwest Pacific took place on 20 October 2022. In addition, ICG/PTWS WG2 TT on TSPs met on 16 January 2023, with the following organization present at the meeting: PTWC, CATAC, NWPTAC, SCSTAC and ITIC. Finally, the Ninth Meeting of the ICG/PTWS Regional WG on Tsunami Warning and Mitigation for PICT was held 2–3 February in Nadi, Fiji.
44. In closing, Mr Nishimae outlined future plans for the ICG/PTWS, which include a meeting of the Steering Committee (6–9 March 2023), ICG/PTWS-XXX (September 2023, hosted by the Kingdom of Tonga), scheduled and unscheduled TSP communications tests, and preparations for PacWave 2024.
45. Mr Mike Angove (USA) commented that, although the PTWC is currently working to establish the NTWC of US as a backup TSP, this is still in process and therefore the NTWC of US is not officially a TSP. He therefore requested a correction be made to remove it as a listed ICG/PTWS TSP.
46. Mr Charles McCreery (PTWC, USA) expressed appreciation for the work of the Task Team on HTHH Volcanic Tsunami Hazard Response, led by Mr François Schindelé (France) and including the PTWC, ITIC, and NTWCs and emergency management representatives from New Zealand and Chile.
47. Ms Sarah Grimes (World Meteorological Organization) recalled the recommendation from TOWS-WG-XV (February 2022) about the expansion of the PTWS Earthquake Source Zone (ESZ) to also contain the Southwest Atlantic region and specifically the area around the South Sandwich Islands. She further noted the recommendation on the operation of CATAC as an interim service, requesting an update on the evolution of both recommendations. Mr Nishimae responded that both recommendations will be discussed at the upcoming ICG/PTWS Steering Committee meeting and remain priority items. He further noted that the expansion of the ESZ would require further discussion with concerned Member States. The ICG/PTWS must also clearly identify the specific area of expansion that would be requested.

48. Following on the discussion about the expansion of the PTWS ESZ, the Chair, Mr Alexander Frolov, suggested that it may be useful to engage in consultations with concerned Member States. Ms Grimes expressed agreement with the recommended approach from Mr Frolov, reiterating that expansion of the PTWS ESZ and formalisation of CATAC as a Tsunami Service Provider were two priority items for WMO.
49. Ms Laura Kong (ITIC) shared additional elements on the report of PTWS about HTHH, specifically highlighting three points:
- (i) to support the immediate needs of Tonga's NTWC, which suffered a 6-week communication blackout after the massive eruption/explosion severed the telecommunication cable one hour after the eruption, the PTWC and New Zealand provided operational earthquake and volcano hazard situational reports. This began on 25 January 2023 after the ITIC was first able to make direct satellite phone connection with the Tonga Meteorological Services;
 - (ii) over 30 virtual meetings were conducted, facilitated by ITIC/UNESCO/IOC at the request of Tonga, to focus on coordinated re-strengthening of the Tonga NTWC through technical assistance and provision of equipment from Australia, New Zealand, UNESCO/IOC, USA, and the Pacific Community. Specifically, the PTWS supported immediate installation of seismometers, re-supply of communication devices, and virtual technical assistance to the Tonga Geological Service to conduct a post-tsunami field survey. UNESCO/IOC coordination support was provided by the Tsunami Unit staff based in Fiji;
 - (iii) the impacts of the 15 January 2022 HTHH event triggered the undertaking of the IOC Post-Event Assessment Survey through IOC Circular Letter [2877](#), issued on 31 January 2022. Almost all countries responded to the survey, and the IOC has compiled the results and is preparing the final report for publication with due consultation with ICG/PTWS related WGs.
50. Ms Kong recognised the efforts of the ICG/PTWS in enabling regional sharing of information during tsunami events. This is exemplified in the South-East Pacific (SEP) and PICT (during PacWave 22) regions. During the last 12 months, the ICG/PTWS Regional WG-SEP was able to run different online, hybrid and presentational activities. For training purposes, a functional exercise for the SEP NTWCs was held on early Jun 2022 by Dirección General Marítima (DIMAR) of Colombia and the Instituto Oceanográfico de la Armada (INOCAR) of Ecuador, simulating an emergency triggered by a main event followed by a strong aftershock. Afterward, PacWave 22 simulated a near 8 Mw event in the Chile-Peru border, with the Servicio Hidrográfico y Oceanográfico de la Armada (SHOA) of Chile acting as the TSP. In some countries PacWave 22 also involved national disaster management organizations. These challenging events encouraged improvements by testing communications and SOPs in non-ideal conditions. It is important to note that Chile has developed a tool to create synthetic marigrams for the different stations being monitored, thus simulating very realistic conditions for regular training. Also, with the support of UNESCO/IOC, the Flanders Marine Institute (VLIZ) and the National Oceanic and Atmospheric Administration (NOAA), on September 2022, SHOA/Chile conducted a workshop for SEP NTWCs, in which 26 additional sea level stations across the region were added to the IOC Sea Level Monitoring Facility. Finally, with the support of the Permanent Commission for the Southeast Pacific (CPPS), representatives from all SEP countries were able to meet in Santiago, Chile, for the annual regional meeting where lessons learned from HTHH event and best practices, among others, were shared.
51. Ms Kong also spoke about the Tsunami Ready recognition programme in the Pacific, highlighting the challenge of involving countries with existing strong preparedness programmes. Given this identified difficulty, the PTWS is working to develop a process for

cross-checking Tsunami Ready indicators to existing preparedness programmes in countries, to support achieving of the ODTP objective of “100 percent of communities at risk to be prepared and resilient to tsunamis by 2030”.

52. Regarding the proposed expansion of the PTWS ESZ, Mr Yuelong Miao, Vice-Chair IOTWMS also recognised the challenge of providing tsunami information products to stations in Antarctica, given that these are under international jurisdiction. He noted that the Council of Managers of National Antarctic Programs (COMNAP) produced a Report on emergency plans and implementation of natural disaster risk assessment at Antarctic stations (2021). The desk study found that, out of sixty-seven (67) Antarctic stations, forty-one (41) stations are at a height above sea level less than or equal to 30 metres, with twenty-one (21) of those stations sitting at a height above sea level less than or equal to 10 metres. He suggested that it may be useful to convene a technical tsunami group to study these hazards. It would also be relevant to UNESCO/IOC to engage with COMNAP. Mr Miao encouraged TOWS-WG to consider whether it is relevant to engage with COMNAP and proposed to create a link if requested. He also noted that COMNAP prepared a tsunami brochure, which he is supporting to update. He suggested sharing the brochure with any interested members of TOWS-WG for their feedback and contributions.

2.1.5 International Oceanographic Data and Information Exchange (IODE)

53. Mr Peter Pissierssens, Head of the IOC International Oceanographic Data and Information Exchange (IODE) Office, presented a report on the IODE programme (available as a [presentation](#)). The report was mainly focused on updates made to the Data Exchange Policy as well as the existing (OTGA) and potential cooperation between TOWS-WG and IODE.
54. Mr Pissierssens began by drawing attention to the past (2022) and upcoming (2023) international ocean data conferences. The objective of these conferences is to develop guidance for the international ocean data and information community aimed at realizing the implementation of the ocean data and information “global commons” by 2030. The first meeting took place between 14 and 16 February 2022 in Sopot, Poland, and was attended by over 200 online and 60 on-site participants. It was organized jointly by the Government of Poland, IODE and the Decade Coordination Unit. The next meeting is planned for 20 to 21 March 2023 in Paris, France, with an expected 120 in-person participants and 200 online participants. He noted that there would be one or two presentations related to ocean hazards at the 2023 conference. Mr Pissierssens invited the tsunami community to submit papers more actively for the next conference, planned for 2025.
55. Next, Mr Pissierssens highlighted the several IOC Manuals and Guides which had been updated by IODE, including the Guide for Establishing an IODE National Oceanographic Data Centre, IODE Associate Data Unit or IODE Associate Information Unit (3rd revised edition) (Manuals and Guides, [5](#)), the IODE Quality Management Framework for National Oceanographic Data Centres and Associate Data Units (revised edition, Manuals and Guides, [67](#)), and the Guidelines for a Data Management Plan (Manuals and Guides, [73](#)).
56. The IOC Ocean Data and Information System Project (ODIS) was established by the IOC Assembly (Decision A-31/3.4.2). A closely related project to ODIS is the [Ocean InfoHub](#), which is a project aimed at building a sustainable, interoperable and inclusive digital ecosystem for all Ocean data centres. The main idea is to create an “internet of ocean data and information” that can be accessed, as data provider or data user, using very light technology. The Ocean InfoHub has started by connecting global IOC-associated online resources, including OceanExpert, AquaDocs, the GOOS/IODE Ocean Best Practices System (OBPS), the Ocean Biodiversity Information System (OBIS), and the World Ocean Database (WOD). The project is currently being implemented in three pilot regions which are Africa,

Latin America and the Caribbean, and the Pacific Small Islands Developing States (SIDS). Mr Pissierssens also shared on-screen the portal that has been created for Ocean InfoHub and which allows users to search and retrieve data and information.

57. Given that Ocean InfoHub is based on the identified need to have an organized and accessible means for searching and finding ocean-related data and information, one of the key elements and first steps for ODIS and OIH has been to build a catalogue of information and data sources (called [ODISCat](#)). Mr Pissierssens noted that there are about 47 records related to tsunamis and nearly 183 records related to sea-level. He requested that the tsunami community explore ODISCat and confirm whether their data sources are reflected in the catalogue, and if not add the records.
58. Mr Pissierssens drew attention to other important upcoming IODE activities, including the revision and update of the IOC Data Policy. In fact, the IOC Data Policy and Terms of Use (2023) is planned to be submitted to IODE-XXVII for approval, then submitted to the IOC Assembly in June 2023. In the past version of the policy, the focus was on obligations for data providers; the updated version adds rules (terms of use) for data users. For instance, the new policy includes conditions of use, FAIR and CARE principles, and access restrictions. Another important document being revised is the IOC Capacity Development Strategy; the updated version will also be submitted for approval of the IOC Assembly in June 2023. A key new element of the policy is the UN Ocean Decade. Mr Pissierssens noted that this Strategy will be particularly beneficial for supporting capacity development programmes, including for the tsunami community.
59. IODE has just under 20 courses currently available through the [OceanTeacher Global Academy \(OTGA\)](#) in data and information management. The benefit of OTGA is that although courses can be created locally, they can then be shared globally, thereby benefitting a wider group of ocean stakeholders. Of these OTGA courses, a few are focused on tsunamis including one on Tsunami Ready and another on Tsunami Community Preparedness. In addition, new courses are under development including about Tsunami Awareness. Mr Pissierssens noted that the delivery of courses is increasingly either hybrid or fully online/self-based, which allows for greater versatility in use and to reach a larger audience.
60. In 2023, IODE launched the [Ocean CD-Hub](#) which is a database of Capacity Development opportunities that are provided by Member States and organizations (UN and non-UN). At the moment, the database includes 416 records, with only three for tsunamis. Mr Pissierssens therefore encouraged Member States and organizations of the tsunami community to submit more entries. Ocean CD-Hub is a complementary service to ODISCat (ocean related web-based sources/systems of data and information as well as products and services).
61. Mr Frolov highlighted the need for further collaboration between the IODE and the tsunami community. He also requested that Mr Pissierssens provide additional information on the IOC Data Policy. Mr Pissierssens responded that, because the main objective of the previous policy was for data to be free and open, this provided only limited opportunities for data owners to retain “ownership” of their work. However, the new IOC Data Policy recognises rights of Member States or organizations to restrict—although preferably on a temporary basis, for instance for security, commercial, or other, concerns—access certain to their data. Nonetheless, if this occurs, the IODE requests that the metadata be made available, so that there is awareness that the data exists. In addition, the new IOC Data Policy further expands on rights of data users; for instance, the use of creative licences to correctly attribute data. Overall, the main challenge is that rules of access to and use of data vary greatly throughout the globe, and thus the new IOC Data Policy needs to accommodate this spectrum of situations and challenges.

62. Mr Chang Seng (Secretariat) requested further clarification on how the gap in time between when data is created and when it is available (for instance, due to the need of scientists to wait for publication) will be addressed in practice. Mr Pissierssens responded that the policy invites programmes to develop more detailed policies which are specific to their data types in order to identify best conditions of use. Thus, there may be different rules and restrictions applied by a community of data providers; the objective is for each community of data to develop and agree upon a specific approach.
63. Mr Frolov suggested that ICGs may wish to discuss on the need to define special agreements for international exchange of tsunami data, taking into account the new IOC Data Policy.
64. In closing, Mr Pissierssens noted that draft updated IOC Data Policy ([IOC/IODE-XXVII/6.4](#)) is available for review and will be discussed at the IODE-XXVII (22–24 March 2023).

2.2 REPORT OF NON-IOC BODIES

2.2.1 World Tsunami Awareness Day (UNDRR)

65. Ms Rosalind Cook, External Relations Officer, United Nations Office for Disaster Risk Reduction (UNDRR), presented the report on this item (available as a [presentation](#)).
66. Ms Cook began by expressing appreciation for the collaboration with and participation of the tsunami community in WTAD 2022 activities. Ms Cook recalled that, at the UN Ocean Conference side event “[Coastal alert – tackling tsunami risks together: partnerships and solutions for a safe ocean resilient to tsunamis](#)”, the UN Secretary-General’s Call to Action on Early Warnings for All” Initiative (EW4All) was highlighted, and several Member States encouraged deeper inclusion of tsunami risk into the Initiative Action Plan. This was reflected in the final version of the Action Plan, which was unveiled at COP27 Charm-el-Cheikh; although the Plan is largely focused on climate change, tsunamis are included as part of multi-hazard risks. Key elements of the Action Plan were carried forward to WTAD 2022, notably through a high-level event on “Early Warning and Early Action Before Every Tsunami” held on 4 November 2022. Prior to this event, UNDRR, jointly with WMO, also published a report on the “[Global status of multi-hazard early warning systems: Target G](#)” (the theme of WTAD 22); this report found that over 50 percent of the world does not have a strong early warning system and laid out good practices in the field of tsunami early warning. UNDRR is co-leading the EW4ALL Initiative with WMO and a range of other partners.
67. Overall, a key highlight from WTAD 2022 was that it focused on connecting high level political support to citizens on the ground to drive change. This success of this objective was notably measured through increased activity on the UNDRR website pages with tsunami-related resources as well as WTAD hashtags (such as #TsunamiDay) trending in several countries.
68. Ms Cook next presented on WTAD 2023 and introduced its theme of “Fighting inequality for a resilient future”. To support and further explain this theme, UNDRR has developed six key messages as well as four key objectives within the theme; these will be available on the WTAD 2023 website. Ms Cook requested that UNESCO/IOC Member States contribute best practices and resources that could be used to inform the communications products for the WTAD 2023 on this theme. This would notably include any evidence of specific risks faced by vulnerably communities or groups as well as specific action taken in countries or regions to tackle these risks.
69. The key planned activities for WTAD 2023 include a continuation of the GetToHighGround Campaign, which calls for a culture of tsunami and coastal hazards

awareness for all people at risk. This could include notably a walk through of tsunami evacuation routes with communities or connecting this campaign into existing activities such as drills. This campaign began in WTAD 22 and demonstrated a strong engagement and interest, suggesting an opportunity for growth of the campaign and therefore increased awareness. During WTAD 2022, the campaign was supported by Ecuador, Cook Islands, Indonesia, Mauritius, Portugal, and Samoa. For WTAD 2023, Ms Cook noted that UNDRR plans to further collaborate with their regional offices in implementing the GetToHighGround Campaign, based on recommendations from last year's event.

70. In addition, a high-level event will also be held in New York for WTAD 2023, in close collaboration with UNESCO/IOC and the Government of Japan. Moreover, a social and digital activation toolkit with social cards, customizable cards, videos, and dedicated WTAD webpage will be available. Ms Cook also noted that videos would also be produced in collaboration with UNESCO/IOC, based on successes of past years including important visibility on social media. Ms Cook expressed special thanks to the tsunami community for providing important footage and resources to be included in these videos. She also noted that the process for preparing videos would be further refined for WTAD 2023, including by developing key topics, draft scripts, and requesting specific footage in advance, to streamline creation of videos. Lastly, Ms Cook recalled that the branding for WTAD had been upgraded last year; it is therefore important for countries and organizations participating in WTAD to use these new materials.
71. In closing, Ms Cook shared a UNDRR video about the GetToHighGround Campaign for WTAD 2022.
72. Mr Angove (USA) expressed appreciation for the momentum and results achieved by WTAD and noted the importance and relevance of the theme for WTAD 2023. He suggested this theme could and should consider a dimension of creating early warning systems for all, and not only for those that can afford it. Mr Angove therefore encouraged countries to reflect on how to deploy an effective system globally within WTAD 2023.
73. Mr Chang Seng (Secretariat) suggested that the topic for WTAD 2023 may also provide the opportunity to explore roots and causes of vulnerability and inequality (e.g. corruption, accountability, etc.) Ms Cook responded that UNDRR considers the theme of WTAD 2023 to be more focused on at-risk groups and less on the roots of inequality, given that these can be politically very sensitive topics. The focus for UNDRR is therefore on reaching the last mile, and the actual populations that are most vulnerable. Nonetheless, she added that the WTAD 2023 theme was meant to provide an umbrella under which partners could tailor the theme to their specific needs and priorities.
74. Ms Anugrah (Indonesia) expressed appreciation to UNDRR for recognising the important contribution of Indonesia to WTAD 2022. Relating to the GetToHighGround Campaign, she noted that Indonesia had 3,500 people participating in the activity. Participants involved in Indonesia were mainly from nine communities that have since become Tsunami Ready. The activity also included two airports that joined the community drills. The activities were entitled the "Tsunami Fun Drills", with a summative video available.
75. Ms Harkunti Rahayu (Indonesia), Chair of the TOWS-WG Task Team on Disaster Management and Preparedness (TT-DMP) noted that TT-DMP had discussed methods for promoting the GetToHighGround campaign. There is a challenge within some communities and countries for which high ground is not the best practice; for instance, the recommendation may be for vertical evacuation instead. She therefore suggested that the campaign be expanded to be more inclusive. In addition, relating to the theme of WTAD 2023, Ms Rahayu suggested that the concept of inequality be expanded to include groups that do not have access to tsunami information.

2.2.2 World Meteorological Organization (WMO)

76. Ms Sarah Grimes, Mr Cyrille Honoré and Mr Hassan Haddouch presented the report on this item (available as a [presentation](#)).
77. Ms Grimes provided a brief overview of the World Meteorological Organization's (WMO) role in supporting the tsunami community, including with over 35 percent of Meteorological Services globally being TSPs and operational 24/7. In addition, even more Meteorological Services back up the national service provider and/or support with infrastructure; in some regions a majority of National Meteorological and Hydrological Services (NMHS) are involved in tsunami EWS processes (e.g. 80 percent of NMHS in the Pacific Islands). In 2022, WMO prepared a short video (available [here](#)) about how NMHS and WMO support tsunami early warning.
78. Ms Grimes stressed that WMO supports tsunami early warning processes through two key areas: Infrastructure, especially via the WMO Information System (WIS), and observations; and early warning services, especially to strengthen the last mile of communication. WMO supports NMHS to strengthen their efforts in tsunami early warning and maximise efficiencies. Ms Grimes also outlined key relevant WMO structures, including within the Commission for Weather, Climate, Water and Related Environmental Services and Applications (SERCOM) Standing Committees, and specifically the Standing Committee on Marine Meteorological and Oceanographic Services (SC-MMO) and the Standing Committee on Disaster Risk Reduction and Public Services (SC-DRR). An IOC representative is included in the SC-MMO as well as the WMO Infrastructure Commission (INFCOM) and the WMO Research Board. In addition, there exists a WMO-IOC Joint Collaborative Board (JCB), with a WMO-IOC Strategy approved by WMO and IOC in June 2021.
79. Mr Haddouch presented on WIS, recalling that it was originally integrated with the Global telecommunication System (GTS) and limited to the weather community. An updated version of WIS has been designed (WIS 2.0) in order to address some limitations of the previous version and to meet the needs of all WMO programmes. WIS 2.0 is now based on two key components: global services and WIS2 node. WIS2 node is the component to provide data and associated metadata, and it replaces the GTS Message Switching System for data exchange. All national centers and data and production centers are going to implement a WIS2 Node to exchange data in WIS2. The WIS2 Node shares data from an HTTPS service and sends notifications to Message Queuing Telemetry Transport (MQTT) subscribers.
80. The Global Services component provides the new concept of data exchange under WIS 2.0 and comprises the following four elements:
- **Global Cache:** A storage providing a copy of the WMO Core data from national centers and data and production centers to be accessed by the users.
 - **Global Broker:** Providing notifications of all the data available in the Global Caches or in originating centers. Users will subscribe to a Global Broker to get notifications of new data to be downloaded from Global Caches or WIS2 node.
 - **Global Discovery Catalogue:** It is a discovery catalogue of data and services. It provides an API to list the available data and services, as well as harvests metadata from the WIS2 Nodes.
 - **Global Monitoring:** It provides monitoring of the data exchanged in WIS2. Sensor Centers will make available statistics from data in real time. Global Monitoring Center will collect statistics from Sensor Centers and provide web accessible maps and results.

81. Mr Cyrille Honoré next provided information about the EW4ALL Initiative. Mr Honoré began by recalling that it was announced on World Meteorological Day 2022 and launched at COP27 in November 2022, with an Action Plan developed by WMO and other key partners. The Initiative has already garnered significant support, including high-level support, through its compelling and ambitious objectives to scale up and accelerate efforts for early warning.
82. The EW4ALL will be led by a Board with two co-chairs [Mr Petteri Taalas (WMO SG) and Ms Mami Mizutori (UNDRR)], and composed by key UN organizations, the International Telecommunication Union (ITU), the International Federation of Red Cross and Red Crescent Societies (IFRC), up to three private sectors representatives and funding agencies. The Initiative approach is built on the four traditional pillars of multi-hazard early warning systems, as well as a fifth pillar for monitoring and evaluation. Although each pillar is led by a specific organization, a key priority is to ensure the different pillars of the Initiative are not conducted in silos, but rather through collaboration.
83. Mr Honoré highlighted that integrating Common Alerting Protocols (CAPs) is a key element of the EW4ALL Initiative; he therefore encouraged NMHS to use these, where appropriate, for TEWs. Mr Honoré concluded that WMO's short-term objective for the EW4ALL Initiative is that a deeper analysis and workplan be developed in order to begin supporting work at country level.
84. Ms Sarah Grimes next summarized other key activities and objectives of WMO, including its programme on coastal inundation (and its links with multi-hazard early warning and tsunami). Ms Grimes drew attention to the Guidelines on Implementation of a Coastal Inundation Forecasting–Early Warning System ([WMO-1293](#)) as well as a series of awareness videos (available in multiple languages) on coastal inundation and the value of ocean buoys, all of which articulate that tsunamis are a form of coastal inundation and are critical to be considered. Ms Grimes also highlighted the Worldwide Navigation Warning Service and the WMO Advisory Group on the Worldwide Met-Ocean Information Warning Service (WWNWS/WWMIWS) coordinate services for maritime hazards wherein tsunamis are relevant. WMO has also developed Marine Services Courses including for the Pacific Islands including tsunami aspects in the context of Multi-Hazard Early Warning Systems (MHEWS). For the Caribbean and Africa regions these will be developed in 2023. She noted that WMO would be reaching out to engage the tsunami community in these courses.
85. Ms Grimes next provided an update on WMO's stance relating to meteo-tsunamis. WMO recognises that meteo-tsunamis are driven by an atmospheric forcing of a long-range wave (and therefore are non-seismic), by air-pressure disturbances often associated with fast-moving weather events. They are forecast by national meteorological and hydrological services and in most cases, from the marine weather operational areas (not from the tsunami early warning areas). As such, WMO needs to be involved in efforts to address meteo-tsunamis. Ms Grimes therefore reported that WMO requests that the issue be raised to the WMO-IOC JCB to clarify the roles and responsibilities of WMO and IOC, and how best to support Member States. In addition, Ms Grimes also noted the existence of a TT on Meteotsunamis within UNESCO/IOC and requested that WMO expert membership be engaged to continue work on the details of a potential future detection and alerting service.
86. In closing, Ms Grimes outlined key WMO events in 2023 and 2024 including the First Meeting of the EW4ALL senior leadership group (21 March 2023), the World Meteorological Day and 150th anniversary of WMO (23 March 2023), the Sendai Framework Mid-Term Review high-level meeting (18-19 May 2023), the 19th Congress of WMO (22 May to 2 June 2023), the 77th WMO Executive Council (3-4 June 2023), and the WMO SERCOM-3 (March 2024).

87. Ms Chacon, Chair ICG/CARIBE EWS, noted that in the Caribbean the percentage of NTWCs that are NMHS is closer to 40 percent. In addition, Ms Chacon expressed her concern that the use of GTS (WIS 2.0) for tsunami messages remains low in the Caribbean region; based on CARIBE WAVE questionnaires, it is less than 10 percent. This has been mentioned to WMO, but there have been few improvements relating to uptake; Ms Chacon therefore requested that WMO advise on a strategy to encourage use of WIS 2.0. Ms Chacon suggested that the invitation of a WMO expert to the Task Team CARIBE WAVE may provide a good practice to address this challenge. Mr Haddouch responded by recalling that GTS was established in the 1970s and has enabled WMO members to share data and products. With the reforms included in WIS 2.0, WMO will continue using GTS for some time, though with the aim to begin transition in 2025 and complete implementation of WIS 2.0 by 2030. Thus, GTS will continue as a platform for data exchange, noting WIS 2.0 is an easier platform for sharing of information.
88. Following from the above comment, Chair Mr Frolov noted that GTS is based on dedicated lines between countries; he enquired whether any updates were planned in terms of connections between countries (for instance by using Internet). Mr Haddouch responded that WIS 2.0 will only use the Internet, considering the concept of WIS 2.0 is easy access.
89. Mr Angove (USA) noted that the intent of the TT Meteotsunami was focused on how they related to tsunami services; he agreed that the issue should also be raised to the JCB. He also recognised that, based on these initial discussions, a key complication will be separating roles and responsibilities. Mr Rick Bailey suggested that the discussion of meteo-tsunamis should first occur within the TOWS-WG and then the JCB.
90. Mr Yuji Nishimae (Japan), Chair ICG/PTWS expressed appreciation for WMO's support in tsunami early warning. He also noted that in Japan, the Japanese Meteorological Agency (JMA) is a NMHS that also operates the earthquake and tsunami services, though in separate sections. However, the weather forecast section of JMA is the one which is responsible for the issuance of meteo-tsunami warnings; although, these are not called meteo-tsunamis.
91. Ms Grimes acknowledged that several NMHS services around the world do not call meteo-tsunamis by this name and that there is a confusion of terms. Ms Grimes therefore reiterated her recommendation that the issue be raised within the JCB, as opposed to TOWS-WG, given that the former is the more appropriate space for decisions to be taken, with all the relevant agencies involved.
92. Chair Mr Frolov suggested Ms Grimes request for the topic of meteo-tsunamis to be included in the agenda of the upcoming JCB meeting for discussion. He also suggested that an IOC-WMO Expert Group meeting be organized, in order to first have a discussion at the expert level.
93. Ms Weniza (Indonesia) noted WMO's materials related to coastal inundation and coastal buoys, remarking that under ICG/IOTWMS assessments of inundation levels are provided by TSPs.
94. In closing, Chair Mr Frolov recalled the key outputs of the last JCB meeting (1–2 March 2022) relating to coastal inundation, including proposals for testing the response and resilience to coastal flooding for coastal communities; this is considered a critical step towards global MHEWS. Mr Frolov suggested that a possible means for addressing this challenge would be through the ODTP.

2.2.3 International Union of Geodesy and Geophysics (IUGG)

95. Ms Laura Kong (USA, ITIC) presented the report on this item (available as a [presentation](#)).
96. Ms Kong began by recalling the creation, governance, and membership of the IUGG Joint Tsunami Commission, which is sponsored by the International Association of Seismology and Physics of the Earth's Interior (IASPEI), the International Association for the Physical Sciences of the Oceans (IAPSO), and International Association of Volcanology and Chemistry of the Earth's Interior (IAVCEI). The purpose of the Commission is to promote the exchange of scientific and technical information about tsunamis among nations concerned with the tsunami hazard. The Commission includes the following specialized WGs: Tsunami terminology, Science-based tsunami warning, Tsunami magnitude, GNSS data for tsunami warning, Meteotsunami, and Tsunami data.
97. Ms Kong next highlighted key activities and events which the Commission has helped convene, including the most recent meeting of the IUGG Joint Tsunami Commission (2 July 2022), the European Geosciences Union (EGU) Meeting on tsunamis from source processes to coastal hazard and warning (April 2023), the AGU Interdisciplinary tsunami science meeting (December 2022), and the Second World Conference on Meteotsunamis (May 2022). In addition, IUGG Joint Tsunami Commission plans to contribute to convene a PTWS Tsunami Workshop at ICG/PTWS-XXX (September 2023) and the IOC Second international tsunami symposium (December 2024). Moreover, members of the IUGG Joint Tsunami Commission have supported several key publications, including 19 publications on the 2018 Sulawesi/Palu event and the 2018 Anak Krakatau, as well as six papers on the 2022 HTHH event.
98. In closing, Ms Kong highlighted the key activities within the IUGG Joint Tsunami Commission related to the UNESCO/IOC, including the update of the IOC Tsunami Glossary (last update in 2019) which will be supported by the Joint Tsunami Commission tsunami terminology working group (WG). In addition, the Joint Tsunami Commission science-based tsunami warning WG will support the TOWS-WG report on tsunamis generated by volcanoes, and their meteotsunami WG will support the TOWS-WG Meteo-tsunami report.

2.2.4 International Hydrographic Organization (IHO)

99. The Chair, Mr Alexander Frolov, noted that Mr Christopher Janus, Chair of the International Hydrological Organization (IHO) WWNWS, Branch Chief, National Geospatial-Intelligence Agency (NGA), Maritime Watch NAVAREA IV/XII was not able to attend this meeting due to overlap with another meeting and sent written inputs:
100. In September 2022, at the last joint meeting with the WWNWS/WWMIWS, the two groups agreed to establish a WMO Task Team on Volcanic Activity and Safety of Marine Navigation. During the WWNWS/WWMIWS September 2022 meeting, following a comprehensive presentation from NAV and MET Areas XIV, it was proposed that a review of activities and actions could be undertaken to improve coordination to ensure the maritime community receives the necessary information in a timely manner. METeorological AREA (METAREA) X provided several comments from his other position as the Chair of the Intergovernmental Coordination Group for the Indian Ocean Tsunami Warning and Mitigation System (ICG/IOTWMS) Working Group on Tsunami Detection, Warning and Dissemination. He explained how the global tsunami warning service functioned and he noted the Tsunami Service Providers are not authorized to issue warnings but to provide advice, and it is a sovereign right to issue the warnings.

The, the joint meeting of WWNWS/WWMIWS agreed to establish a WMO Task Team on Volcanic Activity and Safety of Marine Navigation that should provide an update at the WWNWS-XV meeting in September 2023.

3. REVIEW OF PROGRESS

3.1 STATUS OF IMPLEMENTATION OF DECISION IOC-XXXI/3.4.1

101. Mr Bernardo Aliaga reported on Decisions adopted at the 55th IOC Executive Council (June 2022) and on the status of implementation of the TOWS-WG-XV decisions and recommendations (available as a [document](#)).
102. With respect to recommendations from the IOC Assembly at its 30th Session (Decision IOC-XXXI/3.4.1), Mr Aliaga recalled that IOC Circular Letter [2876](#) (24 January 2022) announced the membership of the ODTP-SC for the period 2022–2023, to be chaired by Mr Srinivas Kumar Tummala (India). So far, the ODTP-SC has met three times (including twice in person) and delivered the draft 10-year Research, Development and Implementation Plan as requested, which is available with IOC Circular letter [2932](#) (15 February 2023).
103. Mr Aliaga next reported on IOC Decision IOC/EC-55/3.5.1, drawing particular attention to the recommendation of ICG/PTWS for Member States to make data from their GNSS networks publically available in real-time. Although there is no specific status update for this recommendation yet, Mr Aliaga noted that some TSPs in the Indian Ocean, notably in Australia, are already integrating GNSS into earthquake warning. In addition, Mr Aliaga reported that the establishment of the UNESCO/IOC Tsunami Ready Recognition Programme had been announced under IOC Circular Letter [2896](#) (11 July 2022). Mr Aliaga also noted the recommendation of GOOS to consider ocean bottom pressure as an Essential Ocean Variable, given its importance for the detection and characterisation of tsunamis and computation of general ocean circulation; this recommendation has been fulfilled by GOOS. Lastly, Mr Aliaga drew attention to a recommendation highlighting the important cooperation between UNESCO/IOC and UNDRR, for WTAD and beyond. Overall, significant progress has been achieved within the Tsunami Programme.

4. REPORTS OF THE INTER-ICG TASK TEAMS

4.1 INTER-ICG TASK TEAM ON DISASTER MANAGEMENT AND PREPAREDNESS (TT-DMP)

104. Ms Harkunti Rahayu, Chair of the Inter-ICG Task Team on Disaster Management and Preparedness, reported on the outcomes of TT-DMP which met on 27-28 February 2023. Her report is available as a [presentation](#). The full summary of the Task Team meeting and its recommendations are provided in [Annex III](#) of this report.

1.4 INTER-ICG TASK TEAM ON TSUNAMI WATCH OPERATIONS

105. Mr Yuji Nishimae, Chair of the Inter-ICG Task Team on Tsunami Watch Operations, reported on the outcomes of TT-TWO which met on 27–28 February 2023. His report is available as a presentation. The full summary of the Task Team meeting and its recommendations are provided in [Annex IV](#) of this report.

5. UN OCEAN DECADE TSUNAMI PROGRAMME

5.1 PRESENTATION AND ENDORSEMENT OF THE DRAFT 10-YEAR SCIENCE PLAN

106. Mr Srinivas Kumar Tummala (India), Chair of the Scientific Committee of the Ocean Decade Tsunami Programme presented the report on this item (available as a [presentation](#)).
107. Mr Srinivas Kumar Tummala summarised the main objectives of and provided detailed information on the ODTP. The ODTP Ocean Decade Tsunami Programme [Draft Research & Development Implementation Plan](#) was made available to the TOWS-WG as a full document with an [Executive summary](#).
108. Mr Yuji Nishimae (Japan), Chair TT-TWO, commented that the UN Ocean Decade should seek to develop multi-hazard and multi-purpose instruments. For instance, in the tsunami community, efforts should not be only focused on enhancing earthquake detection instrumentation, but also instruments that can be used in the detection of other hazards given that instruments are expensive, and that a key aim of the UN Ocean Decade is a multi-hazard approach. Mr Kumar Tummala responded that he overall agreed with Mr Nishimae, and that the draft 10-year Research, Development and Implementaion Plan aims to align with this suggestion.
109. Mr Nishimae also recalled that some oceans and coastal areas are currently not covered by IOC ICGs, such as the South Atlantic, and reiterated the importance of all countries globally benefitting from the same level of preparedness, given the UN Ocean Decade aim of “100 percent of communities at risk to be prepared and resilient to tsunamis by 2030”. Mr Kummar Tummala recalled the discussion under agenda item 2.1.4. and noted that IOC was working to address this important gap. Ms Laura Kong suggested that, to avoid excluding countries, the draft Plan refer to countries generally, and not countries that are Member States of IOC.
110. Mr Miao (Australia), Vice-Chair ICG/IOTWMS, commended the ODTP-SC for elaborating a strong Implementaiton Plan. Mr Miao also enquired whether there are opportunitites for finessing of target percentage, especially depending on milestones, for aspirational goals under the plan. Specifically, he suggested separating targets into different groups (e.g. for each country to show they are putting efforts into tsunami capability). Lastly, Mr Miao suggested that, given the specific challenges of less developed countries (LDCs) and Small Island Developing States (SIDS) relating to capacity development, a more detailed explanation of identified support and approaches be included in the Plan. Mr Kummmar Tummala agreed with Mr Miao’s comment of elaborating on capacity development for LDCs and SIDs. In addition, he agreed that the aspirational targets would be revisited to further qualify and finetune them.
111. In closing, Mr Alexander Frolov recalled that the TOWS-WG is the Steering Committee for the ODTP, thus adding a significant element to its mandate and responsibilities. Mr Frolov suggested that the ICGs should update their Terms of Reference according to their implementing role for the ODTP.

5.2 REPORT ON THE PROGRESS OF THE TSUNAMI READY COALITION

112. Mr Alexander Frolov, Chair of TOWS-WG, reported that the IOC Chair, Mr Ariel Troisi, after due consultations with the Chair of TOWS-WG, and following the advice of the Task Team Chairs, decided to confirm Ms Laura Kong (USA, ITIC) as a Chair of the Tsunami Ready Coalition over the period of 2023–2024 based on her expert understanding of tsunami preparedness but also demonstrated working capacity and high visibility in multiple domains.

