

**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)**

**Twelfth Meeting**  
Paris, France  
21–22 February 2019

**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)**

**Twelfth Meeting**  
Paris, France  
21–22 February 2019

**UNESCO 2019**

IOC/TOWS-WG-XII/3  
Paris, June 2019  
Original: English\*

---

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

## TABLE OF CONTENTS

	page
<i>Executive Summary</i> .....	(III)
<i>Resume executif</i> .....	(VI)
<i>Resumen dispositivo</i> .....	(X)
<i>Рабочее резюме</i> .....	(XIV)
<b>1. OPENING AND WELCOME</b> .....	<b>1</b>
1.1 OPENING.....	1
1.2 ADOPTION OF AGENDA.....	1
1.3 WORKING ARRANGEMENTS .....	1
<b>2. REPORTS FROM PARTICIPANT BODIES</b> .....	<b>1</b>
2.1 REPORT FROM IOC BODIES .....	1
2.1.1 Tsunami and other Coastal Hazards Warning System for the Caribbean and Adjacent Regions (CARIBE-EWS) .....	1
2.1.2 Indian Ocean Tsunami Warning and Mitigation System (IOTWMS).....	3
2.1.3 Tsunami Early Warning and Mitigation System in the North-Eastern Atlantic, the Mediterranean and Connected Seas (NEAMTWS).....	4
2.1.4 Pacific Tsunami Warning and Mitigation System (PTWS).....	5
2.2 REPORT OF NON-IOC BODIES.....	7
2.2.1 World Tsunami Awareness Day (UNISDR) .....	7
2.2.2 World Meteorological Organization .....	8
<b>3. REVIEW OF PROGRESS</b> .....	<b>10</b>
3.1 STATUS OF IMPLEMENTATION OF IOC DECISION EC-LI/3.3(III) .....	10
<b>4. REPORTS OF THE INTER-ICG TASK TEAMS</b> .....	<b>11</b>
4.1 INTER-ICG TASK TEAM ON DISASTER MANAGEMENT AND PREPAREDNESS .....	11
4.2 INTER-ICG TASK TEAM ON TSUNAMI WATCH OPERATIONS.....	11
<b>5. OTHER ISSUES</b> .....	<b>11</b>
<b>6. DATE AND PLACE OF THE NEXT MEETING</b> .....	<b>12</b>
<b>7. CLOSURE OF MEETING</b> .....	<b>12</b>

**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 Twelfth Meeting of the Working Group on Tsunamis and Other Hazards Related to Sea-Level Warning and Mitigation Systems (TOWS-WG-XII) was held in Paris, France, on 21 and 22 February 2019 under the Chairmanship of Mr Alexander Postnov (IOC Vice-Chair). The meeting evaluated progress in actions and decisions taken by the governing bodies through [IOC/EC-LI/3](#).

**The Group noted** the decision by the UN General Assembly, as part of the Omnibus Resolution for Oceans and the law of the sea (A/RES/72/73), to “*proclaim the United Nations Decade of Ocean Science for Sustainable Development for the 10-year period beginning on 1 January 2021, and called upon the Intergovernmental Oceanographic Commission to prepare an implementation plan for the Decade in consultation with Member States, UN Bodies, and relevant stakeholder*”.

**The Group reviewed** reports by the IOC Intergovernmental Coordination Groups as well as its own Task Teams on Disaster Management and Preparedness and Watch Operations.

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

- Three exercises carried out (CARIBE WAVE 18, IOWave18, PacWave18) and regular communication tests performed,
- Progress in sharing the results of Tsunami exercises and communication tests with World Meteorological Organization (WMO),
- Recovery and reconstruction of observation networks in Caribbean following recent hurricanes,
- CARIBE-EWS Implementation Plan for 2018–2023 adopted,
- Two communities in the Caribbean and Adjacent Regions (St. Patrick, Grenada, and Fort Liberte, Haiti) achieved UNESCO-IOC Tsunami Ready recognition, New funding from DIPECHO and USAID/OFDA towards piloting Tsunami Ready program in the Caribbean and Central America,
- A volcanic scenario will be included in CARIBE WAVE 19 (March 2019) as a first,
- Methodological guidelines “How to prepare, conduct, and evaluate a community-based tsunami response exercise” has been completed and is available in French, Spanish and English and under consideration of CARIBE-EWS for final publication,
- The improvements in alert message delivery rates for IOTWMS,
- India and Oman testing Tsunami Ready,
- UNESCAP funding for Strengthening Tsunami Early Warning in the North West Indian Ocean Region,
- Growing interest for piloting Tsunami Ready in NEAMTWS,
- Instituto Português do Mar e da Atmosfera (IPMA, Portugal) seeking accreditation as a Tsunami Service Provider in NEAMTWS,

- European Commission support towards projects contributing to NEAMTWS,
- South China Sea Tsunami Advisory Centre (SCSTAC) intent to go to full operation in late 2019,
- North West Pacific Tsunami Advisory Center (NWPTAC) to make full changeover to Enhanced Products at end of February 2019,
- Central American Tsunami Advisory Center (CATAC) plans to start trial operation in August 2019,
- ITIC Training activities including the ITP-Hawaii course in Chile August 2018 as a first,
- Acknowledge JICA and DIPECHO support for CATAC and Tsunami Ready and preparedness in Central America,
- PTWS completion of its Key Performance Indicators Framework,
- Completion and submission of a Community White Paper "Ocean Observations Required to Minimize Uncertainty in Global Tsunami Forecasts, Warnings, and Emergency Response" to the OceanObs19 conference.

**The Group reiterated** the importance of collecting event data strictly in accordance with the International Tsunami Survey Team (ITST) protocols, while continuing to be respectful of the country's needs and requirements, encourage timely data and information sharing by the Survey Teams to facilitate immediate submission of a consolidated summary report to the host country to assist with response and recovery planning and request ICGs to facilitate, in coordination with existing science organisations, special sessions at meetings/workshops to promote sharing of lessons learnt and compilation of all event data.

**The Group approved** updates to the [Tsunami Glossary](#).

**The Group approved** changes to the Area of Service Map (see Appendix 3 to Annex IV).

**The Group approved** the proposal on TSP Messages for the Maritime Community and requested the ICGs to consider the proposal for implementation in their respective basins. (see Appendix 4 to Annex IV).

**The Group agreed** to produce a compelling high level concept note to the Implementation and Science Plans for the UN Decade of Ocean Science for Sustainable Development and convey it to global and regional Decade planning meetings.

**The Group recommended** the Assembly to encourage Member States to:

- increase and sustain technical and financial support of the tsunami and other coastal hazards warning systems in their respective regions,
- emphasize to national civil protection/disaster management agencies the role they play in strengthening the warning chain to ensure optimal community response and stress the importance that the agencies participate in regional Tsunami governance and technical forums,
- continue to strengthen tsunami awareness and preparedness in communities and among authorities through communication, evacuation planning, tsunami exercises, training, information, and piloting recognition programmes such as Tsunami Ready,

- densify sea level networks capable of Tsunami detection as well as seismic network particularly nearby tsunamigenic sources,
- extend sharing of real time tsunami source and tsunami detection observations,
- collect high resolution coastal bathymetry and extend the data sharing for improved characterization of Tsunami and other coastal hazards and risks, and also advocate this through IHO and regional hydrographic commissions,
- register National Tsunami Warning Centers (NTWCs) and Tsunami Warning Focal Points (TWFPs) as alerting authorities in the “WMO Alerting Authority Register” via the WMO National Permanent Representative and in follow-up to WMO Circular Letter.

**The Group recommended** the Assembly to instruct ICGs to:

- advocate Fourth edition of World Tsunami Awareness Day (WTAD 2019) among Member States and highlight target [d] of the Sendai Framework that stresses substantial reduction of disaster damage to critical infrastructure and disruption of basic services and with an emphasis of ports, harbours and vertical evacuation,
- consider the [PTWS Key Performance Indicator Framework](#) and provide input to a consolidated report for the TOWS-XIII,
- continue the Tsunami Ready pilot activities with UNESCO-IOC recognition, including conducting surveys on Member State status, interest and feed back in the implementation of Tsunami Ready.

**The Group accepted** the reports from the Task Teams on Disaster Management and Preparedness and Watch Operations and instructed the Task Teams to continue efforts for monitoring and responding to tsunamis generated by non-seismic sources and possible integration into Tsunami watch operation.

**The Group recommended** the Assembly to take the following actions:

- to extend the tenure of TOWS and its task teams on (i) Disaster Management and Preparedness and (ii) Tsunami Watch Operations, with ToRs as given in [IOC Resolution XXIV-4](#) [for TOWS-WG] and [IOC/TOWS-WG-VI/3](#) [Annex II; for TTDMP] and ToRs for TTTWO as given in [IOC/TOWS-WG-X/3](#), Appendix 1 to Annex II.

**The Group noted with appreciation** the information presented by the WMO and the Head of the IOC Ocean Observations and Services Section on JCOMM governance reform.

## **Resumé exécutif**

---

La 12<sup>e</sup> 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-XII) s'est tenue les 21 et 22 février 2019 à Paris (France), sous la présidence de M. Alexander Postnov (Vice-Président de la COI). Les participants à la réunion ont évalué les progrès réalisés concernant les actions menées et les décisions prises par les organes directeurs, notamment le Conseil ([IOC/EC-LI/3](#)).

**Le Groupe a pris note** de la décision de l'Assemblée générale des Nations Unies, au titre de sa résolution d'ensemble pour les océans et le droit de la mer (A/RES/72/73), « de proclamer la Décennie des Nations Unies pour les sciences océaniques au service du développement durable, pour la période commençant le 1<sup>er</sup> janvier 2021 », et de la demande adressée à la Commission océanographique intergouvernementale « d'élaborer un plan de concrétisation de la Décennie en concertation avec les États membres, les organismes des Nations Unies et les parties prenantes concernées ».

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

**Le Groupe a noté** avec satisfaction les progrès accomplis au cours de la période intersessions, notamment :

- les trois exercices menés à bien (CARIBEWave 18, IOWave 18 et PACWave 18) et les tests de communication régulièrement effectués ;
- les progrès réalisés dans la transmission des résultats des exercices d'alerte aux tsunamis et des tests de communication à l'Organisation météorologique mondiale (OMM) ;
- le rétablissement et la reconstruction des réseaux d'observation de la mer des Caraïbes à la suite des derniers ouragans ;
- l'adoption du Plan de mise en œuvre pour 2018-2023 du Système d'alerte aux tsunamis et autres risques côtiers dans la mer des Caraïbes et les régions adjacentes (CARIBE-EWS) ;
- l'obtention de la certification Tsunami Ready de la COI par deux circonscriptions de la mer des Caraïbes et des régions adjacentes (Saint-Patrick, Grenade ; Fort-Liberté, Haïti), et l'octroi de nouveaux fonds par le Programme de préparation aux catastrophes du Service d'aide humanitaire de la Commission européenne (DIPECHO) et le Bureau d'assistance en cas de catastrophe à l'étranger (OFDA) de l'Agence des États-Unis pour le développement international (USAID) en vue de la mise à l'essai du programme Tsunami Ready dans les Caraïbes et en Amérique centrale ;
- l'intégration, pour la première fois, d'un scénario d'éruption volcanique dans CARIBEWave 19 (mars 2019) ;
- l'achèvement du guide méthodologique intitulé *Comment préparer, conduire et évaluer un exercice tsunami pour sa communauté ?*, disponible en français, en espagnol et en anglais, et actuellement examiné par le CARIBE-EWS en vue de sa publication finale ;

- l'amélioration du taux de diffusion des messages d'alerte du Système d'alerte aux tsunamis et de mitigation dans l'océan Indien (IOTWMS) ;
- la mise à l'essai du programme Tsunami Ready par l'Inde et Oman ;
- l'obtention de fonds de la Commission économique et sociale des Nations Unies pour l'Asie et le Pacifique (CESAP) afin de renforcer le système d'alerte rapide aux tsunamis dans la région de l'océan Indien du Nord-Ouest ;
- l'intérêt croissant pour la mise à l'essai du programme Tsunami Ready dans le cadre du Système d'alerte rapide aux tsunamis et de mitigation dans l'Atlantique du Nord-Est, la Méditerranée et les mers adjacentes (NEAMTWS) ;
- la candidature de l'Instituto Português do Mar e da Atmosfera (IPMA, Portugal) aux fonctions de prestataire de services relatifs aux tsunamis (TSP) dans le cadre du NEAMTWS ;
- l'appui fourni par la Commission européenne à des projets contribuant au NEAMTWS ;
- l'intention du Centre consultatif pour les tsunamis pour la mer de Chine méridionale (SCSTAC) d'être pleinement opérationnel à la fin de 2019 ;
- le passage complet aux produits améliorés opéré par le Centre consultatif sur les tsunamis dans le Pacifique Nord-Ouest (NWPTAC) à la fin de février 2019 ;
- la mise en fonctionnement, à titre expérimental, du Centre consultatif sur les tsunamis en Amérique centrale (CATAC) en août 2019 ;
- les activités de formation du Centre international d'information sur les tsunamis (CIIT), y compris le programme ITP-Hawaï qui s'est tenu au Chili pour la première fois (août 2018) ;
- l'appui fourni par l'Agence japonaise de coopération internationale (JICA) et le DIPECHO pour le CATAC ainsi que pour le programme Tsunami Ready et la préparation aux tsunamis en Amérique centrale ;
- l'achèvement du Cadre des principaux indicateurs de performance du Système d'alerte aux tsunamis et de mitigation dans le Pacifique (PTWS) ;
- l'élaboration et la présentation, lors de la conférence OceanObs19, d'un livre blanc des communautés intitulé *Ocean Observations Required to Minimize Uncertainty in Global Tsunami Forecasts, Warnings, and Emergency Response* (observations océaniques requises pour réduire autant que possible l'incertitude en matière de prévision, d'alerte et d'intervention d'urgence à l'échelle mondiale concernant les tsunamis).