113. Ms Laura Kong (USA, ITIC) presented the report on the progress of the Tsunami Ready Coalition (available as a [presentation](#)). Ms Kong began by recalling that IOC Decision EC-55/3.5.1 (July 2022) approved the establishment of the UNESCO/IOC Tsunami Ready Recognition Programme as well as the Terms of Reference for the Tsunami Ready Coalition (included under Annex 2 to the Decision) and the revised Terms of Reference for TOWS-WG. The Decision noted that the membership of TOWS-WG will be constituted by the Chairpersons of the four ICGs, the ODTP-SC, the Chair of the Tsunami Ready Coalition, and representatives of the GOOS Steering Committee and IODE among others.
114. Ms Kong specifically elaborated on the Terms of Reference for the Tsunami Ready Coalition, highlighting its goal to contribute to increasing the number of Tsunami Ready recognized communities as part of the UN Ocean Decade. The specific objectives of the Coalition include to raise the profile of Tsunami Ready in collaboration with critical stakeholders across the UN system, interested regional organizations, national disaster managements agencies, and the public; and increase funding resources for the implementation of Tsunami Ready. Another key objective is to advise the TOWS-WG, TT-DMP, and TT-TWO on the implementation of Tsunami Ready, such as through flexibility with regards to accomplishing Tsunami Ready indicators, consideration of unique regional and/or local circumstances, and recognition of similar standards already in place. Ms Kong noted that discussion on the latter is already under way in several ICGs, given it is a critical challenge in order to achieve the UN Ocean Decade goal of “100 percent of communities at risk to be prepared and resilient to tsunamis by 2030”.
115. Ms Kong importantly drew attention to the fact that the Tsunami Ready Coalition will *not* have a programmatic role with regards to Tsunami Ready; indeed, the mandate for implementation of Tsunami Ready will remain the mandate and responsibility of the TT-DMP and respective ICGs. In addition, technical elements will continue to be specified by the IOC Secretariat, and specifically Manuals and Guides, [74: Standard Guidelines for the Tsunami Ready programme](#).
116. Ms Kong further noted that, given the potential size of the Coalition, an appropriate governance structure would need to be elaborated which allows for the Coalition to meet its Terms of Reference. Relating to leadership, she reminded the Group that the Chair of the Tsunami Ready Coalition is appointed by the Chair of IOC in consultation with the Chair of TOWS-WG. In addition, reporting of activities under the Tsunami Ready Coalition will be done to TOWS-WG. Given the short delay since being nominated Chair, Ms Kong remarked that a more detailed governance structure had not yet been agreed upon.
117. With regards to the membership of the Tsunami Ready Coalition, Ms Kong shared suggestions of potential international, regional, and national organizations which could be appropriate. The organizations were from a wide range of backgrounds and expertise, and Ms Kong drew attention to a key challenge of the Tsunami Ready Coalition which would be successfully orient and prioritise within such a large group of members. Nonetheless, this potentially significant membership also allows stronger engagement.
118. Lastly, Ms Kong reflected that the objective for the Coalition within the next few months would be to gather information and consider can and should be done within this space. She therefore encouraged reflection and brainstorming in the short term, to support building a strong Coalition, in terms of structure, membership, and activities.
119. Mr Zuñiga (Chile) commented that the Tsunami Ready programme is unique and important insofar as it merges most key elements of tsunami early warning, ranging of technical instrumentation to preparedness and community resilience. Given the current challenges of implementing Tsunami Ready, Mr Zuniga enquired whether the main objective of the Tsunami Ready Coalition is only related to the Tsunami Ready programme, or if it could

be expanded to include a wider understanding of the themes within and objectives of Tsunami Ready.

120. Chair Mr Frolov suggested that the Tsunami Ready Coalition be considered within a wider scope, noting for instance the broad array of members. In addition, Mr Frolov informed Ms Kong, Chair of the Tsunami Ready Coalition, of the intention of the IOC Tsunami Unit Secretariat to provide financial support for the activities of the Tsunami Ready Coalition. Lastly, given the scale of the Tsunami Ready Coalition, Mr Frolov suggested that Ms Kong explore with TOWS-WG Chair the possibility of appointing Vice-Chairs.
121. Ms Kong agreed with Mr Zuñiga's interpretation of the Tsunami Ready Coalition mandate as extending beyond the UNESCO/IOC Tsunami Ready Programme, noting this would be explored within the next year whilst building the governance structure. Ms Kong also expressed thanks for the financial support from UNESCO/IOC, and further noted that human, in addition to financial, resources would be greatly appreciated.
122. **The Group decided** that the Chair of the Tsunami Ready Coalition Ms Laura Kong, would propose a governing structure for the Tsunami Ready Coalition to the TOWS-WG-XVII (February 2024).

1.5 REPORT OF THE DECADE COORDINATION UNIT

123. Mr Bernardo Aliaga (Secretariat) presented on the report on this item (available as a [presentation](#)) on behalf of the Decade Coordination Unit.
124. Mr Aliaga began by providing a brief overview of the UN Ocean Decade and the Decade Action Framework. He specifically reminded the Group of the vision of UN Ocean Decade of "the science we need for the ocean we want" as well as its key mission of "transformative ocean science solutions for sustainable development, connecting people and our ocean". Mr Aliaga also drew attention to the role of IOC, through the Decade Coordination Unit, in articulating and enabling implementation of the UN Ocean Decade. Regarding the organisational and governance structure of the UN Ocean Decade, Mr Aliaga stressed the importance of a multifaceted structure ranging from Ocean Decade Challenges to Objectives to Actions. Mr Aliaga recalled the different types of Actions within the Ocean Decade, including Programmes, Projects, Activities and Contributions, all of which are solicited on a regular basis. Currently, the UN Ocean Decade comprises 45 global programmes, 69 in-kind or financial contributions, 214 projects populating the programmes, and 420 Decade Activities. Overall, Decade Actions are led by partners from 42 different countries. Relating to regional and national coordination, the UN Ocean Decade comprises seven regional taskforces and programmes, eight Decade implementing partners, 32 national Decade Committees, and nine Decade Collaboration Centers/Coordination Offices. Mr Aliaga highlighted various tsunami membership and involvement at different levels of the UN Ocean Decade, noting for instance the involvement of a member of the tsunami community, Ms Silvia Chacon, in the Ocean Decade Advisory Board.
125. Next Mr Aliaga recalled the last UN Ocean Decade Call for Actions which was open between 15 October 2022 to 31 January 2023 and focused on Challenge 6 (Coastal resilience) and Challenge 8 (Digital representation of the ocean). He noted that currently, there are five tsunami projects under evaluation relating to Challenge 6. The next Call for Actions will open on 15 April 2023 and will focus on Challenge 1 (Understand and beat marine pollution) and Challenge 2 (Protect and restore ecosystems and biodiversity), based on gaps identified through a thematic analysis of programmes and projects.
126. Relating to coordination of the UN Ocean Decade, Mr Aliaga drew attention to the decentralized coordination structure which includes Decade Coordination Offices, Decade

Collaborative Centres, Decade Implementing Partners, and National Decade Committees. There is a need to address critical gaps in coordination structures, including specifically for Arctic, Southern Ocean, African, Caribbean and South Pacific Decade Coordination Offices and Decade Collaborative Centres. He reported that the Decade Collaborative Centre for Coastal Resilience (DCC-CR) based in Bologna, Italy, aims to connect key institutions on resilience, including multi-hazard early warning. Although it is largely centered on Italy and Europe, it also includes a Caribbean organizations.

127. Mr Aliaga next outlined the Monitoring and Evaluation system for the UN Ocean Decade which was rolled out in January 2023 across all Decade Actions and structures that were endorsed before 8 June 2022 to feed into Annual Report July 2022 to June 2023. It is currently being piloted by three Decade Actions, one Decade Collaborative Centre, and one National Decade Committee. Based on the feedback received from stakeholders, the perception of the system is overall positive, although the forms for reporting should be shortened, clarification of certain definitions should be provided, and there were some challenges with measuring some 'infrastructure' elements. Mr Aliaga suggested that, overall, the tsunami community is well-positioned to contribute to this Monitoring and Evaluation system; he noted that the ODTP-SC is currently considering how this will process will fit within the ODTP. Mr Aliaga also drew attention to the other Monitoring and Evaluation approach that will be rolled out in February 2023 and seeks to identify mid-term milestones (these will likely be in 2027, given that the delay will likely be too short for objectives by 2025).
128. Mr Aliaga also noted that focus of the UN Ocean Decade on the African region, through its Priority Africa 2023–2024. Specific partners and donors' meetings are planned in mid-March 2023, back-to-back with first in-person taskforce meeting, to discuss possible future support to expand a co-design training (pre-cursor to securing support for co-design processes). The objective is to develop a concept for a multi-partner Africa-focused sponsored Call for Decade Actions in 2023 or 2024.
129. Mr Aliaga next outlined the approach for resource mobilization within the UN Ocean Decade, highlighting that the UN Ocean Decade is not a financing mechanism but instead can provide access to new opportunities. The key mechanisms for fundraising are the Ocean Decade Alliance, the Foundations Dialogue, bilateral support from governments, and in-kind support from industry. However, key existing gaps and challenges include multi-lateral development banks / International Financial Institutions and the private sector.
130. In closing, Mr Aliaga noted that the Second International Ocean Decade Conference will be held on 10–12 April 2024, with parallel partner events, exhibitions and networking opportunities. A call for events and speakers will be launched in June 2023
131. Chair Mr Frolov congratulated the Tsunami Secretariat and the Group for registering the ODTP as an official Decade Programme and enquired whether the same should be done for the Tsunami Ready programme. Mr Aliaga responded that it was the intention of the Tsunami Secretariat to work towards submitting the Tsunami Ready programme as a Decade Programme.

6. OTHER ISSUES

132. No other issues were reported.

7. DATE AND PLACE OF THE NEXT MEETING

133. The Chair and Technical Secretary established the date of TOWS-WG-XVII to be during the week 19–23 February 2024, with specific dates to be confirmed by the Secretariat through a circular letter.

8. CLOSURE OF MEETING

134. Ms Christa von Hillebrandt-Andrade (USA), noting this was her last year attending TOWS-WG, expressed deep appreciation for the leadership of Mr Alexander Frolov within TOWS-WG, as well as the work and dedication of the Group.
135. Chair Mr Alexander Frolov expressed his thanks for the opportunity to lead the TOWS-WG since 2021. He specifically recognised the expertise of the members of the Group, which has enabled key achievements and milestones throughout the years.
136. The Sixteenth meeting of TOWS-WG in Paris, France, was closed at 15:40 CET on 3 March 2023.

ANNEX I

AGENDA

1. OPENING AND WELCOME

- 1.1 OPENING
- 1.2 ADOPTION OF AGENDA
- 1.3 WORKING ARRANGEMENTS

2. REPORTS FROM PARTICIPANT BODIES

- 2.1 REPORT FROM IOC BODIES
- 2.2 REPORT OF NON-IOC BODIES
 - 2.2.1 World Tsunami Awareness Day (UNDRR)
 - 2.2.2 World Meteorological Organization (WMO)
 - 2.2.3 International Union of Geodesy and Geophysics (IUGG)
 - 2.2.4 International Hydrological Organization (IHO)

3. REVIEW OF PROGRESS

- 3.1 STATUS OF IMPLEMENTATION OF IOC DECISION A-31/4.3.1

4. REPORTS OF THE INTER-ICG TASK TEAMS

- 4.1 INTER-ICG TASK TEAM ON DISASTER MANAGEMENT AND PREPAREDNESS
- 4.2 INTER-ICG TASK TEAM ON TSUNAMI WATCH OPERATIONS

5. UN OCEAN DECADE TSUNAMI PROGRAMME

6. OTHER ISSUES

7. DATE AND PLACE OF THE NEXT MEETING

8. CLOSURE

ANNEX II

DECISIONS AND RECOMMENDATIONS

The Sixteenth Meeting of the Working Group on Tsunamis and Other Hazards Related to Sea-Level Warning and Mitigation Systems (TOWS-WG-XVI) was held in hybrid format (in-person and online), during 2–3 March 2023 under the Chairpersonship of Mr Alexander Frolov (IOC Vice-Chair). The meeting evaluated the progress made in respect to the Decision IOC-XXXI/3.4.1 of the IOC Assembly at its Thirty-first session (14–25 June 2021, Paris) and the Decision IOC/EC/55/3.5.1 of the IOC Executive Council at its 55th Session (14–17 June 2022).

The Group expressed its solidarity with the people who are affected by the Türkiye-Syria earthquake on 6 February 2023;

The Group reviewed reports by the IOC Intergovernmental Coordination Groups (ICGs) as well as of the Task Team on Disaster Management and Preparedness (TT-DMP) and Task Team on Tsunami Watch Operations (TT-TWO);

The Group noted with appreciation the progress made during the intersessional period, including:

- Wave exercises conducted in the Caribbean (CARIBE WAVE 22) and Pacific (PacWave 22) regions;
- Work of the *Ad Hoc* Teams on Meteotsunamis and Tsunamis Generated by Volcanoes under the TT TWO;
- Continuing expansion of capabilities and services of the Tsunami Service Providers (TSPs) for each region, especially with regards to tsunami events, and including development of new products and capabilities, such as for the maritime community and growing capability in response to tsunamis generated by non-seismic and complex events;
- Enhancements to monitoring and detection capabilities, such as growing use of GNSS data globally and installation of undersea cable systems (SMART) in the North-eastern Atlantic and Southwest Pacific Oceans;
- Continued progress in the implementation of UNESCO/IOC Tsunami Ready in the North-eastern Atlantic, the Mediterranean and connected seas, Indian Ocean, Pacific Ocean, and Caribbean and Adjacent regions;
- Efforts of the [Indian Ocean Tsunami Information Centre](#) (IOTIC) and [International Tsunami Information Center](#) (ITIC) in preparing Tsunami Awareness, UNESCO/IOC Tsunami Ready and Tsunami Evacuation Maps, Plans and Procedures (TEMPP) training through the [Ocean Teacher Global Academy](#) (OTGA) platform and hybrid training workshops and training videos;
- Development of a questionnaire in the Caribbean and Adjacent regions to receive feedbacks from the UNESCO/IOC Tsunami Ready communities on their implementation process;
- Initiatives like [Hotel Resilient](#) , as a benchmarking and certification of hotels and resorts for disaster risk management (multi-hazard including tsunami) and climate change adaptation, as well as the example for a major hotel in Waikiki, Hawaii, United States;

- Work of the Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System (ICG/PTWS) to develop a [National Tsunami Warning Centre \(NTWC\) Competency Framework](#) (2019), and the ITIC's leadership to pilot training courses based on the Framework;
- Activities undertaken by the respective regions for [World Tsunami Awareness Day \(WTAD\) 2022](#), and as part of this, the strong engagement in the [#GetToHighGround](#) Initiative, and the success achieved through United Nations Office of Disaster Risk Reduction (UNDRR) and IOC collaboration;
- Efforts of the Intergovernmental Coordination Group for the Tsunami and other Coastal Hazards Warning System for the Caribbean and Adjacent Regions (ICG/CARIBE-EWS) and the IOC Secretariat to coordinate and contribute to global initiatives related to Multi-Hazard Early Warning Systems (MHEWS);
- The ICG/PTWS for quick implementation of the Interim Hunga Tonga – Hunga Ha'apai (HTHH) Volcano Tsunami Response Procedures by 15 March 2022 ([Circular Letter 2882](#));

Further noting the unprecedented nature of the 15 January HTHH volcanic eruption and tsunami, which severed communications with the outside for nearly six weeks, the Group **commends** the ICG/PTWS for immediately providing support to the Kingdom of Tonga through the provision of operational earthquake, tsunami, and volcano situational reports, and technical assistance and provision of seismic, sea-level, communication and survey equipment by the ITIC, the Pacific Tsunami Warning Center (PTWC), New Zealand, Australia, the United States, the Pacific Community (SPC), and facilitated by the IOC Tsunami Unit in Suva, Fiji;

The Group recommended continued collaboration between the UNESCO/IOC and the UNDRR, **noting** the 2023 WTAD theme will highlight the importance of fighting inequality for a resilient future and activities will include continuing the [#GetToHighGround](#) initiative and the [#TsunamiReady](#) to engage citizens on tsunami awareness. The theme aligns closely with the current focus of the TOWS-WG in the context of the UN Ocean Decade, The Mid-Term Review of the Sendai Framework, and action to accelerate the implementation of the [UN Early Warnings for All \(EW4All\) initiative](#) to ensure everyone on earth is covered by MHEWS in the next four years, prioritizing the most at-risk communities. **The Group requested** the UNDRR to strengthen collaboration with respective ICGs and corresponding Tsunami Information Centres (TICs);

The Group recommended the continued collaboration between the UNESCO/IOC and the World Meteorological Organization (WMO), highlighting the role that many National Meteorological and Hydrological Services (NMHS) have in tsunami early warning and the role that WMO plays in supporting the NMHS in this regard, especially as linked to infrastructure and communications;

In particular, **the Group recommended** IOC Member States using the full capacity of the WMO Information System (WIS) and its Global Telecommunications System (GTS) for tsunami warning dissemination, where appropriate, and recommended subscription through WMO Global Information System Centres (GISCs) providing access to GTS data stream and tsunami warnings via ftp, sftp and email. **The Group recommended** further coordinating with GISCs in case of delivery delays or any communication issues, and for ICGs to provide feedback on the use of GTS and WMO WIS;

The Group noted the Call to Action on emergency alerting launched jointly by International Telecommunication Union (ITU), the International Federation of Red Cross and Red Crescent

Societies (IFRC) and WMO leveraging the use of the Common Alerting Protocol (CAP) format, [ITU-T Recommendation X.1303](#);

The Group recommended the TOWS-WG TT-TWO, in consultation with WMO and the national Tsunami Warning Focal Points (TWFPs) and NTWCs, continue its work in adopting the Common Alerting Protocol (CAP) format by regional TSPs and NTWCs;

The Group noted with appreciation the nomination of Ms Laura Kong as the Chair of the UNESCO/IOC Tsunami Ready Coalition;

The Group decided to organize a Scientific Symposium and recommended an Organizing Committee be composed of two Co-chairs nominated by the TT-TWO and TT-DMP, the Chair of the UN Ocean Decade Tsunami Programme Scientific Committee (ODTP-SC), a representative from the Indonesian Agency for Meteorology, Climatology and Geophysics (BMKG), a representative of the IUGG-Joint Tsunami Commission, and a representative of each of the TICs. **The Group accepted** with appreciation the offer of the Government of the Republic of Indonesia to host the symposium in December 2024 as part of the plans by the Intergovernmental Coordination Group for the Indian Ocean Tsunami Warning and Mitigation System (ICG/IOTWMS) to commemorate the 20th Anniversary of the Indian Ocean Tsunami of 2004;

The Group accepted the reports and recommendations from the Inter-ICG TT-DMP and TT-TWO and **recommended** to extend the tenure of both with their same Terms of Reference;

The Group instructed both TOWS-WG task teams to continue efforts for also monitoring and responding to tsunamis generated by non-seismic and complex sources and possible integration into tsunami watch operations and community preparedness activities;

The Group further instructed the TT-DMP to:

- Prepare a guideline for mainstreaming tsunami disaster risk reduction for coastal urban development planning;
- Prepare a guideline for critical infrastructures from tsunami impacts e.g., AirportGetReady to Tsunami;
- Update the [Guide to tsunamis for hotels: tsunami evacuation procedures \(IOC Manuals and Guides, 69\)](#) developed by the Intergovernmental Coordination Group for the Tsunami Warning and mitigation System in the North-Eastern Atlantic, the Mediterranean and connected seas Tsunami (ICG/NEAMTWS) in 2012 to include the ITIC materials and other recent documents, and translate in other languages, including other lessons learned;

The Group further instructed the TT-TWO to:

- Monitor and participate in developments in the detailed design of a robust, risk-based detection and monitoring network for tsunami warning, as outlined in the Ocean Decade Tsunami Programme Research and Development Implementation Plan in support of the enhanced timeliness and accuracy of warnings for tsunamis from all sources goal;

The Group commended the work of the *Ad Hoc* Team on Tsunamis Generated by Volcanoes;

The Group decided warning systems for tsunamis generated by volcanoes should be considered and coordinated as part of the UNESCO/IOC Global tsunami and other Ocean-related Hazards Warning and Mitigation System (GOHWMS), and also when possible be part of a MHEWS;

The Group decided to continue the *Ad Hoc* Team on Tsunamis Generated by Volcanoes in order to complete its report in time for tabling at the IOC Assembly at its 32nd Session in 2023 by the Chair of TOWS-WG;

The Group commended the work of the *Ad Hoc* Team on Meteotsunamis;

The Group acknowledged that meteotsunamis are a meteorological driven phenomenon, and as such, better clarifying the roles of NMHS and WMO will be critical in supporting the development of any potential future detection and alerting service for meteotsunamis;

The Group decided to continue the *Ad Hoc* Team on Meteotsunamis to finalise its report, **recommended** that WMO experts be engaged to assist in this task, and **also acknowledged** that WMO requests the WMO-IOC Joint Collaborative Board to discuss tsunami related issues with respect to meteotsunami, to clarify the roles and responsibilities for the WMO and UNESCO/IOC, and how best to strengthen collaboration for supporting Member States;

The Group welcomed the continuing collaboration with the International Union of Geodesy and Geophysics (IUGG) and **noted** the:

- Recent European Geosciences Union (EGU) 2022 meetings on Tsunamis from source processes to coastal hazard and warning;
- Support provided by IUGG to UNESCO/IOC on the tsunami glossary update in 2019 and report on meteotsunamis;

The Group further welcomed the:

- Engagement of TOWS-WG Task Team members at the 28th IUGG General Assembly, 11–20 July 2023 at the Messe Berlin, City Cube, Germany;
- Proposed joint IUGG and UNESCO/IOC Tsunami workshop prior to ICG/PTWS meeting in September 2023 in Tonga;

The Group noted the expanded services to be offered by [Galileo European Global Navigation System](#) in 2024 for satellite-based dissemination of targeted alerts to the population and the Galileo demonstration examples to be carried out in France, Germany, Cyprus, and Belgium and the workshop planned in February 2024 and **welcomed** the offer of the Galileo Programme to provide relevant documents, storylines, protocols, guidelines, and manuals to support the design of the demonstration examples;

The Group noted that Japan has defined a flag called “Tsunami Flag” as a visual communication method of tsunami warning in order to disseminate tsunami warning to people with hearing difficulties and people at the beach. The flag has been used since June 2020;

The Group recommended the IOC Assembly at its 32nd Session in 2023 to endorse the 10-Year Research, Development and Implementation Plan of the Ocean Decade Tsunami Programme with the proposed modifications, including those proposed by the inter ICG Task Teams;

The Group recommended the IOC Assembly at its 32nd session in 2023 to instruct the regional ICGs:

- Encourage sea level data is sampled at one second intervals and with the highest available accuracy and transmitted in real-time as a matter of priority, given the critical need to resolve and understand the near-field threat to high at-risk communities where

a tsunami generated by non-subduction earthquake sources as well as non-seismic sources (e.g. generated by volcanoes) may arrive in minutes;

- Encourage sea-level network operators to undertake regular and routine calibration of their sea-level monitoring instrumentation, following recommendations of IOC Manuals & Guides 3 and 14 (Volumes I–V);
- Routinely monitor the status of seismic and sea level related observing networks to identify and better help rectify gaps in coverage and free and open data exchange;
- Consider and implement the recommendations of the *Ad Hoc* Team on Tsunamis Generated by Volcanoes with respect to the hazard assessment, monitoring and warning requirements, including costs of deploying and maintaining such systems. Where identified tsunamis generated by volcanoes may impact multiple Member States, TSPs for the relevant ocean basin tsunami warning and mitigation systems should consider if they need to be involved in monitoring and provision of threat advice;
- TSPs in collaboration with NAVAREA operators of the International Hydrographic Organization (IHO) test the tsunami maritime safety products in 2023/24, with a view to operationally implementing in 2024/25;
- Add the task to the Terms of Reference of the ICGs and TICs to facilitate the implementation and functioning of the UNESCO/IOC Tsunami Ready Recognition Programme;
- Add the role of ICGs in their Terms of Reference as regional Steering Committees for the Ocean Decade Tsunami Programme (ODTP);
- Undertake sub-regional exercises as part of WAVE Exercises as an efficient way to further engage Member States on exercises as appropriate;
- Follow the initiative of ICG/PTWS to enable sub-regional live information sharing during tsunami events to inform neighbouring country decision-making;
- Explore and inform the TOWS-WG TT-DMP on mechanisms for recognition of UNESCO/IOC Tsunami Ready similar standards already in place in some countries;
- Caribbean Tsunami Information Centre (CTIC) to share UNESCO/IOC Tsunami Ready survey questionnaire and feedback forms on implementation process to receive information from the UNESCO/IOC Tsunami Ready communities;
- Encourage the use of standard text in the UNESCO/IOC Tsunami Ready signage for vertical evacuation, such as “Go to the designated building for vertical evacuation”;
- Properly inform the public on the validity of the recognition, as indicated on the UNESCO/IOC Tsunami Ready signage and certificate under the UNESCO/IOC Tsunami Ready logo;
- ITIC to pilot the Draft PTWS [National Tsunami Warning Centre \(NTWC\) Competency Framework](#) (2019) for endorsement by ICG/PTWS with the goal to develop a global framework for all ICGs to use;

The Group recommended the IOC Assembly at its 32nd session in 2023 to request the IOC Member States with potential tsunamigenic volcanoes to take action to implement volcano

tsunami warning as soon as possible, following guidance listed in the report of the TOWS-WG *Ad Hoc* Team on Tsunamis Generated by Volcanoes;

The Group recommended the IOC Assembly at its 32nd session in 2023 to request the IOC Secretariat to:

- Provide a timelier update of the UNESCO/IOC Tsunami Ready database;
- Explore how to develop an automated application system for UNESCO/IOC Tsunami Ready application and renewal;
- Enhance the renewal process of UNESCO/IOC Tsunami Ready and learning about the renewal experience in the United States TsunamiReady® program;
- Facilitate the finalization of the OTGA basic tsunami training materials as soon as possible to support the UNESCO/IOC Tsunami Ready;
- Develop a paper on the tsunami threat on coasts along the Southern Atlantic Ocean to assist IOC concerned Member States on the decision to be part of the global Tsunami Warning and Mitigation System;
- Help inform Member States widely on the potential tsunami hazard from volcanoes:
 - Publish the Tsunamis Generated by Volcanoes report as an UNESCO/IOC publication in 2023;
 - Distribute the Tsunamis Generated by Volcanoes Report, including the List of Tsunamigenic Volcanoes to Volcano Observatories;
 - Distribute the Tsunamis Generated by Volcanoes Report, including the List of Tsunamigenic Volcanoes to UNESCO/IOC Member States.

ANNEX III

**REPORT OF THE TOWS-WG INTER-ICG TASK TEAM
ON DISASTER MANAGEMENT AND PREPAREDNESS**

27–28 February 2023
Paris, France

 <p>unesco Intergovernmental Oceanographic Commission</p>	<p>MEETING OF THE INTER-ICG TASK TEAM ON DISASTER MANAGEMENT AND PREPAREDNESS</p> <p>INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION (IOC) of UNESCO</p>
<p>27–28 February 2023 (hybrid)</p>	

**TOWS Task Team on Disaster Management and Preparedness (TT-DMP)
Members and Observers**

Harkunti Pertiwi Rahayu (Chair)	ICG/IOTWMS	Denis Chang Seng	IOC Secretariat / TT- DMP Secretariat / ICG/NEAMTWS/NEAMTIC
Laura Kong	ITIC, ICG/PTWS	Jamel Ben Abdallah	CoastWave Project Consultant
Ardito Kodijat	IOTIC, ICG/IOTWMS	Regina Khanbekova (Observer)	UNDRR/ Invited Guest
Cecilia Valbonesi (Online)	ICG/NEAMTWS	Silvia Chacón- Barrantes (Observer)	ICG/ CARIBE-EWS
Marinos Charalampakis (Online)	ICG/NEAMTWS	Ignacio Aguirre Ayerbe (Observer) (Online)	ICG/NEAMTWS
Christa von Hillebrandt- Andrade	ICG/CARIBE-EWS	Alejandro Rojas Aldana (observer)	ICG/NEAMTWS/ NEAMTIC
Alison Brome	CTIC; ICG/CARIBE- EWS		
Derya Vennin	ICG/NEAMTWS /CoastWave Project		

1. TT-DMP SESSION ORGANIZATION

Logistics, participants, agenda

Ms Harkunti Pertiwi Rahayu, the new Chair of Disaster Management and Preparedness Task Team (TT-DMP), opened the meeting and warmly welcomed all members, observers and participants of the TOWS-16 Task Team on Disaster Management and Preparedness (TT-DMP) meeting. She asked participants to introduce themselves including those participating

online.

Mr Denis Chang Seng, IOC Programme Specialist and Technical Secretary supporting TT - DMP briefed the group regarding documentation and meeting logistics. All members were encouraged to contribute to the online Google summary report document. Mr Seng reported that Mr David Coetzee and Ms Ashleigh Fromont will not be able to participate due to the current situation regarding cyclone impact in New Zealand.

The Chairperson then introduced the provisional agenda. The Group examined and adopted the TT - DMP Agenda with the addition of one agenda item on the Ten-Year Research, Development and Implementation Plan for Ocean Decade Tsunami Programme (ODTP).

2. REFLECTION ON TT- DMP RECOMMENDATIONS TO TOWS-WG XV (2022)

The Chairperson and meeting participants reflected on the recommendations of the Task Team to the TOWS WG 15 session. It was pointed out that several recommendations have been addressed, including the translation of the IOC Manual Guide 86 Multi-Annual Community Tsunami Exercise Programme: Guidelines for the Tsunami and other Coastal Hazards Warning System for the Caribbean and Adjacent Regions into French and Spanish. It was noted that the TT-DMP will need to consider a mechanism to equate tsunami preparedness programmes in other countries that will not be implementing UNESOC/IOC Tsunami Ready Recognition Programme to UNESCO/IOC Tsunami Ready. The mechanism will be discussed under sub-agenda 3 on tools aligned with TR indicators (non-implementation of TRR) to be presented by Ms Christa von Hillebrandt- Andrade.

The Group noted that updated TORs of the IOTIC were approved by the ICG/IOTWMS at its 13th session, which took place in Bali from 28 November to 1 December 2022. The ITC reported that ICG/PTWS-XXIX.4 (December 2021), mandates the International Tsunami Information Center (ITIC) to facilitate implementation of and documentation for UNESCO/IOC Tsunami Ready Recognition Programme and other similar initiatives in the PTWS.

3. TSUNAMI READY MANUAL, GUIDES AND SUPPORT TOOLS

The Chairperson introduced agenda 3 and the sub-agenda items.

- ***UNESCO IOC Tsunami Ready Guidelines***

The meeting noted that there are no new updates concerning UNESCO IOC Tsunami Ready Guidelines MG 74. The Group noted that MG 74 is under implementation in all four ocean basins. In addition, Mr Denis Chang Seng reported that MG 74 is currently being implemented in CoastWAVE project countries. The experiences in the NEAM region will be reported to the TOWS Task Teams for consideration in any future revision of the Manuals and Guides 74.

- ***Tsunami Ready (TR) Communication Tools***

Mr Ardito Kodijat and Ms Laura Kong reported that there are no new Tsunami Ready Communication tools from the Indian Ocean and the Pacific beyond those reflected in the MG 74.

- ***Tsunami Ready Procedures and Workflow***

Ms Christa von Hillebrandt reported that CARIBE EWS are updating a questionnaire to receive feedbacks from the communities as they become recognized as Tsunami Ready. She enquired if other regions are doing the same.

Mr Ardito Kodijat reported that in the Indian Ocean they do not have questionnaires for feedback. However, the Tsunami Ready Recognized communities are requested to submit an annual report to update and monitor the progress. This annual report also helps to ensure there is a continuation and sustainability of the implementation of TRRP in the TR communities. The annual reporting is similar to the form the community submitted in their first application. He noted that annual reporting is not part of M & G 74, but it is very useful for the continuation of work and renewal of TRR communities. The form is also useful as it helps to identify if there is a need for external assistance and what kind of support is needed at the national and local level for implementing TRR.

Mr Denis Chang Seng reported that it is very likely that surveys will be conducted as part of potential Phase 2 of the CoastWAVE project in the NEAM TR communities. In particular, there is an interest to also assess how risk perceptions have changed after the project intervention.

Ms Laura Kong pointed out that in the absence of official communication documents e.g., Official Letter and no established NTRB, there is potential for confusion in countries. She noted that several PTWS countries are watching and planning, but lack concrete actions yet. She emphasized the importance and timeliness of establishing the NTRB.

Mr Denis Chang Seng reported that in the NEAM region, aside from Italy, all project countries implementing TR established their NTRB midway through the process, and that the NTRBs generally have a focused role compared to other regions. However, it should be noted that it is likely that the roles of NTRB in the NEAM region may expand in the future, and that countries will learn from each other how to establish NTRB earlier during the process.

Recommendations to TOWS-WG

Welcomes the development of a questionnaire in the Caribbean to receive feedbacks from the UNESCO IOC Tsunami Ready communities on their implementation process;

Recommends CTIC to share UNESCO IOC Tsunami Ready survey questionnaire and feedback forms on implementation process to receive information from the UNESCO IOC Tsunami Ready communities.

- ***Update on Tsunami Ready Interactive Map Viewer***

Ms Laura Kong provided an update of the Tsunami Ready Map Viewer and Tsunami Ready website. Work is in progress to improve the organization and timeliness of documentation updates. She pointed out the challenges of the TR Map viewer for countries with many Tsunami Communities.

The Viewer groups TR communities by country and is not able to show all communities in a region at the same time, and so could provide a misleading representation of regional tsunami readiness. Member State feedback has continually noted that the TR Map viewer is not up to date. Several communities who had already submitted applications are waiting to be included in the TR Map Viewer.

Secretariat confirmed that Mr Angelos Haidar, TSU Programme Assistance is now responsible, on an interim basis, for the TR Database following the departure of Mrs Esmeralda Borja as Project Assistant.

The meeting noted that based on guidelines and best practices for example from the Indian Ocean and other regions, the Secretariat only processes applications when TRRP is completed. The TR web site, hosted by the ITIC, stands up a community web page after the Secretariat confirms that TR application is completed.

Recommendations to TOWS-WG

Requests the Secretariat to provide a timelier update of the UNESCO IOC Tsunami Ready database.

- ***What is a community?***

Ms Christa von Hillebrandt addressed the question concerning what a community is in the context of Tsunami Ready. This is important for the implementation of Tsunami Ready and the Ocean Decade Tsunami Programme and its goal of “100% of at-risk communities are prepared for and resilient to tsunamis through programmes like Tsunami Ready.”

Tsunami Ready is a performance-based community recognition programme. Therefore, the selection of the appropriate community is key for the implementation and sustainability of the programme. Nevertheless, there are many different interpretations of what defines a “community”.

Among the many definitions, for Tsunami Ready, it would be most appropriate to use those that have an identifiable geographical boundary, either administrative/political boundaries and/or disaster management areas of responsibility. In addition, it is important that the communities perceive the risk for greater engagement in the implementation of Tsunami Ready. Another consideration is that the community has an established authority to apply for recognition and existing resources to implement and sustain it.

Mr Ardito Kodijat reported that in the Indian Ocean, clear boundaries (administratively or natural boundaries), the size of the community, and the characteristics of the community (rural, urban, agriculture, industrial, tourism, etc.) are key elements to consider when identifying TR communities.

The group also discussed strategies on how to best implement Tsunami Ready, e.g., use of flow charts, worksheet of activities and flyers to implement, identify target communities and achieve each TR Indicator. It was noted that implementation may be different depending on geographical and administrative differences, the size of the population, the characteristics of the communities (agriculture vs touristic), and interest of the national civil protection agencies.

Recommendations to TOWS-WG

Recommends developing additional implementation guidance documents to support the implementation of Tsunami Ready.

- ***Tsunami and Critical Infrastructures***

Ms Harkunti Pertiwi Rahayu delivered a presentation on tsunamis and critical infrastructures as an important aspect of mainstreaming DRR and to respond SFDRR global target in “*reducing disaster damage to critical infrastructures and disruption of basic services, among them health and educational facilities, including through developing their resilience*”. Resilient critical Infrastructures are important for building tsunami resilience. Key lessons learned for example in Indonesia include airport and Air Traffic Control impacted by earthquakes and tsunami. Other country examples include collapsed bridges and damaged power plants leading to radiation leakage, and contamination. It is important to build resilient critical infrastructures, including airports and ports to facilitate *swift recovery*. Thus, prevention and structural mitigation are significantly important to complement preparedness and response. Initiatives in Indonesia to promote resilient infrastructures include Airport Ready to Tsunami.

Mr Denis Chang Seng noted that a lot of resilience emphasis is placed on the robustness of critical infrastructures, to minimize and prevent failures. However, critical infrastructure resilience also includes redundancy and rapid restoration time respectively when a system is unable to accommodate and absorb shocks.

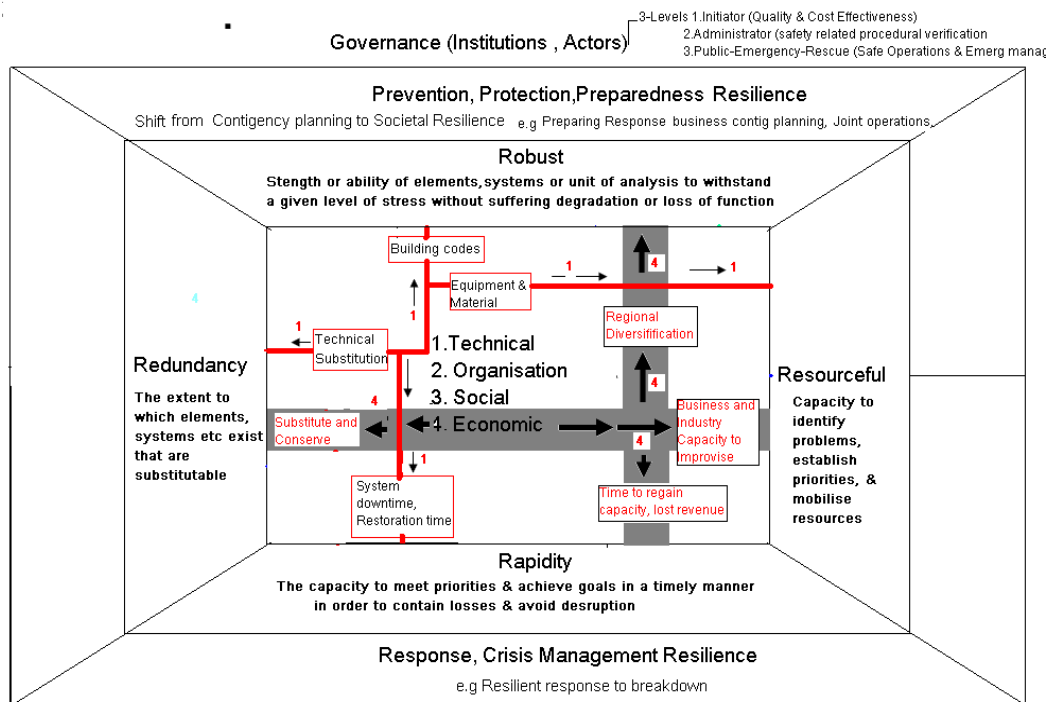


Figure 1. Typology of resilience in the context of critical infrastructure Source Embrace Project 2012

○ **Making Cities Resilient (MCR2030)**

Mr Denis Chang Seng provided a report on the progress made towards developing partnership and future opportunities concerning Making Cities Resilient (MCR2030). Making Cities Resilient 2030 (MCR2030) is a unique cross-stakeholder initiative with the following aims:

- Improving local resilience through advocacy, sharing knowledge and experiences,
- Establishing mutually reinforcing city-to-city learning networks,
- Injecting technical expertise,
- Connecting multiple layers of government and building partnerships

He reported that he has registered IOC UNESCO as an official partner of MCR2030. The next step is to include the core business and activities of the Tsunami Resilience Section on the MCR2030 DashBoard. In particular, it is important to highlight UNESCO IOC Tsunami Ready Recognition Programme. A list of cities and partners have joined the MCR2030, and it provides a space to match common interests and needs.

In terms of contributions from TSU Resilience Section, he suggested that all TICs join the MCR2030 DashBoard so that they can receive information about activities and meetings organized. Many activities are apparently concentrated in SE Asia and European cities. Webinars are frequently organized to help stakeholders understand how to get involved and learn more about the Sendai Framework Voluntary Commitment process. He stressed that contributing to MCR2030 is an additional effort for the Tsunami Programme but is mutually reinforcing.

- **Hotel Resilience**

Mr Bijan Khazai, CEO of Hotel Resilient (<https://hotelresilient.org/>) presented the Hotel Resilient Programme. Hotel Resilient is a benchmarking and certification of hotels and resorts for disaster risk management (multi-hazard including tsunami) and climate change adaptation based on assessment, resilient planning, design, and operations for hotels. They support hotels from the design of crisis management systems to the implementation of protocols, facilitation of training, and completion of audits towards a certification. It was noted that they have a global tsunami risk model at a 10 km scale resolution.

- **Tsunami Response Plan for Hotels in Waikiki**

Ms Laura Kong shared the tsunami response plan example for a major hotel in Waikiki, Hawaii, United States. The plan is available for sharing as a general template, or example, for tsunami response by a large business or hotel. The plan calls for vertical evacuation to the 4th floor or higher in steel-reinforced concrete buildings higher than 10 floors. The Response Plan is developed and maintained by the hotel security department and documents the standard operating procedures to be done by all hotel staff (front desk, security, etc.) during a tsunami warning. The plan is not posted to the hotel web site but is practiced by the hotel employees regularly. It contains information on tsunami terminology, alert system, protocols for hotel and guest notification, tsunami inundation and evacuation maps, action steps, vertical evacuation plans, tsunami flood secure procedures, and post tsunami flood procedure.

The plan contains a map of sea level stations and travel times. The hotels are notified by the Pacific Tsunami Warning Center (PTWC). The guests are notified by sirens at least 5 hours before the tsunami arrival time, and the hotel manager on duty will make a Public Address (PA) announcement explaining the situation. Hotel guests will need to vertically evacuate four floors or higher. Vertical evacuation plans are designed for local events (immediate action) and events outside of the inundation zone.

ITIC noted that the TT-DMP had previously discussed and elaborated on existing materials for hotel tsunami response, including the availability of “A guide to tsunamis for Hotels” (Manuals and Guides 69) in 2012, and the 2013 ITIC “Tsunami Response Workshop for Businesses: Preparing hotels and businesses for the next tsunami: Tsunami Response - Guidance and Templates, Resource Documents” (2013, http://itic.ioc-unesco.org/index.php?option=com_content&view=article&id=1877:tsunami-response-training-for-businesses&catid=2128&Itemid=2557).

Within the United States, its TsunamiReady program includes TsunamiReady supporters and TsunamiReady champions to recognize significant outstanding involvement/support in TR implementation by individuals and for stakeholders (e.g., hotels) that have taken additional steps to be prepared for tsunamis. These are in addition to TR communities.

Recommendations to TOWS-WG

Recommends to prepare a guideline for critical infrastructures from tsunami impacts e.g., AirportGetReady to Tsunami;

Recommends that TICs join the MCR2030 to explore potential regional and city interest and opportunities in tsunami preparedness and UNESCO IOC Tsunami Ready Recognition Programme;

Recommends to update the Tsunami Hotel guide (IOC Manuals and Guides 69) developed by NEAMTWS in 2012 to include the ITIC materials and other recent documents, and translate in other languages, including other lessons learned;

Further recommends to consider for the future to integrating into the UNESCO IOC Tsunami Ready Recognition Programme other options to recognize entities other than Communities.

- ***Inclusion of Other National Programmes and Initiatives in the UNESCO IOC Tsunami Ready Recognition Programme (Non-implementation of TRR)***

Ms Christa von Hillebrandt introduced the topic of how countries with strong existing tsunami programmes for tsunami preparedness can be addressed in the UNESCO IOC Tsunami Ready Recognition Programme, noting that the UN Ocean Decade Tsunami Programme's goal is that 100% of communities at risk from tsunami should be prepared and resilient by 2030.

In the Pacific and Caribbean, the ITIC noted that there are a number of countries that already have strong preparedness programmes, such as Japan, USA (Caribbean and Pacific), Chile, New Zealand, and Australia. For such countries, starting a UNESCO IOC Tsunami Ready Recognition Programme would be duplicative and burdensome, in addition to being costly.

Recognizing this,

The ICG/PTWS-XXIX (December 2021) Working Group on Disaster Risk Management and Preparedness

Noting that some Member States already have similar tsunami hazard mitigation programmes in place that **encourages** Member States to apply other programmes, to confirm alignment with the twelve UNESCO IOC Tsunami Ready Indicators in relevant communities and report outcomes;

Requests Working Group 3 to explore, in cooperation with the TOWS Task Team on Disaster Management and Preparedness, ways to recognize communities that choose not to implement the UNESCO IOC Tsunami Ready Recognition Programme, as compliant with the Tsunami Ready indicators,

New Zealand has begun to consider this issue, using the concept of “cross-crediting” National programme indicators with those of the UNESCO IOC Tsunami Ready Recognition Programme to align and ensure the same degree of readiness in the TR “Assess, Prepare, Response” indicators.

The meeting noted that the ICG/PTWS Steering Committee will meet next week in Paris, 6-9 March 2023 to further discuss the issue, and New Zealand will further elaborate on their progress, and the ICG/PTWS-XXX Session will meet in September 2023 in Tonga.

Mr Ardito Kodijat raised the question who will decide if a national programme and or initiatives are similar to UNESCO IOC Tsunami Ready and contributes to the goal of 100% of at-risk communities prepared for and resilient to tsunami.

For these initiatives, the Tsunami Ready Map Viewer could use different colors or symbols to distinguish the different initiatives.

Recommendations to TOWS-WG

Appreciates the progress by the PTWS concerning exploring mechanisms of how to include other tsunami preparedness and readiness programmes and initiatives in the UN Ocean Decade Tsunami Programme “tsunami readiness” goal.

Recommends ICGs to explore and inform on mechanisms for recognition of UNESCO IOC Tsunami Ready similar standards already in place in some countries.

4. IMPLEMENTATION STATUS OF TSUNAMI READY PILOT PROGRAMMES, PROGRESS AND CHALLENGES

○ ICG//NEAMTWS

Ms Cecilia Valbonesi reported on the recent developments concerning piloting Tsunami Ready in three municipalities (Palmi, Marzanemi, and Minturno) in Italy.

Ms Derya Venin reported on the progress of the IOC DG ECHO project, "Strengthening the Resilience of Coastal Communities in the NEAM region to the Impact of Tsunamis and Other Sea Level-Related Coastal Hazards" or "CoastWAVE". The project is implementing Global Tsunami Ready Standards and Guidelines and Tsunami Ready Recognition Programme (TRRP) at 7 communities in 7 countries: El Jadida (Morocco), Chipiona (Spain), Alexandria (Egypt), Marsaxlokk (Malta), Larnaka (Cyprus), Samos (Greece) and Istanbul, (Turkey). A first regional training workshop in NEAM region on Standard Operating Procedures (SOPs) was co-organized by IOC UNESCO and the Joint Research Centre of the European Commission (EC-JRC) in Ispra, Italy 2022. A second online training workshop on TRRP was organized mainly for project countries with the aim of providing the knowledge and tools to better implement UNESCO IOC TRRP. The training was facilitated by the support of IOTWS.

Mr Denis Chang Seng provided an overview of the status of TR implementation in the seven project CoastWAVE countries across all the twelve indicators. There is good progress of implementation for most of the Assessment, and some of the Preparedness and Response Indicators of Tsunami Ready. Overall, 70 % of indicators can be considered as work in progress. The response indicator on emergency operations plan (EOP) is still the least progress indicator subject to the development of national and local SOPs. It is to be noted that most countries have established a National Tsunami Ready Board

● ICG/IOTWMS

Mr Ardito Kodijat reported on the progress in implementing TRR in the Indian Ocean. In 2022 there were nine TRR communities in Indonesia. There is no additional TRR community in India. Therefore, there is a total of 11 TRR communities in the Indian Ocean. Maldives as a SIDS has indicated interest to start the TRRP in 2023. He presented several lessons learnt from Indonesia; one concern is on the Tsunami Ready signage to be used in communities who do not have higher ground (far inland) to evacuate to. The Tsunami Ready signage has been designed for people who need to evacuate to vertical evacuation buildings. The meeting noted the importance of building codes and structural checks by mandated authorities (Public works in Indonesia). The meeting agreed to use simple message such as "*go to the designated building for vertical evacuation*".

○ IGG/PTWS

Ms Laura Kong of ITIC reported on the progress of Tsunami Ready implementation in the ICG/PTWS. There has been official recognition (all under the pilot programme) of 10 communities in 4 countries (Honduras; El Salvador, Costa Rica, and Samoa); confirmation of plans to become recognized in 1 community (Panama); and progress in the implementation in 14 communities from 6 countries (Ecuador, Costa Rica, Marshall Islands, Federated States of Micronesia). Recognition is expected to be completed in the latter 14 communities by end of 2023 or early 2024.

A total of 5 Member States have expressed interest to implement Tsunami Ready: Vanuatu, Solomon Islands, Tonga, Samoa, and France (French Polynesia and Caledonia). Most countries have already achieved some of the TR indicators. Implementation will be done in a multi-hazard context where there already exists Community Based Disaster Risk Management

Programmes (some in place since 2010), or Community Climate and Disaster Risk Management Programmes (for example, since 2015).

The ITIC and IOTIC conducted a 3-day Regional Tsunami Ready Training for the Pacific Island Countries and Territories (PICT) from 30 January to 1 February 2023, bringing together 11 countries and participants from disaster management offices, tsunami warning centres, and geological services. Training materials were based on materials developed for the Ocean Teacher Global Academy Tsunami Ready training that had been used in the Indian Ocean. Following, the PICT TR training materials were shared to the NEAMTWS who conducted an adapted NEAM Tsunami Ready training under the COASTWAVE Project.

PTWS TR funding for implementation has been or will be a combination of national resources and donor support (DIPECHO, USAID, SPC, NORAD (Norway), AUSAID, UNDP, UNDRR).

- **ICG/CARIBE-EWS**

Ms Alison Brome reported a total of 15 communities from 12 countries have been recognized as TR in the Caribbean. Renewals discussions have started in 2 communities in Grenada and 1 in Anguilla. There are pending discussions for renewals to be initiated in 2 communities from Nicaragua, 3 from Honduras (2 in Caribbean and 1 in Pacific), and 1 from Haiti.

In addition, projects are contributing to the implementation of Tsunami Ready mainly: 1). Strengthening capacities for tsunami early warning in Grenada; 2). Towards a safer ocean in the Caribbean through tsunami-ready communities (NORAD project communities in Barbados, Jamaica and Trinidad and Tobago); 3). UNESCO/IOC EWS Dominican Republic; and 4). and ITIC-CAR USAID/BHA project in four communities (Barbados, Dominica, Saint Lucia and Saint Vincent and the Grenadines, Dominica)

The hiring of local and/or national consultants to work with the community is a learned best practice.

- **Other Challenges**

The meeting also discussed the challenges in the TR renewal process. Commonly the renewal has taken a similar level of resources and engagement as the initial recognition process. The conduct of tsunami exercises and education/awareness activities regularly support the sustainability for Tsunami Ready communities. Ardito Kodijat highlighted that in the Indian Ocean, the TRR community is required to submit an annual report to update their activities, the progress, and improvements. The annual report helps to check if there is sustainability of the Tsunami Ready in the community.

The meeting also discussed and noted the challenges in the TR application process as this requires a significant amount of document submission and processing, which is time consuming and requires human resources. The meeting noted that much of the submission process could be done through online tools and automatic file processing.

Recommendations to TOWS-WG

Appreciates continued progress in the implementation of UNESCO IOC Tsunami Ready in the Caribbean regions, the Indian Ocean, the Northeast Atlantic, Mediterranean and connected seas and Pacific Ocean;

Recommends additional guidance to be provided by UNESCO IOC on the renewal process of UNESCO IOC Tsunami Ready Recognition Programme and TICs to organize an online meeting on the renewal of UNESCO IOC Tsunami Ready Recognition Programme;

Notes the importance to properly inform the public on the validity of the recognition, currently indicated on the UNESCO IOC Tsunami Ready Recognition signage and certificate under the UNESCO IOC Tsunami Ready Recognition logo;

Notes the new tsunami signage developed by IOTIC for vertical evacuation when there is no high ground and/or could not go inland;

Recommends the development of standard text in the UNESCO IOC Tsunami Ready signage for vertical evacuation and request the TT DMP members to take stock of its region for discussion at next TT meeting;

Request Secretariat to explore and implement more efficient ways in which to process the UNESCO IOC Tsunami Ready application and renewal system, such as through automation.

5. TRAINING AND GUIDANCE

- **IOC Ocean Teacher Global Academy: ITIC and Indonesia BMKG as OTGA STC – reports (via IOTIC)**

Ms Laura Kong provided an update on the progress of the ITIC training courses under the IOC Ocean Teacher Global Academy (OTGA) platform. The courses will cover: Tsunami Awareness; Tsunami Early Warning Systems; Tsunami Evacuation Maps, Plans and Procedures; Tsunami Warning Center and Emergency Management Response SOPs; and Tsunami Warning Center Competencies.

The Tsunami Awareness course is close to complete. The challenge has been to create a self-paced interactive online course. Currently, there is a need to update tsunami hazard maps to 2022 and to conduct a test of the course before going live. The course will be self-paced, without interaction of a trainer. Students will take a post-test, and if they pass, will receive a Certificate of completion. Tsunami Awareness course completion will be a pre-requisite for all subsequent OTGA tsunami courses.

Mr Ardito Kodijat reported that the Tsunami Ready training under the OTGA platform is still ongoing. All presentations for the training materials are already developed. These materials were tested in a number Tsunami Ready events in the different regions such as the Indian Ocean Tsunami Ready Workshop in November 2022, the Pacific Island Countries and Territories Tsunami Ready Training in January 2023, the Fiji National Tsunami Ready Training in February 2023, and in the CoastWAVE Tsunami Ready Workshop in February 2023. The IOTIC also conducted online training for Indonesian Tsunami Ready facilitators between January and February 2023 with the objective to try out the presentations in terms of duration, and to develop quizzes for the lectures, and assignments.

Based on these testing, the Tsunami Ready OTGA training can be simplified from the initial plan to have three courses and three modules: Tsunami Ready Training for Decision Makers and Community and Training for Tsunami Ready Facilitators with two courses: Introduction to Tsunami Ready and the Indicators and Facilitating Tsunami Ready.

Mr Ardito Kodijat suggested that to move forward with the Tsunami Ready OTGA training, it would be ideal for a small group of Tsunami Ready practitioners from different regions to work together in order to allow maximum inclusion of global examples of TR activities. Ms Laura Kong confirmed that it may be more productive for a small group to meet in person to finalize the OTGA training documents (modules, activities, tests, resource materials, etc.). At a minimum, the IOTIC and ITIC plan to closely collaborate to finish the OTGA Tsunami Ready course in the next six months.

Appreciates efforts of the Indian Ocean Tsunami Information Centre (IOTIC) and International Tsunami Information Centre (ITIC) in preparing Tsunami Awareness, UNESCO IOC Tsunami Ready and Tsunami Evacuation Maps, Plans and Procedures (TEMPP) training through the Ocean Teacher Global Academy (OTGA) platform and hybrid training workshops and training videos.

Requests the finalization of the OTGA basic tsunami training materials as soon as possible to support the UNESCO IOC Tsunami Ready Recognition Programme.

Requests Secretariat to facilitate the organization of a UNESCO IOC Tsunami Ready expert meeting to finalize the OTGA Tsunami Ready training programme.

- **Tsunami in School Programme**

The meeting reported that there is no new development concerning tsunamis in the school programme. Mr Ardito Kodijat highlighted that the request to compile educational materials has already been completed.

6. WTAD 2022

Ms Regina Khanbekova (UNDRR), reported that World Tsunami Awareness Day 2022 advocated reducing tsunami risk globally through increasing access to early warning systems. The UN Secretary-General, Antonio Guterres launched the Early Warnings For All Action Plan (EW4ALL) to achieve early warning for all in 5 years. This will save lives and protect livelihoods. In addition, the UNDRR event in New York on “Early Warning and Early Action Before Every Tsunami” served to build partnerships and leverage data to ensure no one is left behind, and minimize the risks posed by tsunamis and other hazards.

Citizen engagement to build a culture of the tsunami and other coastal hazards awareness for all the people at risk took place with the conduction of the #gettohighground public-facing campaign, where citizens participated in fun walks of tsunami evacuation routes at the local level. The campaign was supported by Member States such as Indonesia, Samoa, Ecuador, the Cook Islands, Portugal, and Mauritius. Approximately 4000 people participated. It was noted that for some communities, the option to go to higher ground is not feasible, and in this case “GetToHighPlace” may be more relevant and inclusive”.

For the 2023 campaign, the theme will focus on fighting inequality for a resilient future. It inspires to engage with more Member States, Making Cities Resilient (MCR) 2030, and advocate decision makers on the importance of EWS coverage using strategic communications, and through a series of events in partnership with Japan to promote the World Tsunami Museum Conferences. WTAD 2023 will maintain the strong synergy between partners such as UNESCO/IOC, WMO and UN System.

Ms Christa von Hillebrandt suggested that for WTAD, UNDRR also consider promoting the hashtag #tsunamiready and that for exercises like CARIBE WAVE, the UNDRR hashtags also be used.

Mr Ardito Kodijat raised the question on how to engage with UNDRR regional office to strengthen the collaboration on organizing WTAD in the different regions.

TICs, TT-DMP representatives reported on the key activities and achievements of WTAD 2022.

ICG/NEAMTWS

Ms Cecilia Valbonesi (NEAM) reported that Sesimbra, Portugal participated in the

“*gettohighground*” campaign. The Secretary of State for Home Affairs Ms Patricia Gaspard participated. To celebrate its 10 years in operations, KOERI organized a WTAD Tsunami Drill Exercise on 4 November 2022 in the CoastWAVE project municipality of Büyükçekmece. The tsunami drill exercise was followed by an exercise evaluation meeting and a Tsunami Early Warning and Risk Mitigation Workshop on 5 November. Italy also conducted exercises and activities in the three pilot Tsunami Ready communities. A video on [tsunami risk in the Mediterranean](#) was also prepared jointly with the UNDRR.

ICG/IOTWMS

Mr Ardito Kodijat reported that Indonesia organized a Tsunami Fun Drill on the World Tsunami Awareness Day in the nine villages recognized as UNESCO IOC Tsunami Ready. A total of 3500 people including people with disabilities participated. In addition, the tsunami fun drill also involved two airports and 12 hotels located in the Tsunami Ready community villages.

ICG/PTWS

Ms Laura Kong summarized the contributions of the PTWS to the WTAD 2022. These included numerous national activities, including the UNDRR - UNESCO IOC video on the [Tsunami in Tonga](#), and the SPC DRR Senior Advisor participation to the global Early Warning Early Action Before Every Tsunami Webinar on 4 November 2022 in Bangkok.

Previously, the UNDRR-UNESCO IOC WTAD short videos on joining the Global Tsunami Ready Community in the Pacific have been featured: Tonga (2022), New Zealand and Solomon Islands (2021), Costa Rica, New Zealand, Fiji, Philippines, Samoa, Tonga, Hawaii, and Vanuatu (2020). In 2021, the ITIC organized Tsunami Ready ‘shout-outs’ (Be Aware, Be Prepared, Be Tsunami Ready) by PTWS countries in the Western Pacific, Pacific Islands, and Eastern Pacific.

Since 2016, the ITIC has summarized tsunami activities and the UNDRR-UNESCO IOC short videos through dedicated web pages at:

http://itic.ioc-unesco.org/index.php?option=com_content&view=category&layout=blog&id=2262&Itemid=2782

Caribe-EWS

CTIC collaborated with UNDRR for the development of a video highlighting how countries and communities help prepare for tsunami risk in the Caribbean (<https://youtu.be/XbV1bV0JHdM>). In addition, ITIC-CAR participated in the UNDRR Americas Office launch of the documentary “Forget me Not” on the unexpected friendship between a survivor in Japan and a couple in Alaska who found and returned a tsunami debris.

Recommendations to TOWS-WG

Notes the activities undertaken by the respective regions for WTAD 2022, and as part of this, the strong engagement in the #GetToHighGround initiative, and the success achieved through the United Nations Disaster Risk Reduction (UNDRR), and IOC collaboration;

Further notes to build connections with EW4ALL, Multi- Hazard approach and coastal risk and Making Cities Resilient (MCR2030);

Recommends continued collaboration between the UNESCO/IOC and the UNDRR, noting the 2023 WTAD theme will highlight the importance of fighting inequality for a resilient future

and activities will include continuing the #GetToHighGround initiative and the #TsunamiReady to engage citizens on tsunami awareness. The theme aligns closely with the current focus of the TOWS-WG in the context of the UN Ocean Decade, The Mid-Term Review of the Sendai Framework, and action to accelerate the implementation of the Early Warnings for All (EW4All) initiative to ensure everyone on earth is covered by MHEWS in the next four years, prioritizing the most at-risk communities.

The Group **requested** the UNDRR to strengthen collaboration with respective ICGs and corresponding TICs and use the hashtag #TsunamiReady.

7. TEN YEAR RESEARCH, DEVELOPMENT AND IMPLEMENTATION PLAN FOR THE OCEAN DECADE TSUNAMI READY PROGRAMME

Ms Christa von Hillebrandt reported on the Ten-Year Research, Development and Implementation Plan (RDI) for the ODTP. The plan is developed and structured in the following four key chapters.

1. Risk Knowledge
2. Warning and Dissemination and communication
3. Preparedness and Response
4. Implementation and Mitigation Measures- including urban planning

The ODTP Research, Development and Implementation Plan overarching considerations include a focus on Capacity Development – ensure investment in capacity development for the different stakeholders including the generators and the users of the tsunami early warning system and governance, including the connections with Decade Programmes, Projects, Contributions, Decade Coordination Centres and Communities of Practice:

- Multi-hazard framework – UNDRR, Early Warnings for All
- International Cooperation – Scientific Committee, TR Coalition
- Inclusiveness, gender diversity and youth involvement
- Accountability

The document includes pathways to implementation through the IOC Programme, countries/Member States, ICGs and its TICs. It is important to highlight and clarify the essential role and contributions of TICs for implementing TR, as well as TSPs and Working Groups within the ICG framework. It was noted that TICs are currently not explicitly mentioned.

Recommendations to TOWS-WG

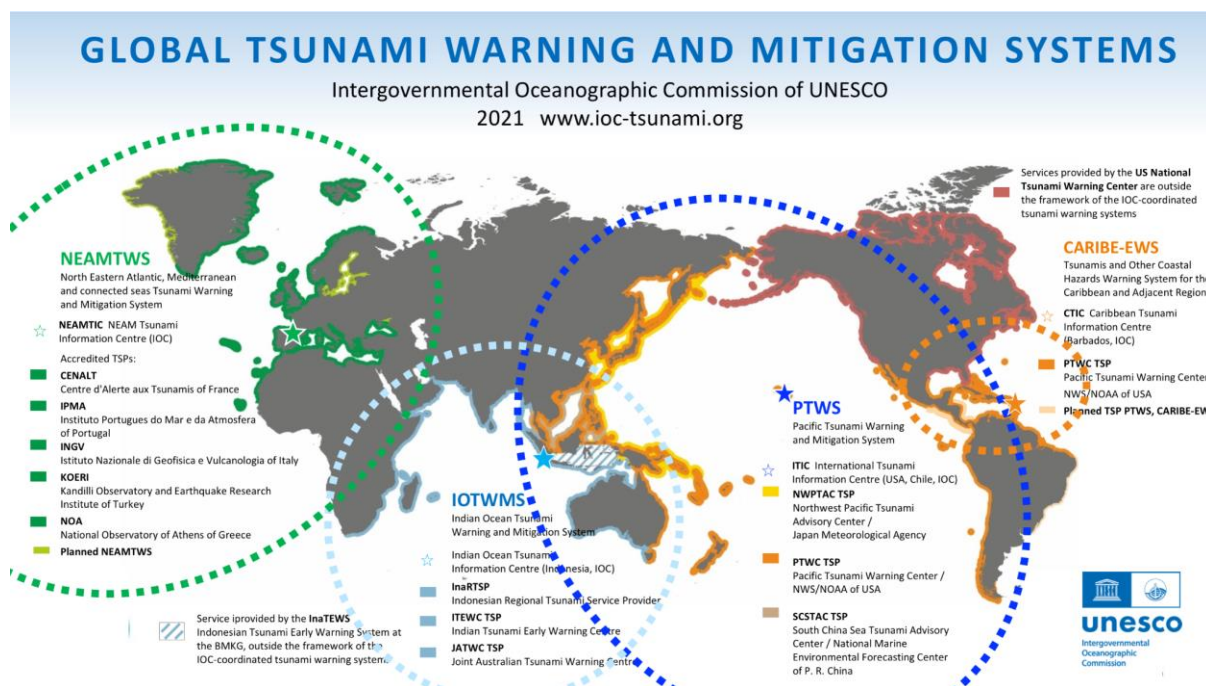
Noted the absence of the Tsunami Information Centers in the governance sections, especially for its important role in facilitating the implementation of the UNESCO IOC TRRP as a key contributor to the UNOD,

Recommends to expand and explicitly state the role of the ICGs, their Working Groups, Tsunami National Contacts, National Tsunami Warning Centers, Tsunami Warning Focal Points, Tsunami Service Providers, and Tsunami Information Centres in the Governance and Implementation chapters of the ODTP RDI.

Recommends work with relevant ICG Working Groups and Task Teams, in coordination with the Tsunami Information Centres, to propose mechanisms by which National tsunami preparedness and readiness programmes and initiatives will be able to fully participate and contribute to the UN Ocean Decade Tsunami Programme's "100 percent of at-risk communities to be prepared and resilient to Tsunamis" goal.

Requests add the role of ICGs in their Terms of Reference as regional Steering Committees for the Ocean Decade Tsunami Programme;

Requests to include the map of the Global Tsunami Warning and Mitigation System map in the Governance chapter to clearly illustrate the components.



7. DISCUSS OUTCOMES OF THE JOINT MEETING

TT DMP discussed the meeting arrangement and the TT DMP and TT TWO Joint Agenda (see next pages) timetable, expressing that there was not enough time to fully and meaningfully discuss all the Agenda topics within the timetable provided.

Recommendations to TOWS-WG

Recommends organizing TOWS Task Team meetings over a full 3-days, with one full day on Joint agenda discussions.

8. OTHER BUSINESS

Ms Harkunti Pertiwi Rahayu provided a presentation on mainstreaming Disaster Risk Reduction in Urban Planning to respond to the global commitment, i.e., Sendai Framework for Disaster Risk Reduction, SDGs Goal no 11 building resilient cities, and Paris Agreement and strengthening one of the UN ODP targets on mitigation. Mainstreaming disaster risk reduction into development plans is the key to preventing systemic disaster impacts on development. Mainstreaming DRR is a cross-sectoral development effort that is currently being pursued globally since 2007, through addressing disaster risk reduction in medium-term strategic development frameworks, legislation and institutional structures, sector strategies and policies, budgetary processes, as well as design and implementation of individual development programs/projects.

Recommendations to TOWS-WG

Notes the importance of mainstreaming disaster risk reduction in urban planning and development is a key to preventing systemic disaster impacts, and that this is a cross-sectoral effort,

Recommends TT-DMP to share the information to its ICGs to obtain feedback and guidance on whether to prepare a global guideline for mainstreaming tsunami disaster risk reduction for coastal urban development planning.

9. DEVELOP TT DMP WORK PLAN

The TT DMP discussed the drafting of the TT DMP summary report and the contributions of members to the online Google document to facilitate reporting on Thursday 2 March to the TOWS WG.

10. MEETING CLOSE

The chair invited any final comments. She closed the TT DMP meeting at 6:15 p.m. (CET).



MEETING OF THE INTER-ICG TASK TEAM ON DISASTER MANAGEMENT AND PREPAREDNESS

INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION OF UNESCO

27–28 February 2023 (hybrid)

JOINT TT TWO AND TT DMP MEETING

1ST JOINT TT TWO AND TT DMP SESSION AND OPENING (CHAIRD BY PROF HARKUNTI PERTIWI RAHAYU AND MR YUJI NISHIMAE)

J1 WELCOME & INTRODUCTION

Mr Bernardo Aliaga, Head of Tsunami Unit welcomed all participants to the joint opening session of the UNESCO/IOC Working Group on Tsunamis and Other Hazards Related to Sea-Level Warning and Mitigation Systems (TOWS-WG) task teams. This is the first face-to-face meeting of the Task Teams following two-years of meeting online due to COVID. Today marks the commemoration of the 27 February 1960 Chile earthquake and tsunami. Mr Aliaga highlighted the progress since the ITSU (International Tsunami Warning System in the Pacific) was established by IOC in 1965 and the subsequent establishment of the four Intergovernmental Coordination Groups (ICGs) in 2005 following the 2004 Indian Ocean Tsunami for the Indian Ocean, Pacific, Caribbean and Adjacent Seas, NE Atlantic & Mediterranean Seas. The global tsunami warning and mitigation system and its four ICGs have advanced implementation through the work of their task teams and working groups, allowing the expansion and efficiency of the system. Through this time, the development of global standards has been overseen by the TOWS-WG. Looking forward to 2030, the Ocean Decade Tsunami Programme (ODTP) has two goals: 1) Improved timeliness and accuracy of tsunami warnings; and 2) 100% of at-risk communities are prepared for and resilient to tsunamis. Integration of tsunami warning and mitigation into the international development of the global Multi-Hazard Early Warning System (MHEWS) led by the World Meteorological Organization (WMO) is an ongoing focus.

The task team chairs, Ms Harkunti Rahayu (TT-DMP) and Mr Yuji Nishimae (TT-TWO) outlined the overall objectives of the overall two task team meetings, including this joint session.

Mr Yuji Nishimae, Chair of TT-TWO, recalled the experience of the Japan Meteorological Agency (JMA) in implementing its tsunami warning system. He congratulated Mr Aliaga on his promotion to Head of the Tsunami Unit at UNESCO/IOC. He recalled the Turkish earthquake on 20 February 2023 and expressed his sympathies to those affected by this devastating event. He called on the support of all participants for productive discussions.

Ms Harkunti Pertiwi Rahayu, Chair of TT-DMP, also congratulated Mr Aliaga on his promotion. She noted her attendance at her first meeting of the TOWS-WG and ongoing contributions as chair of the ICG/IOTWMS Working Group 1, Tsunami Risk, Community Awareness and Preparedness. She recalled the ODTP goal for tsunami resilient coastal communities. In conclusion, Ms Harkunti welcomed all participants and encouraged active discussion during the two task team meetings and joint session.

J2 WAVE EXERCISES AND SIGNIFICANT TSUNAMI EVENTS IN EACH ICG (share outcomes, lessons learned)

Ms Harkunti Pertiwi Rahayu and Mr Yuji Nishimae invited co-chairs and/or representatives of Tsunami Wave Exercises from each ICG to provide a short summary of recent exercises, share outcomes and lessons learnt, as well as significant events in each region.

WAVE EXERCISES

○ ICG/CARIBE-EWS

Ms Elizabeth Vanacore presented a report on the CaribeWave22 exercise. The CaribeWave22 exercise was conducted on 10 March 2022. It was composed of two earthquake and tsunami scenarios: Western Muertos Trough (south of Hispaniola) and Northern Panama Deformed Belt. The exercise results indicated that the Dummy (Start of Exercise) message was received by 34 Member States, representing 91% of the CARIBE-EWS Member States and Territories. There was a strong dependency on email for the reception of products from the PTWC. The exercise planning went well under extenuating circumstances, resulting in an 88% of satisfaction of Member States and territories, and a total participation of 413,285 people from the Caribbean.

The Caribe Wave23 exercise will take place on 23 March 2023. There will be two scenarios, one based on an earthquake in the Gulf of Honduras and second, for testing of volcano EWS, an eruption and flank collapse of Mount Pelée, Martinique.

○ ICG/IOTWMS

There was no update provided about the upcoming IOWave23 exercise.

○ ICG/NEAMTWS

Mr Marinos Charalampakis reported on the development concerning organizing NEAMWave23. The NEAMWave23 exercise is planned either between 30-31 October or 6-7 November 2023. There is a need to have a stronger engagement with the Civil Protection Agencies (CPAs). There is an interest to organize an online meeting between the CPAs and the European Civil Protection Mechanism ahead of the exercise. The TT-TE is preparing informative material (NEAMWave exercise concept papers, best practices, etc.) to share with the national CPAs.

There is an agreement among TSPs to implement two exercise scenarios:

1. North-eastern Atlantic: Conducted by IPMA (Portugal) and CENALT (France)
2. Mediterranean Sea: INGV (Italy), NOA (Greece), KOER (Turkiye).

A key aim of NEAMWave23 exercise is to engage with CoastWAVE Tsunami Ready communities. CoastWAVE project countries will need to decide if they will make the NEAMWave23 exercise an action or not.