**Le Groupe a réaffirmé** qu'il était important de collecter des données sur les cas de tsunamis dans le strict respect des protocoles de l'équipe internationale d'étude sur les tsunamis (ITST), tout en continuant de tenir compte des besoins et exigences du pays concerné, d'encourager la communication en temps utile de données et d'informations par les équipes d'étude de façon à soumettre immédiatement un rapport de synthèse au pays hôte pour l'aider à planifier l'intervention et le relèvement, et de demander aux GIC d'animer, en coordination avec les organisations scientifiques en place, des séances spéciales lors de

réunions ou d'ateliers afin de favoriser l'échange des enseignements tirés et la compilation de l'ensemble des données relatives aux cas de tsunamis.

**Le Groupe a approuvé** l'actualisation du [Glossaire sur les tsunamis](#).

**Le Groupe a approuvé** les modifications apportées à la carte de la zone de couverture (voir l'appendice 3 de l'annexe IV).

**Le Groupe a approuvé** la proposition concernant les messages des TSP à la communauté maritime, et demandé aux GIC d'examiner cette proposition en vue de la mettre en œuvre dans leurs bassins respectifs (voir l'appendice 4 de l'annexe IV).

**Le Groupe est convenu** d'élaborer une note conceptuelle de haut niveau qui soit convaincante sur le plan de mise en œuvre et le plan scientifique de la Décennie des Nations Unies pour les sciences océaniques au service du développement durable, et de la diffuser dans le cadre des réunions mondiales et régionales de planification de la Décennie.

**Le Groupe a recommandé** à l'Assemblée d'encourager les États membres à :

- accroître et pérenniser leur appui technique et financier aux systèmes d'alerte aux tsunamis et autres aléas côtiers dans leurs régions respectives ;
- mettre en avant le rôle joué par les organismes nationaux de protection civile et de gestion des catastrophes pour renforcer la chaîne d'alerte et assurer ainsi une réaction optimale des populations, et souligner l'importance de la participation de ces organismes aux forums régionaux techniques et de gouvernance relatifs aux tsunamis ;
- continuer de renforcer la sensibilisation et la préparation aux tsunamis dans les communautés et auprès des autorités, par le biais d'activités de communication, de formation et d'information, de la planification des évacuations, d'exercices d'alerte aux tsunamis et de la mise à l'essai de programmes de reconnaissance tels que Tsunami Ready ;
- densifier les réseaux marégraphiques capables de détecter des tsunamis ainsi que les réseaux sismiques, en particulier à proximité des sources tsunamigènes ;
- développer la communication d'observations en temps réel sur les sources des tsunamis et la détection de ces derniers ;
- collecter des données bathymétriques côtières en haute résolution et développer la communication de ces données afin d'améliorer la caractérisation des tsunamis et autres aléas et risques côtiers, et plaider en faveur de cette démarche par l'entremise de l'Organisation hydrographique internationale (OHI) et des commissions hydrographiques régionales ;
- inscrire les centres nationaux d'alerte aux tsunamis (NTWC) et les points focaux pour l'alerte aux tsunamis (TWFP) au Registre des autorités d'alerte de l'OMM par l'intermédiaire des représentants permanents des pays auprès de cette organisation, pour donner suite à la lettre circulaire de l'OMM.

**Le Groupe a recommandé** à l'Assemblée de donner instruction aux GIC :

- de promouvoir la quatrième édition de la Journée mondiale de sensibilisation aux tsunamis (2019) auprès des États membres et de mettre en avant l'objectif (d) du

Cadre de Sendai, qui vise à réduire nettement la perturbation des services de base et les dommages causés par les catastrophes aux infrastructures essentielles, en mettant l'accent sur les ports et l'évacuation verticale ;

- d'examiner le [Cadre des principaux indicateurs de performance du PTWS](#) et de contribuer à l'élaboration d'un rapport de synthèse en vue de la 13<sup>e</sup> réunion du Groupe (TOWS-WG-XIII) ;
- de poursuivre les activités pilotes de Tsunami Ready reconnues par la COI, notamment en réalisant des enquêtes sur la situation, l'intérêt et l'avis des États membres à l'égard de la mise en œuvre de ce programme.

**Le Groupe a approuvé** les rapports soumis par les équipes spéciales sur la gestion et la préparation en cas de catastrophe et sur les opérations de veille aux tsunamis, et leur a donné instruction de poursuivre leurs activités de surveillance et de réponse pour les tsunamis générés par des sources non sismiques ainsi que leurs efforts en vue de leur possible intégration dans les opérations de veille aux tsunamis.

**Le Groupe a recommandé** à l'Assemblée de prendre les mesures suivantes :

- prolonger les fonctions du TOWS-WG et de ses équipes spéciales sur (i) la gestion et la préparation en cas de catastrophe et (ii) les opérations de veille aux tsunamis, selon les mandats respectivement définis dans la [résolution XXIV-4](#), à l'annexe II du document [IOC/TOWS-WG-VI/3](#), et à l'appendice 1 de l'annex II du document [IOC/TOWS-WG-X/3](#).

**Le Groupe a pris note avec satisfaction** des informations présentées par l'OMM et par le Chef de la Section des observations et services océaniques de la COI au sujet de la réforme de la gouvernance de la Commission technique mixte d'océanographie et de météorologie maritime (JCOMM).

## **Resumen dispositivo**

---

La 12<sup>a</sup> reunión del Grupo de Trabajo sobre sistemas de alerta contra tsunamis y otros peligros relacionados con el nivel del mar y atenuación de sus efectos (TOWS-WG) se celebró en París (Francia) los días 21 y 22 de febrero de 2019 bajo la presidencia del Sr. Alexander Postnov (Vicepresidente de la COI). En la reunión se pasó revista a los avances relacionados con las medidas y decisiones adoptadas por los órganos rectores mediante la decisión [IOC/EC-LI/3](#).

**El Grupo tomó nota** de la decisión de la Asamblea General de las Naciones Unidas, como parte de la resolución general sobre los océanos y el derecho del mar (A/RES/72/73), de "*proclamar el Decenio de las Naciones Unidas de las Ciencias Oceánicas para el Desarrollo Sostenible en el período de diez años que comenzará el 1 de enero de 2021*". En esa misma resolución se "*exhort[ó] a la Comisión Oceanográfica Intergubernamental a preparar un plan de ejecución para el Decenio de las Ciencias Oceánicas en consulta con los Estados Miembros, los organismos especializados, [...] y los interesados pertinentes*".

**El Grupo examinó** informes de los grupos intergubernamentales de coordinación (ICG) de la COI, así como de sus propios equipos de trabajo sobre gestión de desastres y preparación y sobre actividades de vigilancia.

**El Grupo tomó nota** con satisfacción de los progresos obtenidos durante el periodo entre reuniones, a saber:

- realización de tres ejercicios (CARIBE WAVE 18, IOWave 18, PacWave 18) y pruebas periódicas de verificación de las comunicaciones;
- avances en el aprovechamiento compartido de los resultados de las simulaciones de tsunamis y las pruebas de verificación de las comunicaciones con la Organización Meteorológica Mundial (OMM);
- recuperación y reconstrucción de las redes de observación en el Caribe tras los huracanes recientes;
- aprobación del Plan de Aplicación de CARIBE-EWS para 2018-2023;
- reconocimiento Tsunami Ready de la COI de la UNESCO otorgado a dos comunidades del Caribe y regiones adyacentes (St. Patrick, Granada y Fort Liberté (Haití));
- nueva financiación de DIPECHO y USAID/OFDA para poner a prueba el programa Tsunami Ready en el Caribe y América Central;
- inclusión por primera vez de un escenario volcánico en el CARIBE WAVE 19 (marzo de 2019);
- finalización de las directrices metodológicas "*How to prepare, conduct, and evaluate a community-based tsunami response exercise*" (cómo preparar, llevar a cabo y evaluar un ejercicio de respuesta comunitaria a los tsunamis), disponibles en español, francés e inglés, que el CARIBE EWS está examinando con miras a su publicación final;
- mejoras en las tasas de entrega de mensajes de alerta para el IOTWMS;
- puesta a prueba por la India y Omán de Tsunami Ready;

- financiación de la CESPAP para el fortalecimiento de la alerta temprana contra los tsunamis en la región noroccidental del Océano Índico;
- aumento del interés por la realización de pruebas piloto de Tsunami Ready en el NEAMTWS;
- solicitud de acreditación del Instituto Português do Mar e da Atmosfera (IPMA, Portugal) como proveedor de servicios de tsunamis en el NEAMTWS;
- apoyo de la Comisión Europea a proyectos que contribuyen al NEAMTWS;
- intención del Centro de Asesoramiento sobre los Tsunamis en el Mar de China Meridional (SCSTAC) de entrar en funcionamiento completamente a finales de 2019;
- cambio total del Centro de Asesoramiento sobre los Tsunamis del Pacífico Noroccidental (NWPTAC) a Productos Mejorados a finales de febrero de 2019;
- planes del Centro de Asesoramiento sobre los Tsunamis de América Central (CATAC) de iniciar las operaciones de prueba en agosto de 2019;
- incorporación por primera vez en las actividades de formación del ITIC del curso ITP-Hawaii en Chile en agosto de 2018;
- reconocimiento del apoyo de JICA y DIPECHO a CATAC y Tsunami Ready, y preparación en América Central;
- finalización por el PTWS de su marco de indicadores clave del desempeño;
- finalización de un libro blanco comunitario titulado "*Ocean Observations Required to Minimize Uncertainty in Global Tsunami Forecasts, Warnings, and Emergency Response*" (observaciones del océano necesarias para reducir al mínimo la incertidumbre en las predicciones mundiales de tsunamis, las alertas y la respuesta de emergencia) y su presentación en la Conferencia OceanObs19.

**El Grupo reiteró** la importancia de recabar datos sobre los tsunamis en estricta conformidad con los protocolos del equipo internacional de estudio del tsunami (ITST), velando siempre por respetar las necesidades y los requisitos del país, alentar a los equipos de reconocimiento a que compartan oportunamente los datos y la información a fin de facilitar la presentación inmediata de un informe resumido consolidado al país anfitrión para ayudar en la planificación de la respuesta y la recuperación, y pedir a los ICG que promuevan, en coordinación con las organizaciones científicas existentes, la celebración de sesiones especiales en las reuniones/talleres, a fin de fomentar el aprovechamiento compartido de las enseñanzas extraídas y la compilación de datos sobre todos los tsunamis.

**El Grupo aprobó** las actualizaciones del [Glosario de tsunamis](#).

**El Grupo aprobó** cambios en el mapa de la zona de servicio (véase el Apéndice 3 del Anexo IV).

**El Grupo aprobó** la propuesta relativa a los mensajes del TSP para la comunidad marítima y pidió a los ICG que examinaran la propuesta con miras a aplicarla en sus cuencas respectivas (véase el Apéndice 4 del Anexo IV).

**El Grupo convino** en elaborar una nota conceptual convincente de alto nivel para los planes de ejecución y científicos del Decenio de las Naciones Unidas de las Ciencias

Oceánicas para el Desarrollo Sostenible, y en transmitirla a las reuniones mundiales y regionales de planificación del Decenio.

**El Grupo recomendó** a la Asamblea que alentara a los Estados Miembros a realizar lo siguiente:

- mantener y reforzar el apoyo técnico y financiero a los sistemas de alerta contra los tsunamis y otros peligros costeros en sus regiones respectivas;
- hacer hincapié ante los organismos nacionales de protección civil y gestión de desastres en la función que desempeñan en el fortalecimiento de la cadena de alerta para garantizar una respuesta óptima de la comunidad, y poner de relieve la importancia de que los organismos participen en los foros regionales de gobernanza y aspectos técnicos sobre tsunamis;
- seguir afianzando la sensibilización y preparación acerca de los tsunamis en las comunidades y entre las autoridades mediante la comunicación, la planificación de las evacuaciones, los ejercicios relativos a los tsunamis, la formación, la información, y los programas piloto de reconocimiento, como Tsunami Ready;
- densificar las redes de medición del nivel del mar capaces de detectar tsunamis, así como la red sísmica, en particular las fuentes tsunamigénicas cercanas;
- ampliar el aprovechamiento compartido de las observaciones en tiempo real de las fuentes de los tsunamis y de detección de tsunamis;
- recopilar información costera de alta resolución de la batimetría y ampliar el intercambio de datos para mejorar la caracterización de los tsunamis y otros peligros y riesgos costeros, y además promover lo anterior por conducto de la OHI y las comisiones hidrográficas regionales;
- inscribir los centros nacionales de alerta contra los tsunamis (NTWC) y los puntos focales de alerta contra los tsunamis (TWFP) como autoridades de alerta en el "Registro de autoridades de alerta" de la OMM por conducto del Representante Permanente Nacional de la OMM y en seguimiento de la circular de la OMM.