○ ICG/PTWS

Ms Laura Kong and Cdr Carlos Zuniga reported on the PacWave22 exercise. The exercise was organized between September - November 2022 with emphasis on regional cooperation in South America, South China Sea and Pacific Islands. The TSP live communication test took place on 13 October 2022 with the participation of 27 countries. All the TSPs that participated in the exercise sent messages according to procedures, 24 respondents reported to have

received the message from PTWC correctly, 11 from NWPTAC, 7 from SCSTAC and 3 from CATAAC.

The PICT regional exercise took place on 9 November 2022 with the participation of 18 Pacific Islands, countries and territories. The scenario was the Hunga Tonga Hunga Ha'apai (HTHH) volcanic eruption and tsunami of 15 January 2022. It consisted of a 2-hour live tabletop exercise to test the HTHH PTWC Interim Procedures and PTWS products, and whether the HTHH PTWS products are interpreted by PICT Member States accurately and in a timely manner, and the testing of live information sharing between countries of the region to test its efficacy and value. Controllers simulated four PTWC bulletins sent by e-mail using a Listserv (hosted by ITIC, same as that used for the Tsunami Bulletin Board) and through a WhatsApp group. The use of HF radio was also tested since post-HTHH. HF radio proved to be one of the few (the other being satellite phones) communication methods after the blackout. All information was immediately shared (no delay or review). Only 5 mails were not distributed because they were sent from an unregistered email into Listserv.

A PACWave22 PICT Cold wash debrief took place on 16 November 2022. Participants noted the email communication method as the most important for the Live TSP test. For the HTHH scenario, the PTWC products were understood and useful, and the live information sharing overwhelmingly endorsed as highly useful, with the greatest interest in sharing via Whatsapp communications in future exercises. It was noted that if Tonga had been able to share what was observed (seen) '*natural massive eruption warning signs*' and issued a national tsunami warning minutes later, this would have significantly helped neighboring countries in their tsunami warning decision-making.

As a further indication of its usefulness, the WhatsApp tool was used in 3 real events soon after, including one on which Tonga was only able to receive the PTWC messages through WhatsApp because their email server was down at that moment.

Cdr Zuniga shared information of the Southeast Pacific (South America) regional exercise, which consisted of two exercises.

Recommendations to TOWS-WG

Commends the PTWS Pacific Islands and Southeast Pacific for testing and enabling communication methods by which to share key tsunami information regionally to assist neighboring countries in their national tsunami warning decision-making.

Recommends ICGs to align Wave exercises with World Tsunami Awareness Day and UNESCO IOC Tsunami Ready implementation.

SIGNIFICANT TSUNAMI EVENTS

- **ICG/CARIBE EWS**

Mr Chip McCreery reported that four or five events have been reported in the Caribbean region, but with no threat messages being required to be issued.

- **ICG/IOTWMS**

Mr Pattabhi Rama Rao reported that in the Indian Ocean region two (2) events over the required earthquake thresholds were responded to. For both events, the three Indian Ocean Tsunami Service providers (TSPs) issued no threat bulletins to the Indian Ocean region.

○ **ICG/NEAMTWS**

Ms H el ene H ebert reported seventeen earthquakes were monitored in 2022 and five in 2023.

Ms Christa von Hillebrandt-Andrade noted that the ICG/NEAMTWS threshold magnitude for reporting events could result in public enquiry if they are different and below the threshold of the ICG/PTWS.

Mr Francois Schindele commented that the Earthquake Source Zone (ESZ) southern latitude for the South Atlantic may not include all events south of that, which could generate tsunamis that could impact coastlines of the South Atlantic, Pacific and Indian oceans.

Prof. Ahmet Cevdet Yalciner was invited to report on the T urkiye earthquakes and sea level anomalies, starting on 6 February 2023. His presentation focused on the coastal structure of the Gulf of Iskenderun and tsunamis in the Eastern Mediterranean, where the death toll has exceeded 50,000 persons due to the earthquakes. The magnitude 7.7 earthquake, which occurred on 20 February 2023, resulted in a small tsunami in the Gulf of Iskenderun. The earthquake was associated with a significant magnitude 6.6 foreshock (6 February 2023) and many aftershocks. Initial assessments of coastal structures in the Gulf of Iskenderun indicate local subsidence and damage, which includes four tide gauge stations and other structures. Further investigations are being conducted to better understand the resulting tsunami.

Mr Rick Bailey, UNESCO/IOC Secretariat, enquired about the lessons learnt in tsunami and community education. Mr Yalciner responded that the NEAMTWS is working well. Regional awareness has been increased through the warning messages.

Ms Chacon Barrantes asked about the community response. Mr Yalciner replied that there was much interest from the community and a desire to learn how to respond to tsunami threats. Mr Musavver Didem Cambaz expanded that the local people left their homes as a response to the earthquake and wanted to learn the appropriate tsunami response.

Ms Harkunti Rahayu asked if the coastal infrastructure damage was due to subsidence or the earthquake. Mr Yalciner responded damages to structures resulted from subsidence as well as fire.

Mr Denis Chang-Seng raised the importance of evacuating buildings in response to earthquakes and noted renewed interest in countries joining the ICG/NEAMTWS and its activities.

Mr Alejandro Rojas Aldana asked about the communication surrounding the earthquake. Mr Yalciner noted an important lesson that the people in the damage zone could not send messages, and communication failures resulted in confusion.

Mr Mohammad Mokhtari enquired about prior tsunami events. Mr Yalciner responded that a tsunami in 2020 resulted in wave damage and one fatality. A DART (*Deep-ocean Assessment and Reporting of Tsunamis*) system could be implemented to improve the warning system.

○ **ICG/PTWS**

Mr Chip McCreery noted since the last TOWS-WG meeting, twenty-seven (27) tsunami information statements and twelve (12) tsunami threat sequences have been issued in the Pacific region. The Hunga Tonga Hunga Ha'apai (HTHH) volcanic event (prior to last meeting) was included in the count due to its significance and follow-up work, which has raised awareness on non-seismic tsunami generation.

Mr McCreery reviewed the response to the HTHH event. The resulting tsunami was detected in all ocean basins and the precise mechanism is under investigation. The PTWS has developed and implemented new interim products (subject to ICG/PTWS approval at its next session) in case of similar future events. In response to the HTHH event in the Pacific Ocean and two non-seismic and complex source events in Indonesia in the Indian Ocean and connecting seas, TOWS-WG has formed two *ad hoc* teams, one on tsunamis generated by volcanoes and another on meteotsunamis.

Mr Mohammad Mokhtari asked about detection of non-seismic events in other ocean basins, with reference to the Makran region. Mr McCreery noted that the coastal sea-level gauges are not well set-up to alert for significant wave heights due to possibility for sea-level noise also triggering. However, during the precursory activity in Hunga Tonga a trigger was programmed on the nearby sea-level gauge. This gauge and a nearby DART signal were used to action the response. Something similar may be able to be implemented in the Makran region.

Recommendations to TOWS-WG:

- TOWS-WG, given the critical need to resolve and understand the near-field threat to high at-risk communities where a tsunami may arrive in 5-30 minutes, reiterate the urgent need for all Member States to sample sea level data at one second intervals and transmit this in real-time.
- TOWS-WG request IOC Assembly at its next session to reconsider the request to extend the Pacific Earthquake Observing Zone to include the South Atlantic, given the ongoing threat in this region to generate tsunamis that also impact the Pacific and Indian Oceans (e.g., South Sandwich Islands event, 12 August 2021)

J3 REPORT FROM AD HOC TEAM ON TSUNAMIS GENERATED BY VOLCANOES

Mr Francois Schindele (France), Mr Raphael Paris (France) and Ms Laura Kong (United States of America) reported on the *Ad Hoc* Team on Tsunamis Generated by Volcanoes (TGV) under the TT TWO. The scientists on the team also included Emily Lane (New Zealand), Maurizio Ripepe (Italy) and Vasily Titov (United States of America). A survey on volcano observatory activities with regards volcanic activity hazard assessment and related tsunami monitoring and warning systems was circulated to volcanic observatories and relevant institutes. The *Ad Hoc* Team TGV report is being finalised and includes chapters on tsunamis generated by volcanic activity, numerical modeling of volcanic tsunamis, volcanic tsunami hazard assessment, volcano monitoring requirements for tsunami warning, volcanic tsunami warning systems and standard operating procedures, and recommendations. A draft of the report was tabled at the meeting.

Mr Raphael Paris reported on the first two chapters of the report: 'Tsunamis generated by volcano activity and instability' and 'Numerical modeling of volcanic tsunamis'.

Mr Francois Schindele reported on the three different volcanic tsunami hazard assessments with an example of the worst-case scenario for Stromboli. The Stromboli volcanic tsunami warning system has been long standing with tsunami beacons in the seas on the southern and northern volcanic flanks. The system was successful in detecting the Stromboli event on 4 December 2022. The signage at Stromboli shows the hazard zone and evacuation routes for tsunami events.

Ms Laura Kong noted that of the twenty-five (25) volcano observatories surveyed, fifteen (15) countries have responded to the volcano observatory questionnaire. The current practice is to detect and then warn. There are two possible triggers for tsunami warnings: Volcanic Ash Advisory Centre (VAAC) notices of activity and actual tsunami wave detection. Most volcano observatories do not have sea level stations. Since most volcanic observatories do not have

24x7 operations, they cannot be tsunami warning centres.

Ms Laura Kong then presented the preliminary recommendations and gaps for warning of tsunamis generated by volcanoes. These recommendations were further discussed later in the day and the final recommendations presented to the joint session of the task teams on Day 2 of the meetings.

Cmdr Carlos Zuniga asked about Deception Island in Antarctica, which is outside of the monitored networks. Mr Raphael Paris responded that this can be included in the report.

Mr Chip McCreery noted that low-cost flood sensors have been installed in key localities on land to monitor for inundation. These 'wet sensors' are easy to deploy and have been reliably detecting flooding at a given elevations for the past 10+ years.

Recommendations to Member States

Monitoring and Warning:

1. As a first step, organization(s) should be designated for monitoring and warning of Tsunamis Generated by Volcanoes (TGV). The second and third steps are to install monitoring instrumentation and develop Standard Operating Procedures (SOPs) to handle volcanic tsunamis.
2. The TGV monitoring and warning system should be implemented by, or in cooperation with the National Tsunami Warning Centre (NTWC) and regional Tsunami Service Provider and national and regional Volcano Service Providers, where such exist.
3. All volcanoes mentioned in the TGV report should be monitored and have processes in place to warn for tsunamis. Should other, potentially tsunamigenic volcanoes begin erupting, these should also be monitored and included within the tsunami warning process.
4. Detect/warn geophysical (seismology, GNSS, tiltmeter, barometric and sea level data streams need to be available to the designated tsunami monitoring/warning agency (and possibly also to the volcano monitoring agency)
5. As well as monitoring systems for volcano activity and potential far-field propagation of sea level signal, a sea level gauges network with real-time continuous data transmission should be deployed close to each identified volcano to verify risk and then ongoing monitoring and warning. One second sampling with 1 cm accuracy (< 1 mm sampling) is recommended for recording and automatic detection. Data transmission through radio or microwave links, fiber optic, or dedicated telephone lines, or other modes should be implemented to ensure the data is transmitted and received and widely shared with the international community in a timely manner.
6. Methods to also specifically alert persons in remote areas (such as scientific teams in the field, or recreational hikers) should be considered.
7. TGV SOPs for tsunami warning should be linked with existing Volcano Alert Activity scales.

Risk Assessment and Preparedness:

8. TGV hazard and risk assessment should be undertaken to determine vulnerable areas.
9. For TGV, multi-stakeholder meetings should be convened that included science agencies, volcano and tsunami warning operations centres, and disaster

management agencies. For each identified potential source, worst-case and credible scenario planning discussions should start as soon as possible.

10. During a period of heightened TGV hazard, consider closing access to vulnerable areas. When an eruption is imminent and the tsunami hazard is high, consider evacuating populations from vulnerable locations.
11. Specific TGV signage and evacuation routes should be implemented in all areas that may be impacted by tsunamis generated by volcanoes.
12. TGV public awareness campaigns should be conducted regularly – the type and frequency of awareness activities may be different for the local population compared to transient populations such as tourists.

Recommendations to TOWS-WG

1. TGV warning notification systems should be considered and coordinated as part of the UNESCO/IOC Global Tsunami Warning and Mitigation System, and also when possible be part of a Multi-Hazard Early Warning System (MHEWS).
2. TOWS-WGs recommend ICGs examine TGVs in the region of responsibility and review TGV hazard monitoring and warning requirements, including costs of deploying and maintaining such systems.
3. TOWS-WG recommend, where identified TGVs may impact multiple Member States, Tsunami Service Providers (TSPs) for the relevant ocean basin tsunami warning and mitigation systems consider if they need to be involved in monitoring and provision of threat advice.
4. UNESCO/IOC Ad hoc Team on TGV should continue and finalize the TGV Report by mid-2023.

Recommendations to UNESCO/IOC Secretariat

IOC Secretariat to help inform Member States widely on the potential tsunami hazard from volcanoes:

1. Publish the TGV report as an UNESCO/IOC publication in 2023
2. Provide the TGV Report, including the List of Tsunamigenic Volcanoes to Volcano Observatories
3. Provide the TGV Report, including the List of Tsunamigenic Volcanoes to UNESCO/IOC Member States

J4 REPORT FROM AD-HOC TEAM ON METEO-TSUNAMIS

Mr Mike Angove reported on the work of the *Ad-Hoc* Team on Meteotsunamis under TOWS-WG TT TWO. The report assessed the current global status and advised on gaps related to meteotsunami monitoring and warning systems. It also identified guidelines for Standard Operating Procedures (SOP) development to monitor and warn for meteotsunamis, and reviewed relationships and coordination requirements between TSPs/NTWCs and regional/national meteorological services to monitor and warn for meteotsunamis.

Where they exist, meteotsunami alert products are currently addressed within the SOPs of national or regional meteorological services. Meteotsunami are common in some parts of the world where the required conditions occur, happen infrequently, but can cause a significant risk to life and property (i.e., Balearic Island region in Mediterranean Sea). The global tsunami warning system can play a supporting role in direct tsunami detection. A future unified system with a combination of direct tsunami detection and NWP-based meteotsunami forecasts is

considered worthwhile. Local understanding of the meteotsunami threat is critical.

Observed significant meteotsunami occurrences are typically mid-latitude features related to fast moving (i.e., over 30 nautical miles) mesoscale complexes. They have been observed in the Adriatic Sea, Mediterranean Sea, Nagasaki Bay, Lake Michigan, and the Persian Gulf. Mr Rick Bailey also noted they have been observed off the west coast of Australia, causing a ship to break its moorings and nearly collide with a major road bridge.

Dedicated meteotsunami alerting systems are in place in the Balearic Islands, Adriatic Sea, and South Korean Peninsula. Other areas have more generalized systems based on detection of flooding.

Using the global tsunami warning system for meteotsunami may be considered. However, rethinking of global tsunami observation may allow for instrumentation specifically tuned for meteotsunami.

Generalized SOPs for meteotsunami have been developed by the *ad hoc* team.

Further discussion is needed on preferred forecasting and warning organisations (i.e., organisations responsible for meteorology and/or tsunami warnings). It is recommended that meteotsunami alerting is jointly coordinated by WMO and UNESCO/IOC. A new instrumentation strategy should be considered and a framework for a unified meteotsunami system should be established.

Recommendations to TOWS-WG

Noting the report from the *Ad Hoc* Team on Meteotsunamis initially sought to look at meteotsunami the perspective of global tsunami services;

Further noting the report from the *Ad Hoc* Team on Meteotsunamis discovered responsibility for issuing public alerts related to meteotsunami currently is typically addressed by national or regional Met services offices, but usually in the context of storm surge or anomalous coastal flooding event;

Further noting as tsunami detection and measurement capabilities are rapidly improving and this is expected to accelerate under the UN Ocean Decade, it is now possible to consider non-seismic tsunami sources in the global instrumentation strategy, including volcanoes and meteotsunami, among others;

Further noting combining the direct tsunami detection capability of the GTWS with the NWP-based algorithms tuned to meteotsunami prediction could deliver significant advances in global capability at minimal cost;

1. TOWS-WG initiates a comprehensive dialogue between the IOC and WMO to ensure full exchange of information in support of a robust international alerting system for meteotsunamis is achieved. It is the *Ad Hoc* Team for meteotsunami's recommendation that this report be used as a starting point of those discussions.
2. TOWS-WG to establish a mechanism for input from national and regional meteorological services offices on data needs for meteotsunami monitoring and alerting as the Global Tsunami Early Warning System (GTEWS) considers a new generation of tsunami detection and measurement networks.
3. TOWS-WG to establish a task team made up of experts from both GETWS and NWP systems be formed with the expressed intent of outlining the potential construction of an integrated meteotsunami prediction system.

4. TOWS-WG establish an *ad-hoc* team to conduct a global meteotsunami hazard assessment to provide all MS advice on the meteotsunami hazard and risks on their coasts.

Commends the work of the *Ad Hoc* Team on Meteotsunamis.

Acknowledges that meteotsunami are a meteorological driven phenomenon, and as such, better clarification of the roles of NMHS and WMO and IOC will be critical in supporting the development of any potential future detection and alerting service for meteotsunamis.

Recommends that WMO experts be engaged to assist in this task and **acknowledges** that WMO requests the WMO-IOC Joint Collaborative Board to discuss tsunami related issues with respect to meteotsunami, to clarify the roles and responsibilities for the WMO and UNESCO/IOC, and how best to strengthen collaboration for supporting Member States.

Recommends the *ad-hoc* team on Meteotsunami continue through 2023, including WMO representatives for the purpose of recommending a global altering strategy to include specific roles of met services and TSPs/NTWCs.

Recommends the establishment of an *ad-hoc* team to conduct a global meteotsunami hazard assessment to provide all MS advice on the meteotsunami hazard and risks on their coasts.

J5 PLANNING FOR OCEAN DECADE

The Chair asked the Secretariat to report on the work on the status, activities, and plans for the Ocean Decade.

- **Ocean Decade Tsunami Programme Endorsement**

Mr Mike Angove reported on the instrumentation and warning vision to build off the legacy seismic analysis capability, with a view to combine this with more direct in-situ tsunami measurement, in order to enable positive confirmation of tsunami generation from a source event to provide more accurate forecast information. The identification of a global sensor strategy to achieve these goals would include many sources of measurement and detection. This will require Member State to enhance current monitoring coverage. The recommended enhanced global monitoring systems would go to the ICGs and/or TOWS-WG to coordinate implementation.

Ms Harkunti Rahayu noted that the goal of 100% of communities at risk to be prepared and resilient to tsunami will be first discussed by the TT-DMO.

- **Draft of the 10—year research and development implementation plan for the ODTP**

The Scientific Committee has met three times over the last year. The first draft of the Ocean Decade Tsunami Programme Research and Development Implementation Plan was released in November 2022 for Member State comments. The second draft was released on 13 February 2023 for review by the TOWS-WG and its task teams. Following this review and feedback, the Scientific Committee will finalize the report for the UNESCO/IOC Assembly in June 2023 and seek endorsement from Member States.

- **Progress report of the Tsunami Ready Coalition**

Mr Bernardo Aliaga, new Head of the IOC Tsunami Unit announced the appointment of Ms Laura Kong as the Chair of the Tsunami Ready Coalition. She was nominated by the TOWS

Task Team Chairs and endorsed by TOWS WG Chair. Ms Kong has a strong background and experience in tsunami warning and mitigation, and preparedness. The goal of the Coalition is to “Contribute to increasing the number of Tsunami Ready communities as part of the Ocean Decade” through the following objectives:

- a. Raising the profile of UNESCO Tsunami Ready in collaboration with critical stakeholders across the UN system, interested regional organizations, national disaster management agencies and the public,
 - b. Increasing funding resources for the implementation of Tsunami Ready,
 - c. Advising the IOC TOWS-WG, TT-DMP, and TT-TWO on the implementation of UNESCO Tsunami Ready, including on: i) Flexibility with regards to accomplishing the indicators to allow for circumstances where formal bureaucratic frameworks/requirements may pose barriers; and ii) Consideration of unique regional and/or local circumstances.
- **Plans for the 2nd UNESCO/IOC Science Symposium on advances in tsunami warning to enhance community responses:**

Ms Harkunti Rahayu, chair of the 2nd UNESCO/IOC Science Symposium Organizing Committee, reported that Indonesia and the ICG/IOTWMS plans to host an Indian Ocean Tsunami Symposium in the first week of December 2024 in Aceh, Indonesia, back-to-back with the 14th Session of the ICG/IOTWMS in Jakarta. The year 2024 will mark the 20th commemoration since the Indian Ocean Tsunami of 2004 killed nearly 200,000 people in Indonesia and in total more than 230,000 across the Indian Ocean. The Government of the Republic of Indonesia, through the Head of the Indonesian Agency for Meteorology, Climatology and Geophysics (BMKG and Chair of the ICG/IOTWMS, Ms Dwikorita Karnawati, has offered to make the symposium global and accordingly host the 2nd UNESCO/IOC Science Symposium on advances in tsunami warning to enhance community responses.

The TT-DMP recommended having discussions about the nomination of a Tsunami Symposium vice-chair and members of the committee.

Recommendations to TOWS-WG

Noted with appreciation the nomination of Ms Laura Kong as the chair of the UNESCO IOC Tsunami Ready Coalition;

Accepts with appreciation the offer of the Government of the Republic of Indonesia to host the Global Symposium in December 2024 as part of the plans by the ICG/IOTWMS to commemorate the 20th Anniversary of the Indian Ocean Tsunami of 2004.

Recommends the nomination of a Tsunami Symposium co-chair and members of the committee.

J6 LOCAL SOURCE SOPs

- ***Visual Communication of Tsunami Warnings***

Mr Yuji Nishimae reported on visual communication of tsunami warnings and advisories in Japan. A study group found that flags were an effective method to communicate tsunami warnings/advisories, and that red and ‘U’ flags are most visible at a distance. A questionnaire of people with hearing and color impairments confirmed the aforementioned flags were most identifiable. The study group then proposed specifications for the flags. In response to the

report, JMA amended the regulation on 24 June 2020 and published a brochure showcasing the adopted flag.

Ms Christa von Hillebrandt-Andrade reported that she observed flags being used in Odisha, India for tsunami alerting while observing IOWave18 exercise. She further asked if other flags are used for beach warnings in Japan. Mr Yuji Nishimae responded that JMA modified the regulation for dissemination flags for tsunami warnings and no other flags are currently used along beaches.

Mr Chip McCreery asked about the practicality of implementation. Mr Yuji Nishimae replied that the local government is responsible for tsunami evacuations and should prepare enough flags to cover the beaches.

Mr Ardito Kodijat asked about the timing of using the flag. Mr Yuji Nishimae explained that the U-flag is used for the first warning to evacuate and is not used even when the tsunami warning is updated after the tsunami strikes.

Ms Harkunti Rahayu noted the merit in flag use for people who have a hearing impairment. She further recalled that this practice is being employed in Oman. Mr Yuji Nishimae also recalled that Oman uses something like fireworks.

Mr Rick Bailey agreed that communities should agree and consult with other groups, such as surf life-saving who also used flags for communicating hazards at the beach.

Ms Christa von Hillebrandt-Andrade suggested a recommendation on disability inclusiveness with regards to tsunami warnings, noting the example from Japan.

Mr Mohammad Mokhtari suggested including a tsunami symbol on the flag. Mr Yuji Nishimae responded that this has been tested and is not as visible as a U-flag.

Mr Elizabeth Vanacore noted the benefit of global harmonization of tsunami warning flags.

Recommendations to TOWS-WG

Noted that Japan has defined a flag called “Tsunami Flag” as a visual communication method of tsunami warning in order to disseminate tsunami warning to people with hearing difficulties and people at the beach. The flag has been used since June 2020.

Recommends global harmonisation of the tsunami beach flag in consultation with other groups using flags to warn for other coastal hazards, and the broader consideration of people with disabilities in tsunami warnings.

Recommendations to TOWS-WG TT DMP

1. TT DMP to further investigate requirements and methods to warn people with disabilities and underserved communities, especially given WTAD objective 2023 “fighting inequality for a resilient future”.
2. TT DMP take action now to upgrade NTWC competency training framework from a Pacific to global approach and include competency training for Tsunami Warning Focal Points (TWFPs) in the framework given their key role in tsunami warnings.

J7 GLOBAL NTWC COMPETENCY FRAMEWORK

Ms Laura Kong reported on the Global Competency Framework for National Tsunami Warning Centres. The ICG/PTWS Task Team on Minimum Competency Levels for NTWC Operational

Staff was formed based on the request from the Pacific Small Island Developing States (SIDs) for a competency framework for NTWC personnel. The task team has proposed a first draft of the framework, which was approved in 2019 (ICG/PTWS-XXIX). The document outlines two tiers of competencies (i.e., expert and basic).

As an example of the value for capacity building, Ms Laura Kong gave the example of Tonga. Since 2009, capacity building initiatives have been conducted through five in-Tonga trainings and abroad, where Tonga participated in international training on tsunami warning operations. They built their warning response capacity over time, and their built capacity to respond well was demonstrated for the 2022 HTHH event. Further, the Solomon Islands Meteorological Service underwent impact based forecast training and identified that DRR aspects should be included within the competency framework. A capacity training workshop in the South-West Pacific (SWP) in 2022 highlighted the need for training of the trainers and for support to map and develop a framework among the Pacific Island Countries (PICT). The PICT Task Team on Capacity Development met on 2 February 2023.

Ms Laura Kong further outlined the task team's plans to finish the PTWS Competency Framework for approval in September 2023 at the next ICG/PTWS-XXX. The ITIC plans to work with expert and advanced NTWC partners to develop a Concept Note for Implementation, which is planned as a funded pilot in 2024 and beyond. In August 2023, the ITIC plans to partner with New Zealand to conduct its 2-week ITP-Hawaii in New Zealand, where warning centre operations will be a focus. Additionally, the 2024 ITIC Training Programme (ITP-Hawaii) is planned to be in Chile (2018 was first time), which operates advanced seismic monitoring and tsunami warning centres.

Mr Chang-Seng asked how this can be utilized in other regions. Ms Laura Kong noted the documents outline the requirements for staff at warning centres everywhere. The PTWC NTWC competency framework contains global content, which could be implemented in other areas.

Mr Elizabeth Vanacore noted that warning centres may need competency in understanding the products they are receiving from TSPs. Ms Laura Kong responded that the task team Framework document provides a basis for developing a global competency framework.

Recommendations to TOWS-WG

Noted the work of the PTWS to develop a National Tsunami Warning Centre (NTWC) Competency Framework (2017), and the ITIC's leadership to pilot training courses based on the Framework;

Recommends ITIC to pilot the PTWS NTWC Competency Framework with the goal to develop a global framework for all ICGs to use.

J8 IUGG UPDATE

Ms Laura Kong provided an update on the International Union of Geodesy and Geophysics (IUGG) Joint Tsunami Commission (JTC). IUGG/JTC promotes the exchange of scientific and technical information about tsunamis among nations concerned with the tsunami hazard. There are six Working Groups: Tsunami Terminology, Science-based Tsunami Warning, Tsunami Magnitude, GNSS Data for Tsunami Warning, Meteotsunami, and Tsunami Data. Future meetings being organized include the EGU 2023 on tsunamis from source processes to coastal hazard and warning. Proposed meetings include the IUGG JTC - PTWS Tsunami Symposium (ICG/PTWS-XXX) in September 2023 in Tonga and the proposed IOC – IUGG/JTC 2nd International Tsunami Symposium in December 2024. Recent publication series edited by the IUGG/JTC include special journal issues on the Sulawesi/Palu (2018) and

Anak/Krakatau (2018) Tsunami as a Topical collection in Pure and Applied Geophysics (19 papers), and the Tonga Volcanic Explosion 2022 as a topical collection in Pure and Applied Geophysics (6 papers and ongoing). Support provided to the IOC includes the Tsunami Glossary 2019 update, and Tsunami Generated by Volcanoes and Meteotsunami *ad hoc* team reports.

Ms Christa von Hillebrandt informed the meeting that the 28th IUGG General Assembly will be held 11-20 July 2023 at the Messe Berlin – City Cube, Berlin, Germany. It is a special opportunity for participants from around the world to come together and share their science and culture. She noted that there will be a tsunami symposium consisting of 70 abstracts and it would be interesting to see the outcome.

Recommendations to TOWS-WG

Notes the recent EGU 2022 meetings on tsunamis from source processes to coastal hazard and warning;

Notes the publication of IUGG concerning the Sulawesi/Palu (2018) and Anak/Krakatau (2018) Tsunamis;

Further notes the support provided by IUGG to IOC on the tsunami glossary update in 2019 and reports on meteotsunamis and tsunamis generated by volcanoes;

Welcomes the engagement of the members of the TOWS-WG task teams at the 28th IUGG General Assembly, 11-20 July 2023 at the Messe Berlin – City Cube, Berlin, Germany;

Further welcomes the proposed joint IUGG and IOC Tsunami Symposium prior to ICG/PTWS meeting in September 2023 in Tonga.

J9 EMERGENCY WARNING SERVICE IN GALILEO

Mr Eric Guyader, an engineer at the European Commission - Galileo Programme delivered an online presentation on the new emergency warning service in Galileo. Galileo has been in operation for 20 years, and it is now introducing its services in a wider public context. It is a new service to help alert the population. The initiative is in line with global trends and contributes to the UN DRR targets. It offers a satellite dissemination means of alerts to the population. Messages can be broadcasted to any place on earth. Galileo can alert population through smart phones. Anyone with a smart phone can receive alerts, however it is the sovereign responsibility of nations to issue alerts and choose best means of alert dissemination. Galileo must first consult with each nation it proposed sending alerts to. Galileo programme takes care of the formatting and dissemination of the alert message. There is no need for any specific network connection. Only relevant people can receive the message, and it can target populations as large as a continent to a building block. It uses an eclipse approach to target the population. Galileo takes care of 130 hazards. The target date to start full implementation is 2024. Several bilateral contacts have been established mainly with CPAs. There are ongoing discussions with countries including Australia to use Galileo services in ocean /maritime area. Field demonstration is expected to be carried out in four locations in France, Germany, Cyprus, and Belgium. They are developing the capacity and scenarios to carry out the demonstration examples. There is a workshop planned in February 2024. Galileo Programme is happy to receive relevant materials, story lines, protocols, guidelines to help design the demonstration examples in those mentioned countries. It was clarified that instructions can be sent to people inside or outside the threat zone. There are no cost implications, it is free of charge aside the operational cost. There are only 32 authorized entities able to contact Galileo, and these are pre-agreed authorized entities. It was clarified that the ellipse corresponds to people threatened. Cancellation of alerts works in the same

way as issuing alerts. Mrs. Caroline Morisot-Pagnon attended the meeting in person and was available to provide further information on the Galileo services.

Recommendations to TOWS-WG

Noted the expanded services to be offered by Galileo European Global Navigation System in 2024 for satellite-based dissemination of targeted alerts to the population and the Galileo demonstration examples to be carried out in France, Germany, Cyprus, and Belgium, the workshop planned in February 2024, and **welcomed** the offer of the Galileo Programme to provide relevant documents, storylines, protocols, guidelines and manuals to support the design of the demonstration examples.

J10 UN SEC GENERAL “EARLY WARNING FOR ALL’

Mr Denis Chang Seng reported that the World Meteorological Organization (WMO) will provide an official report on the progress concerning implementing “Early Warning for All” during the TOWS-WG session on 2 March 2023. However, he remarked that it is important to briefly report and discuss the matter during the task teams meetings. “Early Warning for All” aims to ensure that every person on earth is covered by an early warning system by the year 2027. WMO is leading the initiative with UNDRR and partners. “Early Warnings for All” Action Plan was unveiled at COP27, Sharm el-Sheikh, Egypt, 7 November 2022. There are currently four “Early Warning for All” pillars:

Pillar 1: Risk Knowledge and Management

Pillar 2: Observations, Monitoring and Forecasting

Pillar 3: Dissemination and Communication

Pillar 4: Preparedness to Respond

“Early Warnings for All” (EW4ALL) will address the following:

- Enhancing capacity to detect hazard,
- Close the observing gaps,
- meet the data needs for monitoring hazards (Estimated for 70 priority countries)
- Enhance the existing framework and the capabilities of global data processing, forecasting, and analysis systems.
- Sustainable data and Information exchange infrastructure to support EWS
- Optimize international efforts on observation, monitoring, and forecasting
- Upscale successful regional initiatives on sharing data and forecasting products

WMO and partners are working on the action plan. Following recent discussions, it is understood that UNESCO is tasked to contribute to Pillar 2 on Observation, monitoring and forecasting together with WMO, UNEP and UNDP. UNESCO's (All Sector approach) position is to contribute to multi-hazards (flood, drought, tsunami, and earthquake). UNESCO can contribute to Innovation EWS (AI, Citizen Science) in Pilot Projects. Several steps are being undertaken to advance the initiative. For instance, WMO is developing a shared workspace for EW4All Pillar 2 group to collect inputs and share information and initial country mapping. IOC has already provided a list of countries where we have project interventions.

Recommendations to TOWS-WG

Acknowledges the gaps in the global coverage of the tsunami early warning system and **recommends** full global coverage be pursued to ensure that all at risk coastal areas are

assured of access to tsunami early warnings by 2027. This is a commitment to the UN “Early Warnings for All” initiative.

J11 PLANNING FOR WTAD 2023

Ms Regina Khanbekova (UNDRR), reported that World Tsunami Awareness Day (WTAD) 2022 advocated on reducing tsunami risk globally through increasing access to early warning systems. Through political engagement to drive change, the UN Secretary-General, Antonio Guterres launched the “Early Warnings For All” Action Plan to achieve early warning for all in five years. This will save lives and protect livelihoods. In addition, the UNDRR event in New York on “Early Warning and Early Action Before Every Tsunami” served to build partnerships and leverage data to ensure no one is left behind, and aims to minimize the risks posed by tsunamis and other hazards.

Citizen engagement to build a culture of tsunami and other coastal hazards awareness for all the people at risk took place with the conduction of the *#gettohighground* public-facing campaign, where citizens participated in fun walks of tsunami evacuation routes at local level. The campaign was supported by Member States such as Indonesia, Samoa, Ecuador, Cook Islands, Portugal, and Mauritius. Approximately 4000 people participated in the *#gettohighground* campaign.

For the 2023 campaign, the theme will focus on fighting inequality for a resilient future. It will look to engage with more Member States, Making Cities Resilient (MCR) 2030, advocate decision makers on the importance of EWS coverage using strategic communications, and to continue the strong synergy between partners such as UNESCO/IOC, WMO and the UN System.

TICs, TT-DMP representatives reported on the key activities and achievements of WTAD 2022

Ms. Christa von Hillebrandt-Andrade requested that UNDRR also use the hashtag *#TsunamiReady* as part of its WTAD in support of the Ocean Decade goal of 100% of at-risk communities are ready for and resilient to tsunamis by 2030 through programmes like UNESCO IOC Tsunami Ready Recognition Programme.

Recommendations to TOWS-WG

Notes the activities undertaken by the respective regions for WTAD 2022, and as part of this, the strong engagement in the *#GetToHighGround* initiative, and the success achieved through the United Nations Office for Disaster Risk Reduction (UNDRR), and IOC collaboration;

Further notes to build connections with EW4ALL multi-hazard approach to coastal risk and Making Cities Resilient (MCR2030);

Further notes the 2023 WTAD theme will highlight the importance of fighting inequality for a resilient future;

Further notes activities will include continuing the *#GetToHighGround* initiative and the *#TsunamiReady* to engage citizens on tsunami awareness. The theme aligns closely with the current focus of the TOWS-WG in the context of the UN Ocean Decade, The Mid-Term Review of the Sendai Framework, and action to accelerate the implementation of the Early Warnings for All (EW4All) initiative to ensure everyone on earth is covered by MHEWS in the next four years, prioritizing the most at-risk communities;

Recommends continued collaboration between the UNESCO IOC and the UNDRR;

Requests the UNDRR to strengthen collaboration with respective ICGs and corresponding TICs.

J12 TSUNAMI GLOSSARY UPDATE

Ms Laura Kong provided an update on the status of the 2019 Tsunami Glossary. In the last session of the TOWS-WG-XV meeting in 2022, Ms Laura Kong recommended delaying the next update until 2023, due to delays caused by unforeseen events and to enable accommodation of the new Tsunami Ready terminology when it becomes an IOC Programme, as well as terminology related to tsunamis generated by non-seismic and complex sources under development. TOWS-WG agreed to postpone the next update of the Tsunami Glossary to 2023 to facilitate the incorporation of important changes.

In addition, the group again noted the importance of translating the Tsunami Glossary into languages additional to the UN languages, so many more people and authorities at the local level can understand and use the terminology consistently, and the importance of having abbreviated definitions for key terms for use in social media and other abbreviated language communication tools.