**El Grupo recomendó** a la Asamblea que encargara a los ICG lo siguiente:

- promover la cuarta edición del Día Mundial de Concienciación sobre los Sunamis (2019) entre los Estados Miembros y destacar la meta d) del Marco de Sendái que pone de relieve la reducción considerable de los daños causados por los desastres en las infraestructuras vitales y la interrupción de los servicios básicos, prestando especial atención a los puertos, los muelles y las evacuaciones verticales;
- examinar el [marco de indicadores clave del desempeño del PTWS](#) y hacer aportaciones a un informe consolidado la 13ª reunión del TOWS;
- continuar las actividades piloto de Tsunami Ready con el reconocimiento de la COI de la UNESCO, comprendida la realización de encuestas sobre la situación, el interés y las reacciones de los Estados Miembros en relación con la ejecución de Tsunami Ready.

**El Grupo acogió con agrado** los informes de los equipos de trabajo sobre gestión de desastres y preparación y sobre actividades de vigilancia, y encargó a los equipos de tareas

que prosiguieran sus esfuerzos de vigilancia y respuesta a los tsunamis generados por fuentes no sísmicas y su posible integración en las operaciones de vigilancia de tsunamis.

**El Grupo recomendó** a la Asamblea que adoptara las siguientes medidas:

- ampliar el mandato del TOWS y sus equipos de trabajo en cuanto a i) la gestión de desastres y la preparación, y ii) las operaciones de vigilancia de los tsunamis, partiendo del mandato que figura en la resolución XXIV-4 de la COI (para el TOWS-WG) y el documento IOC/TOWS-WG-VI/3 (Anexo II, para el equipo de trabajo sobre gestión de desastres y preparación), y el mandato del equipo de trabajo sobre actividades de vigilancia de tsunamis, tal como figura en el Apéndice 1 del Anexo II del documento IOC/TOWS-WG-X.

**El Grupo tomó nota con reconocimiento** de la información presentada por la OMM y el Jefe de la Sección de Observaciones y Servicios Oceánicos de la COI sobre la reforma de la gobernanza de la JCOMM.

## **Рабочее резюме**

---

Двенадцатое совещание рабочей группы по системам предупреждения о цунами и других опасных явлениях, связанных с изменением уровня моря, и смягчения их последствий (РГ-СПЦО-XII) состоялось 21-22 февраля 2019 г. в Париже (Франция) под председательством г-на Александра Постнова (заместитель Председателя МОК). Участники совещания оценили прогресс в осуществлении мероприятий и выполнении решений руководящих органов, перечисленных в документе [IOC/EC-LI/3](#).

**Группа приняла к сведению** принятое Генеральной Ассамблеей Организации Объединенных Наций в рамках сводной резолюции по вопросам Мирового океана и морского права (A/RES/72/73) решение «провозгласить 10-летний период, начинающийся 1 января 2021 г., Десятилетием Организации Объединенных Наций, посвященным науке об океане в интересах устойчивого развития, и призвать Межправительственную океанографическую комиссию подготовить план проведения этого Десятилетия в консультации с государствами-членами, органами Организации Объединенных Наций и соответствующими заинтересованными сторонами».

**Группа рассмотрела** доклады, представленные межправительственными координационными группами МОК и собственными целевыми группами по обеспечению готовности к стихийным бедствиям и ликвидации их последствий, а также по наблюдению за цунами.

**Группа с удовлетворением отметила** прогресс, достигнутый в межсессионный период, в том числе следующие аспекты:

- проведение трех учений (Карибская волна-18, Индийская волна-18 и Тихоокеанская волна-18) и регулярных проверок систем оповещения;
- прогресс в обмене информацией о результатах учений по готовности к цунами и проверки систем оповещения с Всемирной метеорологической организацией (ВМО);
- восстановление и реконструкция сетей наблюдения в Карибском бассейне после недавних ураганов;
- принятие плана осуществления КАРИБ-СРП на 2018-2023 гг.;
- завершение программы готовности к цунами в двух общинах в Карибском бассейне и прилегающих регионах (Сент-Патрик, Гренада, и Форт-Либерти, Гаити) с вручением им сертификата ЮНЕСКО-МОК; новые поступления по линии программы DIPESHO и ЮСАИД-ОФДА на осуществление программы готовности к цунами в странах Карибского бассейна и Центральной Америки;
- впервые в программу учений «Карибская волна-19» (март 2019 г.) был включен сценарий извержения вулкана;
- завершение работы над методологическими руководящими принципами подготовки, проведения и оценки учений по реагированию на цунами на уровне общин на французском, испанском и английском языках, которые в настоящее время находятся на рассмотрении КАРИБ СРП перед окончательной публикацией;
- улучшение скорости доставки оповещений в СПЦСПИО;

- апробирование программы готовности к цунами в Индии и Омане;
- финансирование по линии ЭСКАТО ООН для повышения эффективности системы раннего предупреждения о цунами в северо-западной части Индийского океана;
- растущий интерес к программе готовности к цунами в СПЦСВАСМ;
- заявка Португальского института моря и атмосферы (IPMA, Португалия) на аккредитацию в качестве поставщика услуг по цунами в СПЦСВАСМ;
- поддержка Европейской комиссией проектов, способствующих работе СПЦСВАСМ;
- планы Консультативного центра по цунами в Южно-Китайском море (КЦЦЮКМ) начать полномасштабную работу в конце 2019 г.;
- полный переход Консультативного центра по цунами в северо-западной части Тихого океана (КЦЦСЗТО) на усовершенствованные продукты в конце февраля 2019 г.;
- планы Консультативного центра по цунами для Центральной Америки (КЦЦЦА) приступить к работе в тестовом режиме в августе 2019 г.;
- учебные мероприятия ИТИК, в том числе первый курс по учебной программе ИТСУ-Гавайи в Чили в августе 2018 г.;
- признание поддержки по линии ЯАМС и DIPESHO, предназначенной для КЦЦЦА и проведения программы готовности к цунами в Центральной Америке;
- завершение работы СПЦТО над системой ключевых показателей эффективности;
- завершение и представление Конференции по океаническим наблюдениям-2019 совместной аналитической записки под названием «Океанические наблюдения, необходимые для сведения к минимуму неопределенности в глобальных мерах по прогнозированию и предупреждению вызванных цунами чрезвычайных ситуаций, а также по реагированию на них».

**Группа вновь подчеркнула** важное значение строгого соблюдения протоколов Международной группы по наблюдению за цунами (МГНЦ) при сборе данных о происшествиях и учета при этом потребностей и требований каждой конкретной страны, поощрения своевременного обмена данными и информацией между группами наблюдения с целью содействия незамедлительному представлению сводного краткого доклада принимающей стране для оказания ей помощи в планировании мер реагирования и восстановления и просит МКГ в координации с действующими научными организациями оказать содействие в проведении специальных сессий в ходе совещаний/практических семинаров для поощрения обмена информацией о накопленном опыте и составления подборки данных по всем происшествиям.

**Группа одобрила** обновление [гlossария по цунами](#).

**Группа одобрила** внесение изменений в карту зоны обслуживания (см. добавление 3 к приложению IV).

**Группа одобрила предложение** по сообщениям поставщиков услуг по цунами для морского сообщества и просила МКГ рассмотреть это предложение на предмет его осуществления в их соответствующих бассейнах (см. добавление 4 к приложению IV).

**Группа приняла решение** подготовить аргументированную концептуальную записку высокого уровня по плану проведения и научному плану Десятилетия ООН, посвященного науке об океане в интересах устойчивого развития, и направить ее глобальным и региональным совещаниям по планированию Десятилетия.

**Группа рекомендовала** Ассамблее призвать государства-члены:

- увеличить и сохранять техническую и финансовую поддержку систем предупреждения о цунами и других бедствиях в прибрежной зоне в их соответствующих регионах;
- обратить особое внимание национальных учреждений гражданской обороны/чрезвычайных ситуаций на их роль в укреплении системы оповещения в целях обеспечения оптимального реагирования общин и подчеркнуть важность участия этих учреждений в работе региональных руководящих и технических форумов по цунами;
- продолжать работу по повышению осведомленности и готовности общин и органов власти к цунами посредством коммуникации, планирования эвакуации, учений по цунами, подготовки кадров, информирования и проведения программ сертификации, таких как программа «Готовность к цунами»;
- повышать плотность размещения способных распознавать цунами станций наблюдения за уровнем моря и сейсмических станций, особенно вблизи цунамигенных источников;
- расширять обмен данными наблюдений в режиме реального времени за источниками цунами и их обнаружением;
- собирать прибрежные батиметрические данные в высоком разрешении и расширять обмен данными в целях усовершенствования классификации цунами и других опасных явлений и рисков в прибрежных районах, а также распространять призывы к такой работе через МГО и региональные гидрографические комиссии;
- регистрировать национальные центры предупреждения о цунами (НЦПЦ) и координаторов по предупреждению о цунами (КПЦ) в качестве органов по предупреждению в «Реестре органов ВМО по предупреждению» через национального постоянного представителя в ВМО и в соответствии с циркулярным письмом ВМО.

**Группа рекомендовала** Ассамблее поручить МКГ:

- призвать государства-члены провести в 2019 г. четвертый Всемирный день распространения информации о проблеме цунами и обратить их особое внимание на целевой показатель [d] Сендайской рамочной программы, в котором подчеркивается необходимость значительного сокращения наносимого важнейшим объектам инфраструктуры ущерба, а также нарушений работы основных служб и делается упор на портах, гаванях и вертикальной эвакуации;

- рассмотреть **систему ключевых показателей эффективности СПЦТО** и представить материалы для сводного доклада к СПЦО-XIII;
- продолжать пилотные мероприятия по программе готовности к цунами с вручением сертификатов ЮНЕСКО-МОК, включая проведение обзоров положения дел в государствах-членах, их заинтересованности и замечаний по осуществлению программы готовности к цунами.

**Группа одобрила** доклады целевых групп по обеспечению готовности к стихийным бедствиям и ликвидации их последствий, а также по наблюдению за цунами и поручила им продолжать работу по мониторингу цунами несейсмического происхождения и реагированию на них, а также рассмотреть возможность их включения в круг ведения группы по наблюдению за цунами.

**Группа рекомендовала** Ассамблее принять следующие меры:

- продлить срок полномочий СПЦО и ее целевых групп (i) по обеспечению готовности к стихийным бедствиям и ликвидации их последствий и (ii) по наблюдению за цунами с кругом ведения, определенным в резолюции МОК XXIV-4 [для РГ-СПЦО], документе IOC/TOWS-WG-VI/3 [приложение II, для ЦГ-ГСБЛП] и в добавлении 1 приложения II к документу IOC/TOWS-WG-X [для ЦГ-НЦ].

**Группа приняла к сведению с удовлетворением** представленную ВМО и руководителем секции океанических наблюдений и служб информацию о реформе управления СКОММ.

## **1. OPENING AND WELCOME**

### **1.1 OPENING**

1. The Chair, Alexander Postnov, opened the meeting and welcomed participants.

### **1.2 ADOPTION OF AGENDA**

2. The agenda was adopted as given in Annex I.

### **1.3 WORKING ARRANGEMENTS**

3. Mr Thorkild Aarup provided an overview of logistic details for the meeting. All documents and presentations delivered at this meeting are available from the following website: [www.ioc-unesco.org/tows-wg12](http://www.ioc-unesco.org/tows-wg12).

## **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)**

4. Dr Silvia 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), recalled the lessons learnt from the impact of Hurricanes Irma and Maria in 2017, and reported on the slow recovery of essential capabilities to detect earthquakes and tsunamis due to destruction of seismic stations, and 15 tide gauges. On the positive side, the ICG/CARIBE EWS pilot Tsunami Ready and the USA TsunamiReady helped communities to respond.
5. She indicated that ICG/CARIBE EWS is currently organized with a Board of Officers, four Working Groups (WGs) and five Task Teams (TTs) for the period 2018-2019. She further indicated that all of CARIBE-EWS nations and territories have designated Tsunami Warning Focal Points (TWFPs) and half of them have nominated National Tsunami Warning Centres (NTWCs).
6. Ms Chacon recalled that the Hawaii, USA, based Pacific Tsunami Warning Center (PTWC) is the CARIBE-EWS Regional Tsunami Service Provider, which began the issuance of Enhanced Products as of 1 March 2016 and also began covering the domestic service for Puerto Rico and Virgin Islands in 2017 becoming the sole CARIBE-EWS Regional Tsunami Service Provider. She noted that a Sub-Regional Tsunami Service Provider is being developed by Nicaragua, with the name Central America Tsunami Advisory Center (CATAC) that will work under subscription for the Caribbean issuing products in Spanish and in Central America and Panama times. CATAC is expected to start issuing experimental products in August 2019 but will participate in CARIBE WAVE 19 exercise with experimental products.
7. She indicated that the US NWS Caribbean Tsunami Warning Program established by NOAA NWS as a contribution to the CARIBE EWS in 2010 and located in Mayagüez, Puerto Rico, continued to be a key support on sea level, seismic and GNSS monitoring efforts, CARIBE WAVE exercises, and the UNESCO/IOC pilot Tsunami Ready Programme.
8. She recalled that the ICG/CARIBE-EWS decided in 2009 to accept the offer of the Government of Barbados to establish and host a Caribbean Tsunami Information Center (CTIC), which was established in 2013 through an MOU between UNESCO and Government

of Barbados and is currently staffed by Ms Alison Brome, Programme Officer for Coastal Hazards, Tsunami Unit, posted at Bridgetown, Barbados.

9. She reported on the Thirteenth session of the ICG/CARIBE-EWS hosted in Willemstad, Curacao, 24–27 April 2018.
10. The Thirteenth session of the ICG/CARIBE-EWS noted the conclusion of the study carried out by a dedicated Task Team on Global Navigation Satellite System (GNSS) under Working Group 1 on Monitoring and Detection Systems. It demonstrates that real-time GNSS high rate data help to improve earthquake and tsunami detection and assessment. The TT was transformed into a subgroup of WG1 to incorporate GNSS stations into the Warning System.
11. Dr Chacon reported that the ICG/CARIBE-EWS Group of Experts to address other coastal hazards in the Caribbean and adjacent regions met in Cartagena, Colombia, on 28–30 November 2018 and will report on its recommendations at the Fourteenth session to be held in Costa Rica 8-11 April 2019.
12. She also reported that to support the IOC Assembly approved CARIBE EWS Tsunami Ready Guidelines, there are several initiatives in progress. Tsunami Ready pilots were implemented in 2018 in Grenada, Haiti and Barbados. Funding has been secured for two additional Pilots in Jamaica and Belize with funding (USD 500,000) provided by USAID/OFDA, to be implemented by CTWP. UNESCO/IOC was granted two DIPECHO projects by the European Union to develop Tsunami Ready pilots in Central America (EUR 400,000) through the San José Office of UNESCO, and through CTIC (EUR 500,000) in Antigua, Barbados, Dominican Republic, Saint Vincent and the Grenadines and Trinidad and Tobago.
13. Dr Chacon informed that a Task Team on Volcanic Sources for Tsunamis was created in 2016 after the volcanic crisis of submarine volcano Kick'em Jenny in 2015. The work performed by this TT led to the use of a volcanic scenario for the CARIBE WAVE exercise 2019, which became more relevant after the Sunda strait tsunami in November 2018.
14. Dr Chacon informed that over 600,000 people from Bermuda through Brazil and across the entire Caribbean participated in the CARIBE WAVE 18 tsunami exercise on March, 15. The next Exercise CARIBE WAVE 19 scheduled on 14 March 2019 will consider two scenarios for the Member States to choose from: an earthquake located off the North Panama Deformed Belt and a simulated volcanic source at Kick'em Jenny.
15. In response to a question of Dr Schindele (France), Dr Chacon reported that the Task Team on Volcanic Sources under the Chairship of Dr Valerie Clouard (France) is scheduled to deliver a second report at the fourteenth session, and is available to exchange information and experiences with other ICGs.

#### **Recommendations:**

16. The TOWS-WG **noted** that tsunami community preparedness is essential and **recommended giving special priority** to the UNESCO/IOC Tsunami Ready pilot, considering its critical role in saving lives and livelihoods.
17. The TOWS-WG **acknowledges that** coastal bathymetric data is essential on the characterization of the threat and on the development of tsunami evacuation maps (part of the UNESCO/IOC CARIBE EWS Tsunami Ready Guidelines) and **recommends giving**

**special priority** to the collection of such data considering their multiple applications on preparedness for tsunamis and other coastal hazards.

### **2.1.2 Indian Ocean Tsunami Warning and Mitigation System (IOTWMS)**

18. Dr Yuelong Miao made the presentation on IOTWMS on behalf of the Chair. He provided an overview of the structure of the ICG/IOTWMS which comprises a Steering Group, two technical Working Groups, one sub-regional Working Group, a Task Team for the IOWave18 exercise and a Task Team for the Capacity Assessment of Tsunami Preparedness. IOTWMS Secretariat is supported by funding from the Bureau of Meteorology, Government of Australia, and the IOTIC is supported by BMKG until 2022 under a partnership agreement between with IOC/UNESCO. Intergovernmental coordination has been substantially enhanced through Integrated meetings and activities held during the intersessional period.
19. Dr Miao reported that seismic and sea level monitoring networks, including tide gauges and tsunami buoys, have greatly expanded in the Indian Ocean. There are three operational Tsunami Service Providers from Australia, India and Indonesia providing interoperable tsunami threat information to the National Tsunami Warning Centres (NTWCs), which in turn are responsible for provision of detailed tsunami threat information for their coastal regions. Tsunami detection, warning and dissemination has been strengthened with TSPs incorporating several technical enhancements in their procedures and products including launching of new public website by TSP-Australia. Routine communications tests conducted every June and December ensured operational lines of communication between TSPs and the NTWCs. Databases of the IOTWMS broadband seismometer and sea level stations has been updated.
20. On Tsunami Risk, Community Awareness and Preparedness, Dr Miao reported that there have been many achievements through the activities of the Indian Ocean Tsunami Information Centre (IOTIC) and the Secretariat, including piloting of the Indian Ocean Tsunami Ready (IOTR). Capacity Development activities, including trainings on Standard Operating Procedures (SOPs) and Tsunami Evacuation Maps, Plans and Procedures (TEMPP), have seen considerable improvement, with 5 trainings conducted in the inter-sessional period covering 21 and 22 Member States respectively.
21. IOWave18 has been regarded as highly successful with all 24 active Member States participating and 11 conducting community evacuations involving about 115,000 people. There has been substantial progress towards capacity assessment of tsunami preparedness, finalisation of the Indian Ocean Tsunami Ready guidelines, piloting of IOTR in India and Oman, all of which contribute significantly towards enhancing community preparedness and response. A post-IOWave18 workshop was conducted to share lessons learnt from the community evacuations and IOTR piloting.
22. Dr Miao mentioned that current and future work of the ICG/IOTWMS is focused towards system sustainment and enhancements, strengthening early warning in the Makran region as well as enhancing community awareness and response. There are several gaps in observing networks where IOC can help by advocating wider data sharing within Member States. The recent Palu and Sunda Strait tsunamis once again highlighted the urgent need to enhance community preparedness for near-field tsunamis, and at the same time strengthen warning systems to be able to warn for tsunamis caused due to landslides and volcanic activities. The Indian Ocean Tsunami Ready (IOTR) programme that provides a structured framework for enhancing the state of community readiness has attracted recent interest of several Member States in the Indian Ocean and needs to be encouraged.

23. Upcoming activities include the 12<sup>th</sup> session of the ICG/IOTWMS scheduled during 09–12 March 2019 with a back to back Expert Consultation on Scientific Tsunami Hazard Assessment of the Makran Subduction Zone on 8 March 2019 in Kish Island, Iran (Islamic Republic of).

**Key Messages for Recommendations:**

- Advocate continued efforts from all MSs in order to sustain and make enhancements to the IOTWMS;
- Encourage all MSs to share data from additional seismic, sea level, GNSS and other relevant data to enable the effective operation of the tsunami warning systems;
- Greater efforts required to handle local source tsunamis in the wake of the two recent Indonesian events in Palu and Sunda Strait, both in the detection and warning, and in raising public awareness and preparedness;
- Note the IOTR piloting currently taking place in a few Indian Ocean countries and seek IOC's continued support in this endeavour.

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

24. Mr Gerassimos Papadopoulos reported on this item. The 15<sup>th</sup> session of ICG/NEAMTWS was held from 26 to 28 November 2018 in Paris, France. A strategy for NEAMTWS has been developed to guide the future development of NEAMTWS. The strategy provides a proposed action plan with three phase implementation: (1) NEAMTWS website maintenance and updates; (2) redevelopment of NEAMTWS website; and (3) development of NEAMTWS as a training center/platform. The strategy was discussed and ICG/NEAMTWS endorsed that phases 1 and 2 should start, while phase 3 will depend on further study/elaboration and additional funding.
25. A number of EU funded projects contribute to the further development of NEAMTWS:
26. The European Plate Observing System (EPOS) is a long-term plan to facilitate integrated use of data, data products, and facilities from distributed research infrastructures for solid Earth science in Europe. EPOS has been designed with the vision of creating a single distributed pan-European infrastructure for solid Earth science to support a safe and sustainable society. EPOS mission is to integrate the diverse and advanced European Research Infrastructures for solid Earth relying on new e-science opportunities to monitor and unravel the dynamic and complex Earth System. EPOS will facilitate sharing the outcomes of research, not solely by linking data to publications, by guaranteeing data traceability and re-use, but also in convincing scientists to share the products of their investigations. There are currently efforts under way to also include a tsunami component in EPOS, and NEAMTWS is linking with EPOS to that effect. More information about EPOS is available at: <https://www.epos-ip.org/>
27. A European Cooperation in Science and Technology (COST) action project has been funded. It is a four years project to accelerate global science in tsunami hazard and risk analysis in the NEAM region. The project was approved in November 2018. Tsunami experts in NEAM region are welcome to participate in the project with endorsement from their national representative. The project is coordinated by Prof. Joern Behrens from the University of Hamburg, Germany.

28. The Last Mile project is funded by the DG-ECHO and implemented with the joint effort between the European Commission Joint Research Center (JRC), KOERI (Turkey) and NOAA (Greece) for the development of local tsunami warning systems in the coastal islands of Greece and the Bodrum area of Turkey.
29. Mr Papadopoulos highlighted that gaps remain in the NEAMTWS seismic and sea level detection network for North Africa. IOC has organized information meeting on NEAMTWS in Rabat in collaboration with the Islamic Education, Scientific, and Cultural Organisation (ISESCO), the UNESCO Rabat Office and the UNESCO SC Sector (12-13 November 2018).
30. Mr Papadopoulos also informed that the Instituto Português do Mar e da Atmosfera (IPMA), which presently serves as a candidate Tsunami Service Provider, has applied to be accredited Tsunami Service Provider. He also highlighted that the next NEAMWave Tsunami Exercise is planned for 2020. A number of local/national exercises have also been carried out in France, Greece and Turkey. Israel will carry out an earthquake and tsunami exercise on 12 March 2019 focusing on schools along Israel's Mediterranean coast which is expected to include 10,000 students.
31. **Recommendations:** Good effort on upstream component – but deficits on downstream activities. Mr Papadopoulos emphasized the need to increase the participation of Member States in the ICG/NEAMTWS activities, with particular focus on the downstream component concerning tsunami education, awareness and preparedness, and to explore the adaptation of community preparedness and recognition programmes, such as Tsunami Ready for the NEAM region, including Tsunami Hazard and Tsunami Evacuation Maps, Plans, and Procedures (TEMPP). He emphasized that this is a particular responsibility of national civil protection authorities.

#### 2.1.4 Pacific Tsunami Warning and Mitigation System (PTWS)

32. Dr Wilfried Strauch (Nicaragua), Chair (a.i.) of the Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System (ICG/PTWS), reported for ICG/PTWS. He recalled the Area of Responsibility (AoR) of the ICG/PTWS and its governance structure. He indicated that the PTWS has a Steering Committee, three technical Working Groups, four regional working groups and six Task Teams.
33. He recalled the key role of its two Tsunami Service Providers (TSPs), the Pacific Tsunami Warning Center (PTWC) and the North West Pacific Tsunami Advisory Center (NWPTAC), providing details about the Enhanced PTWS Products provided by PTWC and the current seismic and sea level monitoring network available to TSPs. He reported on eight earthquakes with tsunami measurements recorded in 2018, within the PTWC EQ source zone and mentioned the deadly earthquake and tsunami in Celebes Sea, Palu area, 28/09/2018, slightly outside the PTWC EQ source zone and under the responsibility of Indonesia NTWC.
34. Dr Strauch reported as well as on the International Tsunami Information Center (ITIC) -IOC training activities in 2018-2019, including on the successful ITP-Hawaii in Chile (hosted by SHOA in Valparaiso) that provided training on End-to-End Tsunami Early Warning Systems to 35 persons from 12 countries (Pacific, Caribbean, Europe).
35. Dr Strauch recalled that for the current intersessional period and in accordance with the decisions of the Twenty-seventh Session of the Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System, there will be a more balanced effort of the ICG/PTWS across: a) risk and hazard assessment; b) warning systems; and c) awareness and preparedness. Including through a more proactive role in the field of Disaster

Management through the initiatives of TEMPP (Tsunami Evacuation Mapping and Planning) and Tsunami Ready pilots.