The 2023 version of the Tsunami Glossary will contain updates to tsunami maps and tables, information on meteotsunami, tsunami generation theory, and tsunami numerical modeling. New material will be included on lamb waves, the UNESCO/IOC Tsunami Ready Recognition Programme, and tsunamis generated by volcanoes.

There was a discussion about the definition of meteotsunami, and it was decided the *Ad Hoc* Team on Meteotsunamis will provide this for the glossary.

Ms Elizabeth Vanacore raised the issue that the definition of arrival time is currently the arrival of the maximum tsunami wave amplitude and suggested it be revised to be the time of the first maximum or minimum tsunami wave amplitude. It was decided to adopt the definition given in the Tsunami Watch Operations Global Service Definition Document (IOC TS 130, 2016).

Mr Mohhamad Mokhtari asked if tsunami sources such as splay-faulting and landslides could be defined within the glossary. He also mentioned that translation of the glossary into the local language will be important for implementation of the UNESCO/IOC TRRP.

Mr Bill Fry suggested the addition of another term to define the time that the tsunami reaches a threshold value. Mr Bernardo Aliaga replied that the update could be included in a future addition.

Recommendations to TOWS-WG

Express appreciation to the IUGG-JTC Terminology Working Group and ITIC for leading the effort to review the Tsunami Glossary 2019.

Approves the glossary updates and requested the IOC to implement the updates to create the Tsunami Glossary 2023, with support from ITIC.

Requests the IUGG JTC Terminology Working Group and ITIC to undertake a review to advise the next meeting of the TOWS Inter-agency Task Teams on whether the 2023 Tsunami Glossary is sufficient to meet the needs of the scientific community, tsunami stakeholders, and other practitioners, or if separate target audience specific versions are required.

Appendix 1

List of Participants

TOWS-WG-Inter-ICG Task Team on Disaster Management Preparedness (TT-DMP), 27–28 February 2023 (Hybrid)

Chairperson

Ms Harkunti RAHAYU

Institut Teknologi Bandung (Bandung
Institute of Technology)
Campus
Jl. Ganesha no. 10
Bandung
West Java 40132
Indonesia
Email: harkunti_rahayu@yahoo.com

Members

Ms Alison BROME

Programme Officer for Coastal Hazards,
Tsunami Unit, Intergovernmental
Oceanographic Commission of UNESCO
Caribbean Tsunami Information Centre
C/O Coastal Zone Management Unit
8th Floor Warrens Tower II, Warrens,
St Michael
Bridgetown, BB12001
Barbados
Tel: +246 535-5700/5703
Email: a.brome@unesco.org

Mr Marinos CHARALAMPAKIS (Online)

Institute of Geodynamics, National
Observatory of Athens
P.O. Box 20048
11810 Athens
Greece
Tel: +30 2103 490 175
Email: cmarinos@noa.gr

Mr Ardito M. KODIJAT

Head of the Indian Ocean Tsunami
Information Centre
UNESCO Office Jakarta
Jl. Galuh II no 5
Kebayoran Baru
Jakarta Selatan
DKI 12110
Indonesia
Tel: +62-21-7399818 Ext 878
Email: a.kodijat@unesco.org

Ms Laura KONG

Director ITIC

UNESCO IOC NOAA International Tsunami
Information Centre
1845 Wasp Blvd, Bldg 176
Honolulu, Hawaii 96818 USA
United States
Tel: 1-808-725-6051
Email: laura.kong@noaa.gov

Ms Cecilia VALBONESI (Online)

Istituto Nazionale di Geofisica e
Vulcanologia Roma
Via di Vigna Murata, 605
00143 Roma
Italy
Email: cecilia.valbonesi@unifi.it

Ms Christa VON HILLEBRANDT- ANDRADE

Manager
International Tsunami Information Center
Caribbean Office
Mayaguez, Puerto Rico 00680
United States
Tel: 1-787-249-8307
Fax: 1-787-265-1684
Email: christa.vonh@noaa.gov

Observers

Regina KHANBEKOVA

Associate Communications Officer
UNDRR
Tel: +41766232027
Email: regina.khanbekova@un.org

Mr Ignacio AGUIRRE AYERBE (Online)

Environmental Hydraulics Institute
Universidad de Cantabria
PCTCAN
c) Isabel Torres 15
39011 Santander, Spain
Tel: +34942201616
Email: ignacio.aguirre@unican.es

Ms Silvia CHACON BARRANTES

Professor and Researcher
Sistema Nacional de Monitoreo de
Tsunamis (SINAMOT)
Universidad Nacional, Campus Omar

Dengo
Avenida 1, Calle 9. Apartado Postal: 86-3000
Heredia, Costa Rica
Tel: +506 83096690
Email: silviach@una.ac.cr

IOC Secretariat

Mr Denis CHANG SENG
(TT-DMP Secretary)
Programme Specialist
ICG/NEAMTWS Technical Secretary
Intergovernmental Oceanographic
Commission of UNESCO
7, place de Fontenoy
75732 Paris cedex 07 France
Tel: +33 1 45 68 09 51
Email: d.chang-seng@unesco.org

Ms Derya VENNIN
Assoc. Project Officer at UNESCO/IOC
Intergovernmental Oceanographic
Commission of UNESCO
7, place de Fontenoy
75732 Paris cedex 07
France
Tel: +331456 81874
Email: d.dilmen-vennin@unesco.org

Mr Alejandro ROJAS ALDANA
Consultant
Tsunami Section
UNESCO/IOC
7 place de Fontenoy
75007 Paris
France
Tel: +573202636820
Email: a.rojas-aldana@unesco.org

Mr Jamel Ben Abdallah
CoastWAVE Project Consultant
UNESCO/IOC
7 place de Fontenoy
75007 Paris
France
Email : j.benabdallah@unesco.org

Appendix 2

List of acronyms


ASEAN	Association of Southeast Asian Nations
CDEMA	Caribbean Disaster Emergency Management Agency
CEPREDENAC	Coordination Center for the Prevention of Natural Disasters in Central America
CPPS	Permanent Commission of the South East Pacific
CTBTO	Comprehensive Nuclear-Test-Ban Treaty Organization
CTIC	Caribbean Tsunami Information Centre
EMIZA	État-major Interministériel de la Zone Antilles
GOOS	Global Ocean Observing System
ICG	Intergovernmental Coordination Group
ICG/CARIBE-EWS	Intergovernmental Coordination Group for the Tsunami and Other Coastal Hazards Warning System for the Caribbean and Adjacent Regions
ICSU	International Council of Science
IGCP	UNESCO International Geoscience Programme
IHO	International Hydrographic Organization
IOC	Intergovernmental Oceanographic Commission (UNESCO)
IOCAFRICA	Intergovernmental Oceanographic Sub-Commission for Africa and Adjacent Island States
IOCARIBE	IOC Sub-Commission for the Caribbean and Adjacent Regions
IOTIC	Indian Ocean Tsunami Information Centre
ITIC	International Tsunami Information Center
ITU	International Telecommunication Union
IUGG	International Union of Geodesy and Geophysics
NEAMTIC	Tsunami Information Centre for the North-eastern Atlantic, the Mediterranean and Connected Seas
NGO	non-governmental organisation
NTWC	National Tsunami Warning Centre
NTRB	National Tsunami Ready Board
OTGA	Ocean Teacher Global Academy
RTRB	Regional Tsunami Ready Board
SFDRR	Sendai Framework for Disaster Risk Reduction
SPC	Secretariat of the Pacific Community
SPREP	Secretariat of the Pacific Regional Environment Programme

TIC	Tsunami Information Centres
TNC	Tsunami National Contact
TOWS-WG	Working Group on Tsunamis and Other Hazards Related to Sea-Level Warning and Mitigation Systems
TRLC	Tsunami Ready Local Committee
TT DMP	Task Team on Disaster Management and Preparedness
TT TWO	Task Team on Tsunami Watch Operations
TWFP	Tsunami Warning Focal Point
UN	United Nations
UNDP	United Nations Development Programme
UNDRR	United Nations Office for Disaster Risk Reduction
UNESCAP	UN Economic and Social Commission for Asia and the Pacific
UNESCO	United Nations Educational, Scientific and Cultural Organization
WESTPAC	IOC Sub-Commission for the Western Pacific
WMO	World Meteorological Organization

ANNEX IV

**REPORT OF THE TOWS-WG INTER-ICG TASK TEAM
ON TSUNAMI WATCH OPERATIONS**

27–28 February 2023
Paris, France

 <p>unesco Intergovernmental Oceanographic Commission</p>	<p align="center">MEETING OF THE INTER-ICG TASK TEAM ON TSUNAMI WATCH OPERATIONS</p> <p align="center">INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION (IOC) of UNESCO</p>
	<p align="center">27–28 February 2023 (hybrid)</p>

UNESCO/IOC Working Group on Tsunamis and Other Hazards
Related to Sea-Level Warning and Mitigation Systems (TOWS-WG):

**Task Team on Tsunami Watch Operations (TT-TWO)
Members, Invited Experts and Secretariat**

Mr. Yuji NISHIMAE (Chair)	ICG/PTWS	Dr. Charles (Chip) McCREERY	ICG/CARIBE-EWS
Dr Dakui Wang (absent)	ICG/PTWS	Ms. Elizabeth VANACORE	ICG/ CARIBE-EWS
Mr. Pattabhi Rama Rao ELURI (online)	ICG/IOTWMS	Mr. Rick BAILEY	UNESCO/IOC Technical Secretary TT TWO Head of Secretariat ICG/IOTWMS
Dr. Mohammad MOKHTARI (Online)	ICG/IOTWMS	Mr. Bernardo Aliaga ROSSEL	UNESCO/IOC Head, IOC Tsunami Resilience Section
Mr. Alessio PIATANESI (Online)	ICG/NEAMTWS	Ms Nora. Gale	UNESCO/IOC Secretariat ICG/IOTWMS
Dr. H�el�ene H�EBERT	ICG/NEAMTWS	Dr. Fran�ois SCHINDEL�E	Invited expert Chair <i>Ad Hoc</i> Team Tsunamis Generated by Volcanoes
Alison Brome	ICG/CARIBE-EWS	Mr. Michael ANGOVE	Invited expert Chair <i>Ad Hoc</i> Team on Mete- tsunamis
Dr. Ahmet C. YALCINER	Invited Expert		

TASK TEAM ON TSUNAMI WATCH OPERATIONS (TT TWO) AND TASK TEAM ON DISASTER MANAGEMENT AND PREPAREDNESS (TT DMP) JOINT SESSION #1

(Chaired by Prof Harkunti Pertiwi Rahayu and Mr Yuji Nishimae)

J1 WELCOME & INTRODUCTION

Mr Bernardo Aliaga, Head of Tsunami Unit welcomed all participants to the joint opening session of the UNESCO/IOC Working Group on Tsunamis and Other Hazards Related to Sea-Level Warning and Mitigation Systems (TOWS-WG) task teams. This is the first face-to-face meeting of the task teams following two-years of meeting online due to COVID. Today marks the commemoration of the 27 February 1960 Chile earthquake and tsunami. Mr Aliaga highlighted the progress since the ITSU (International Tsunami Warning System in the Pacific) was established by IOC in 1965 and the subsequent establishment of the four Intergovernmental Coordination Groups (ICGs) in 2005 following the 2004 Indian Ocean Tsunami for the Indian Ocean, Pacific, Caribbean and Adjacent Seas, NE Atlantic & Mediterranean Seas. The global tsunami warning and mitigation system and its four ICGs have advanced implementation through the work of their task teams and working groups, allowing the expansion and efficiency of the system. Through this time, the development of global standards has been overseen by the TOWS-WG. Looking forward to 2030, the Ocean Decade Tsunami Programme (ODTP) has two goals: 1) Improved timeliness and accuracy of tsunami warnings; and 2) 100% of at-risk communities are prepared for and resilient to tsunamis. Integration of tsunami warning and mitigation into the international development of the global Multi-Hazard Early Warning System (MHEWS) led by the World Meteorological Organization (WMO) is an ongoing focus.

The task team chairs, Ms Harkunti Rahayu (TT-DMP) and Mr Yuji Nishimae (TT-TWO) outlined the overall objectives of the overall two task team meetings, including this joint session.

Mr Yuji Nishimae, Chair of TT-TWO, recalled the experience of the Japan Meteorological Agency (JMA) in implementing its tsunami warning system. He congratulated Mr Aliaga on his promotion to Head of the Tsunami Unit at UNESCO/IOC. He recalled the Turkish earthquake on 20 February 2023 and expressed his sympathies to those affected by this devastating event. He called on the support of all participants for productive discussions.

Ms Harkunti Pertiwi Rahayu, Chair of TT-DMP, also congratulated Mr Aliaga on his promotion. She noted her attendance at her first meeting of the TOWS-WG and ongoing contributions as chair of the ICG/IOTWMS Working Group 1, Tsunami Risk, Community Awareness and Preparedness. She recalled the ODTP goal for tsunami resilient coastal communities. In conclusion, Ms Harkunti welcomed all participants and encouraged active discussion during the two task team meetings and joint session.

J2 WAVE EXERCISES AND SIGNIFICANT TSUNAMI EVENTS IN EACH ICG (share outcomes, lessons learned)

Ms Harkunti Rahayu and Mr Yuji Nishimae invited representatives of Tsunami Wave Exercises from each ICG to provide a short summary of recent exercises, share outcomes and lessons learnt, as well as significant events in each region.

WAVE EXERCISES

○ **ICG/CARIBE-EWS**

Ms Elizabeth Vanacore presented a report on the CaribeWave22 exercise. The CaribeWave22 exercise was conducted on 10 March 2022. It was composed of two earthquake and tsunami scenarios: Western Muertos Trough (south of Hispaniola) and Northern Panama Deformed Belt. The exercise results indicated that the Dummy (Start of Exercise) message was received by 34 Member States, representing 91% of the CARIBE-EWS Member States and Territories. There was a strong dependency on email for the reception of products from the PTWC. The exercise planning went well under extenuating circumstances, resulting in an 88% of satisfaction of Member States and territories, and a total participation of 413,285 people from the Caribbean.

The Caribe Wave23 exercise will take place on 23 March 2023. There will be two scenarios, one based on an earthquake in the Gulf of Honduras and second, for testing of volcano EWS, an eruption and flank collapse of Mount Pelée, Martinique.

○ **ICG/IOTWMS**

Mr Ardito Kodijat reported there was no IOWAVE exercise in 2022, as in coordination with the ICG/PTWS the ICG/IOTWMS postponed the next IOWAVE exercise until 2023 (IOWAVE23). This was to alleviate the exercise load in any one year for Member States who are members of both the ICG/PPTWS and ICG/IOTWMS.

○ **ICG/NEAMTWS**

Mr Marinos Charalampakis reported on the development concerning organizing NEAMWave23. The NEAMWave23 exercise is planned either between 30-31 October or 6-7 November 2023. There is a need to have a stronger engagement with the Civil Protection Agencies (CPAs). There is an interest to organize an online meeting between the CPAs and the European Civil Protection Mechanism ahead of the exercise. The TT-TE is preparing informative material (NEAMWave exercise concept papers, best practices, etc.) to share with the national CPAs.

There is an agreement among TSPs to implement two exercise scenarios:

3. North-eastern Atlantic: Conducted by IPMA (Portugal) and CENALT (France)
4. Mediterranean Sea: INGV (Italy), NOA (Greece), KOER (Turkiye).

A key aim of NEAMWave23 exercise is to engage with CoastWAVE Tsunami Ready communities. CoastWAVE project countries will need to decide if they will make the NEAMWave23 exercise an action or not.

○ **ICG/PTWS**

Ms Laura Kong and Cmdr Carlos Zuniga reported on the PacWave22 exercise. The exercise was organized between September - November 2022 with emphasis on regional cooperation in South America, South China Sea, and Pacific Islands. The TSP live communication test took place on 13 October 2022 with the participation of 27 countries. All the TSPs that participated in the exercise sent messages according to procedures, 24 respondents reported to have received the message from PTWC correctly, 11 from NWPTAC, 7 from SCSTAC and 3 from CATAC.

The PICT regional exercise took place on 9 November 2022 with the participation of 18 Pacific Islands, countries, and territories. The scenario was the Hunga Tonga Hunga Ha'apai (HTHH) volcanic eruption and tsunami of 15 January 2022. It consisted of a 2-hour live tabletop exercise to test the HTHH PTWC Interim Procedures and PTWS products, and whether the HTHH PTWS products are interpreted by PICT Member States accurately and in a timely manner, and the testing of live information sharing between countries of the region to test its efficacy and value. Controllers simulated four PTWC bulletins sent by e-mail using a Listserv (hosted by ITIC, same as that used for the Tsunami Bulletin Board) and through a WhatsApp group. The use of HF radio was also tested since post-HTHH. HF radio proved to be one of the few (the other being satellite phones) communication methods after the blackout. All information was immediately shared (no delay or review). Only 5 mails were not distributed because they were sent from an unregistered email into Listserv.

A PacWave22 PICT Cold wash debrief took place on 16 November 2022. Participants noted the email communication method as the most important for the Live TSP test. For the HTHH scenario, the PTWC products were understood and useful, and the live information sharing overwhelmingly endorsed as highly useful, with the greatest interest in sharing via WhatsApp communications in future exercises. It was noted that if Tonga had been able to share what was observed (seen) '*natural massive eruption warning signs*' and issued a national tsunami warning minutes later, this would have significantly helped neighboring countries in their tsunami warning decision-making.

As a further indication of its usefulness, the WhatsApp tool was used in 3 real events soon after, including one on which Tonga was only able to receive the PTWC messages through WhatsApp because their email server was down at that moment.

Cdr Zuniga shared information of the Southeast Pacific (South America) regional exercise, which consisted of two exercises.

Recommendations to TOWS-WG

Commends the PTWS Pacific Islands and Southeast Pacific for testing and enabling communication methods by which to share key tsunami information regionally to assist neighboring countries in their national tsunami warning decision-making.

Recommends ICGs to align Wave exercises with World Tsunami Awareness Day and UNESCO/IOC Tsunami Ready implementation.

SIGNIFICANT TSUNAMI EVENTS

○ **ICG/CARIBE EWS**

Mr Chip McCreery reported that four or five events have been reported in the Caribbean region, but with no threat messages being required to be issued.

○ **ICG/IOTWMS**

Mr Pattabhi Rama Rao reported that in the Indian Ocean region two (2) events over the required earthquake thresholds were responded to. For both events, the three Indian Ocean Tsunami Service providers (TSPs) issued no threat bulletins to the Indian Ocean region.

○ **ICG/NEAMTWS**

Mr H el ene H ebert reported seventeen earthquakes were monitored in 2022 and five in 2023.

Ms Christa von Hillebrandt-Andrade noted that the ICG/NEAMTWS threshold magnitude for reporting events could result in public enquiry if they are different and below the threshold of the ICG/PTWS.

Mr Francois Schindele commented that the Earthquake Source Zone (ESZ) southern latitude for the South Atlantic may not include all events south of that, which could generate tsunamis that could impact coastlines of the South Atlantic, Pacific and Indian oceans.

Prof. Ahmet Cevdet Yalciner was invited to report on the T urkiye earthquakes and sea level anomalies, starting on 6 February 2023. His presentation focused on the coastal structure of the Gulf of Iskenderun and tsunamis in the Eastern Mediterranean, where the death toll has exceeded 50,000 persons due to the earthquakes. The magnitude 7.7 earthquake, which occurred on 20 February 2023, resulted in a small tsunami in the Gulf of Iskenderun. The earthquake was associated with a significant magnitude 6.6 foreshock (6 February 2023) and many aftershocks. Initial assessments of coastal structures in the Gulf of Iskenderun indicate local subsidence and damage, which includes four tide gauge stations and other structures. Further investigations are being conducted to better understand the resulting tsunami.

Mr Rick Bailey, UNESCO/IOC Secretariat, enquired about the lessons learnt in tsunami and community education. Mr Yalciner responded that the NEAMTWS is working well. Regional awareness has been increased through the warning messages.

Ms Chacon Barrantes asked about the community response. Mr Yalciner replied that there was much interest from the community and a desire to learn how to respond to tsunami threats. Mr Musavver Didem Cambaz expanded that the local people left their homes as a response to the earthquake and wanted to learn the appropriate tsunami response.

Ms Harkunti Rahayu asked if the coastal infrastructure damage was due to subsidence or the earthquake. Mr Yalciner responded damages to structures resulted from subsidence as well as fire.

Mr Denis Chang-Seng raised the importance of evacuating buildings in response to earthquakes and noted renewed interest in countries joining the ICG/NEAMTWS.

Mr Alejandro Rojas Aldana asked about the communication surrounding the earthquake. Mr Yalciner noted an important lesson that the people in the damage zone could not send messages, and communication failures resulted in confusion.

Mr Mohammad Mokhtari enquired about prior tsunami events. Mr Yalciner responded that a tsunami in 2020 resulted in wave damage and one fatality. A DART (*Deep-ocean Assessment and Reporting of Tsunamis*) system could be implemented to improve the warning system.

○ **ICG/PTWS**

Mr Chip McCreery noted since the last TOWS-WG meeting, twenty-seven (27) tsunami information statements and twelve (12) tsunami threat sequences have been issued in the Pacific region. The Hunga Tonga Hunga Ha'apai (HTHH) volcanic event (prior to last meeting) was included in the count due to its significance and follow-up work, which has raised awareness on non-seismic tsunami generation.

Mr McCreery reviewed the response to the HTHH event. The resulting tsunami was detected in all ocean basins and the precise mechanism is under investigation. The PTWS has developed and implemented new interim products (subject to ICG/PTWS approval at its next session) in case of similar future events. In response to the HTHH event in the Pacific Ocean and two non-seismic and complex source events in Indonesia in the Indian Ocean and connecting seas, TOWS-WG has formed two *ad hoc* teams, one on tsunamis generated by volcanoes and another on meteo-tsunamis.

Mr Mohammad Mokhtari asked about detection of non-seismic events in other ocean basins, with reference to the Makran region. Mr McCreery noted that the coastal sea-level gauges are not well set-up to alert for significant wave heights due to possibility for sea-level noise also triggering. However, during the precursory activity in Hunga Tonga a trigger was programmed on the nearby sea-level gauge. This gauge and a nearby DART signal were used to action the response. Something similar may be able to be implemented in the Makran region.

Recommendations to TOWS-WG:

1. TOWS-WG, given the critical need to resolve and understand the near-field threat to high at-risk communities where a tsunami may arrive in 5-30 minutes, reiterate the urgent need for all Member States to sample sea level data at one second intervals and transmit this in real-time.
2. TOWS-WG request IOC Assembly at its next session to reconsider the request to extend the Pacific Earthquake Observing Zone to include the South Atlantic, given the ongoing threat in this region to generate tsunamis that also impact the Pacific and Indian Oceans (eg South Sandwich Islands event, 12 August 2021)

J3 REPORT FROM AD HOC TEAM ON TSUNAMIS GENERATED BY VOLCANOES

Mr Francois Schindele (France), Mr Raphael Paris (France) and Ms Laura Kong (United States of America) reported on the *Ad Hoc* Team on Tsunamis Generated by Volcanoes (TGV) under the TT TWO. The scientists on the team also included Emily Lane (New Zealand), Maurizio Ripepe (Italy) and Vasily Titov (United States of America). A survey on volcano observatory activities with regards volcanic activity hazard assessment and related tsunami monitoring and warning systems was circulated to volcanic observatories and relevant institutes. The *Ad Hoc* Team TGV report is being finalised and includes chapters on tsunamis generated by volcanic activity, numerical modeling of volcanic tsunamis, volcanic tsunami hazard assessment, volcano monitoring requirements for tsunami warning, volcanic tsunami warning systems and standard operating procedures, and recommendations. A draft of the report was tabled at the meeting.

Mr Raphael Paris reported on the first two chapters of the report: 'Tsunamis generated by volcano activity and instability' and 'Numerical modeling of volcanic tsunamis'.

Mr Francois Schindele reported on the three different volcanic tsunami hazard assessments with an example of the worst-case scenario for Stromboli. The Stromboli volcanic tsunami warning system has been long standing with tsunami beacons in the seas on the southern and northern volcanic flanks. The system was successful in detecting the Stromboli event on 4 December 2022. The signage at Stromboli shows the hazard zone and evacuation routes for tsunami events.

Ms Laura Kong noted that of the twenty-five (25) volcano observatories surveyed, fifteen (15) countries have responded to the volcano observatory questionnaire. The current practice is to detect and then warn. There are two possible triggers for tsunami warnings: Volcanic Ash Advisory Centre (VAAC) notices of activity and actual tsunami wave detection. Most volcano

observatories do not have sea level stations. Since most volcanic observatories do not have 24x7 operations, they cannot be tsunami warning centres.

Ms Laura Kong then presented the preliminary recommendations and gaps for warning of tsunamis generated by volcanoes. These recommendations were further discussed later in the day and the final recommendations presented to the joint session of the task teams on Day 2 of the meetings.

Cmdr Carlos Zuniga asked about Deception Island in Antarctica, which is outside of the monitored networks. Mr Raphael Paris responded that this can be included in the report.

Mr Chip McCreery noted that low-cost flood sensors have been installed in key localities on land to monitor for inundation. These 'wet sensors' are easy to deploy, and have been reliably detecting flooding at a given elevations for the past 10+ years.

Recommendations to Member States

Monitoring and Warning:

1. As a first step, organization(s) should be designated for monitoring and warning of Tsunamis Generated by Volcanoes (TGV). The second and third steps are to install monitoring instrumentation and develop Standard Operating Procedures (SOPs) to handle volcanic tsunamis.
2. The TGV monitoring and warning system should be implemented by, or in cooperation with the National Tsunami Warning Centre (NTWC) and regional Tsunami Service Provider and national and regional Volcano Service Providers, where such exist.
3. All volcanoes mentioned in the TGV report should be monitored and have processes in place to warn for tsunamis. Should other, potentially tsunamigenic volcanoes begin erupting, these should also be monitored and included within the tsunami warning process.
4. Detect/warn geophysical (seismology, GNSS, tiltmeter, barometric and sea level data streams need to be available to the designated tsunami monitoring/warning agency (and possibly also to the volcano monitoring agency)
5. As well as monitoring systems for volcano activity and potential far-field propagation of sea level signal, a sea level gauges network with real-time continuous data transmission should be deployed close to each identified volcano to verify risk and then ongoing monitoring and warning. One second sampling with 1 cm accuracy (< 1 mm sampling) is recommended for recording and automatic detection. Data transmission through radio or microwave links, fiber optic, or dedicated telephone lines, or other modes should be implemented to ensure the data is transmitted and received and widely shared with the international community in a timely manner.
6. Methods to also specifically alert persons in remote areas (such as scientific teams in the field, or recreational hikers) should be considered.
7. TGV SOPs for tsunami warning should be linked with existing Volcano Alert Activity scales.

Risk Assessment and Preparedness:

8. TGV hazard and risk assessment should be undertaken to determine vulnerable areas.

9. For TGV, multi-stakeholder meetings should be convened that included science agencies, volcano and tsunami warning operations centres, and disaster management agencies. For each identified potential source, worst-case and credible scenario planning discussions should start as soon as possible.
10. During a period of heightened TGV hazard, consider closing access to vulnerable areas. When an eruption is imminent and the tsunami hazard is high, consider evacuating populations from vulnerable locations.
11. Specific TGV signage and evacuation routes should be implemented in all areas that may be impacted by tsunamis generated by volcanoes.
12. TGV public awareness campaigns should be conducted regularly – the type and frequency of awareness activities may be different for the local population compared to transient populations such as tourists.

Recommendations to TOWS-WG

1. TGV warning notification systems should be considered and coordinated as part of the UNESCO/IOC Global Tsunami Warning and Mitigation System, and also when possible be part of a Multi-Hazard Early Warning System (MHEWS).
2. TOWS-WGs recommend ICGs examine TGVs in the region of responsibility and review TGV hazard monitoring and warning requirements, including costs of deploying and maintaining such systems.
3. TOWS-WG recommend, where identified TGVs may impact multiple Member States, Tsunami Service Providers (TSPs) for the relevant ocean basin tsunami warning and mitigation systems consider if they need to be involved in monitoring and provision of threat advice.
4. UNESCO/IOC Ad hoc Team on TGV should continue and finalize the TGV Report by mid-2023.

Recommendations to UNESCO/IOC Secretariat

IOC Secretariat to help inform Member States widely on the potential tsunami hazard from volcanoes:

1. Publish the TGV report as an UNESCO/IOC publication in 2023
2. Provide the TGV Report, including the List of Tsunamigenic Volcanoes to Volcano Observatories
3. Provide the TGV Report, including the List of Tsunamigenic Volcanoes to UNESCO/IOC Member States

J4 REPORT FROM AD-HOC TEAM ON METEO-TSUNAMIS

Mr Mike Angove reported on the work of the *Ad-Hoc* Team on Meteo-tsunamis under TOWS-WG TT TWO. The report assessed the current global status and advised on gaps related to meteo-tsunami monitoring and warning systems. It also identified guidelines for Standard Operating Procedures (SOP) development to monitor and warn for meteo-tsunamis, and reviewed relationships and coordination requirements between TSPs/NTWCs and regional/national meteorological services to monitor and warn for meteo-tsunamis.

Where they exist, meteo-tsunami alert products are currently addressed within the SOPs of national or regional meteorological services. Meteo-tsunami are common in some parts of the world where the required conditions occur, happen infrequently, but can cause a

significant risk to life and property (i.e., Balearic Island region in Mediterranean Sea). The global tsunami warning system can play a supporting role in direct tsunami detection. A future unified system with a combination of direct tsunami detection and NWP-based meteo-tsunami forecasts is considered worthwhile. Local understanding of the meteo-tsunami threat is critical.

Observed significant meteo-tsunami occurrences are typically mid-latitude features related to fast moving (i.e., over 30 nautical miles) mesoscale complexes. They have been observed in the Adriatic Sea, Mediterranean Sea, Nagasaki Bay, Lake Michigan, and the Persian Gulf. Mr Rick Bailey also noted they have been observed off the west coast of Australia, causing a ship to break its moorings and nearly collide with a major road bridge.

Dedicated meteo-tsunami alerting systems are in place in the Balearic Islands, Adriatic Sea, and South Korean Peninsula. Other areas have more generalized systems based on detection of flooding.

Using the global tsunami warning system for meteo-tsunami may be considered. However, rethinking of global tsunami observation may allow for instrumentation specifically tuned for meteo-tsunami.

Generalized SOPs for meteo-tsunami have been developed by the *ad hoc* team.

Further discussion is needed on preferred forecasting and warning organisations (i.e., organisations responsible for meteorology and/or tsunami warnings). It is recommended that meteo-tsunami alerting is jointly coordinated by WMO and UNESCO/IOC. A new instrumentation strategy should be considered and a framework for a unified meteo-tsunami system should be established.

Recommendations to TOWS-WG

Noting the report from the *Ad Hoc* Team on Meteo-tsunamis initially sought to look at meteotsunami the perspective of global tsunami services;

Further noting the report from the *Ad Hoc* Team on Meteo-tsunamis discovered responsibility for issuing public alerts related to meteotsunami currently is typically addressed by national or regional Met services offices, but usually in the context of storm surge or anomalous coastal flooding event;

Further noting as tsunami detection and measurement capabilities are rapidly improving and this is expected to accelerate under the UN Ocean Decade, it is now possible to consider non-seismic tsunami sources in the global instrumentation strategy, including volcanoes and meteotsunami, among others;

Further noting combining the direct tsunami detection capability of the GTWS with the NWP-based algorithms tuned to meteo-tsunami prediction could deliver significant advances in global capability at minimal cost;

1. TOWS-WG initiates a comprehensive dialogue between the IOC and WMO to ensure full exchange of information in support of a robust international alerting system for meteo-tsunamis is achieved. It is the *Ad Hoc* Team for Meteo-tsunami's recommendation that this report be used as a starting point of those discussions.
2. TOWS-WG to establish a mechanism for input from national and regional meteorological services offices on data needs for meteo-tsunami monitoring and alerting as the Global Tsunami Early Warning System (GTEWS) considers a new

generation of tsunami detection and measurement networks.

3. TOWS-WG to establish a task team made up of experts from both GETWS and NWP systems be formed with the expressed intent of outlining the potential construction of an integrated meteo-tsunami prediction system.
4. TOWS-WG establish an *ad-hoc* team to conduct a global meteotsunami hazard assessment to provide all MS advice on the meteotsunami hazard and risks on their coasts.

Recommends the *ad-hoc* team on Meteotsunami continue through 2023, including WMO representatives for the purpose of recommending a global altering strategy to include specific roles of met services and TSPs/NTWCs.

Recommends the establishment of an *ad-hoc* team to conduct a global meteotsunami hazard assessment to provide all MS advice on the meteotsunami hazard and risks on their coasts.

J5 PLANNING FOR OCEAN DECADE

The Chair asked the Secretariat to report on the work on the status, activities, and plans for the Ocean Decade.

Ocean Decade Tsunami Programme Endorsement

Mr Mike Angove reported on the instrumentation and warning vision to build off the legacy seismic analysis capability, with a view to combine this with more direct in-situ tsunami measurement, in order to enable positive confirmation of tsunami generation from a source event to provide more accurate forecast information. The identification of a global sensor strategy to achieve these goals would include many sources of measurement and detection. This will require Member State to enhance current monitoring coverage. The recommended enhanced global monitoring systems would go to the ICGs and/or TOWS-WG to coordinate implementation.

Ms Harkunti Rahayu noted that the goal of 100% of communities at risk to be prepared and resilient to tsunami will be first discussed by the TT-DMO.

Draft of the 10—year research and development implementation plan for the ODTP

The Scientific Committee has met three times over the last year. The first draft of the Ocean Decade Tsunami Programme Research and Development Implementation Plan was released in November 2022 for Member State comments. The second draft was released on 13 February 2023 for review by the TOWS-WG and its task teams. Following this review and feedback, the Scientific Committee will finalize the report for the UNESCO/IOC Assembly in June 2023 and seek endorsement from Member States.

Progress report of the Tsunami Ready Coalition

Mr Bernardo Aliaga, new Head of the IOC Tsunami Unit announced the appointment of Ms Laura Kong as the Chair of the Tsunami Ready Coalition. She was nominated by the by the TOWS Task Team Chairs and endorsed by TOWS WG Chair. Ms Kong has a strong background and experience in tsunami warning and mitigation, and preparedness. The goal of the Coalition is to “Contribute to increasing the number of Tsunami Ready communities as part of the Ocean Decade” through the following objectives:

- a. Raising the profile of UNESCO Tsunami Ready in collaboration with critical stakeholders across the UN system, interested regional organizations, national disaster management agencies and the public,
- b. Increasing funding resources for the implementation of Tsunami Ready,
- c. Advising the IOC TOWS-WG, TT-DMP, and TT-TWO on the implementation of UNESCO Tsunami Ready, including on: i) Flexibility with regards to accomplishing the indicators to allow for circumstances where formal bureaucratic frameworks/requirements may pose barriers; and ii) Consideration of unique regional and/or local circumstances.

Plans for the 2nd UNESCO/IOC Science Symposium on advances in tsunami warning to enhance community responses:

Ms Harkunti Rahayu, chair of the 2nd UNESCO/IOC Science Symposium Organizing Committee, reported that Indonesia and the ICG/IOTWMS plans to host an Indian Ocean Tsunami Symposium in the first week of December 2024 in Aceh, Indonesia, back-to-back with the 14th Session of the ICG/IOTWMS in Jakarta. The year 2024 will mark the 20th commemoration since the Indian Ocean Tsunami of 2004 killed nearly 200,000 people in Indonesia and in total more than 230,000 across the Indian Ocean. The Government of the Republic of Indonesia, through the Head of the Indonesian Agency for Meteorology, Climatology and Geophysics (BMKG and Chair of the ICG/IOTWNMS, Ms Dwikorita Karnawati, has offered to make the symposium global and accordingly host the 2nd UNESCO/IOC Science Symposium on advances in tsunami warning to enhance community responses.

The TT-DMP recommended having discussions about the nomination of a Tsunami Symposium vice-chair and members of the committee.

Recommendations to TOWS-WG

Noted with appreciation the nomination of Ms Laura Kong as the chair of the UNESCO/IOC Tsunami Ready Coalition;

Accepts with appreciation the offer of the Government of the Republic of Indonesia to host the Global Symposium in December 2024 as part of the plans by the ICG/IOTWMS to commemorate the 20th Anniversary of the Indian Ocean Tsunami of 2004.

Recommends the nomination of a Tsunami Symposium co-chair and members of the committee.

TASK TEAM ON TSUNAMI WATCH OPERATIONS (TT TWO) SEPARATE SESSION #1

(Chaired by Mr Yuji Nishimae)

1. TT TWO SESSION ORGANISATION

Logistics, participants, agenda

Mr Yuji Nishimae welcomed all participants to the separate session and meeting of the TOWS-WG Task Team on Tsunami Watch Operations (TT TWO). He requested the members of the Task Team to introduce themselves.