36. He reported that PTWS organised an Exercise Pacific Wave 2018 (PacWave18) from September to November 2018, in support to the International Disaster Risk Reduction Day (13 October) and the World Tsunami Awareness Day (5 November). Regular monthly communication test were organised by PTWC and NWPTAC organised two regular test per year.
37. Dr Strauch noted that the ICG/PTWS Steering Committee and Working Groups/Task Teams met on 4-8 June 2018, in Honolulu, USA, with detailed orientations decided for the Working groups and Task Teams to comply with the decisions and recommendations of ICG/PTWS XXVII.
38. Dr Strauch indicated that at its 26<sup>th</sup> session, the ICG/PTWS agreed establishing a Task Team to develop a framework for future goals and performance monitoring measures for TSPs, NTWCs and national warning systems. The Framework has to be aligned with the PTWS Medium Term Strategy and the Sendai Framework for Disaster Risk Reduction. The Framework was completed in 2018 and distributed to member states, TSPs and NTWCs in February 2019. Main goals that summarize the overall objectives for the performance monitoring are:
  - Goal 1: Understanding and managing tsunami hazard risk;
  - Goal 2: Tsunami detection, warning & dissemination;
  - Goal 3: Enhancing tsunami preparedness for effective community response;
  - Goal 4: International coordination and cooperation.
39. Member State Guidance for National Reporting against the Framework was prepared. The first online survey – to be completed by Member States and ITPs by 15 March 2019 to support reporting on the status of the PTWS to the ICG/PTWS in April 2019.
40. Dr Strauch recalled that the ICG/PTWS also decided to establish a Task Team on Tsunami Evacuation Maps, Plans, and Procedures (TEMPP) and Tsunami Ready to develop a new programme aimed at facilitating tsunami resilience through community preparedness, specifically through the preparation of tsunami evacuation maps and associated response plans for tsunami-vulnerable coastal communities. A Pilot training course was localised in Honduras (Central America) in 2016-2017 that led to first applications of knowledge in Nicaragua, in 2018/2019 done by personnel trained in the course. He was glad to report that the situation has improved greatly in terms of staff capabilities in this field thanks to these efforts.
41. He recalled that the ICG also endorsed the Northwest Pacific Tsunami Advisory Center's (NWPTAC) plan to begin issuing in experimental mode its new NWPTAC Enhanced products in 2017, which is now complete. As the experience was positive, NWPTAC will do the full change over to Enhanced Products, including a change on Area of Service (AoS) as from 28 February 2019. A *Users' Guide for the Northwest Pacific Tsunami Advisory Center (NWPTAC): Enhanced Products for the Pacific Tsunami Warning System* (IOC Technical Series No 142) has been published by IOC.
42. Dr Strauch reported that the 7<sup>th</sup> session of the ICG/PTWS Regional Working Group on Tsunami Warning and Mitigation System in the South China Sea Region (WG-SCS) was held in Hanoi, Vietnam, on 6-8 March 2018. The PTWS WG-SCS organised a Regional

Training Workshop on Tsunami SOPs and ICG/PTWS SCS Tsunami Advisory Products in Beijing, China, on 8-11 May 2018. The WG-SCS also decided to commence the trial operation of the South China Sea Tsunami Advisory Center (SCSTAC), which began on 26 January 2018, with full operation planned in late 2019.

43. He reported on the DIPECHO project “Building resilient communities and integrated Early Warning Systems for tsunamis but also on storm hazards in Central America” lead by UNESCO San Jose Office and IOC, that was very successful and provided very useful support for developing SOPs and community level SOPs and drills in El Salvador, Guatemala, Honduras and Nicaragua.
44. He noted that the 4<sup>th</sup> session of the ICG/PTWS Regional Working Group on Tsunami Warning and Mitigation System in the Pacific coast of Central America (WG-CA) took place in Managua, Nicaragua, on 11 February 2019. He noted a DIPECHO project by the European Union to develop Tsunami Ready pilots in Central America (EUR 400,000) through the San José Office of UNESCO and reported on progress of Central American Tsunami Advisory Center CATAC, with the support of JICA/Japan. Progress includes new Seismic and Sea level Stations in Nicaragua and Central America, upgraded Datacentre with Seismic/Tsunami processing capacity, 24/7 personnel extended to 15 watch standers, capacitation of personnel locally, and in Japan. The PTWS WG-CA recommended ICG/PTWS to start experimental operation of CATAC in August 2019.
45. Mr Strauch informed that the ICG/PTWS 28<sup>th</sup> session is scheduled near Managua, Nicaragua, on 2-5 April 2019, organised by UNESCO/IOC, Nicaraguan Geosciences Institute INETER and the Central American Tsunami Advisory Center (CATAC).
46. In response to a question by Mr Aarup (IOC Secretariat), Mr Strauch indicated that CATAC will deliver messages and tsunami information products in Spanish and in Central America and Panama times.
47. Ms Hillebrandt inquired about the availability of data from sea level stations provided through CATAC. Dr Strauch indicated the stations are being installed and all data will be delivered through the IOC Sea Level Monitoring Stations Facility.
48. Dr Chacon noted that the ICG/CARIBE EWS and ICG/PTWS are being hosted both in Central America in subsequent weeks with the aim of facilitating participation of Central America countries.
49. **Recommendation:** The Group indicated that data exchange continues to be relevant for tsunami early warning operations and encouraged Member States to reinforce cooperation in this area.

## 2.2 REPORT OF NON-IOC BODIES

### 2.2.1 World Tsunami Awareness Day (UNISDR)

50. Ms Brigitte Leoni provided a report on the World Tsunami Awareness Day (5 November 2018 in accordance with UN GA Resolution A/70/203). This was the third edition. Awareness about the day is steadily increasing. She thanked the Tsunami community for its contributions towards the WTAD.
51. The 2019 WTAD theme will focus on Sendai Target (d) “Protecting critical infrastructure against tsunami risk”. The theme will also be aligned with the “2019 Build to last campaign” (#BuildToLast).

52. It is currently estimated that US\$6 trillion will have to be invested in infrastructure (urban, land-use and energy systems) every year until 2030 (Global Commission on the Economy and Climate, 2014). Most of these infrastructure will be built on coastal areas and will need to be built to last to avoid increasing disaster losses. Many critical infrastructure such as airports, nuclear plants, communication transmitters, bridges and roads are located near coastal areas at elevations lower than 10 m. Today there are over 1,400 aerodromes worldwide that are used for international air transport (Source ICAO and NOAA). 25 % of those are located near the coasts and that percentage reaches 45 % in Asia which represents the most exposed region of all. Investing in #BuildToLast infrastructure and early warning systems are key to save more people and their assets in the future.
53. The objectives for WTAD 2019 will be (i) to raise awareness on the benefits of safe tsunami infrastructures; (ii) to evidence progress on tsunami early warning and disaster risk reduction measures to reduce tsunami infrastructure losses; (iii) reaffirm the interlinkage between DRR and SDGs and how target “d” reduces poverty and protect economic growth and sustainable development. Ms Leoni appealed for strong support of IOC/UNESCO and partners towards these objectives.
54. Activities for WTAD 2019 will focus on (i) raising awareness on safer buildings against tsunamis to save more lives in the future and better protect people’ assets; (ii) highlighting initiatives to improve road infrastructure resilience, vertical buildings (i.e. Washington, D.C.), mangrove plantation; (iii) documenting how buildings were resilient against tsunamis in Indonesia (2004, 2019) and what are the current initiatives to make infrastructure resilient to tsunamis; (iv) working closely with IOC/UNESCO and other partners UN Habitat, the Rockefeller center, World Bank and private sector to promote infrastructure resilience; (v) motivating partners and national governments to organize events, workshops and create the buzz around the WTAD; and (vi) collecting and compiling stories and good case studies.
55. The main messages for WTAD 2019 will be investing in early warning systems and safe buildings reduce disaster losses and long term development gains.
56. **Recommendations:** Advocate WTAD and highlight target [d] of the Sendai Framework that stress substantial reduction of disaster damage to critical infrastructure and disruption of basic services and with an emphasis of ports, harbors and vertical evacuation.

### 2.2.2 World Meteorological Organization

57. David Thomas and Cyrille Honoré reported on this item.
58. David Thomas highlighted the importance of Tsunami Communication Test exercises for WMO and expressed appreciation of WMO to participate to these. He encouraged all ICGs to alert WMO on communication exercises. The exercises help monitor, identify gaps and improve performance concerning delivery of Tsunami alert messages on the GTS. Based on advance notification of exercises WMO will inform the Global Information System Centres that form the backbone of the GTS/WMO Information System.
59. David Thomas illustrated performance issues with examples from the report of the IOTWMS Communication Test Exercise on 13 December 2017: (i) The GTS reception rate was 74%, up from 68% in the previous test, and similar to most tests in the previous 4 years which were generally around 70-80%; (ii) Sixteen of the 20 NTWCs received GTS messages, including Bangladesh which had not received any in the previous two tests. Maldives and Thailand did not receive any GTS messages although they had in the previous test, and Comoros and Iran again did not receive any GTS messages as in the previous test (Iran has no GTS connection); (iii) TSP India's GTS messages were received by 16 NTWCs, and Australia's and Indonesia's by 15 NTWCs each; (iv) GTS message delay times continued to

be low in this test, with most messages received within 1-3 minutes and only a few messages delayed longer than this. The only significant delays reported were in two of TSP Indonesia's GTS messages to Pakistan, which were delayed by exactly 5 hours. It's possible this was a reporting error because the reception times match the local Pakistan times (UTC+5 hours).

60. David Thomas reminded the TOWS-WG about WMO-IOC International Forum of Users of Satellite Data Telecommunication Systems (Satcom Forum) which covers a wide user basis, and address remote data communication requirements – including tariff negotiations as needed – for automatic environment observing systems. He appealed for IOC for IOC to identify representative to replace Tom Gross (from the IOC GOOS Office) who has retired.
61. David Thomas also reminded earlier requests from TOWS and IOC to encourage Tsunami Service Providers and National Tsunami Warning Centres to register with the WMO Register of Alerting Authorities via the National WMO representative. Only few appear to have done so far. He emphasized that relevant authorities include Tsunami in their authorisation abstract.
62. Cyrille Honoré provided an update on the WMO Coastal Inundation Forecasting Demonstration Projects (Bangladesh, Caribbean, Fiji and Indonesia). CIFDP has recently been evaluated and the evaluation report is available at: [https://www.jcomm.info/index.php?option=com\\_content&view=article&id=373](https://www.jcomm.info/index.php?option=com_content&view=article&id=373). JCOMM-5 and the 15<sup>th</sup> session of the WMO Commission for Hydrology (CHy) endorsed the assessment of CIFDP which recommended to continue as 'Coastal Inundation Forecasting' with stronger links to tsunami early warning, and more inclusive MHEWS (with links to severe weather and flash flood). A follow on report has examined the synergies of CIFDP along with the Severe Weather Forecasting Demo Project (SWFDP) and the Flash Flood Guidance System. That report is available at: [http://www.wmo.int/pages/prog/www/DPS/documents/PartB-Concept\\_IntegratedMHEWSforFFGSCIFDPandSWFDPwithCNAttachment-final1.pdf](http://www.wmo.int/pages/prog/www/DPS/documents/PartB-Concept_IntegratedMHEWSforFFGSCIFDPandSWFDPwithCNAttachment-final1.pdf). The reports will be presented to the WMO Congress with a recommendation (See Res 5.1/4) for an MHEWS, drawing on the 3 initiatives and transitioning these initiatives out of the demonstration phase: [http://meetings.wmo.int/cg-18/\\_layouts/15/WopiFrame.aspx?sourcedoc=/cg-18/English/1.%20DRAFTS%20FOR%20DISCUSSION/Cg-18-d05-1-MHEWS-draft1\\_en.docx&action=default](http://meetings.wmo.int/cg-18/_layouts/15/WopiFrame.aspx?sourcedoc=/cg-18/English/1.%20DRAFTS%20FOR%20DISCUSSION/Cg-18-d05-1-MHEWS-draft1_en.docx&action=default)
63. The 18<sup>th</sup> World Meteorological Congress (June 2019) will take decisions on the future structure of WMO – this prompts change for JCOMM. In 2018, the IOC Executive Council and the WMO Executive Council established a Joint WMO-IOC Consultation Group to discuss the Reform of JCOMM. Co-chairs Ariel Troisi (Argentina) and Louis Uccellini (USA). Although prompted by the WMO Reform this is an opportunity to look at JCOMM and reshape it for the future. The WMO Reform emphasizes an earth system approach, efficiency, partnership, connection to research, ultimately for better provision of services. The full background for the WMO Governance Review and Implications for JCOMM, GCOS, GOOS, and WCRP are described in greater details in the IOC document [IOC/INF-1359](#).
64. Cyrille Honoré and Albert Fischer (Head of the IOC Ocean Observation and Services Section) provided an update on the ongoing discussions in the Joint WMO-IOC Consultation Group. A report will be submitted to the 18<sup>th</sup> session of the World Meteorological Congress and the 30<sup>th</sup> session of the IOC Assembly by the co-chairs of the Consultation Group on the Reform of JCOMM. The outcomes of the joint consultation are converging towards (i) Establishment of a Joint WMO-IOC Collaborative Board as a high-level coordination mechanism with broader engagement of the key relevant bodies of the WMO and IOC; (ii) Incorporation of current JCOMM functions and activities in marine observations, data

management, forecasting systems and services in relevant WMO and IOC bodies, with closer links with co-sponsored programmes (GCOS, GOOS, WCRP). Further details about the consultation, findings and recommendations are provided in the IOC Document IOC/INF-1373 Report of the Co-Chairs of the Joint WMO-IOC Consultation Group on the Future of JCOMM.

65. While TOWS-WG is not directly implicated by the organisational changes in JCOMM and its program areas, it is anticipated that the proposed reform will see a “Standing Committee on Marine Meteorology and Oceanography Services” in the proposed WMO Commission for Application and Services, that will comprise of working groups reflecting the current work of the JCOMM Services & Forecast Systems Programme Area (SFSPA) (with the exception of Expert Team on Operational Ocean Forecast Systems, which is foreseen to continue under GOOS with a close link to the Commission for Observation, Infrastructure, and Information Systems (COIIS) seamless forecasting and prediction activity). These activities are expected to maintain a strong link with the TOWS-WG.
66. Christa von Hillebrandt inquired about WMO travel support towards Caribbean Met Service institutions that are designated Tsunami Warning Focal Points in order for those to attend training activities under the CARIBE-EWS. WMO representatives indicated that will inquire with WMO Capacity Building section concerning that inquiry.

### **3. REVIEW OF PROGRESS**

#### **3.1 STATUS OF IMPLEMENTATION OF IOC DECISION EC-LI/3.3(III)**

67. Thorkild Aarup reported briefly on Decisions adopted at the 51st IOC Executive Council (June 2018) and highlighted responses to a few of the decision points.
68. In terms of resources – then three proposals had been awarded to IOC (i) on preparedness and awareness for Central America (April 2018, EU DIPECHO); (ii) Caribbean (August 2018, EU DIPECHO); and (iii) UNESCAP with a focus on preparedness and awareness for Makran zone (to start mid 2019). He also highlighted recent support from the USAID/OFDA towards piloting Tsunami Ready program in the Caribbean. Several countries continue to provide national investments in developing national Tsunami resilience.
69. In terms of promotion of tsunami awareness – then IOC has continued to promote tsunami awareness in communities and among authorities through communication and tsunami wave exercises, training, information, and community preparedness and recognition programmes and the many publications and news items and media alerts attest to that. On 16 October 2018 IOC/UNESCO and UNISDR convened a high-level panel event on Reducing Human and Economic Impacts from Tsunamis at UNESCO as a contribution to the 3rd edition of World Tsunami Awareness Day (commemorated on 5 November 2018). The meeting exemplified real impacts of tsunamis for SIDS and their coastal tourism sector, and underscored the need for continued community preparedness to avoid complacency.
70. In terms of advocating desification of detection network – then IOC has continued this advocacy. Some progress has been seen over recent year in the Mediterranean where the JRC has provided a number of tide gauges. The IOC has highlighted importance of detection network to national delegations from North African countries. Several efforts are under way to repair damaged stations in Puerto Rico and other island states following the hurricanes in 2018. Liason activities with IHO regional hydrographic commissions have continued (notably Caribbean, Mediterranean and Black Sea and Indian Ocean) providing progress reports on the regional Tsunami Warning Systems while stressing the need for maintaining the Tsunami detection network.

71. The Summary Statement and Recommendations from the symposium “Advances in Tsunami Warning to Enhance Community Responses” (12–14 February 2018, Paris, France) has been distributed to Member States of IOC Assembly and Member States of each ICG (IOC/BRO/2018/3).
72. IOC has encouraged Member States to register their National Tsunami Warning Centers in the WMO alert registry
73. Thorkild Aarup also highlighted that ICG/PTWS has completed its key performance indicators (KPIs) framework and it is now ready to share with other ICGs and it is expected that a consolidated report can be prepared for TOWS-WG-XIII (February 2020). The PTWS KPI framework is available at:  
[http://www.ioc-tsunami.org/index.php?option=com\\_oe&task=viewDocumentRecord&docID=23532](http://www.ioc-tsunami.org/index.php?option=com_oe&task=viewDocumentRecord&docID=23532). (This topic is also discussed in the report of the Inter-ICG Task Teams).

#### **4. REPORTS OF THE INTER-ICG TASK TEAMS**

##### **4.1 INTER-ICG TASK TEAM ON DISASTER MANAGEMENT AND PREPAREDNESS**

74. David Coetze reported on the outcome of the Inter-ICG Task Team on Disaster Management and Preparedness which met on 19 and 20 February 2019 in Paris, France. The full summary of the Task Team meeting and its recommendations are provided in Annex III of this report.

##### **4.2 INTER-ICG TASK TEAM ON TSUNAMI WATCH OPERATIONS**

75. Charles McCreery reported on the outcome of the Inter-ICG Task Team on Tsunami Watch Operations which met on 19 and 20 February 2019 in Paris, France. The full summary of the Task Team meeting and its recommendations are provided in Annex IV of this report.

#### **5. OTHER ISSUES**

76. Christa von Hillebrandt (as member of the Executive Planning Group for the Ocean Decade) provided a presentation on the developments of the United Nations Decade of Ocean Science for Sustainable Development (2021-2030). The IOC has been tasked by the United Nations General Assembly (UNGA) to prepare and coordinate the development of an Implementation Plan for the Decade during the Preparatory Phase (2018-2020). This Implementation Plan will be submitted for approval to the 75th session of the UNGA in autumn 2020. The planning process is guided by the revised Roadmap document endorsed by the 51<sup>st</sup> session of the IOC Executive Council (July 2018): [http://ioc-unesco.org/components/com\\_oe/oe.php?task=download&id=38665&version=1.0&lang=1&format=1](http://ioc-unesco.org/components/com_oe/oe.php?task=download&id=38665&version=1.0&lang=1&format=1).
77. She reminded that the Summary Statement from the symposium “Advances in Tsunami Warning to Enhance Community Responses” (IOC/UNESCO Symposium, 12–14 February 2018, IOC/BRO/2018/3) and the OceanObs 2019 Community White Paper "Ocean Observations Required to Minimize Uncertainty in Global Tsunami Forecasts, Warnings, and Emergency Response" already recommend actions and enabling Tsunami research program activities that can offer a transformative contribution to the Decade and towards strengthened Tsunami preparedness and an enhanced Tsunami Early Warning Systems.

**6. DATE AND PLACE OF THE NEXT MEETING**

78. The Chair and Technical Secretary will establish when and where the 13<sup>th</sup> session of TOWS-WG will take place.

**7. CLOSURE OF MEETING**

79. Mr Postnov noted that this would be the last TOWS-WG meeting that he would chair as he will conclude his second term as Vice Chair for IOC in June 2019 at the end of the 30<sup>th</sup> IOC Assembly. The TOWS-WG thanked him very warmly for his work and provided a round of applause.
80. The Twelfth meeting of TOWS-WG was closed at 13:00 on 22 February 2019.

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

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

2.1.2. Indian Ocean Tsunami Warning and Mitigation System (IOTWMS)

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

2.1.4 Pacific Tsunami Warning and Mitigation System (PTWS)

2.2 REPORT OF NON-IOC BODIES

2.2.1 World Tsunami Awareness Day (UNISDR)

2.2.2 Report from World Meteorological Organization (WMO)

**3. REVIEW OF PROGRESS**

3.1 STATUS OF IMPLEMENTATION OF IOC DECISION EC-LI/3.3(III)

**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. OTHER ISSUES**

**6. DATE AND PLACE OF THE NEXT MEETING**

**7. CLOSURE**

## ANNEX II

### DECISIONS AND RECOMMENDATIONS

The Twelfth Meeting of the Working Group on Tsunamis and Other Hazards Related to Sea-Level Warning and Mitigation Systems (TOWS-WG-XII) was held in Paris, France, on 21-22 February 2019 under the Chairmanship of Mr Alexander Postnov (IOC Vice-Chair). The meeting evaluated progress in actions and decisions taken by the Governing Bodies through IOC-EC-LI/3.

**Noting** the decision by the UN General Assembly, as part of the Omnibus Resolution for Oceans and the law of the sea (A/RES/72/73), to “*proclaim the United Nations Decade of Ocean Science for Sustainable Development for the 10-year period beginning on 1 January 2021, and called upon the Intergovernmental Oceanographic Commission to prepare an implementation plan for the Decade in consultation with Member States, UN Bodies, and relevant stakeholder*”,

**The Group reviewed** reports by the IOC Intergovernmental Coordination Groups as well as its own Task Teams on Disaster Management and Preparedness and Watch Operations.

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

- Three exercises carried out (CARIBE WAVE 18, IOWave18, PacWave18) and regular communication tests performed,
- Progress in sharing the results of Tsunami exercises and communication tests with World Meteorological Organization (WMO),
- Recovery and reconstruction of observation networks in Caribbean following recent hurricanes,
- CARIBE-EWS Implementation Plan for 2018-2023 adopted,
- Two communities in the Caribbean and Adjacent Regions (St. Patrick, Grenada, and Fort Liberte, Haiti) achieved UNESCO-IOC Tsunami Ready recognition, New funding from DIPECHO and USAID/OFDA towards piloting Tsunami Ready program in the Caribbean and Central America,
- A volcanic scenario will be included in CARIBE WAVE 19 (March 2019) as a first,
- Methodological guidelines “How to prepare, conduct, and evaluate a community-based tsunami response exercise” has been completed and is available in French, Spanish and English and under consideration of CARIBE EWS for final publication,
- The improvements in alert message delivery rates for IOTWMS,
- India and Oman testing Tsunami Ready,
- UNESCAP funding for Strengthening Tsunami Early Warning in the North West Indian Ocean Region,
- Growing interest for piloting Tsunami Ready in NEAMTWS,

- Instituto Português do Mar e da Atmosfera (IPMA, Portugal) seeking accreditation as a Tsunami Service Provider in NEAMTWS,
- European Commission support towards projects contributing to NEAMTWS,
- South China Sea Tsunami Advisory Centre (SCSTAC) intent to go to full operation in late 2019,
- North West Pacific Tsunami Advisory Center (NWPTAC) to make full changeover to Enhanced Products at end of February 2019,
- Central American Tsunami Advisory Center (CATAC) plans to start trial operation in August 2019,
- ITIC Training activities including the ITP-Hawaii course in Chile August 2018 as a first,
- Acknowledge JICA and DIPECHO support for CATAC and Tsunami Ready and preparedness in Central America,
- PTWS completion of its Key Performance Indicators Framework,
- Completion and submission of a Community White Paper "Ocean Observations Required to Minimize Uncertainty in Global Tsunami Forecasts, Warnings, and Emergency Response" to the OceanObs19 conference.

**The Group reiterated** the importance of collecting event data strictly in accordance with the International Tsunami Survey Team (ITST) protocols, while continuing to be respectful of the Country's needs and requirements, encourage timely data and information sharing by the Survey Teams to facilitate immediate submission of a consolidated summary report to the host country to assist with response and recovery planning and request ICGs to facilitate, in coordination with existing science organisations, special sessions at meetings/workshops to promote sharing of lessons learnt and compilation of all event data.

**The Group approved** updates to the [Tsunami Glossary](#).

**The Group approved** changes to the Area of Service Map (see Appendix 3 to Annex IV).

**The Group approved** the proposal on TSP Messages for the Maritime Community and requested the ICGs to consider the proposal for implementation in their respective basins. (see Appendix 4 to Annex IV).

**The Group agreed** to produce a compelling high level concept note to the Implementation and Science Plans for the UN Decade of Ocean Science for Sustainable Development and convey it to global and regional Decade planning meetings.

**The Group recommended** the Assembly to encourage Member States to:

- increase and sustain technical and financial support of the tsunami and other coastal hazards warning systems in their respective regions,
- emphasize to national civil protection/disaster management agencies the role they play in strengthening the warning chain to ensure optimal community response and stress the importance that the agencies participate in regional Tsunami governance and technical forums,

- continue to strengthen tsunami awareness and preparedness in communities and among authorities through communication, evacuation planning, tsunami exercises, training, information, and piloting recognition programmes such as Tsunami Ready,
- densify sea level networks capable of Tsunami detection as well as seismic network particularly nearby tsunamigenic sources,
- extend sharing of real time tsunami source and tsunami detection observations,
- collect high resolution coastal bathymetry and extend the data sharing for improved characterization of Tsunami and other coastal hazards and risks, and also advocate this through IHO and regional hydrographic commissions,
- register National Tsunami Warning Centers (NTWCs) and Tsunami Warning Focal Points (TWFPs) as alerting authorities in the “WMO Alerting Authority Register” via the WMO National Permanent Representative and in follow-up to WMO Circular Letter.

**The Group recommended** the Assembly to instruct ICGs:

- to advocate Fourth edition of World Tsunami Awareness Day (WTAD 2019) among member states and highlight target [d] of the Sendai Framework that stress substantial reduction of disaster damage to critical infrastructure and disruption of basic services and with an emphasis of ports, harbors and vertical evacuation,
- to consider the [PTWS Key Performance Indicator Framework](#) and provide input to a consolidated report for the TOWS-XIII,
- to continue the Tsunami Ready pilot activities with UNESCO-IOC recognition, including conducting surveys on Member State status, interest and feed back in the implementation of Tsunami Ready.

**The Group accepted** the reports from the Task Teams on Disaster Management and Preparedness and Watch Operations and instructed the Task Teams to continue efforts for monitoring and responding to tsunamis generated by non-seismic sources and possible integration into Tsunami watch operation.

**The Group recommended** the Assembly to take the following actions:

- to extend the tenure of TOWS and its Task Teams on (i) Disaster Management and Preparedness and (ii) Tsunami Watch Operations, with ToRs as given in IOC Resolution XXIV-4 [for TOWS-WG] and IOC/TOWS-WG-VI/3 [Annex II; for TTDMP] and ToRs for TTTWO as given in IOC/TOWS-WG-X Appendix I.

**The Group noted with appreciation** the information presented by the WMO and the Head of the IOC Ocean Observations and Services Section on JCOMM governance reform.