Mr Rick Bailey, UNESCO/IOC Technical Secretariat for TT TWO, reviewed the meeting logistics and agenda (refer to Appendix 1). He proposed that *Agenda Item #2 Review of Action Items* be included under *Agenda Items #11 Discussion on the Workplan*, which was supported by the Chair. Mr Rick Bailey further spoke about the importance of data sharing and planning for the Ocean Decade. The group adopted the modified agenda.

Mr Mohammad Mokhtari asked about discussing mud volcanoes within the agenda. Mr Rick Bailey replied that this could be included in the Ocean Decade planning discussions.

2. REVIEW OF ACTION ITEMS

Open recommendations and action items were reviewed by the Task Team prior to the meeting and during each relevant agenda item. New actions and recommendations arising from the current meeting were reviewed and included under *Agenda Item #11*. A summary of all recommendations and actions can be found in Appendix 4.

3. TSUNAMI WATCH OPERATIONS: STATUS AND PLANS IN ALL ICGS

The Chairperson introduced this agenda.

3.1 CARIBE-EWS

Ms Elizabeth Vanacore reported that many Member States are preferring to use low-technology communication methods (i.e., radio) that are reliable during tsunami events.

Mr McCreery reported on the CARIBE-EWS status and plans. Maps of the current seismic and sea level monitoring stations in the Caribbean region were shown. Upcoming changes to products include listing countries and territories in alphabetical order in the initial threat message and grouping estimated tsunami arrivals by country/territory. Types of water level measurement will be indicated on tsunami bulletins, descriptive text informing of the small possibility of a local tsunami may be added to information statements, and initial alerts may be based on travel time instead of distance. Future activities of CARIBE-EWS include the addition of South Pacific seismic data to forecasts, incorporation of GNSS data, faster RIFT server, and a seamless backup to US TWC. A longer-term focus is progressing the SMART cable project for more deep ocean sensors.

Mr Bill Fry asked if there is standardization for arrival times across TSPs to which Mr Chip McCreery replied there are not. Mr Rick Bailey noted the ICG/IOTWMS provides the time for four arrivals. Mr Francois Schindele noted that the Global Standard Tsunami Service Definition should be referenced for reporting guidelines.

Mr Elizabeth Vanacore noted that the group should revisit the tsunami arrival in the discussion on the glossary tomorrow as the first arrival may be a trough.

Mr Yuji Nishimae noted there are major problems about instrument reliability. And maintenance Ms Vanacore replied that funding, Covid relating travel restrictions, and the occurrences of other natural hazards have poised issues.

Mr Yuji Nishimae emphasized the importance of equipment maintenance to collect data for tsunami warnings. Mr Bill Fry noted that New Zealand has struggled to repair monitoring stations in other countries quickly (i.e., New Caledonia). This could be greatly assisted with a recommendation from TOWS-WG. Ms Vanacore conveyed the benefit of training local people to be the first responders for fixing equipment issues and noted this has been done in CARIBE-EWS.

3.2 IOTWMS

Mr Pattabhi Rama Rao presented the status and plans of the ICG/IOTWMS. In the Indian Ocean region, there are three interoperable TSPs located in Australia, India and Indonesia providing harmonized threat information. Email is the most reliable dissemination mechanism for TSP notifications, which is shortly followed by fax. Highlights of the last year include the updated version of the IOTWMS Standard Service Definition Document (version 5) and the development of maritime bulletins by TSP Australia. A Key Performance Indicator (KPI) web application has been developed by TSP India and is under test. Member States have tested TSP Indonesia's new WRS notification tool during two IOTWMS communication tests. A strategic pathway has been identified in alignment with the UNDOS outcomes. The future plans are to implement the UNESCO/IOC Tsunami Ready Recognition Programme, conduct IOWave23, commemorate the 20th anniversary of the 2004 Indian Ocean tsunami, and complete the next phase of the UNESCAP-fund project in the Northwest Indian Ocean.

Mr Mike Angove recalled the 2017 meteo tsunami in the Persian Gulf and asked if there are procedures within the IOTWMS and/or its Member States to address meteo-tsunami events. Mr Pattabhi replied that he is not aware of any developments in this area.

Mr McCreery asked about the KPI reporting web application for the TSPs and noted this would be useful for the reporting of all TSPs. Mr Pattabhi replied that after it is fully tested and implemented, the application will be made available for all TSPs.

3.3 NEAMTWS

Mr Alessio Piatanesi presented the status and plans of NEAMTWS. A meeting of the Task Team will be held during the first quarter of 2023 in coordination with meetings of the Steering Committee and other Task Teams. Future activities include to coordinate the development of sea-level reading procedures with other TSPs; to coordination with TSPs on a common tsunami Common Alerting Protocol (CAP) template; to server both NEAMTWS and national needs simultaneously; to develop the TSP Inter-Operability Tool (TSP-IOT) especially for overlapping regions; and to improve the Performance Monitoring Framework for NEAMTWS upstream components. Stromboli was provided as an example where the integration of the existing beacon system with national and NEAM tsunami warning systems has proven worthwhile.

Ms Vanacore noted that the Atlantic events can affect the Caribbean and asked if there are plans for coordination amongst these ICGs. Mr Piatanesi and Mr McCreery agreed that inter-basin collaboration and coordination is needed.

There was a discussion about the need to develop a CAP template for sharing tsunami information between TSPs (in addition to the format utilized by NTWCs). Mr Pattabhi shared that the ICG/IOTWMS has evaluated the use of CAP and decided that is not relevant at the TSP level but will be implemented at the national level. Mr Fry noted that New Zealand has had great success with CAP at the national level, especially at the administration level. Overall, the Task Team broadly agreed to investigate the usefulness of CAP messaging between TSPs in different basins.

Ms Vanacore replied that we should gather the existing CAP messaging formats and look for commonalities. Mr Yuji Nishimae mentioned that he thinks sharing information among the TSPs is important, however, they do not stick to the CAP format specifically. Cdr Carlos Zuniga recalled the Turkey event in February 2023 and noted that coordination among the TSP for sharing their assessment would be worthwhile.

3.4 **PTWS**

Mr Yuji Nishimae presented the status and plans of ICG/PTWS. There are four PTWS-TSPs including PTWC, NWPTAC, SCSTAC, and CATAAC. The Steering Committee will next meet at UNESCO/IOC in Paris during 6-9 March 2023. The ICG/PTWS-XXX will be held in the Kingdom of Tonga during 10-16 September 2023. The TSPs continue to conduct regular communications tests and the last test was held by NWPTAC in February 2023. PacWave22 was successfully conducted during 2022 and preparations for Exercise Pacific Wave 2024 will commence following ICG/PTWS-XXX.

Actions for TT TWO and ICGs

1. In addition to providing guidance to NTWCs, develop a global CAP template for all TSPs, not for public exchange, but to facilitate exchange of bulletins between basin TSPs and their NTWCs, and between TSPs of different basins.
2. All ICGs routinely monitor and report on status of sea level and seismic networks (like CARIBE-EWS currently does) to better understand data availability and work with operators to resolve instrument issues, in order to help improve present tsunami forecasts and help identify needs and monitor implementation of enhanced data systems to meet UN Ocean Decade goals

Recommendation to IOC Sea Level Monitoring Facility:

UNESCO/IOC Sea Level Monitoring Facility increase the tabled sea level data at one second intervals (where available) and display sea level time series as a continuous line.

4. **PLANNING FOR THE OCEAN DECADE**

There was a discussion about the role of the UNESCO/IOC in tsunami and if this extends to meteo-tsunami and other sea level hazards. Mr Rick Bailey reminded the group that UNESCO/IOC was given the UN mandate for tsunamis, following the devastating Indian Ocean Tsunami of 2004. As 'other sea level hazards' are included within the TOWS-WG acronym, the inclusion of meteo-tsunami would be valid.

The group also discussed the tsunami generated by the shock waves following the HTHH eruption and if this is classified as a meteo-tsunami. Mr Mike Angove asked what organisation(s) would be responsible for similar future events. Mr Mohammad Mokhtari noted that the source of the tsunami is currently debatable and suggested an alternative point of view where the focus is placed on tsunami propagation and inundation [not the source mechanism]. Mr Yuji Nishimae recalled the tsunami following the HTHH eruption traveled at

the speed of sound and therefore presents unique warning challenges.

Mr Yutaro Taira explained that JMA monitors for both storm surge and tsunami, enabling easy cooperation within the one organisation. However, in many Member States the hazards are overseen by separate agencies. Thus, the challenge is inter-agency collaboration.

There was a discussion about the best way to monitor for such even more infrequent anomalous events. Mr Mike Angrove presented the concept of an outer and inner grid of nested instrumentation providing coverage for both typical earthquake subduction and non-seismic and complex source [even less frequent] events. Mr Francois Schindele emphasized that the near-field cannot be forgotten and should be a focus area of Member States. Ms Elizabeth Vanacore recalled that a cost-benefit analysis is important for decisions related to instrumentation. Mr Rick Bailey further noted the importance of risk assessments as the first fundamental inputs to instrument network design. Cmdr Carlos Zuniga supported the greater network density, while noting the importance in providing guidance to the met services on how to handle meteo-tsunami.

The group discussed the near-field events and if there is a need to provide a definition that includes timeframe, which currently varies between countries. Member States including New Zealand and the United States implemented densified instrumentation in the near-field to enable more precise tsunami monitoring and forecasting.

Action for TT TWO

TT TWO on US and NZ efforts to explore specific design of risk-based grid integrated monitoring network in support of UN Decade Objectives and provide, recognizing the role of the TT TWO in helping to enhance the monitoring and warning aspects of the Global Tsunami Warning and Mitigation System

-

TASK TEAM ON TSUNAMI WATCH OPERATIONS (TT TWO) AND TASK TEAM ON DISASTER MANAGEMENT AND PREPAREDNESS (TT DMP) JOINT SESSION #2

(Chaired by Prof Harkunti Pertiwi Rahayu and Mr Yuji Nishimae)

J6 LOCAL SOURCE SOPs

Visual Communication of Tsunami Warnings

Mr Yuji Nishimae reported on visual communication of tsunami warnings and advisories in Japan. A study group found that flags were an effective method to communicate tsunami warnings/advisories, and that red and 'U' flags are most visible at a distance. A questionnaire of people with hearing and color impairments confirmed the aforementioned flags were most identifiable. The study group then proposed specifications for the flags. In response to the report, JMA amended the regulation on 24 June 2020 and published a brochure showcasing the adopted flag.

Ms Christa von Hillebrandt-Andrade reported that she observed flags being used in Odisha, India for tsunami alerting while observing IOWave18 exercise. She further asked if other flags are used for beach warnings in Japan. Mr Yuji Nishimae responded that JMA modified the regulation for dissemination flags for tsunami warnings and no other flags are currently used along beaches.

Mr Chip McCreery asked about the practicality of implementation. Mr Yuji Nishimae replied that the local government is responsible for tsunami evacuations and should prepare enough flags to cover the beaches.

Mr Ardito Kodijat asked about the timing of using the flag. Mr Yuji Nishimae explained that the U-flag is used for the first warning to evacuate and is not used even when the tsunami warning is updated after the tsunami strikes.

Ms Harkunti Rahayu noted the merit in flag use for people who have a hearing impairment. She further recalled that this practice is being employed in Oman. Mr Yuji Nishimae also recalled that Oman uses something like fireworks.

Mr Rick Bailey agreed that communities should agree and consult with other groups, such as surf life-saving who also used flags for communicating hazards at the beach.

Ms Christa von Hillebrandt-Andrade suggested a recommendation on disability inclusiveness with regards to tsunami warnings, noting the example from Japan.

Mr Mohammad Mokhtari suggested including a tsunami symbol on the flag. Mr Yuji Nishimae responded that this has been tested and is not as visible as a U-flag.

Mr Elizabeth Vanacore noted the benefit of global harmonization of tsunami warning flags.

Recommendations to TOWS-WG

Noted that Japan has defined a flag called "Tsunami Flag" as a visual communication method of tsunami warning in order to disseminate tsunami warning to people with hearing difficulties and people at the beach. The flag has been used since June 2020.

Recommends global harmonisation of the tsunami beach flag in consultation with other groups using flags to warn for other coastal hazards, and the broader consideration of people with disabilities in tsunami warnings.

Recommendations to TOWS-WG TT DMP

1. TT DMP to further investigate requirements and methods to warn people with disabilities and underserved communities, especially given WTAD objective 2023 “fighting inequality for a resilient future”.
2. TT DMP take action now to upgrade NTWC competency training framework from a Pacific to global approach and include competency training for Tsunami Warning Focal Points (TWFPs) in the framework given their key role in tsunami warnings.

J7 GLOBAL NTWC COMPETENCY FRAMEWORK

Ms Laura Kong reported on the Global Competency Framework for National Tsunami Warning Centres. The ICG/PTWS Task Team on Minimum Competency Levels for NTWC Operational Staff was formed based on the request from the Pacific Small Island Developing States (SIDS) for a competency framework for NTWC personnel. The task team has proposed a first draft of the framework, which was approved in 2019 (ICG/PTWS-XXIX). The document outlines two tiers of competencies (i.e., expert and basic).

As an example of the value for capacity building, Ms Laura Kong gave the example of Tonga. Since 2009, capacity building initiatives have been conducted through five in-Tonga trainings and abroad, where Tonga participated in international training on tsunami warning operations. They built their warning response capacity over time, and their built capacity to respond well was demonstrated for the 2022 HTHH event. Further, the Solomon Islands Meteorological Service underwent impact based forecast training and identified that DRR aspects should be included within the competency framework. A capacity training workshop in the South-West Pacific (SWP) in 2022 highlighted the need for training of the trainers and for support to map and develop a framework among the Pacific Island Countries (PICT). The PICT Task Team on Capacity Development met on 2 February 2023.

Ms Laura Kong further outlined the task team’s plans to finish the PTWS Competency Framework for approval in September 2023 at the next ICG/PTWS-XXX. The ITIC plans to work with expert and advanced NTWC partners to develop a Concept Note for Implementation, which is planned as a funded pilot in 2024 and beyond. In August 2023, the ITIC plans to partner with New Zealand to conduct its 2-week ITP-Hawaii in New Zealand, where warning centre operations will be a focus. Additionally, the 2024 ITIC Training Programme (ITP-Hawaii) is planned to be in Chile (2018 was first time), which operates advanced seismic monitoring and tsunami warning centres.

Mr Chang-Seng asked how this can be utilized in other regions. Ms Laura Kong noted the documents outline the requirements for staff at warning centres everywhere. The PTWC NTWC competency framework contains global content, which could be implemented in other areas.

Mr Elizabeth Vanacore noted that warning centres may need competency in understanding the products they are receiving from TSPs. Ms Laura Kong responded that the task team Framework document provides a basis for developing a global competency framework.

Recommendations to TOWS-WG

Noted the work of the PTWS to develop a National Tsunami Warning Centre (NTWC) Competency Framework (2017), and the ITIC's leadership to pilot training courses based on the Framework;

Recommends ITIC to pilot the PTWS NTWC Competency Framework with the goal to develop a global framework for all ICGs to use.

J8 IUGG UPDATE

Ms Laura Kong provided an update on the International Union of Geodesy and Geophysics (IUGG) Joint Tsunami Commission (JTC). IUGG/JTC promotes the exchange of scientific and technical information about tsunamis among nations concerned with the tsunami hazard. There are six Working Groups: Tsunami Terminology, Science-based Tsunami Warning, Tsunami Magnitude, GNSS Data for Tsunami Warning, Meteo-tsunami, and Tsunami Data. Future meetings being organized include the EGU 2023 on tsunamis from source processes to coastal hazard and warning. Proposed meetings include the IUGG JTC - PTWS Tsunami Symposium (ICG/PTWS-XXX) in September 2023 in Tonga and the proposed IOC – IUGG/JTC 2nd International Tsunami Symposium in December 2024. Recent publication series edited by the IUGG/JTC include special journal issues on the Sulawesi/Palu (2018) and Anak/Krakatau (2018) Tsunami as a Topical collection in Pure and Applied Geophysics (19 papers), and the Tonga Volcanic Explosion 2022 as a topical collection in Pure and Applied Geophysics (6 papers and ongoing). Support provided to the IOC includes the Tsunami Glossary 2019 update, and Tsunami Generated by Volcanoes and Meteotsunami *ad hoc* team reports.

Ms Christa von Hillebrandt informed the meeting that the 28th IUGG General Assembly will be held 11-20 July 2023 at the Messe Berlin – City Cube, Berlin, Germany. It is a special opportunity for participants from around the world to come together and share their science and culture. She noted that there will be a tsunami symposium consisting of 70 abstracts and it would be interesting to see the outcome.

Recommendations to TOWS-WG

Notes the recent EGU 2022 meetings on tsunamis from source processes to coastal hazard and warning;

Notes the publication of IUGG concerning the Sulawesi/Palu (2018) and Anak/Krakatau (2018) Tsunamis;

Further notes the support provided by IUGG to IOC on the tsunami glossary update in 2019 and reports on meteo-tsunamis and tsunamis generated by volcanoes;

Welcomes the engagement of the members of the TOWS-WG task teams at the 28th IUGG General Assembly, 11-20 July 2023 at the Messe Berlin – City Cube, Berlin, Germany;

Further welcomes the proposed joint IUGG and IOC Tsunami Symposium prior to ICG/PTWS meeting in September 2023 in Tonga.

J9 EMERGENCY WARNING SERVICE IN GALILEO

Mr Eric Guyader, an engineer at the European Commission - Galileo Programme delivered an online presentation on the new emergency warning service in Galileo. Galileo has been in operation for 20 years, and it is now introducing its services in a wider public context. It is a new service to help alert the population. The initiative is in line with global trends and contributes to the UN DRR targets. It offers a satellite dissemination means of alerts to the population. Messages can be broadcasted to any place on earth. Galileo can alert population through smart phones. Anyone with a smart phone can receive alerts, however it is the sovereign responsibility of nations to issue alerts and choose best means of alert dissemination. Galileo must first consult with each nation it proposed sending alerts to. Galileo programme takes care of the formatting and dissemination of the alert message. There is no need for any specific network connection. Only relevant people can receive the message, and it can target populations as large as a continent to a building block. It uses an eclipse approach to target the population. Galileo takes care of 130 hazards. The target date to start full implementation is 2024. Several bilateral contacts have been established mainly with CPAs. There are ongoing discussions with countries including Australia to use Galileo services in ocean /maritime area. Field demonstration is expected to be carried out in four locations in France, Germany, Cyprus, and Belgium. They are developing the capacity and scenarios to carry out the demonstration examples. There is a workshop planned in February 2024. Galileo Programme is happy to receive relevant materials, story lines, protocols, guidelines to help design the demonstration examples in those mentioned countries. It was clarified that instructions can be sent to people inside or outside the threat zone. There are no cost implications, it is free of charge aside the operational cost. There are only 32 authorized entities able to contact Galileo, and these are pre-agreed authorized entities. It was clarified that the ellipse corresponds to people threatened. Cancellation of alerts works in the same way as issuing alerts. Mrs. Caroline Morisot-Pagnon attended the meeting in person and was available to provide further information on the Galileo services.

Recommendations to TOWS-WG

Noted the expanded services to be offered by Galileo European Global Navigation System in 2024 for satellite-based dissemination of targeted alerts to the population and the Galileo demonstration examples to be carried out in France, Germany, Cyprus, and Belgium, the workshop planned in February 2024, and **welcomed** the offer of the Galileo Programme to provide relevant documents, storylines, protocols, guidelines and manuals to support the design of the demonstration examples.

J10 UN SEC GENERAL “EARLY WARNING FOR ALL”

Mr Denis Chang Seng reported that the World Meteorological Organization (WMO) will provide an official report on the progress concerning implementing “Early Warning for All” during the TOWS-WG session on 2 March 2023. However, he remarked that it is important to briefly report and discuss the matter during the task teams meetings. “Early Warning for All” aims to ensure that every person on earth is covered by an early warning system by the year 2027. WMO is leading the initiative with UNDRR and partners. “Early Warnings for All” Action Plan was unveiled at COP27, Sharm el-Sheikh, Egypt, 7 November 2022. There are currently four “Early Warning for All” pillars:

- Pillar 1: Risk Knowledge and Management
- Pillar 2: Observations, Monitoring and Forecasting
- Pillar 3: Dissemination and Communication
- Pillar 4: Preparedness to Respond

“Early Warnings for All” (EW4ALL) will address the following:

- Enhancing capacity to detect hazard,
- Close the observing gaps,
- meet the data needs for monitoring hazards (Estimated for 70 priority countries)
- Enhance the existing framework and the capabilities of global data processing, forecasting, and analysis systems.
- Sustainable data and Information exchange infrastructure to support EWS
- Optimize international efforts on observation, monitoring, and forecasting
- Upscale successful regional initiatives on sharing data and forecasting products

WMO and partners are working on the action plan. Following recent discussions, it is understood that UNESCO is tasked to contribute to Pillar 2 on Observation, monitoring and forecasting together with WMO, UNEP and UNDP. UNESCO's (All Sector approach) position is to contribute to multi-hazards (flood, drought, tsunami, and earthquake). UNESCO can contribute to Innovation EWS (AI, Citizen Science) in Pilot Projects. Several steps are being undertaken to advance the initiative. For instance, WMO is developing a shared workspace for EW4All Pillar 2 group to collect inputs and share information and initial country mapping. IOC has already provided a list of countries where we have project interventions.

Recommendations to TOWS-WG

Acknowledges the gaps in the global coverage of the tsunami early warning system and **recommends** full global coverage be pursued to ensure that all at risk coastal areas are assured of access to tsunami early warnings by 2027. This is a commitment to the UN “Early Warnings for All” initiative.

J11 PLANNING FOR WTAD 2023

Ms Regina Khanbekova (UNDRR), reported that World Tsunami Awareness Day (WTAD) 2022 advocated on reducing tsunami risk globally through increasing access to early warning systems. Through political engagement to drive change, the UN Secretary-General, Antonio Guterres launched the “Early Warnings For All” Action Plan to achieve early warning for all in five years. This will save lives and protect livelihoods. In addition, the UNDRR event in New York on “Early Warning and Early Action Before Every Tsunami” served to build partnerships and leverage data to ensure no one is left behind, and aims to minimize the risks posed by tsunamis and other hazards.

Citizen engagement to build a culture of tsunami and other coastal hazards awareness for all the people at risk took place with the conduction of the *#gettohighground* public-facing campaign, where citizens participated in fun walks of tsunami evacuation routes at local level. The campaign was supported by Member States such as Indonesia, Samoa, Ecuador, Cook Islands, Portugal, and Mauritius. Approximately 4000 people participated in the *#gettohighground* campaign.

For the 2023 campaign, the theme will focus on fighting inequality for a resilient future. It will look to engage with more Member States, Making Cities Resilient (MCR) 2030, advocate decision makers on the importance of EWS coverage using strategic communications, and to continue the strong synergy between partners such as UNESCO/IOC, WMO and the UN System.

TICs, TT-DMP representatives reported on the key activities and achievements of WTAD 2022

Ms Christa von Hillebrandt-Andrade requested that UNDRR also use the hashtag #TsunamiReady as part of its WTAD in support of the Ocean Decade goal of 100% of at-risk communities are ready for and resilient to tsunamis by 2030 through programmes like UNESCO/IOC Tsunami Ready Recognition Programme.

Recommendations to TOWS-WG

Notes the activities undertaken by the respective regions for WTAD 2022, and as part of this, the strong engagement in the #GetToHighGround initiative, and the success achieved through the United Nations Office for Disaster Risk Reduction (UNDRR), and IOC collaboration;

Further notes to build connections with EW4ALL multi-hazard approach to coastal risk and Making Cities Resilient (MCR2030);

Further notes the 2023 WTAD theme will highlight the importance of fighting inequality for a resilient future;

Further notes activities will include continuing the #GetToHighGround initiative and the #TsunamiReady to engage citizens on tsunami awareness. The theme aligns closely with the current focus of the TOWS-WG in the context of the UN Ocean Decade, The Mid-Term Review of the Sendai Framework, and action to accelerate the implementation of the Early Warnings for All (EW4All) initiative to ensure everyone on earth is covered by MHEWS in the next four years, prioritizing the most at-risk communities;

Recommends continued collaboration between the UNESCO/IOC and the UNDRR;

Requests the UNDRR to strengthen collaboration with respective ICGs and corresponding TICs.

J12 TSUNAMI GLOSSARY UPDATE

Ms Laura Kong provided an update on the status of the 2019 Tsunami Glossary. In the last session of the TOWS-WG-XV meeting in 2022, Ms Laura Kong recommended delaying the next update until 2023, due to delays caused by unforeseen events and to enable accommodation of the new Tsunami Ready terminology when it becomes an IOC Programme, as well as terminology related to tsunamis generated by non-seismic and complex sources under development. TOWS-WG agreed to postpone the next update of the Tsunami Glossary to 2023 to facilitate the incorporation of important changes.

In addition, the group again noted the importance of translating the Tsunami Glossary into languages additional to the UN languages, so many more people and authorities at the local level can understand and use the terminology consistently, and the importance of having abbreviated definitions for key terms for use in social media and other abbreviated language communication tools.

The 2023 version of the Tsunami Glossary will contain updates to tsunami maps and tables, information on meteo-tsunami, tsunami generation theory, and tsunami numerical modeling. New material will be included on lamb waves, the UNESCO/IOC Tsunami Ready Recognition Programme, and tsunamis generated by volcanoes.

There was a discussion about the definition of meteo-tsunami, and it was decided the *Ad Hoc* Team on Meteo-tsunamis will provide this for the glossary.

Mr Elizabeth Vanacore raised the issue that the definition of arrival time is currently the arrival of the maximum tsunami wave amplitude and suggested it be revised to be the time of the first maximum or minimum tsunami wave amplitude. It was decided to adopt the definition given in the Tsunami Watch Operations Global Service Definition Document (IOC TS 130, 2016).

Mr Mohhamad Mokhtari asked if tsunami sources such as splay-faulting and landslides could be defined within the glossary. He also mentioned that translation of the glossary into the local language will be important for implementation of the UNESCO/IOC TRRP.

Mr Bill Fry suggested the addition of another term to define the time that the tsunami reaches a threshold value. Mr Bernardo Aliaga replied that the update could be included in a future addition.

Recommendations to TOWS-WG

Express appreciation to the IUGG-JTC Terminology Working Group and ITIC for leading the effort to review the Tsunami Glossary 2019.

Approves the glossary updates and requested the IOC to implement the updates to create the Tsunami Glossary 2023, with support from ITIC.

Requests the IUGG JTC Terminology Working Group and ITIC to undertake a review to advise the next meeting of the TOWS Inter-agency Task Teams on whether the 2023 Tsunami Glossary is sufficient to meet the needs of the scientific community, tsunami stakeholders, and other practitioners, or if separate target audience specific versions are required.

TASK TEAM ON TSUNAMI WATCH OPERATIONS (TT TWO) SEPARATE SESSION #2

(Chaired by Mr Yuji Nishimae)

5. DISCUSSION ON SOPS FOR TSUNAMIS GENERATED BY VOLCANOES AND METEO- TSUNAMIS

Mr Mike Angove facilitated the discussion on Standard Operating Procedures (SOPs) for tsunami generated by volcanoes and meteo-tsunami. He drew reference to a chart that has been compiled on the tsunami lifecycle stages (see below).

Tsunami Lifecycle Stage	Time to Impact: < 15 min	Time to Impact: > 15 min < 30 min	Time to impact: >30 min < 60 min	Time to Impact: > 60 min < 180 min	Time to Impact: > 180 min	Primary Tools
Initial indicators	TAO - 5 min	TAO - 5 min	TAO - 5 min	TAO - 5 min	TAO - 5 min	Seismic/geodetic; Natural Warning
Tsunami (detection) confirmation	NA -	TAO - 10 min	TAO - NLT 15 min	TBI NLT - 30 min	TBI NLT - 60 min	Tsumeters, GNSS where avail
Tsunami Characterization and Forecast	NA -	NA	TBI - NLT 20 min	TBI - NLT 45 min	TBI - NLT 90 min	Seismic (CMT) Tsumeter (SL)
Tsunami Validation	TAO - 30mins	TAO - 45mins	TAO - 60mins	TAO - 75mins	TAO - 120mins	Coastal Gauges
Tsunami Cancellation	TAO - 60mins	TAO - 75mins	TAO-90mins	TAO - 120mins	TAO - 180mins	Coastal gauges; Tsumeters

Table 1: Tsunami lifecycle for seismic events.

This includes thresholds for the initial indicators (earthquake parameters), tsunami (detection) confirmation, tsunami characterization and forecast, tsunami validation, and tsunami cancellation. Mr Mike Angove further noted that instrument deployment must be balanced against cost and need. Mr Bill Fry commented that to provide greater impact, the table could also be linked to exposure and risk.

Ms Elizabeth Vanacore emphasized the importance of low probability, high impacts events. She expressed the merit in engaging with network operators as a useful initial step to also identify the challenges faced in instrument maintenance and deployment. Mr Mike Angove replied that in the ICG context, we can look at regions and then reach out to the providers noting that Member State buy-in is essential.

Mr Mike Angove presented a similar life cycle table for non-seismic events (see below) noting that much of the information will not be made available until later in the cycle. Mr Mike Angove noted that for non-seismic events, the instrumentation of SMART cables is of great value.

Tsunami Lifecycle Stage	Time to Impact: < 15 min	Time to Impact: > 15 min < 30 min	Time to impact: >30 min <60 min	Time to Impact: > 60 min < 180 min	Time to Impact: > 180 min	Primary Tool
Initial alert	n/a	n/a	n/a	Watch	Watch	n/a
Tsunami confirmation	NA -	N/A	N/A	TAO NLT - 60 min	TAOI NLT - 60 min	Tsunamieter
Tsunami Forecast	NA	N/A	N/A	TBI - NLT 90min	TBI - NLT 120 min	Tsunamieter
Tsunami Validation	TAO - 60mins	TAO - 60mins	TAO - 60mins	TAO - 90mins	TAO - 180mins	Coastal gage Tsunamieter
Tsunami Cancellation	TAO - 180mins	TAO - 180mins	TAO-180mins	TAO - 180mins	TAO - 180mins	Tsunamieter

Table 1: Tsunami lifecycle for non-seismic events.

Mr Mohhamad Mokhtari recalled the ongoing discussion on the life cycle of tsunami and the merit in relating this to different scenarios (as illustrated in the two charts).

Mr Francois Schindele noted the value of high-resolution bathymetry data in accurate tsunami forecasts.

There was a discussion about the forecast accuracy required by emergency managers. Ms Elizabeth Vanacore noted that for many emergency managers a first-order approximation may be good enough. Mr Bill Fry commented that the accuracy needs will differ between end users and their applications of the forecast.

Mr Yuji Nishimae noted that for non-seismic events identification of the location, wave amplitude and travel time forecasts may prove difficult. Mr Bill Fry noted that disperse ocean observations of the wavefield can be used for forecasting.

The Task Team agreed to establish a subgroup to provide guidance on the feasibility of developing a risk informed grid.

Mr Yuji Nishimae reported on SOPs for tsunamis developed by JMA. JMA's SOPs for tsunamis generated by volcanoes have historically been on a case-by-case basis. However, following the HTHH event JMA developed more systemised procedures and formed two expert study groups.

Mr Yuji Nishimae provided an example of a barometric pressure time-series and corresponding sea level fluctuation in Japan, noting the barometric pressure waves were also observed by the Himawari meteorological satellite. Sea level changes of more than 1 m were observed along the Pacific coast of Japan. Quantitative forecasting of the heigh of sea level change along the Japanese coast is currently difficult, so JMA has used the tsunami warning/advisory system based on sea levels and barometric pressure to call for caution. Mr Yuji Nishimae also shared the procedures for observations of a tsunami inferred from barometric pressure change caused by large-scale volcanic eruptions with both short and a long lead time. JMA has decided to carefully disseminate information and provide explanations for large-scale volcanic eruptions occurring overseas to prepare for tsunamis generated by them. They will issue tsunami warnings related to tsunamis generated by volcanoes based on sea level observations. JMA will conduct public awareness activities, including for rare phenomena that occur infrequently, during normal [quiet] times to connect to disaster mitigation measures.

Mr Francois Schindele summarized the suggestions of the *ad hoc* team, as reported in the joint morning session, including the identification of several methods to forecast for tsunamis generated by volcanoes. Mrr Bill Fry suggested forecasts could be issued based on Centroid

Moment Tensor (CMT) solutions, indicative of inflation or deflation, scaled by sea level measurements. Ms Elizabeth Vanacore suggested that the volcanic observatories could be the first point of information followed by sea level observations.

Mr Mike Angove recalled the three recommendations from the *ad hoc* team on meteo-tsunamis. He questioned if meteo-tsunami are best forecast by meteorology organisations, Tsunami Service Providers, or through a collaboration between the organisations.

The Task Team discussed how advanced forecasting could benefit from the inputs of multiple organisations. Mr Yutaro Taira expressed that in Japan meteo-tsunami are being handle by JMA in the storm surge warning format. Mr Mike Angove noted that this is the case in most countries. However, such forecasts could be improved through calibration using sea-level data in collaboration with the tsunami warning community.

6. DISCUSS OUTCOMES OF THE JOINT MEETING WITH TT DMP

The group reviewed the outcomes of the joint meeting with the Task Team on Disaster Management Preparedness (TT DMP). Emphasis was placed on refining the recommendations from the *ad hoc* teams on tsunami generated by volcanoes and meteo-tsunami.

7. OTHER BUSINESS

No other business was tabled for discussion.

8. UPDATE PRODUCTS FOR MARITIME COMMUNITY

Mr Pattabhi Rama Rao Eluri briefed the group on updates to products for the maritime community. Such products have been developed in consultation with IHO and IOC. The subgroup comprised Mr Yuelong Miao, Rear-Adm Patricio Carrasco, Cmdr Carlos Zuniga and Mr Chip McCreery. TSP Australia has developed a TSP bulletin for NAVAREA coordinators that is ready for implementation by the Indian Ocean TSPs. The bulletins have been added to the IOTWMS SSD. The next step is to inform the NAVAREA coordinators of the commencement of the service through the UNESCO/IOC Secretariat. The contact details for distribution need to be obtained.

Mr Chip McCreery enquired about threshold reporting parametres and the communication mode(s) for providing notification to NAVAREA coordinators. Mr Pattabhi Eluri noted that in the Indian Ocean region, the messages would be distributed when the tsunami is predicted to be at least 0.3 m somewhere on a coast in the region. The notifications will be distributed through email and WWS dissemination modes.

Mr Rick Bailey asked when other basins will be able to implement these products. PTWC TSP in the Pacific replied that they could implement within the next year. Ms Elizabeth Vanacore suggested the products could be tested during upcoming exercises such as CARIBEWave. JMA is currently providing tsunami information to NAVAREA XI coordinator. There was a discussion as to whether the distribution of these NAVAREA maritime community products should be the responsibility of each NTWC and not the TSPs. Mr Rick Bailey reminded the group that these bulletins are for alerting shipping before they enter an impacted area, so they can safely change direction at sea, sometimes at the start of their journey on the other side of the ocean basin. Accordingly, they are for TSPs to distribute to the broader region via NAVAREA coordinators.

Actions for ICGs

TSPs from each basin to issue test the tsunami maritime safety products within next 12 months and implement in 24 months.

9. UPDATES TO AREA OF COVERAGE AND ESZ MAPS OF THE ICGS

Mr Yuji Nishimae reported there have been no changes to the Areas of Coverage and Earthquake Source Zone maps since the 2022 TOWS-WG meeting. In the ICG/PTWS XXIX session, the ICG/PTWS decided to expand the Earthquake Source Zone to include the southernmost Atlantic due to the associated tsunami hazard to the Pacific. The proposal was discussed at TOWS-WG XV and a recommendation taken to the 55th UNESCO/IOC Executive Council in June 2022. However, Argentina expressed it didn't receive the proposal at the required submission time before the Executive Council meeting to fully assess the proposal and requested specified coordinates for the area be provided before a decision could be made at a later meeting of the UNESCO/IOC Assembly.

10. UPDATE TO THE GLOBAL SERVICES DEFINITION DOCUMENT

Mr Chip McCreery introduced this topic and noted that the Global Services Definition Document (GSDD) was last published in 2016. In 2022, Mr Francois Schindele provided the currently reviewed and updated document and summarized the changes requested by TOWS_WG XV. Mr Chip McCreery was nominated to take over the task of updating the document.

During the 2022 TT TWO meeting, Mr Yuji Nishimae recalled that HTHH eruption was 1-month prior. Consequently, the Task Team decided that outcomes from this event should be included in the GSDD. Mr Wilfried Strauch (CARIBE-EWS) noted that the IOC timeseries sea-level data had to be down-sampled to one-minute and further the time-series data should be displayed as a continuous line.