ANNEX III

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

19–20 February 2019, Paris, France

**Task Team Members**

David Coetzee (Chair)	ICG/PTWS
Laura Kong	ITIC; ICG/PTWS
Harkunti Pertiwi Rahayu	ICG/IOTWMS
Ardito Kodijat	IOTIC, ICG/IOTWMS
Marzia Santini	ICG/NEAMTWS
Amir Yahav	ICG/NEAMTWS
Silvia Chachon Barrantes	ICG/CARIBE-EWS
Christa von Hillebrandt-Andrade	ICG/CARIBE-EWS
Alison Brome	CTIC; ICG/CARIBE-EWS
Bernardo Aliaga	IOC Secretariat
Jiuta Korovulavula	IOC Secretariat
Denis Chang Seng	IOC Secretariat; TIC/NEAMTWS
Gerassimos Pappadopoulos	Observer
Ioanna Triantafyllou	Observer

**BACKGROUND AND TERMS OF REFERENCE**

The Terms of Reference (TORs) of the Inter-ICG Task Team on Disaster Management and Preparedness (TT-DMP) are to:

- Facilitate in collaboration with organization such as UNISDR (United Nations Office for Disaster Risk Reduction), the exchange of experiences and information on preparedness actions, education/awareness raising campaigns and other matters related to disaster management and preparedness;
- Promote preparedness in coastal communities through education and awareness products and campaigns;
- Facilitate SOP training across ICGs to strengthen emergency response capabilities of Member States and their Disaster Management Offices;
- Promote preparedness programs and assessment tools that have been successful in one regional Tsunami Warning and Mitigation System in the others as appropriate;
- Facilitate the coordination of the TICs of the ICGs;
- Report to the TOWS–WG.

The representatives to the TT-DMP are nominated by their respective Chairpersons of the Intergovernmental Coordination Groups (ICGs). The membership consists of two representatives from each ICG, one of which should represent the ICG's Tsunami Information Center. The IOC Chair appoints the Chair of the Task Team.

The first meeting of the TT-DMP was held in December 2010 in Seattle, USA (IOC/TOWS-WG/TT2-I/3). Due to funding limitations the task team was unable to reconvene in the period up to February 2014 when it met in Paris, France (IOC/TOWS-WG/TT2-II). Since then the TT-DMP managed to meet annually: March 2015 in Morioka, Japan, and in Paris in February 2016, 2017, 2018, and 2019 prior to the annual meetings of the IOC/TOWS-WG. This report covers the period 2018-2019.

## **TASK TEAM MEETING**

### **1. Opening and Meeting Organization**

The Chair introduced the meeting logistics and asked self-introductions of the participants.

### **2. Reflection on TT Report to TOWS-WG-XI (2018)**

The meeting worked through the previous TT Report to TOWS and confirmed that the meeting agenda reflects the points to be followed up from that report.

The meeting reflected on the recommendations and action points taken in 2018. It noted that most of the action points will be discussed under the 2019 agenda (this meeting).

With regards to the 'Wave exercise' series, the meeting discussed the possibility to align exercise dates across ICGs. This was considered not practical because of different hazard seasons (i.e. cyclones) across the globe. The meeting also noted that for countries that belong to two ICGs, holding of the ICG 'Wave' exercises in the same year or within months of each other, makes it impractical or impossible for the country to participate in both. This was the case for the Indian Ocean and Pacific Ocean for 2018.

The Task Team noted that the questionnaires used by the respective ICGs should be more consistent in respect of the core questions, while also avoiding questions that are part of national reports to ICGs. Questionnaires should however still allow for additional questions that can be tailored on a case-by-case basis to suit any unique exercise objectives. This will assist countries that belong to more than one ICG, and subsequently sometimes have to answer to different questionnaires for similar exercise objectives. Christa von Hillebrandt-Andrade (CARIB EWS) and Ardito Kodijat (IOTWMS) undertook to review the respective ICGs' questionnaires from this perspective.

**Recommendations to TOWS-WG:** Request the ICGs to coordinate on 'Wave' exercise dates in order to minimize duplication and overlap

Note that the TTDMP will review the respective ICG 'Wave' exercises questionnaires with a view on consistency of core questions and avoiding questions that are addressed in national reports to ICGs.

### **3. Updates from ICG Working Groups and TICs**

The task team collected updates on Disaster Management and Preparedness and Tsunami Information Centre activities across ocean basins over the last year. This information reflects the progress and identification of collective relevant issues to be addressed at global level. The reports are posted on the meeting calendar web-page and due to their size are not included in this report. The presentations can be found on the Meeting page in the IOC Tsunami Programme Calendar.

The Task Team noted the good progress made across ICGs and TICs and in particular congratulated NEAMTWS with the progress made in regards to establishing their TIC.

#### **4. Significant Operational Events since Last Meeting**

The Task Team, jointly with the Task Team on Tsunami Watch Operations, reflected on tsunami events over the last year, in particular the Palu, Sunda Strait, Zakynthos, and Loyalty Islands events. Presentations were made by representatives from IOTWMS and NEAMTWS.

**Recommendations to TOWS-WG:** Requests the TOWS-WG to (i) reiterate the importance of collecting data strictly in accordance with the ITST protocols, while continuing to be respectful of the Country's needs and requirements, (ii) timely data and information sharing by the Study Teams to facilitate immediate submission of a consolidated summary report to the host country to assist with response and recovery planning and (iii) ICGs to facilitate, in coordination with existing science organisations, special sessions at meetings / workshops to promote sharing of lessons learnt and compilation of all event data.

IOTWMS and IOTIC explore the possibility of organising a Special Session on Lessons Learnt from Palu and Sunda Strait Tsunamis in the next inter-sessional period, subject to funding availability.

#### **5. Tsunami Glossary Update**

The Task Team, jointly with the Task Team on Tsunami Watch Operations, considered suggested changes to the Tsunami Glossary (2016)

**Recommendation to TOWS-WG:** Approve updates to the Tsunami Glossary.

#### **6. Development of Key Performance Indicators in relation with Sendai Framework Indicators**

The Task Team, jointly with the Task Team on Tsunami Watch Operations received a report from David Coetzee (PTWS) on the framework for future goals and performance monitoring of Tsunami Risk Reduction, Hazard Warning and Mitigation finalise by the PTWS Task Team on Goals and Performance Indicators. This document has been shared with the other ICGs for consideration and feedback ([http://www.ioc-tsunami.org/index.php?option=com\\_oe&task=viewDocumentRecord&docID=23532](http://www.ioc-tsunami.org/index.php?option=com_oe&task=viewDocumentRecord&docID=23532)).

Discussions followed on the status of similar initiatives in other ICGs for monitoring and reporting the status of their systems and relevant documentation for reporting. IOTWMS recently conducted a survey on Capacity Assessment of Tsunami Preparedness of the IOTWMS Member States using a detailed questionnaire covering all the 3 pillars. Harkunti Rahayu made a brief presentation on the preliminary results based on feedback received from 21 out of the 24 active Member States that will be used to prepare an IOTWMS Status Report, with future updates planned before each biennial ICG meeting.

Implementation Plans of Caribe-EWS and NEAMTWS are in different stages of preparation. While appreciating the excellent efforts of the PTWS Task Team, it was felt that that ICGs would need further time to review the PTWS framework in light of their own initiatives. Further, a closely coordinated inter-ICG effort is required to come up with harmonised performance monitoring framework, tools/questionnaires to be used for data collection and structure of documentation for reporting. To facilitate this process, it was decided to constitute a joint TTDMP and TTTWO team comprising representatives from all ICGs to work in the next inter-sessional period and come up with recommendations to the next TOWS-WG Meeting.

**Action:** Appreciating the work of the PTWS Task Team on Future Goals and Performance Indicators, the joint Task Teams requested a team comprising<sup>1</sup> Sarah-Jayne McCurrach (PTWS), Yuelong Miao and Harkunti Rahayu (IOTWMS), Elizabeth Vanacore and Mary Regifo (CARIBE-EWS), and Ocal Necmioglu (NEAMTWS) to review the PTWS performance monitoring framework in light of similar initiatives in other ICGs and recommend a harmonised performance monitoring framework, data collection tools/questionnaire and reporting formats. The team will prepare a report for the next meeting.

## **7. Local Source SOPs**

The Task Team, jointly with the Task Team on Tsunami Watch Operations heard a presentation by Dr Ken Gledhill (PTWS) about the development of guidelines for NTWCs with regards to local source tsunamis. This work is being done at request of the ICG-PTWS. The IOTWS informed that following the Palu event, their Steering Committee requested the ICG to establish a Task Team to develop similar SOPs.

**Recommendation to TOWS-WG:** The PTWS to continue work on Local Source Tsunami SOPs and share their guidance with other ICGs at the next meeting.

## **8. National Tsunami Warning Centre Competency Framework**

The Task Team, jointly with the Task Team on Tsunami Watch Operations heard a presentation by Dr Ken Gledhill about the development of a competency framework for NTWCs.

**Recommendation to TOWS-WG:** PTWS to continue work on National Tsunami Warning Centre Competency Framework and share their guidance with other ICGs at the next meeting.

## **9. Planning for Ocean Decade**

The Task Team, jointly with the Task Team on Tsunami Watch Operations heard a presentation by Christa von Hillebrandt-Andrade about Ocean Decade 19. Mike Angove (USA) provided an update on the submission that is being made to Ocean Decade on minimizing uncertainty in global tsunami forecasts, warnings, and emergency response.

**Recommendation to TOWS-WG:** To contribute to the planning phase of UN Decade of Ocean Science for Sustainable Development (2021 - 2030) sourcing tsunami community contributions in its recognised and successful end-to-end approach.

## **10. Pilot UNESCO-IOC Tsunami Ready Community based tsunami recognition programme**

The Task team discussed a presentation by Christa von Hillebrandt-Andrade on progress with regards to Tsunami Ready pilots in the CARIBE EWS and IOTWMS.

Regarding pilot feedback, the PTWS Task Team on TEMPP and Tsunami Ready was asked to develop a Tsunami Ready evaluation questionnaire that can also be used by the ICG/CARIBE-EWS and ICG/IOTWMS. The PTWS Task Team reached out to the ICG/CARIBE-EWS Task Team on Tsunami Ready and CTIC to obtain their questionnaire, and consulted with the ICG/IOTWMS WG 4 Task Team for Capacity Development for Tsunami Preparedness and the IOTIC on their interest.

---

<sup>1</sup> [sarah-jayne.McCurrach@dpmc.govt.nz](mailto:sarah-jayne.McCurrach@dpmc.govt.nz); [yuelong.miao@bom.gov.au](mailto:yuelong.miao@bom.gov.au); [harkunti\\_rahayu@yahoo.com](mailto:harkunti_rahayu@yahoo.com); [elizabeth.vanacore@upr.edu](mailto:elizabeth.vanacore@upr.edu); [mrengifo@dimar.mil.co](mailto:mrengifo@dimar.mil.co); [ocal.necmioglu@boun.edu.tr](mailto:ocal.necmioglu@boun.edu.tr)

The Task Team considered and consolidated an evaluation survey created by CARIBE EWS with a view on presenting an agreed questionnaire to ICGs for endorsement.

#### **Recommendations to TOWS-WG:**

- Recommend that the official name of Tsunami Ready be: “UNESCO-IOC Tsunami Ready Pilot Program”.
- Encourage ICGs to continue to pilot Tsunami Ready with I UNESCO-IOC recognition, including conducting surveys on Member State status and interest in implementation of Tsunami Ready
- Noting that implementation requires significant funding and resource commitment, and the support of organizations like UNESCAP, USAID/OFDA, DIPECHO in this regard, encourage funding from ICG member states and donor organisations.
- Note that ICGs may consider including an additional Mitigation criterion “Have a Tsunami Risk Reduction Plan”, to be applied when applicable
- Note that the ICG CARIBE EWS is consulting with its member states and the IOC about a logo for Tsunami Ready, and will report back to the Task Team in this regard.
- Note that the Task Team considered and agreed a Tsunami Ready evaluation questionnaire, with a view on seeking endorsements by the respective ICGs.

#### **11. Tsunami Evacuation Mapping**

The Tsunami Evacuation Mapping Planning and Procedures (TEMPP) Guideline is currently being finalised reviewed for publication by the IOC in April 2019 in English and Spanish. The Manual is presented in the form of four training Modules:

1. Identification of inundation areas;
2. Developing evacuation maps;
3. Developing Tsunami Response Plans and Standard Operating Procedures (SOPs); and
4. Exercising.

Each Module is described in accordance to:

- The training approach in the theory of the Module, with the intent to enable training participants to deliver the specific foundation block; and
- The step-by-step process involved in the implementation of each Module, with the intent to serve as an easy reference when the training is being put to practise.

**Recommendation to TOWS-WG:** Note that the development of the TEMPP Guideline has been finalised and it will be published by the IOC by April 2019 in English and Spanish.

## 12. Tsunami Guidance for Maritime and Ports

Dr Laura Kong (ITIC) reported that the ITIC is requesting translated best practices with from Japan. The PTWS has requested the ITIC to compile best practices for sharing on the ITIC web site.

The Task Team discussed the importance of providing guidance for ports given problems with strong currents and sudden ocean drawdown that can ground ships or break moorings. Response plans will require running numerical simulations using plausible scenarios and high-resolution digital elevation models (DEMs). It was considered that commercial shipping operators may have developed useful guidance; it was agreed that ICGs will be requested to encourage member states to engage with shipping operators in this regard.