The following GSDD recommendations from the 2022 TT TWO meeting were discussed:

- Recommends the GSDD be updated with suggested changes by TTTWO, including warning for non-seismic generated tsunamis.
- Recommends ICGs monitor sea level data exchanges and encourage one (1) sample/second data transmission
- Requests IOC Sea Level Facility display data as continuous line representing the waveform (i.e., not as dots representing each data point) and include data transmitted at 1 sample/second data (currently not included).

The Task Team then considered new actions and recommendations related to the GSDD:

Recommendations to TOWS-WG

1. Interim procedures for a repeat tsunamigenic eruption of HTHH Volcano have now been finalized by the ICG/PTWS and can be described and referenced in the GSDD as an example for handling this type of event.
2. The *Ad Hoc* Team on Tsunamis Generated by Volcanos (TGV) report once completed can be described and referenced in the GSDD.
3. Mr Chip McCreery and Mr Francois Schindele finalize the updated GSDD within the next month and send it to the IOC for publication, noting the last published version was in 2016.

Actions TT TWO and ICGs

1. Implement threat levels described in Global Services Definition Document in NEAMTWS to help harmonise global tsunami warning products
2. Develop a recommended basic tsunami warning product/template for use in eg radio
3. The definition of near-field needs to be reviewed
4. Update the GSDD within month for current services
5. TSPs to not list countries with threat less than minimum threshold, subject to review and approval by each ICG as relevant

11. DEVELOP TT TWO WORK PLAN

The Task Team reviewed the new recommendations and actions, especially with regards to those to be presented to the TOWS-WG XV meeting. These and a status of all recommendations and actions related to the TT TWO can be found in Appendix 4.

12. MEETING CLOSE

Mr Yuji Nishimae thanked the online and in-person members, invited experts, and observers for their participation and thanked the UNESCO/IOC Secretariat for their support. Mr Yuji Nishimae expressed appreciation for the active discussion throughout the meeting. He commented he was happy to see everyone again and for the in-person participation, following the previous two online meetings of the Task Team [2021, 2022] due to the Covid pandemic. The group requested the Task Team meet more often through online meetings and asked the Secretariat to help organise this.

Action UNESCO/IOC secretariat

TT TWO to meet more often online (during the intersessional period)

Mr Yuji Nishimae declared the meeting closed at 5:30pm Paris time on 28 February 2023.

Appendix 1: Agenda

Day 1: Monday, February 27, 2023, 0915 - 1800 Paris time
(UTC+1)

Item	Paris time (UTC+1)	Topic	Lead
JOINT TT TWO and TT DMP SESSION #1			
J1	0915 - 0930	Welcome & Introductions	Head TSU TT Chairs
J2	0930 - 1030	Wave exercises and significant tsunami events in each ICG (share outcomes, lessons learned, and coordination on exercise surveys)	Joint presentations by TT reps each ICG Special update from Prof Yalciner (Türkiye EW/Tsu event)
J3	1030 - 1100	Report from Ad Hoc Team Tsunamis Generated by Volcanoes	Francois Schindele, Raphael Paris, and Laura Kong
	1100 - 1130	Break	
J4	1130 - 1200	Report from Ad Hoc Team Meteo-tsunamis	Mike Angove
J5	1200 - 1300	Planning for Ocean Decade <ul style="list-style-type: none"> • Ocean Decade Tsunami Programme Endorsement • Draft of the 10—year research, development and implementation plan for the ODTP • Progress report on the Tsunami Ready Coalition • Plans for the 2nd IOC UNESCO Science Symposium on advances in tsunami warning to enhance community responses 	Secretariat Chairs Srinivas Kumar
	1300 - 1400	Lunch	
SEPARATE TT TWO SESSION #1			
1	1400 - 1410	Session organization Logistics, participants, agenda	Yuji Nishimae Secretariat
2	1410 - 1430	Review Action Items	Secretariat
3	1430 - 1530	Tsunami Watch Operations status and plans in all ICGs, (15 mins ea ICG max)	All
	1530 - 1600	Break	
4	1600 - 1700	Planning for the Ocean Decade: Meeting objective of more timely and accurate tsunami warnings	Yuji Nishimae Secretariat
5	1700 -1800	Discussion on SOPs for Tsunamis Generated by Volcanoes and Meteo-tsunamis	Yuji Nishimae Secretariat Francois Schindele Raphael Paris Mike Angove
	1800	End of Day 1	

**Day 2: Tuesday, February 28, 2023, 0900 – 1700 Paris time
(UTC+1)**

Item	Paris Time (UTC+1)	Topic	Lead
JOINT TT TWO and TT DMP SESSION #2			
J6	0900 - 1000	Local source SOPs - Best practice for warning & response - Training - Visual notifications for tsunami in Coastal areas	Chairs All Yuji Nishimae
J7	1000 - 1015	Global NTWC Competency Framework	Laura Kong
J8	1015 – 1030	IUGG update	Maria Ana/ Laura Kong
J9	1030 - 1100	Emergency Warning Service in Galileo	DG ECHO
	1100 - 1130	<i>Break</i>	
J10	1130 - 1200	UN Sec General “Early warning for all”	WMO/UNDRR Bernardo Aliaga Denis Chang Seng
J11	1200 - 1230	Planning for WTAD 2023	TICs, Secretariat UNDRR
J12	1230 - 1300	Tsunami Glossary update	Laura Kong
	1300 - 1400	<i>Lunch</i>	
SEPARATE TT TWO SESSION #2			
6	1400 - 1430	Discuss outcomes of the joint meeting with TT DMP	All
7	1430 - 1500	Other Business	Yuji Nishimae Secretariat
8	1500 - 1515	Update Products for Maritime Community	Pattabhi
9	1515 - 1530	Updates to Area of Coverage and ESZ Maps of the ICGs	Yuji Nishimae Secretariat
	1530 - 1600	<i>Break</i>	
10	1600 - 1615	Update to the Global Services Definition Document	Chip McCreery Secretariat
11	1615 - 1700	Develop TT TWO Work Plan	Yuji Nishimae Secretariat, All
	1700	<i>Meeting Close</i>	Secretariat, Yuji Nishimae

Appendix 2: List of Participants

Chair

Mr. Yuji NISHIMAE
Senior Scientific Officer
Japan Meteorological Agency, Tokyo
3-6-9 Toranomon, Minato-ku
Tokyo, 105-8431
Japan
Email: nishimae@met.kishou.go.jp

Mr. Alessio PIATANESI
(online)
Istituto Nazionale di Geofisica e Vulcanologia
Roma
Via di Vigna Murata, 605
00143 Roma
Italy
Email: alessio.piatanesi@ingv.it

Members

Mr. Pattabhi Rama Rao ELURI
(online)
Scientist-G & Group Director
Ocean Observations, Modelling and Data
Assimilation (OMDA)
Indian National Centre for Ocean Information
Services
"Ocean Valley", Pragathi Nagar (BO), Nizampet
(SO)
Hyderabad 500 090
Telangana
India
Email: pattabhi@incois.gov.in

Ms. Elizabeth VANACORE
Red Sismica de Puerto Rico
Universidad de Puerto Rico
Mayaguez, Puerto Rico Call Box 9000
United States
Email: elizabeth.vanacore@upr.edu

Invited Experts

Mr. Michael ANGOVE
Chair *Ad Hoc* Team on Meteo-tsunamis
Director, NOAA Tsunami Program
National Weather Service/National Oceanic
Atmospheric Administration
1325 East-West Highway
Silver Spring , MD 20910
United States
Email: michael.angove@noaa.gov

Dr. Hélène HÉBERT
CENALT
Commissariat à l'Énergie Atomique et aux
Énergies Alternatives
Bruyères-le-Châtel
91297 Arpajon
France
Email: helene.hebert@cea.fr

Dr. Raphaël PARIS
Member, *Ad Hoc* Team on Tsunamis Generated
by Volcanoes
Observatoire de Physique du Globe de
Clermont-Ferrand
Université Clermont-Auvergne
Laboratoire Magmas et Volcans
Campus Universitaire des Cézeaux
63178 Aubiere,
France
Email: Raphael.Paris@uca.fr

Dr. Charles (Chip) McCREERY
Director PTWC
Pacific Tsunami Warning Center
1845 Wasp Boulevard, Building 176
Honolulu, HI 96818
United States
Email: charles.mccreery@noaa.gov

Dr. François SCHINDELÉ
Chair, *Ad Hoc* Team on Tsunamis Generated by
Volcanoes
International expert
Commissariat à l'Énergie Atomique et aux
Énergies Alternatives
Bruyères-le-Châtel
91297 Arpajon,
France
Email: francois.schindele@cea.fr

Dr. Mohammad MOKHTARI (online)
Director of National Center for Earthquake
Prediction
Seismotectonic
International Institute of Seismology and
Earthquake Engineering
Tehran,
P.O. Box: 19537-14453
No. 21, Arghavan St., North Devajee, Farmanieh
Iran
Email: m7mokhtari@gmail.com

Dr. Ahmet C. YALCINER
(online)
Chairman, METU Dept. of Civil Engineering Dir,
Ocean Engineering Research Center
Inonu Bulvari 06531
06800 Ankara
Turkiye
Email: yalciner@metu.edu.tr

Observers

Dr. Bill FRY
Scientist, Tectonophysics
GNS Science
P.O. Box 30-368
1 Fairway Drive
Avalon 5010
New Zealand
Email: b.fry@gns.cri.nz

Mr. Yutaro TAIRA
Officer
Seismological and Volcanological Department
Japan Meteorological Agency, Tokyo
3-6-9 Toranomon, Minato-ku
Tokyo, 105-8431,
Japan
Email: taira@met.kishou.go.jp

Cmdr. Carlos ZUNIGA
Deputy Director
Servicio Hidrográfico y Oceanográfico de la
Armada
Errazuriz 254
Playa Ancha 324
Valparaíso,
Chile
Email: czuniga@shoa.cl

Secretariat

Mr. Bernardo ALIAGA ROSSEL
Head, IOC Tsunami Resilience Section
Intergovernmental Oceanographic Commission
of UNESCO
7, place de Fontenoy
75732 Paris cedex 07
France
Tel: +33 1 45 68 03 17
Email: b.aliaga@unesco.org

Mr. Rick BAILEY
Head of UNESCO/IOC Indian Ocean Tsunami
Warning & Mitigation System
Secretariat,
UNESCO/IOC Perth Office
Level 3, 1 Ord Street / PO Box 1370
West Perth, Western Australia 6872
Australia
Email: r.bailey@unesco.org

Ms. Nora GALE
UNESCO/IOC Indian Ocean Tsunami Warning
& Mitigation System
Secretariat,
UNESCO/IOC Perth Office
WA 6872 PO Box 1370, West Perth
Australia
Email: n.gale@unesco.org

Mr. Angelos HAIDAR
IOC Tsunami Resilience Section
7, place de Fontenoy
75732 Paris cedex 07
France
Email: a.haidar@unesco.org

Ms. Celine TIFFAY
IOC Tsunami Resilience Section
7, place de Fontenoy
75732 Paris cedex 07
France
Email: c.tiffay@unesco.org

Appendix 3: List of acronyms

ASEAN	Association of Southeast Asian Nations
BMKG	Indonesian Meteorology, Climatology and Geophysical Agency
CDEMA	Caribbean Disaster Emergency Management Agency
CEPREDENAC	Coordination Centre for the Prevention of Natural Disasters in Central America
CPPS	Permanent Commission of the South-East Pacific
CATAC	Central America Tsunami Advisory Centre
CTBTO	Comprehensive Nuclear-Test-Ban Treaty Organization
CTIC	Caribbean Tsunami Information Centre
EMIZA	État-major Interministériel de la Zone Antilles
GOOS	UNESCO/IOC Global Ocean Observing System
ICG	Intergovernmental Coordination Group
ICG/CARIBE-EWS	Intergovernmental Coordination Group for the Tsunami and Other Coastal Hazards Warning System for the Caribbean and Adjacent Regions
ICG/IOTWMS	Intergovernmental Coordination Group for the Indian Ocean Tsunami Warning and Mitigation System
ICG/NEAMTWS	Intergovernmental Coordination Group for the Tsunami Early Warning and Mitigation System in the North-Eastern Atlantic, the Mediterranean and connected seas
ICG/PTWS	Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System
ICSU	International Council of Science
IGCP	UNESCO International Geoscience Programme
IHO	International Hydrographic Organization
IMO	International Maritime Organisation
INCOIS	Indian National Centre for Ocean Information Services
IOC	Intergovernmental Oceanographic Commission (UNESCO)
IOCAFRICA	Intergovernmental Oceanographic Sub-Commission for Africa and Adjacent Island States
IOCARIBE	IOC Sub-Commission for the Caribbean and Adjacent Regions
IOTIC	Indian Ocean Tsunami Information Centre
ITIC	International Tsunami Information Center
ITU	International Telecommunication Union
IUGG	International Union of Geodesy and Geophysics
JATWC	Joint Australian Tsunami Warning Centre
JMA	Japan Meteorological Agency
NEAMTIC	

	Tsunami Information Centre for the North-eastern Atlantic, the Mediterranean and Connected Seas
NGO	non-governmental organisation
NOAA	US National Oceanic and atmospheric Administration
NTWC	National Tsunami Warning Centre
NTRB	National Tsunami Ready Board
NWPTAC	North-West Pacific Tsunami Advisory Centre
OTGA	Ocean Teacher Global Academy
PTWC	Pacific Tsunami Warning Centre
RTRB	Regional Tsunami Ready Board
SCSTAC	South China Sea Tsunami Advisory Centre
SFDRR	Sendai Framework for Disaster Risk Reduction
SPC	Secretariat of the Pacific Community
SPREP	Secretariat of the Pacific Regional Environment Programme
TIC	Tsunami Information Centres
TNC	Tsunami National Contact
TOWS-WG	Working Group on Tsunamis and Other Hazards Related to Sea-Level Warning and Mitigation Systems
TRLC	Tsunami Ready Local Committee
TSP	Tsunami Service Provider
TT DMP	Task Team on Disaster Management and Preparedness
TT TWO	Task Team on Tsunami Watch Operations
TWFP	Tsunami Warning Focal Point
UN	United Nations
UNDP	United Nations Development Programme
UNDRR	United Nations Office for Disaster Risk Reduction
UNESCAP	UN Economic and Social Commission for Asia and the Pacific
UNESCO	United Nations Educational, Scientific and Cultural Organization
WESTPAC	IOC Sub-Commission for the Western Pacific
WMO	World Meteorological Organization

Appendix 4: Summary of TT TWO Recommendations and Actions

Actions for TT TWO Members and Invited Experts:

1. Implement threat levels described in Global Services Definition Document in NEAMTWS to help harmonise global tsunami warning products (Alessio and Helene)
2. Develop a global CAP template for all TSPs, not for public exchange, but to facilitate exchange of bulletins between basin TSPs and their NTWCs, and between TSPs of different basins (TBC by Secretariat)
3. Routinely monitor and report on status of sea level and seismic networks (like CARIBE-EWS currently does) to better understand data availability and work with operators to resolve instrument issues, in order to help improve present tsunami forecasts and help identify needs and monitor implementation of enhanced data systems to meet UN Ocean Decade goals (Secretariat lead)
4. Develop a recommended basic tsunami warning product/template for use in eg radio (Liz, Derya)
5. Monitor and update TT TWO on US and NZ efforts to explore specific design of risk-based grid integrated monitoring network in support of UN Decade Objectives and provide, recognizing the role of the TT TWO in helping to enhance the monitoring and warning aspects of the Global Tsunami Warning and Mitigation System (Mike Angove and Bill Fry)
6. TSPs from each basin to issue test the tsunami maritime safety products within next 12 months and implement in 24 months. (Pattabhi, Chip, Hebert, Nishimae)
7. The definition of near-field needs to be reviewed (Liz, Alessio, Dakui, Mokhtari)
8. Update the GSDD within month for current services (e.g. HTHH) (Chip and Francois)
9. TSPs to not list countries with threat less than minimum threshold, subject to review and approval by each ICG as relevant (Pattabhi, Chip, Hebert, Nishimae)
10. TT TWO to meet more often online) (during the intersessional period (Secretariat, Chair).

Recommendations to TOWS-WG:

1. TOWS-WG, given the critical need to resolve and understand the near-field threat to high at-risk communities where a tsunami may arrive in 5-30 minutes, reiterate the urgent need for all Member States to sample sea level data at one second intervals and transmit this in real-time.
2. TOWS-WG request IOC Assembly at its next session to reconsider the request to extend the Pacific Earthquake Observing Zone to include the South Atlantic, given the ongoing threat in this region to generate tsunamis that also impact the Pacific and Indian Oceans (eg South Sandwich Islands event, 12 August 2021)

Recommendations to TOWS-WG TT DMP:

1. TT DMP to further investigate requirements and methods to warn people with disabilities and underserved communities, especially given WTAD objective 2023 “fighting inequality for a resilient future”.
2. TT DMP take action now to upgrade NTWC competency training framework from a Pacific to global approach and include competency training for Tsunami Warning Focal Points (TWFPs) in the framework given their key role in tsunami warnings.

Recommendation to IOC Sea Level Monitoring Facility:

UNESCO/IOC Sea Level Monitoring Facility increase the tabled sea level data at one second intervals (where available) and display sea level time series as a continuous line.

Specific Ad Hoc Team TGV Recommendations

Recommendations to Member States:

Monitoring and Warning:

1. As a first step, organisation(s) should be designated for monitoring and warning of Tsunamis Generated by Volcanoes (TGV) . The second and third steps are to install monitoring instrumentation and develop Standard Operating Procedures (SOPs) to handle volcanic tsunamis.
2. The TGV monitoring and warning system should be implemented by, or in cooperation with the National Tsunami Warning Centre (NTWC) and regional Tsunami Service Provider and national and regional Volcano Service Providers , where such exist.
3. All volcanoes mentioned in the TGV report should be monitored and have processes in place to warn for tsunamis. Should other, potentially tsunamigenic volcanoes begin erupting, these should also be monitored and included within the tsunami warning process.
4. Detect/warn geophysical (seismology, GNSS, tiltmeter, barometric and sea level data streams need to be available to the designated tsunami monitoring/warning agency (and possibly also to the volcano monitoring agency)
5. As well as monitoring systems for volcano activity and potential far-field propagation of sea level signal, a sea level gauges network with real-time continuous data transmission should be deployed close to each identified volcano to verify risk and then ongoing monitoring and warning. One second sampling with 1 cm accuracy (< 1 mm sampling) is recommended sampling is recommended for recording and automatic detection. Data transmission through radio or microwave links, fiber optic, or dedicated telephone lines, or other modes should be implemented to ensure the data is transmitted and received and widely shared with international community in a timely manner.
6. Methods to also specifically alert persons in remote areas (such as scientific teams in the field, or recreational hikers) should be considered.
7. TGV SOPs for tsunami warning should be linked with existing Volcano Alert Activity scales.

Risk Assessment and Preparedness:

8. TGV hazard and risk assessment should be undertaken to determine vulnerable areas.
9. For TGV, multi-stakeholder meetings should be convened that included science agencies, volcano and tsunami warning operations centres, and disaster management agencies. For each identified potential source, worst-case and credible scenario planning discussions should start as soon as possible.
10. During a period of heightened TGV hazard, consider closing access to vulnerable areas. When eruption is imminent and then tsunami hazard is high, consider evacuating populations from vulnerable locations.
11. Specific TGV signage and evacuation routes should be implemented in all areas that may be impacted by tsunamis generated by volcanoes.
12. TGV public awareness campaigns should be conducted regularly – the type and frequency of awareness activities may be different for the local population compared to transient populations such as tourists.

Recommendations to UNESCO/IOC Secretariat:

IOC Secretariat to help inform Member States widely on the potential tsunami hazard from volcanoes:

1. Publish the TGV report as an UNESCO/IOC publication in 2023
2. Provide the TGV Report, including the List of Tsunamigenic Volcanoes to Volcano Observatories
3. Provide the TGV Report, including the List of Tsunamigenic Volcanoes to UNESCO/IOC Member States

Recommendation to TOWS-WG:

1. TGV warning notification systems should be considered and coordinated as part of the UNESCO/IOC Global Tsunami Warning and Mitigation System, and also when possible be part of a Multi-Hazard Early Warning System (MHEWS).
2. TOWS-WGs recommend ICGs examine TGVs in region of responsibility and review TGV hazard monitoring and warning requirements, including costs of deploying and maintaining such systems.
3. TOWS-WG recommend, where identified TGVs may impact multiple Member States, Tsunami Service Providers (TSPs) for the relevant ocean basin tsunami warning and mitigation systems consider if they need to be involved in monitoring and provision of threat advice.
4. UNESCO/IOC Ad hoc Team on TGV should continue and finalize the TGV Report by mid-2023.

Specific Ad Hoc Team Meteotsunami Recommendations to TOWS-WG:

Recommendation to TOWS-WG:

1. TOWS-WG initiate a comprehensive dialogue between the IOC and WMO is necessary to ensure full exchange of information in support of a robust international alerting system for meteo-tsunamis is achieved. It is the ad-hoc Meteotsunami team's recommendation that this report be used as a starting point of those discussions.
2. TOWS-WG to establish a mechanism for input from national and regional met services offices on data needs for meteotsunami monitoring and alerting as the GTWS considers a new generation of tsunami detection and measurement networks
3. TOWS-WG establish Framework for a Unified Meteotsunami Global System. Combining the direct tsunami detection capability of the GTWS with the NWP-based algorithms tuned to meteotsunami prediction could deliver significant advances in global capability at minimal cost.
4. TOWS-WG establish a task team made up of experts from both GTWS and NWP systems be formed with the expressed intent of outlining the potential construction of an integrated meteo-tsunami prediction system.
5. *Ad-hoc* Team on Meteotsunami continue through 2023, including WMO representatives for the purpose of recommending a global alerting strategy to include specific roles of met services and TSP/NTWCs.
6. TOWS-WG establish an *ad-hoc* team to conduct a global meteo-tsunami hazard assessment to provide all MS advice on the meteotsunami hazard and risks on their coasts.

ANNEX V

LIST OF PARTICIPANTS

Chairperson

Alexander FROLOV
Advisor to the President
Advisor
Advisor to the President
National Research Centre "Kurchatov Institute"
1, Akademika Kurchatova pl.,
Moscow
123182
Russia
Tel: +79258058001

1845 Wasp Boulevard, Building 176
Honolulu, HI 96818
United States
Tel: +1 808 725 6300
Email: charles.mccreery@noaa.gov

Harkunti RAHAYU
Institut Teknologi Bandung (Bandung Institute
of Technology)
Campus
Jl. Ganesha no. 10
Bandung, West Java 40132
Indonesia

Chairpersons of the four ICG/TWSs

Maria Ana BAPTISTA (online)
Professor
1700 Lisboa
Portugal
Tel: +351217500809
Email: mavbaptista@gmail.com

Silvia CHACON BARRANTES
Professor and Researcher
Sistema Nacional de Monitoreo de Tsunamis
(SINAMOT)
Universidad Nacional, Campus Omar Dengo
Avenida 1, Calle 9. Apartado Postal: 86-3000
Heredia
Costa Rica
Tel: +506 83096690

Dwikorita KARNAWATI (online)
Director General of BMKG
P.O. Box 3540 Jkt.
Jl. Angkasa I No.2 Kemayoran Jakarta Pusat
DKI Jakarta 10720
Indonesia
Email: dwiko@bmkg.go.id

Yuji NISHIMAE
Senior Scientific Officer
Japan Meteorological Agency, Tokyo
3-6-9 Toranomom, Minato-ku
Tokyo,
105-8431
Japan
Tel: +81 (3) 6758 3900

Chairpersons of Inter-ICG Task Teams

Mr Charles (Chip) MCCREERY
Director PTWC
Pacific Tsunami Warning Center

Member of TOWS-WG

Michael ANGOVE
Director, NOAA Tsunami Program
National Weather Service/National Oceanic
Atmospheric Administration
1325 East-West Highway
Silver Spring, MD 20910
United States
Tel: 301-427-9375

Rosalind COOK
United Nations Office for Disaster Risk
Reduction
UN House
Rue Montoyer 14
1000 Brussel
Belgium

Pattabhi Rama Rao ELURI (online)
Scientist-G & Group Director
Ocean Observations, Modelling and Data
Assimilation (OMDA)
Indian National Centre for Ocean Information
Services
"Ocean Valley", Pragathi Nagar (BO),
Nizampet (SO)
Hyderabad 500 090, Telangana
India
Tel: +91-40-23895008

Sarah GRIMES (online)
Head, Marine Services Division; Coordinator,
WMO Ocean Activities
Marine Services
World Meteorological Organization
Case Postale 2300
7bis, avenue de la Paix
CH-1211 Geneva
Switzerland

Tel: +41 22 730 81 11

Hassan HADDOUCH (online)
WIS2 Manager
Infrastructure
World Meteorological Organization
Case Postale 2300
7bis, avenue de la Paix
CH-1211 Geneva
Switzerland

Cyrille HONORÉ (online)
World Meteorological Organization, Weather
and Disaster Risk Reduction Services
Department
7bis, avenue de la Paix
Case postale 2300
1211 Geneva
Switzerland

Yuelong MIAO (online)
Manager for Tsunami and Storm Surge
Environmental Prediction Services
Bureau of Meteorology, Melbourne
700 Collins Street, Docklands
GPO Box 1289
Melbourne VIC 3001
Australia
Tel: +61 3 9669 4110

Peter PISSIERSENS (online)
Head, IOC Project Office for IODE, Oostende,
Belgium and IOC capacity development
coordinator
UNESCO / IOC Project Office for IODE
InnovOcean Campus
Jacobsenstraat 1
8400 Oostende
Belgium
Tel: +32 59340158

Vasily TITOV (online)
Lead Scientist
NOAA Center for Tsunami Research - Pacific
Marine Environmental Laboratory
7600 Sand Point Way NE, Bldg 3
Seattle, Washington WA 98115
United States
Tel: +1 (206) 526 4536

Carlos ZUNIGA
Deputy Director
Servicio Hidrográfico y Oceanográfico de la
Armada
Errazuriz 254
Playa Ancha 324
Valparaíso
Chile
Tel: 322266540

Observer

Suci ANUGRAH
BADAN METEOROLOGI, KLIMATOLOGI,
DAN GEOFISIKA
P.O. Box 3540 Jkt.
Jl. Angkasa I No.2 Kemayoran Jakarta Pusat
DKI Jakarta
10720
Indonesia

Dr. KARYONO
BADAN METEOROLOGI, KLIMATOLOGI,
DAN GEOFISIKA
P.O. Box 3540 Jkt.
Jl. Angkasa I No.2 Kemayoran Jakarta Pusat
DKI Jakarta
10720
Indonesia

Secretariat

Bernardo ALIAGA ROSSEL
Programme Specialist
Intergovernmental Oceanographic
Commission of UNESCO
7, place de Fontenoy
75732 Paris cedex 07
France
Tel: +33 1 45 68 03 17

Rick BAILEY
Head of Secretariat, UNESCO/IOC Indian
Ocean Tsunami Warning & Mitigation System
ICG/IOTWMS Secretariat
UNESCO IOC Perth Regional Programme
Office
Level 3, 1 Ord Street / PO Box 1370
West Perth, Western Australia 6872
Australia
Tel: +61 408027594

Jamel Eddine BEN ABDALLAH
Tsunami Unit
Intergovernmental Oceanographic
Commission of UNESCO
7, Place de Fontenoy
75007 Paris
France
Tel: +33145681571

Alison BROME
Programme Officer for Coastal Hazards,
Tsunami Unit, Intergovernmental
Oceanographic Commission of UNESCO
Tsunami Information Centre
Caribbean Tsunami Information Centre
C/O Coastal Zone Management Unit
8th Floor Warrens Tower II, Warrens, St
Michael

Bridgetown, BB12001
Barbados
Tel: +246 535-5700/5703

Denis CHANG SENG
Programme Specialist (Ocean Observation &
Services Section /Tsunami Unit)
Intergovernmental Oceanographic
Commission of UNESCO
7, place de Fontenoy
75732 Paris cedex 07
France
Tel: +33 1 45 68 09 51

Nora GALE
ICG/IOTWMS Secretariat
IOC/UNESCO Perth Regional Programme
Office
WA 6872 PO Box 1370, West Perth
Australia

Angelos HAIDAR
Programme Assistant
Tsunami
Intergovernmental Oceanographic
Commission of UNESCO
7, place de Fontenoy
75732 Paris cedex 07
France
Tel: +33633011017

Ardito M. KODIJAT
Head of the Indian Ocean Tsunami Information
Centre
UNESCO Office Jakarta
Jl. Galuh II no 5
Kebayoran Baru
Jakarta Selatan
DKI 12110
Indonesia
Tel: +62-21-7399818 Ext 878

Celine TIFFAY
Tsunami Unit
Intergovernmental Oceanographic
Commission of UNESCO
7, place de Fontenoy
75732 Paris cedex 07
France

Derya VENNIN
Assoc. Project Officer at UNESCO/IOC
Intergovernmental Oceanographic
Commission of UNESCO
7, place de Fontenoy
75732 Paris cedex 07
France
Tel: +331456 81874

ANNEX VI

LIST OF ACRONYMS

AGU	American Geophysical Union
BMKG	Indonesian Agency for Meteorological, Climatological and Geophysics
CAP	Common Alert Protocol
CATAC	Central America Tsunami Advisory Center
CARIBE-EWS	Tsunami and Other Coastal Hazards Warning System for the Caribbean and Adjacent Regions
CARIBE WAVE	Caribbean Wave Exercise
CENALT	CENtre d'Alerte aux Tsunamis, France
CPPS	Permanent Commission for the Southeast Pacific
DART	Deep-ocean Assessment and Reporting of Tsunamis
DCC-CR	Decade Collaborative Centre for Coastal Resilience
DG-ECHO	Directorate-General for European Civil Protection and Humanitarian Aid Operations (of the European Commission)
DIMAR	Dirección General Marítima (of Colombia)
EGU	European Geophysical Union
ESZ	Earthquake Source Zone
EW4ALL	EarlyWarningforAll Initiative
GOOS	Global Ocean Observing System (IOC)
GTS	Global Telecommunication System (WMO)
HTHH	Hunga Tonga - Hunga Ha'apai
IASPEI	International Association of Seismology and Physics of the Earth's Interior
IAPSO	International Association for the Physical Sciences of the Oceans
IAVCEI	International Association of Volcanology and Chemistry of the Earth's Interior
ICG	Intergovernmental Coordination Group
ICG/CARIBE-EWS	Intergovernmental Coordination Group for the Tsunami and Other Coastal Hazards Warning System for the Caribbean and Adjacent Regions
ICG/IOTWMS	Intergovernmental Coordination Group for the Indian Ocean Tsunami Warning and Mitigation System
ICG/NEAMTWS	Intergovernmental Coordination Group for the Tsunami Early Warning and Mitigation System in the North-eastern Atlantic, the Mediterranean and Connected Seas
ICG/PTWS	Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System
IFRC	International Federation of Red Cross and Red Crescent Societies
IHO	International Hydrological Organization
INCOIS	Indian National Centre for Ocean Information Services
INFCOM	WMO Infrastructure Commission
INGV	Istituto Nazionale di Geofisica e Vulcanologia (Italy)

INOCAR	Instituto Oceanografico de la Armada (of Ecuador)
IOC	Intergovernmental Oceanographic Commission
IODE	International Oceanographic Data and Information Exchange
IOTIC	Indian Ocean Tsunami Information Centre
IOTWMS	Indian Ocean Tsunami Warning and Mitigation System
IOWave	Indian Ocean Wave Exercise
ITU	International Telecommunications Organization
IUGG	International Union of Geodesy and Geophysics
JATWC	Joint Australian Tsunami Warning Centre
JCB	WMO-IOC Joint Collaborative Board
JMA	Japanese Meteorological Agency
JRC	Joint Research Centre
KPI	Key Performance Indicators
LDCs	least developed countries
MHEWS	Multi-Hazard Early Warning Systems
MQTT	Message Queuing Telemetry Transport
MoU	Memorandum of Understanding
METAREA	METEorological AREA (geographical for marine meteorological information)
NAVAREA	Navigational Area (within the World Wide Navigational Service)
NCEI/WDS	National Centers for Environmental Information World Data System
NEAM	North-eastern Atlantic, the Mediterranean and Connected Seas
NEAMTIC	Tsunami Information Centre for the North-eastern Atlantic, the Mediterranean and Connected Seas
NEAMTWS	Tsunami Early Warning and Mitigation System in the North-eastern Atlantic, the Mediterranean and Connected Seas
NEAMWave	NEAM Tsunami Exercise
NGA	National Geospatial-Intelligence Agency (USA)
NMHS	National Meteorological and Hydrological Services
NOAA	National Oceanic and Atmospheric Administration
NORAD	Norwegian Agency for Development Cooperation
NWPTAC	Northwest Pacific Tsunami Advisory Centre
NTWC	National Tsunami Warning Center
OBIS	Ocean Biodiversity Information System
OBPS	GOOS/IODE Ocean Best Practices System
ODIS	IOC Ocean Data and Information System Project
ODTP	Ocean Decade Tsunami Programme
ODTP-SC	Ocean Decade Tsunami Programme Scientific Committee
ORSNET	Oceania Regional Seismic Network
OTGA	Ocean Teacher Global Academy
PacWave	Pacific Wave Exercise
PICT	Pacific Island Countries and Territories
PTWC	Pacific Tsunami Warning Centre
PTWS	Pacific Tsunami Warning and Mitigation System

SC-DRR	Standing Committee on Disaster Risk Reduction and Public Services (in SERCOM, WMO)
SC-MMO	Standing Committee on Marine Meteorological and Oceanographic Services (in SERCOM, WMO)
SCSTAC	South China Sea Tsunami Advisory Center
SDGs	Sustainable Development Goals
SEP	South-East Pacific
SERCOM	Commission for Weather, Climate, Water and Related Environmental Services and Applications (WMO)
SFDRR	Sendai Framework for Disaster Risk Reduction
SIDS	Small Island developing States
SMA	Seismic Margin Assessment
SOP	Standard Operating Procedure
SRC	Seismic Research Center
TOWS-WG	Working Group on Tsunamis and Other Hazards Related to Sea-Level Warning and Mitigation Systems
TSP	Tsunami Service Provider
TSR	Tsunami Resilience Section of UNESCO/IOC
TT	Task Team
TT-DMP	Task Team on Disaster Management and Preparedness
TT-TWO	Task Team on Tsunami Watch Operations
UN	United Nations
UNDRR	United Nations Office for Disaster Risk Reduction
UNESCAP	UN Economic and Social Commission for Asia and the Pacific
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
USA	United States of America
USAID	United States Agency for International Development
WG	Working Group
WIS	WMO Information System
WMO	World Meteorological Organization
WOD	World Ocean Database
WTAD	World Tsunami Awareness Day
WWMIWS	WMO Advisory Group on the Worldwide Met-Ocean Information Warning Service
WWNWS	World-Wide Navigational Warning Service

In this Series, entitled

Reports of Meetings of Experts and Equivalent Bodies, which was initiated in 1984 and which is published in English only, unless otherwise specified, the reports of the following meetings have already been issued:

1. Third Meeting of the Central Editorial Board for the Geological/Geophysical Atlases of the Atlantic and Pacific Oceans
2. Fourth Meeting of the Central Editorial Board for the Geological/Geophysical Atlases of the Atlantic and Pacific Oceans S. Fourth Session of the Joint IOC-WMO-CPPS Working Group on the Investigations of 'El Niño' (**Also printed in Spanish**)
4. First Session of the IOC-FAO Guiding Group of Experts on the Programme of Ocean Science in Relation to Living Resources
5. First Session of the IOC-UN(OETB) Guiding Group of Experts on the Programme of Ocean Science in Relation to Non-Living Resources
6. First Session of the Editorial Board for the International Bathymetric Chart of the Mediterranean and Overlay Sheets
7. First Session of the Joint CCOP(SOPAC)-IOC Working Group on South Pacific Tectonics and Resources
8. First Session of the IODE Group of Experts on Marine Information Management
9. Tenth Session of the Joint CCOP-IOC Working Group on Post-IDOE Studies in East Asian Tectonics and Resources
10. Sixth Session of the IOC-UNEP Group of Experts on Methods, Standards and Intercalibration
11. First Session of the IOC Consultative Group on Ocean Mapping (**Also printed in French and Spanish**)
12. Joint 100-WMO Meeting for Implementation of IGOSS XBT Ships-of-Opportunity Programmes
13. Second Session of the Joint CCOP/SOPAC-IOC Working Group on South Pacific Tectonics and Resources
14. Third Session of the Group of Experts on Format Development
15. Eleventh Session of the Joint CCOP-IOC Working Group on Post-IDOE Studies of South-East Asian Tectonics and Resources
16. Second Session of the IOC Editorial Board for the International Bathymetric Chart of the Mediterranean and Overlay Sheets
17. Seventh Session of the IOC-UNEP Group of Experts on Methods, Standards and Intercalibration
18. Second Session of the IOC Group of Experts on Effects of Pollutants
19. Primera Reunión del Comité Editorial de la COI para la Carta Batimétrica Internacional del Mar Caribe y Parte del Océano Pacífico frente a Centroamérica (**Spanish only**)
20. Third Session of the Joint CCOP/SOPAC-IOC Working Group on South Pacific Tectonics and Resources
21. Twelfth Session of the Joint CCOP-IOC Working Group on Post-IDOE Studies of South-East Asian Tectonics and Resources
22. Second Session of the IODE Group of Experts on Marine Information Management
23. First Session of the IOC Group of Experts on Marine Geology and Geophysics in the Western Pacific
24. Second Session of the IOC-UN(OETB) Guiding Group of Experts on the Programme of Ocean Science in Relation to Non-Living Resources (**Also printed in French and Spanish**)
25. Third Session of the IOC Group of Experts on Effects of Pollutants
26. Eighth Session of the IOC-UNEP Group of Experts on Methods, Standards and Intercalibration
27. Eleventh Session of the Joint IOC-IHO Guiding Committee for the General Bathymetric Chart of the Oceans (**Also printed in French**)
28. Second Session of the IOC-FAO Guiding Group of Experts on the Programme of Ocean Science in Relation to Living Resources
29. First Session of the IOC-IAEA-UNEP Group of Experts on Standards and Reference Materials
30. First Session of the IOCARIBE Group of Experts on Recruitment in Tropical Coastal Demersal Communities (**Also printed in Spanish**)
31. Second IOC-WMO Meeting for Implementation of IGOSS XBT Ship-of-Opportunity Programmes
32. Thirteenth Session of the Joint CCOP-IOC Working Group on Post-IDOE Studies of East Asia Tectonics and Resources
33. Second Session of the IOC Task Team on the Global Sea-Level Observing System
34. Third Session of the IOC Editorial Board for the International Bathymetric Chart of the Mediterranean and Overlay Sheets
35. Fourth Session of the IOC-UNEP-IMO Group of Experts on Effects of Pollutants
36. First Consultative Meeting on RNODCs and Climate Data Services
37. Second Joint IOC-WMO Meeting of Experts on IGOSS-IODE Data Flow
38. Fourth Session of the Joint CCOP/SOPAC-IOC Working Group on South Pacific Tectonics and Resources
39. Fourth Session of the IODE Group of Experts on Technical Aspects of Data Exchange
40. Fourteenth Session of the Joint CCOP-IOC Working Group on Post-IDOE Studies of East Asian Tectonics and Resources
41. Third Session of the IOC Consultative Group on Ocean Mapping
42. Sixth Session of the Joint IOC-WMO-CCPS Working Group on the Investigations of 'El Niño' (**Also printed in Spanish**)
43. First Session of the IOC Editorial Board for the International Bathymetric Chart of the Western Indian Ocean
44. Third Session of the IOC-UN(OALOS) Guiding Group of Experts on the Programme of Ocean Science in Relation to Non-Living Resources
45. Ninth Session of the IOC-UNEP Group of Experts on Methods, Standards and Intercalibration
46. Second Session of the IOC Editorial Board for the International Bathymetric Chart of the Caribbean Sea and the Gulf of Mexico
47. Cancelled
48. Twelfth Session of the Joint IOC-IHO Guiding Committee for the General Bathymetric Chart of the Oceans
49. Fifteenth Session of the Joint CCOP-IOC Working Group on Post-IDOE Studies of East Asian Tectonics and Resources
50. Third Joint IOC-WMO Meeting for Implementation of IGOSS XBT Ship-of-Opportunity Programmes
51. First Session of the IOC Group of Experts on the Global Sea-Level Observing System
52. Fourth Session of the IOC Editorial Board for the International Bathymetric Chart of the Mediterranean
53. First Session of the IOC Editorial Board for the International Chart of the Central Eastern Atlantic (**Also printed in French**)
54. Third Session of the IOC Editorial Board for the International Bathymetric Chart of the Caribbean Sea and the Gulf of Mexico (**Also printed in Spanish**)
55. Fifth Session of the IOC-UNEP-IMO Group of Experts on Effects of Pollutants
56. Second Session of the IOC Editorial Board for the International Bathymetric Chart of the Western Indian Ocean
57. First Meeting of the IOC *ad hoc* Group of Experts on Ocean Mapping in the WESTPAC Area
58. Fourth Session of the IOC Consultative Group on Ocean Mapping
59. Second Session of the IOC-WMO/IGOSS Group of Experts on Operations and Technical Applications
60. Second Session of the IOC Group of Experts on the Global Sea-Level Observing System

61. UNEP-IOC-WMO Meeting of Experts on Long-Term Global Monitoring System of Coastal and Near-Shore Phenomena Related to Climate Change
62. Third Session of the IOC-FAO Group of Experts on the Programme of Ocean Science in Relation to Living Resources
63. Second Session of the IOC-IAEA-UNEP Group of Experts on Standards and Reference Materials
64. Joint Meeting of the Group of Experts on Pollutants and the Group of Experts on Methods, Standards and Intercalibration
65. First Meeting of the Working Group on Oceanographic Co-operation in the ROPME Sea Area
66. Fifth Session of the Editorial Board for the International Bathymetric and its Geological/Geophysical Series
67. Thirteenth Session of the IOC-IHO Joint Guiding Committee for the General Bathymetric Chart of the Oceans (**Also printed in French**)
68. International Meeting of Scientific and Technical Experts on Climate Change and Oceans
69. UNEP-IOC-WMO-IUCN Meeting of Experts on a Long-Term Global Monitoring System
70. Fourth Joint IOC-WMO Meeting for Implementation of IGOSS XBT Ship-of-Opportunity Programmes
71. ROPME-IOC Meeting of the Steering Committee on Oceanographic Co-operation in the ROPME Sea Area
72. Seventh Session of the Joint IOC-WMO-CPPS Working Group on the Investigations of 'El Niño' (**Spanish only**)
73. Fourth Session of the IOC Editorial Board for the International Bathymetric Chart of the Caribbean Sea and the Gulf of Mexico (**Also printed in Spanish**)
74. UNEP-IOC-ASPEI Global Task Team on the Implications of Climate Change on Coral Reefs
75. Third Session of the IODE Group of Experts on Marine Information Management
76. Fifth Session of the IODE Group of Experts on Technical Aspects of Data Exchange
77. ROPME-IOC Meeting of the Steering Committee for the Integrated Project Plan for the Coastal and Marine Environment of the ROPME Sea Area
78. Third Session of the IOC Group of Experts on the Global Sea-level Observing System
79. Third Session of the IOC-IAEA-UNEP Group of Experts on Standards and Reference Materials
80. Fourteenth Session of the Joint IOC-IHO Guiding Committee for the General Bathymetric Chart of the Oceans
81. Fifth Joint IOG-WMO Meeting for Implementation of IGOSS XBT Ship-of-Opportunity Programmes
82. Second Meeting of the UNEP-IOC-ASPEI Global Task Team on the Implications of climate Change on Coral Reefs
83. Seventh Session of the JSC Ocean Observing System Development Panel
84. Fourth Session of the IODE Group of Experts on Marine Information Management
85. Sixth Session of the IOC Editorial Board for the International Bathymetric chart of the Mediterranean and its Geological/Geophysical Series
86. Fourth Session of the Joint IOC-JGOFS Panel on Carbon Dioxide
87. First Session of the IOC Editorial Board for the International Bathymetric Chart of the Western Pacific
88. Eighth Session of the JSC Ocean Observing System Development Panel
89. Ninth Session of the JSC Ocean Observing System Development Panel
90. Sixth Session of the IODE Group of Experts on Technical Aspects of Data Exchange
91. First Session of the IOC-FAO Group of Experts on OSLR for the IOCINCWIO Region
92. Fifth Session of the Joint IOC-JGOFS CO₂ Advisory Panel Meeting
93. Tenth Session of the JSC Ocean Observing System Development Panel
94. First Session of the Joint CMM-IGOSS-IODE Sub-group on Ocean Satellites and Remote Sensing
95. Third Session of the IOC Editorial Board for the International Chart of the Western Indian Ocean
96. Fourth Session of the IOC Group of Experts on the Global Sea Level Observing System
97. Joint Meeting of GEMSI and GEEP Core Groups
98. First Session of the Joint Scientific and Technical Committee for Global Ocean Observing System
99. Second International Meeting of Scientific and Technical Experts on Climate Change and the Oceans
100. First Meeting of the Officers of the Editorial Board for the International Bathymetric Chart of the Western Pacific
101. Fifth Session of the IOC Editorial Board for the International Bathymetric Chart of the Caribbean Sea and the Gulf of Mexico
102. Second Session of the Joint Scientific and Technical Committee for Global Ocean Observing System
103. Fifteenth Session of the Joint IOC-IHO Committee for the General Bathymetric Chart of the Oceans
104. Fifth Session of the IOC Consultative Group on Ocean Mapping
105. Fifth Session of the IODE Group of Experts on Marine Information Management
106. IOC-NOAA *Ad hoc* Consultation on Marine Biodiversity
107. Sixth Joint IOC-WMO Meeting for Implementation of IGOSS XBT Ship-of-Opportunity Programmes
108. Third Session of the Health of the Oceans (HOTO) Panel of the Joint Scientific and Technical Committee for GLOSS
109. Second Session of the Strategy Subcommittee (SSC) of the IOC-WMO-UNEP Intergovernmental Committee for the Global Ocean Observing System
110. Third Session of the Joint Scientific and Technical Committee for Global Ocean Observing System
111. First Session of the Joint GCOS-GOOS-WCRP Ocean Observations Panel for Climate
112. Sixth Session of the Joint IOC-JGOFS CO₂ Advisory Panel Meeting
113. First Meeting of the IOC/WESTPAC Co-ordinating Committee for the North-East Asian Regional - Global Ocean Observing System (NEAR-GOOS)
114. Eighth Session of the Joint IOC-WMO-CPPS Working Group on the Investigations of "El Niño" (**Spanish only**)
115. Second Session of the IOC Editorial Board of the International Bathymetric Chart of the Central Eastern Atlantic (**Also printed in French**)
116. Tenth Session of the Officers Committee for the Joint IOC-IHO General Bathymetric Chart of the Oceans (GEBCO), USA, 1996
117. IOC Group of Experts on the Global Sea Level Observing System (GLOSS), Fifth Session, USA, 1997
118. Joint Scientific Technical Committee for Global Ocean Observing System (J-GOOS), Fourth Session, USA, 1997
119. First Session of the Joint 100-WMO IGOSS Ship-of-Opportunity Programme Implementation Panel, South Africa, 1997
120. Report of Ocean Climate Time-Series Workshop, Joint GCOS-GOOS-WCRP Ocean Observations Panel for Climate, USA, 1997
121. IOC/WESTPAC Co-ordinating Committee for the North-East Asian Regional Global Ocean Observing System (NEAR-GOOS), Second Session, Thailand, 1997
122. First Session of the IOC-IUCN-NOAA *Ad hoc* Consultative Meeting on Large Marine Ecosystems (LME), France, 1997

123. Second Session of the Joint GCOS-GOOS-WCRP Ocean Observations Panel for Climate (OOPC), South Africa, 1997
124. Sixth Session of the IOC Editorial Board for the International Bathymetric Chart of the Caribbean Sea and the Gulf of Mexico, Colombia, 1996 **(also printed in Spanish)**
125. Seventh Session of the IODE Group of Experts on Technical Aspects of Data Exchange, Ireland, 1997
126. IOC-WMO-UNEP-ICSU Coastal Panel of the Global Ocean Observing System (GOOS), First Session, France, 1997
127. Second Session of the IOC-IUCN-NOAA Consultative Meeting on Large Marine Ecosystems (LME), France, 1998
128. Sixth Session of the IOC Consultative Group on Ocean Mapping (CGOM), Monaco, 1997
129. Sixth Session of the Tropical Atmosphere - Ocean Array (TAO) Implementation Panel, United Kingdom, 1997
130. First Session of the IOC-WMO-UNEP-ICSU Steering Committee of the Global Ocean Observing System (GOOS), France, 1998
131. Fourth Session of the Health of the Oceans (HOTO) Panel of the Global Ocean Observing System (GOOS), Singapore, 1997
132. Sixteenth Session of the Joint IOC-IHO Guiding Committee for the General Bathymetric Chart of the Oceans (GEBCO), United Kingdom, 1997
133. First Session of the IOC-WMO-UNEP-ICSU-FAO Living Marine Resources Panel of the Global Ocean Observing System (GOOS), France, 1998
134. Fourth Session of the IOC Editorial Board for the International Bathymetric Chart of the Western Indian Ocean (IOC/EB-IBCWIO-IW3), South Africa, 1997
135. Third Session of the Joint GCOS-GOOS-WCRP Ocean Observations Panel for Climate (OOPC), France, 1998
136. Seventh Session of the Joint IOC-JGOFS C02 Advisory Panel Meeting, Germany, 1997
137. Implementation of Global Ocean Observations for GOOS/GCOS, First Session, Australia, 1998
138. Implementation of Global Ocean Observations for GOOS/GCOS, Second Session, France, 1998
139. Second Session of the IOC-WMO-UNEP-ICSU Coastal Panel of the Global Ocean Observing System (GOOS), Brazil, 1998
140. Third Session of IOC/WESTPAC Co-ordinating Committee for the North-East Asian Regional - Global Ocean Observing System (NEAR-GOOS), China, 1998
141. Ninth Session of the Joint IOC-WMO-CPPS Working Group on the Investigations of 'El Niño', Ecuador, 1998 **(Spanish only)**
142. Seventh Session of the IOC Editorial Board for the International Bathymetric Chart of the Mediterranean and its Geological/Geophysical Series, Croatia, 1998
143. Seventh Session of the Tropical Atmosphere-Ocean Array (TAO) Implementation Panel, Abidjan, Côte d'Ivoire, 1998
144. Sixth Session of the IODE Group of Experts on Marine Information Management (GEMIM), USA, 1999
145. Second Session of the IOC-WMO-UNEP-ICSU Steering Committee of the Global Ocean Observing System (GOOS), China, 1999
146. Third Session of the IOC-WMO-UNEP-ICSU Coastal Panel of the Global Ocean Observing System (GOOS), Ghana, 1999
147. Fourth Session of the GCOS-GOOS-WCRP Ocean Observations Panel for Climate (OOPC); Fourth Session of the WCRP CLIVAR Upper Ocean Panel (UOP); Special Joint Session of OOPC and UOP, USA, 1999
148. Second Session of the IOC-WMO-UNEP-ICSU-FAO Living Marine Resources Panel of the Global Ocean Observing System (GOOS), France, 1999
149. Eighth Session of the Joint IOC-JGOFS CO2 Advisory Panel Meeting, Japan, 1999
150. Fourth Session of the IOC/WESTPAC Co-ordinating Committee for the North-East Asian Regional – Global Ocean Observing System (NEAR-GOOS), Japan, 1999
151. Seventh Session of the IOC Consultative Group on Ocean Mapping (CGOM), Monaco, 1999
152. Sixth Session of the IOC Group of Experts on the Global Sea level Observing System (GLOSS), France, 1999
153. Seventeenth Session of the Joint IOC-IHO Guiding Committee for the General Bathymetric Chart of the Oceans (GEBCO), Canada, 1999
154. Comité Editorial de la COI para la Carta Batimétrica Internacional del Mar Caribe y el Golfo de Mexico (IBCCA), Septima Reunión, Mexico, 1998
IOC Editorial Board for the International Bathymetric Chart of the Caribbean Sea and the Gulf of Mexico (IBCCA), Seventh Session, Mexico, 1998
155. Initial Global Ocean Observing System (GOOS) Commitments Meeting, IOC-WMO-UNEP-ICSU/Impl-III/3, France, 1999
156. First Session of the *ad hoc* Advisory Group for IOCARIBE-GOOS, Venezuela, 1999 **(also printed in Spanish and French)**
157. Fourth Session of the IOC-WMO-UNEP-ICSU Coastal Panel of the Global Ocean Observing System (GOOS), China, 1999
158. Eighth Session of the IOC Editorial Board for the International Bathymetric Chart of the Mediterranean and its Geological/Geophysical Series, Russian Federation, 1999
159. Third Session of the IOC-WMO-UNEP-ICSU-FAO Living Marine Resources Panel of the Global Ocean Observing System (GOOS), Chile, 1999
160. Fourth Session of the IOC-WMO-UNEP-ICSU-FAO Living Marine Resources Panel of the Global Ocean Observing System (GOOS). Hawaii, 2000
161. Eighth Session of the IODE Group of Experts on Technical Aspects of Data Exchange, USA, 2000
162. Third Session of the IOC-IUCN-NOAA Consultative Meeting on Large Marine Ecosystems (LME), France, 2000
163. Fifth Session of the IOC-WMO-UNEP-ICSU Coastal Panel of the Global Ocean Observing System (GOOS), Poland, 2000
164. Third Session of the IOC-WMO-UNEP-ICSU Steering Committee of the Global Ocean Observing System (GOOS), France, 2000
165. Second Session of the *ad hoc* Advisory Group for IOCARIBE-GOOS, Cuba, 2000 **(also printed in Spanish and French)**
166. First Session of the Coastal Ocean Observations Panel, Costa Rica, 2000
167. First GOOS Users' Forum, 2000
168. Seventh Session of the Group of Experts on the Global Sea Level Observing System, Honolulu, 2001
169. First Session of the Advisory Body of Experts on the Law of the Sea (ABE-LOS), France, 2001 **(also printed in French)**
170. Fourth Session of the IOC-WMO-UNEP-ICSU Steering Committee of the Global Ocean Observing System, Chile, 2001
171. First Session of the IOC-SCOR Ocean CO₂ Advisory Panel, France, 2000
172. Fifth Session of the GCOS-GOOS-WCRP Ocean Observations Panel for Climate (OOPC), Norway, 2000 **(electronic copy only)**
173. Third Session of the *ad hoc* Advisory Group for IOCARIBE-GOOS, USA, 2001 **(also printed in Spanish and French)**
174. Second Session of the Coastal Ocean Observations Panel and GOOS Users' Forum, Italy, 2001
175. Second Session of the Black Sea GOOS Workshop, Georgia, 2001
176. Fifth Session of the IOC/WESTPAC Co-ordinating Committee for the North-East Asian Regional – Global Ocean Observing System (NEAR-GOOS), Republic of Korea, 2000
177. Second Session of the Advisory Body of Experts on the Law of the Sea (IOC/ABE-LOS), Morocco, 2002 **(also printed in French)**
178. Sixth Session of the Joint GCOS-GOOS-WCRP Ocean Observations Panel for Climate (OOPC), Australia, 2001 **(electronic copy only)**
179. *Cancelled*
180. Second Session of the IOC-SCOR Ocean CO₂ Advisory Panel, Honolulu, Hawaii, U.S.A., 2002 **(electronic copy only)**

181. IOC Workshop on the Establishment of SEAGOOS in the Wider Southeast Asian Region, Seoul, Republic of Korea, 2001 (SEAGOOS preparatory workshop) **(electronic copy only)**
182. First Session of the IODE Steering Group for the Resource Kit, USA, 19–21 March 2001
183. Fourth Session of the IOC-IUCN-NOAA Consultative Meeting on Large Marine Ecosystems (LMEs), France, 2002
184. Seventh Session of the IODE Group of Experts on Marine Information Management (GEMIM), France, 2002 **(electronic copy only)**
185. Sixth Session of IOC/WESTPAC Coordinating Committee for the North-East Asian Regional - Global Ocean Observing System (NEAR-GOOS), Republic of Korea, 2001 **(electronic copy only)**
186. First Session of the Global Ocean Observing System (GOOS) Capacity Building Panel, Switzerland, 2002 **(electronic copy only)**
187. Fourth Session of the ad hoc Advisory Group for IOCARIBE-GOOS, 2002, Mexico **(also printed in French and Spanish)**
188. Fifth Session of the IOC Editorial Board for the International Bathymetric Chart of the Western Indian Ocean (IBCWIO), Mauritius, 2000
189. Third session of the Editorial Board for the International Bathymetric Chart of the Western Pacific, China, 2000
190. Third Session of the Coastal Ocean Observations Panel and GOOS Users' Forum, Vietnam, 2002
191. Eighth Session of the IOC Consultative Group on Ocean Mapping, Russian Federation, 2001
192. Third Session of the Advisory Body of Experts on the Law of the Sea (IOC/ABE-LOS), Lisbon, 2003 **(also printed in French)**
193. Extraordinary Session of the Joint IOC-WMO-CPPS Working Group on the Investigations of 'El Niño', Chile, 1999 **(Spanish only; electronic copy only)**
194. Fifth Session of the IOC-WMO-UNEP-ICSU Steering Committee of the Global Ocean Observing System, France, 2002
195. Sixth Session of the IOC-WMO-UNEP-ICSU Steering Committee of the Global Ocean Observing System, South Africa, 2003
196. Fourth Session of the Coastal Ocean Observations Panel, South Africa, 2002 **(electronic copy only)**
197. First Session of the JCOMM/IODE Expert Team On Data Management Practices, Belgium, 2003 *(also JCOMM Meeting Report No. 25)*
198. Fifth Session of the IOC-IUCN-NOAA Consultative Meeting on Large Marine Ecosystems (LMEs), Paris, 2003
199. Ninth Session of the IOC Consultative Group on Ocean Mapping, Monaco, 2003 **(Recommendations in English, French, Russian and Spanish included)**
200. Eighth Session of the IOC Group of Experts on the Global Sea level Observing System (GLOSS), France, 2003 **(electronic copy only)**
201. Fourth Session of the Advisory Body of Experts on the Law of the Sea (IOC/ABE-LOS), Greece, 2004 **(also printed in French)**
202. Sixth Session of the IOC-IUCN-NOAA Consultative Meeting on Large Marine Ecosystems (LMEs), Paris, 2004 **(electronic copy only)**
203. Fifth Session of the Advisory Body of Experts on the Law of the Sea (IOC/ABE-LOS), Argentina, 2005 **(also printed in French)**
204. Ninth Session of the IOC Group of Experts on the Global Sea level Observing System (GLOSS), France, 2005 **(electronic copy only)**
205. Eighth Session of the IOC/WESTPAC Co-ordinating Committee for the North-East Asian Regional – Global Ocean Observing System (NEAR-GOOS), China, 2003 **(electronic copy only)**
206. Sixth Meeting of the Advisory Body of Experts on the Law of the Sea (IOC/ABE-LOS), Spain, 2006 **(also printed in French)**
207. Third Session of the Regional Forum of the Global Ocean Observing System, South Africa, 2006 **(electronic copy only)**
208. Seventh Session of the IOC-UNEP-IUCN-NOAA Consultative Meeting on Large Marine Ecosystems (LMEs), Paris, 2005 **(electronic copy only)**
209. Eighth Session of the IOC-UNEP-IUCN-NOAA Consultative Meeting on Large Marine Ecosystems (LMEs), Paris, 2006 **(electronic copy only)**
210. Seventh Meeting of the IOC Advisory Body of Experts on the Law of the Sea (IOC/ABE-LOS), Gabon, 2007 **(bilingual English/French)**
211. First Meeting of the IOC Working Group on the Future of IOC, Paris, 2008 **(Executive Summary in English, French, Russian and Spanish included)**
212. First meeting of the Working Group on Tsunamis and Other Hazards Related to Sea-Level Warning and Mitigation Systems (TOWS-WG), Paris, 3–4 April 2008 **(Executive Summary in English, French, Russian and Spanish included)**
213. First Session of the Panel for Integrated Coastal Observation (PICO-I), Paris, 10–11 April 2008 **(electronic copy only)**
214. Tenth Session of the IOC Group of Experts on the Global Sea level Observing System (GLOSS), Paris, 6–8 June 2007 **(electronic copy only)**
215. Eighth Meeting of the IOC Advisory Body of Experts on the Law of the Sea (IOC/ABE-LOS), Paris, 21–25 April 2008 **(bilingual English/French)**
216. Fourth Session of the Global Ocean Observing System (GOOS) Regional Alliances Forum (GRF), Guayaquil, Ecuador, 25–27 November 2008 **(electronic copy only)**
217. Second Session of the Working Group on Tsunamis and Other Hazards Related to Sea-Level Warning and Mitigation Systems (TOWS-WG), Paris, 27 March 2009 **(Executive Summary in English, French, Russian and Spanish included)**
218. Ninth Meeting of the IOC Advisory Body of Experts on the Law of the Sea (IOC/ABE-LOS), Paris, 30 March–3 April 2009 **(bilingual English/French)**
219. First Session of the IOC-SCOR International Ocean Carbon Coordination Project (IOCCP) Scientific Steering Group (also IOCCP Reports, 3), Broomfield, Colorado, U.S.A., 1 October 2005 **(electronic copy only)**
220. Second Session of the IOC-SCOR International Ocean Carbon Coordination Project (IOCCP) Scientific Steering Group (also IOCCP Reports, 6), Paris, France, 20 April 2007 **(electronic copy only)**
221. Third Session of the IOC-SCOR International Ocean Carbon Coordination Project (IOCCP) Scientific Steering Group (also IOCCP Reports, 10), Villefranche-sur-mer, France, 3–4 October 2008 **(electronic copy only)**
222. Fourth Session of the IOC-SCOR International Ocean Carbon Coordination Project (IOCCP) Scientific Steering Group (also IOCCP Reports, 15), Jena, Germany, 14 September 2009 **(electronic copy only)**
223. First Meeting of the joint IOC-ICES Study Group on Nutrient Standards (SGONS) (also IOCCP Reports, 20), Paris, France, 23–24 March 2010 **(Executive Summary in E, F, R, S included)**
224. Third Session of the Working Group on Tsunamis and Other Hazards Related to Sea-Level Warning and Mitigation Systems (TOWS-WG), Lisbon, Portugal, 5–6 May 2010 **(Executive Summary in English, French, Russian and Spanish included)**
225. Eleventh Session of the IOC Group of Experts on the Global Sea level Observing System (GLOSS), Paris, 13–15 May 2009 **(electronic copy only)**
226. Second Session of the Panel for Integrated Coastal Observation (PICO-II), Paris, 24–26 February 2009 **(electronic copy only)**
227. First meeting of the Task Team on Seismic Data Exchange in the South West Pacific of the ICG/PTWS Regional Working Group for the Southwest Pacific, Port Vila, Vanuatu, 19–20 October 2009 **(electronic copy only)**
228. Fourth Session of the Working Group on Tsunamis and Other Hazards Related to Sea-Level Warning and Mitigation Systems (TOWS-WG), Paris, France, 20–21 March 2011 **(Executive Summary in English, French, Russian and Spanish included)**
229. Second Session of the IODE Steering Group for Ocean Teacher (SG-OT), Miami, Florida, 11–15 April 2011
230. First Meeting of the Inter-ICG Task Team 1 on Sea Level Monitoring for Tsunami (Working Group on Tsunamis and Other Hazards Related to Sea-Level Warning and Mitigation Systems (TOWS-WG), Seattle, USA, 29 November–1 December 2010
231. First Meeting of the Inter-ICG Task Team 2 on Disaster Management and Preparedness (Working Group on Tsunamis and Other Hazards Related to

- Sea-Level Warning and Mitigation Systems (TOWS-WG), Seattle, USA, 29 November–1 December 2010
232. First Meeting of the Inter-ICG Task Team 3 on Tsunami Watch Operations (Working Group on Tsunamis and Other Hazards Related to Sea-Level Warning and Mitigation Systems (TOWS-WG), Seattle, USA, 29 November–1 December 2010
 233. Primera Reunión del Grupo de Trabajo Regional para América Central del Grupo Intergubernamental de Coordinación del Sistema de Alerta contra los Tsunamis y Atenuación de sus Efectos en el Pacífico (ICG/PTWS), Managua (Nicaragua) del 4 al 6 de noviembre de 2009 (**Resumen dispositivo en español e inglés**)
 234. Segunda Reunión del Grupo de Trabajo Regional para América Central del Grupo Intergubernamental de Coordinación del Sistema de Alerta contra los Tsunamis y Atenuación de sus Efectos en el Pacífico (ICG/PTWS), San Salvador (El Salvador) del 28 al 30 de septiembre de 2011 (**Resumen dispositivo en español e inglés**)
 235. First Session of the Joint IODE-JCOMM Steering Group for the Global Temperature-Salinity Profile Programme (SG-GTSP), 16–20 April 2012, Ostend, Belgium
 236. Ad hoc Session of the Joint JCOMM-IODE Steering Group for the Ocean Data Standards Pilot Project (SG-ODSPP), 23–25 April 2012, Ostend, Belgium
 237. First Meeting of the Regional Working Group on Tsunami Warning and Mitigation System for the South China Sea Region (SCS-WG), Sanya, China, 12–14 December 2011
 238. First Meeting of the IODE Steering Group for OceanDocs (SG-OceanDocs), 24–27 January 2012, Ostend, Belgium
 239. Fifth Session of the Working Group on Tsunamis and Other Hazards Related to Sea-Level Warning and Mitigation Systems (TOWS-WG), Tokyo, Japan, 15 February 2012 (**Executive Summary in English, French, Russian and Spanish included**)
 240. Ad hoc Session of the IODE Group of Experts on Biological and Chemical Data Management and Exchange Practices (GE-BICH), Ostend, Belgium, 25 October 2012
 241. Twelfth Session of the IODE Group of Experts on Marine Information Management (GE-MIM), Miami, USA, 22–25 January 2013
 242. Twelfth Session of the IOC Group of Experts on the Global Sea level Observing System (GLOSS), Paris, 9–11 November 2011 (**electronic copy only**)
 243. Meeting of the Pacific Tsunami Warning System Working Group 2 on Detection, Warning and Dissemination Task Team on PacWave11, Honolulu, USA, 21 May 2012 (**electronic copy only**)
 244. Sixth Session of the Working Group on Tsunamis and Other Hazards Related to Sea-Level Warning and Mitigation Systems (TOWS-WG), Paris, 20–21 February 2013 (**Executive Summary in English, French, Russian and Spanish included**)
 245. Second Meeting of the Regional Working Group on Tsunami Warning and Mitigation System for the South China Sea Region (SCS-WG), Petaling Jaya, Malaysia, 16–18 October 2012 (**electronic copy only**)
 246. Seventh Meeting of the Working Group on Tsunamis and Other Hazards Related to Sea-Level Warning and Mitigation Systems, UNESCO, Paris, 12–13 February 2014 (**Executive Summary in English, French, Russian and Spanish included**)
 247. Third Meeting of the Regional Working Group on Tsunami Warning and Mitigation System for the South China Sea Region (SCS-WG), Hong-Kong, China, 6–7 April 2014 (**electronic copy only**)
 248. Tercera Reunión del Grupo de Trabajo Regional para América Central del Grupo Intergubernamental de Coordinación del Sistema de Alerta contra los Tsunamis y Atenuación de sus Efectos en el Pacífico (ICG/PTWS), Managua, Nicaragua, del 29 al 30 de septiembre de 2014 (**Resumen dispositivo en español e inglés**)
 249. Workshop on Tsunami Modelling and Mitigation of the ICG/CARIBE-EWS Working Group 2: Tsunami Hazard Assessment, 1–3 December 2014, Cartagena de Indias, Colombia (**electronic copy only**)
 250. Fourth meeting of the Regional Working Group on Tsunami Warning and Mitigation System for the South China Sea Region (SCS-WG), Jakarta, Indonesia, 11–12 February 2015 (**electronic copy only**)
 251. Eighth Session of the Working Group on Tsunamis and Other Hazards Related to Sea-Level Warning and Mitigation Systems (TOWS-WG), Paris, 12–13 March 2015 (**Executive Summary in English, French, Russian and Spanish included**)
 252. Ninth Meeting of the Working Group on Tsunamis and Other Hazards Related to Sea-Level Warning and Mitigation Systems, UNESCO, Paris, 25–26 February 2016 (**Executive Summary in English, French, Russian and Spanish included**)
 253. Fifth Meeting of the Regional Working Group on Tsunami Warning and Mitigation System for the South China Sea Region (SCS-WG), Manila, Philippines, 2–3 March 2016 (**electronic copy only**)
 254. Second Meeting of the Regional Working Group for the North West Indian Ocean (WG-NWIO), Tehran, Islamic Republic of, 27–28 February 2017 (**electronic copy only**)
 255. Sixth Meeting of the Regional Working Group on Tsunami Warning and Mitigation System for the South China Sea Region (SCS-WG), Shanghai, China, 1–3 March 2017 (**electronic copy only**)
 256. Tenth Session of the Working Group on Tsunamis and Other Hazards Related to Sea-Level Warning and Mitigation Systems (TOWS-WG), Paris, 23–24 February 2017 (**Executive Summary in English, French, Russian and Spanish included**)
 257. First Meeting of the Group of Experts on Capacity Development (GE-CD), Paris, 21–23 March 2018 (**electronic copy only**)
 258. Eleventh Session of the Working Group on Tsunamis and Other Hazards Related to Sea-Level Warning and Mitigation Systems (TOWS-WG), Paris, 16–17 February 2018 (**Executive Summary in English, French, Russian and Spanish included**)
 259. Seventh Meeting of the Regional Working Group on Tsunami Warning and Mitigation System for the South China Sea Region (SCS-WG), Hanoi, Vietnam, 6–8 March 2018 (**electronic copy only**)
 260. Cuarta reunión del Grupo de Trabajo Regional para América Central del Grupo Intergubernamental de Coordinación del Sistema de Alerta contra los Tsunamis y Atenuación de sus Efectos en el Pacífico (ICG/PTWS), Managua (Nicaragua) el 11 de febrero de 2019 (**Resumen dispositivo y recomendación en español e inglés**)
 261. Eighth Meeting of the Regional Working Group on Tsunami Warning and Mitigation System for the South China Sea Region (SCS-WG), Jakarta, Indonesia, 4–6 March 2019 (**electronic copy only**)
 262. First Joint Meeting of the Task Teams of the IOC Group of Experts on Capacity Development: Capacity development requirements of Member States and implementation of a Clearing House Mechanism (CHM) for the Transfer of Marine Technology, UNESCO, Paris, 13–14 March 2019 (**electronic copy only**)
 263. Twelfth Meeting of the Working Group on Tsunamis and Other Hazards Related to Sea-Level Warning and Mitigation Systems (TOWS-WG-XII), Paris, 21–22 February 2019 (**Executive Summary in English, French, Russian and Spanish included**)
 264. Seventh Meeting of the Regional Working Group on Tsunami Warning and Mitigation System for the Pacific Islands Countries and Territories (PICTs-WG), 8 March 2019, Noumea, New Caledonia (**electronic copy only**).
 265. Thirteenth Meeting of the Working Group on Tsunamis and Other Hazards Related to Sea-Level Warning and Mitigation Systems (TOWS-WG-XIII), Paris, 20–21 February 2020 (**Executive Summary in English, French, Russian and Spanish included**)
 266. Second Meeting of the Group of Experts on Capacity Development (GE-CD), 26 October 2020, (online). (**electronic copy only**)
 267. Fourteenth Meeting of the Working Group on Tsunamis and Other Hazards Related to Sea-Level Warning and Mitigation Systems (TOWS-WG-XIV), Online, 25–26 February 2021 (**Executive Summary in English, French, Russian and Spanish included**)

- 268 Eighth Meeting of the Regional Working Group on Tsunami Warning and Mitigation System for the Pacific Islands Countries and Territories (PICTs-WG), 29 March–1 April 2021 (online)
269. Tenth Meeting of the Regional Working Group on Tsunami Warning and Mitigation System for the South China Sea Region (SCS-WG), 28 and 30 September 2021 (online)
270. Fifteenth Meeting of the Working Group on Tsunamis and Other Hazards Related to Sea-Level Warning and Mitigation Systems (TOWS-WG-XV), 24–25 February 2022 (online)
271. Quinta Reunión del Grupo de Trabajo Regional para América Central del Grupo Intergubernamental de Coordinación del Sistema de Alerta contra los Tsunamis y Atenuación de sus Efectos en el Pacífico (ICG/PTWS), 15 de noviembre de 2021 (En línea)
272. Sixteenth Meeting of the Working Group on Tsunamis and Other Hazards Related to Sea-Level Warning and Mitigation Systems (TOWS-WG-XVI), Paris, 2–3 March 2023 (**Executive Summary in English, French, Russian and Spanish included**)
273. Sexta Reunión del Grupo de Trabajo Regional para América Central del Grupo Intergubernamental de Coordinación del Sistema de Alerta contra los Tsunamis y Atenuación de sus Efectos en el Pacífico (ICG/PTWS), Heredia, Costa Rica, 24 de abril 2023 (**Executive Summary and recommendations in English included**)