It was also noted the theme for World Tsunami Awareness Day 2019 is ‘Critical Infrastructure and Essential Services’; this creates an ideal ‘hook’ for ICGs to put special effort into guidance for ports in 2019. (See recommendation under World Tsunami Awareness Day).

## 13. Structural Design Guidance for buildings

### that can be used as evacuation shelters

The Task Team noted that USA FEMA is updating the 646-P “Guidelines for Design of Structures for Vertical Evacuation from Tsunamis” Third Edition, to include the ASCE 7-16 and IBC 2018 design provisions. This edition combines content that was previously in 2 separate publications: FEMA P-646 report, *Guidelines for Design of Structures for Vertical Evacuation from Tsunamis (2008, 2012)*, provided technical guidance and approaches for tsunami-resistant design, identification of relevant tsunami loads and applicable design criteria, development of methods to calculate tsunami loading, and identification of architectural and structural system attributes suitable for use in vertical evacuation facilities. FEMA P-646A (2009) *Vertical Evacuation from Tsunamis: A Guide for Community Officials*, provided information on how to use vertical evacuation design guidance at the state and local government levels.

Washington State of the USA is developing a Manual for Tsunami Vertical Evacuation Structures, based on their 2016 community-based experience in building a vertical evacuation area above the gymnasium of Ocosta Elementary School in Ocosta, Washington.

New Zealand published an [Assessment and Planning for Tsunami Vertical-Evacuation Guideline](#) that provides step-by-step methodology for:

- Assessing tsunami life safety risk at local level,
- Considering possible measures for improving tsunami evacuation in their areas, and
- As a last resort, evaluating whether options for tsunami vertical evacuation will cover design considerations of tsunami vertical evacuation.

A Second guideline will be developed in 2019 to cover design considerations of tsunami vertical evacuation, taking the USA guidelines into account.

The PTWS has requested the ITIC to compile best practices for sharing on the ITIC web site.

#### 14. Schools Programmes

The meeting re-confirmed the frequent reference to and importance of tsunami education in schools. It was noted that in many countries it forms part of an all-hazard curriculum, while schools also form a primary target in the Tsunami Ready programme.

The Task Team considered a variety of websites containing school materials; Laura Kong (ITIC) undertook to establish links to all the known websites and requested for additional materials and/or links to be provided to ITIC.

#### 15. World Tsunami Awareness Day

The Task Team noted the respective ICGs' activities in 2018 and planning for 2019. Among others, the IOTWMS TIC is planning a special activity in 2019 with the Indonesia BMPD to celebrate the 15<sup>th</sup> anniversary of the 2004 Banda Ache tsunami.

The Task Team considered options for a consistent focus in 2019. Nothing that the theme for World Tsunami Awareness day 2019 is 'Critical Infrastructure and Essential Services', and considering the on-going need with regards to guidance for ports (see 12 above), it was agreed to recommend that TOWS encourage ICGs to recommend to member states to reach out to and work with stakeholders of at least one commercial port with regards to risk assessment and planning for tsunami.

**Recommendation to TOWS: Encourage** ICGs to recommend to member states to reach out to and work with stakeholders of at least one commercial port with regards to risk assessment and planning for tsunami.

#### 16. SUMMARY OF RECOMMENDATIONS TO THE TOWS-WGXII

**The Task Team recommends that the TOWS-WG-XII:**

- 16.1 **Requests** the ICGs to coordinate on 'Wave exercise' dates in order to minimize overlap.
- 16.2 **Notes** that the TTDMP will review the respective ICG 'Wave' exercises questionnaires with a view on consistency of core questions and avoiding questions that are addressed in national reports to ICGs.
- 16.3 **(Reiterate** the importance of collecting data strictly in accordance with the ITST protocols, while continuing to be respectful of the Country's needs and requirements, **encourage** timely data and information sharing by the Study Teams to facilitate immediate submission of a consolidated summary report to the host country to assist with response and recovery planning and **request** ICGs to facilitate, in coordination with existing science organisations, special sessions at meetings/workshops to promote sharing of lessons learnt and compilation of all event data.
- 16.4 **Notes** that IOTWMS and IOTIC explore the possibility of organising a Special Session on Lessons Learnt from Palu and Sunda Strait Tsunamis in the next inter-sessional period, subject to funding availability.
- 16.5 **Approves** updates to the Tsunami Glossary.
- 16.6 **Notes** the PTWS to continue work on Local Source Tsunami SOPs and share their guidance with other ICGs at the next meeting.

- 16.7 **Notes** the PTWS to continue work on National Tsunami Warning Centre Competency Framework and share their guidance with other ICGs at the next meeting.
- 16.8 **Agrees** to contribute to the planning phase of UN Decade of Ocean Science for Sustainable Development (2021-2030) sourcing tsunami community contributions in its recognised and successful end-to-end approach.
- 16.9 With regards to Tsunami Ready:
- Agrees** that the official name of Tsunami Ready be: “UNESCO-IOC Tsunami Ready Pilot Program”.
- Encourage** ICGs to continue to pilot Tsunami Ready with UNESCO-IOC recognition, including conducting surveys on Member State status and interest in implementation of Tsunami Ready, noting that implementation requires significant funding and resource commitment.
- Notes** that ICGs may consider including an additional Mitigation criterion “Have a Tsunami Risk Reduction Plan”, to be applied when applicable.
- Notes** that the ICG CARIBE EWS is consulting with the IOC about a logo for Tsunami Ready, and will report back to the Task Team in this regard.
- Notes** that the Task Team considered and agreed a Tsunami Ready evaluation questionnaire, with a view on seeking endorsements by the respective ICGs.
- Notes** the support of organizations like UNESCAP, USAID/OFDA, DIPECHO and corresponding national, regional and local authorities and invite contributions from other agencies.
- 16.10 **Notes** that the development of the TEMPP Guideline has been finalised and it will be published by the IOC by April 2019 in English and Spanish.
- 16.11 **Encourage** ICGs to recommend to member states to reach out to and work with stakeholders of at least one commercial port with regards to risk assessment and planning for tsunami.
- 16.12 **Extend** the tenure of the Task Team on Disaster Management and Preparedness for a further term with the same Terms of Reference.

ANNEX IV

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

**1. OPENING AND MEETING ORGANIZATION**

Dr Charles (Chip) McCreery, the Chair of the Task Team on Tsunami Watch Operations (TTTWO) welcomed all participants to the meeting (list of participants in Annex V). He introduced the provisional meeting agenda, which was adopted without any modifications (Appendix 1).

**2. REVIEW OF ACTION ITEMS FROM THE PREVIOUS MEETING**

**REVIEW OF ACTIONS:**

Dr McCreery reviewed the outstanding recommendations and actions from the TTTWO meeting held in Paris, France, February 14-15 2018 (ref: Summary Report, TOWS-WG, Eleventh Meeting, Annex IV, Section 13.2, page 33). The status of actions is listed below:

Action Item	Status
<b>Action 1:</b> Dr Yuelong Miao to share a write up with the Task Team on methods to improve travel time estimates in tsunami bulletins and maps	Done. ICGs to consider and adopt
<b>Action 2:</b> IOTWMS to share with the Task Team, procedures for TSPs to handle inadvertent errors in issuing bulletins that are inconsistent with the agreed service definition.	Done. ICGs to consider and adopt the procedure shared by IOTWMS, noting that currently different TSPs handle this differently some of which are based on WMO procedures.
<b>Action 3:</b> CARIBE-EWS to share with the Task Team, procedures for TSPs to handle tsunamis from volcanoes.	Ongoing CARIBE-EWS is using a volcano-triggered tsunami scenario for the upcoming CARIBE Wave exercise, noting that tsunami reaches near-source coasts even before a tsunami warning is issued. There is a need to look further into operational warning possibility / products that could be issued for a volcano-triggered tsunami. CARIBE-ESW to continue its work and share feedback with the other ICGs at next TTTWO meeting.  To be further discussed under Agenda Item 12.
<b>Action 4:</b> PTWC to provide guidance based on their experience with the W phase CMT and RIFT model on procedures to handle tsunamis generated from non-subduction earthquakes and mechanisms for sharing with the other ICGs	Ongoing PTWC has been evaluating the effectiveness of these methods and will present some quantitative results at the next TTTWO meeting. To be further discussed under Agenda Item 12.
<b>Action 5:</b> Dr Yuelong Miao, Mr Carlos Zuniga Araya, Mr Patricio Carrasco and Dr Chip McCreery to help develop draft messages for vessels at sea for TSPs based on the template in IHO Manual S53 for	Done To be further discussed under Agenda Item 13.

Action Item	Status
WWNWS-SC to review and provide feedback	
<b>Action 6:</b> Dr Chip McCreery and Dr Francois Schindele to develop maps of the response of the current seismic and sea level network timing response for earthquakes and tsunamis for the four ICG regions based on the methodology accepted in the current Task Team meeting as examples of how to examine similar responses on a sub-regional level.	Ongoing To be further discussed under Agenda Item 15.

### 3. REVIEW OF THE STATUS OF IMPLEMENTATION OF TOWS-WG REQUESTS TO TTTWO

Dr McCreery listed the five recommendations made by TOWS-WG relevant to TTTWO during the last meeting held in Paris France, February 16-17 2018 (Summary Report, TOWS-WG, Eleventh Meeting, Annex II, page 14). The status of actions is listed below:

Action Item	Status
to finalise sample tsunami threat messages for vessels at sea in consultation with the IHO/IMO/WMO World-Wide Navigational Warning Service Sub-Committee;	Done To be further discussed under Agenda Item 13.
to continue efforts for monitoring and responding to tsunamis generated by non-seismic sources and possible integration into Tsunami watch operation;	Ongoing To be further discussed under Agenda Item 12.
to consider the summary statement from the Symposium;	Ongoing
to prepare concept note for developing capacity that can lead to transformative tsunami warning products that enable stakeholders to manage public response efficiently;	Ongoing
to contribute to OceanObs 19 and the planning of the UN Decade of Ocean Science for Sustainable Development.	Ongoing Manuscript prepared for OceanObs 19. To be further discussed under Agenda Item 10.

### 4. TSUNAMI WATCH OPERATIONS – CURRENT STATUS AND PLANS

#### 4.1 CARIBE-EWS

Dr Elizabeth Vanacore made a presentation on the status of the CARIBE-EWS. The monitoring networks include 30 different seismic networks and operators contributing to the system with current station density meeting the detection time goal of 1 minute for earthquakes within the region. Tide gauge network coverage in the region enables tsunamis originating within the region to be detected at most of the coastal regions within less than 20 minutes. 861 real time GNSS station feeds are contributed from the region to UNAVCO that could be useful in real-time detection of co-seismic displacement. A \$8 million project for upgrading and hardening seismic networks in the region under the purview of USGS is currently underway. CaribeWave19 will use a Kick `em Jenny volcano-triggered tsunami scenario. Dr Wilfried

Strauch presented the progress of Central American Tsunami Advisory Centre (CATAC). New station installations include 8 new sea level stations on Caribbean and Pacific coasts, 8 new broadband stations in Nicaragua and southwest Caribbean Sea and 3 new broadband stations in the southwest Caribbean Sea. Capacity building and tsunami exercises have been undertaken in Nicaragua within the UNESCO/DIPECHO projects. A regional workshop on the advances in CATAC and SOPs was conducted in February 2019, that recommended initiating experimental products in August 2019. CARIBE-EWS has future plans to evaluate volcanic tsunami test products, continue development of real-time GNSS tsunami source evaluation systems, continue development of landslide/volcanic tsunami models and possible products and continue to foster the tsunami model database developed by WG2.

#### **4.2 NEAMTWS**

Dr Francois Schindele made a presentation on the status of NEAMTWS. There are gaps in seismic and sea level observing networks in the northern African region. In other parts of NEAMTWS, however, the observing networks have improved considerably. Several sea level stations have been established in the past year through a project of the Joint Research Centre (JRC). It is important to enhance sea level networks through closer coordination with relevant organisations such as Navy and Hydrographic services, especially considering that tide gauges are the only means of observing small tsunamis that could have otherwise gone unnoticed. NEAMTWS is working towards adaptation of threat levels as recommended by the TOWS-WG.

#### **4.3 PTWS**

Mr Satoshi Harada, Japan Meteorological Agency (JMA) made a presentation on NWPTAC enhanced products. Coastal forecast points, coastal blocks, graphical products and threat thresholds have been finalised in coordination with the recipient countries. Parallel issuance of existing and enhanced products initiated in December 2017 and final changeover to enhanced products is expected to take place in February 2019. A user guide has also been prepared for NWPTAC enhanced products. Dr McCreery, Director of the Pacific Tsunami Warning Centre (PTWC), provided a status report on behalf of the PTWS. There is ongoing work on optimal sensing networks, incorporating GNSS data into operational tsunami warning, tsunami warning centre competency framework, updating fax number database, etc. PTWC is currently upgrading the operational website. PTWS and NWPTAC are currently providing operational products to the South China Sea. Trial operation of the South China Sea Tsunami Advisory Centre (SCSTAC) started in January 2018 with full change over planned in late 2019. The SCSTAC was formally inaugurated by Executive Secretary IOC in May 2018.

#### **4.4 IOTWMS**

Dr Yuelong Miao provided an update on the status of IOTWMS. There are three operational Tsunami Service Providers from Australia, India and Indonesia providing interoperable tsunami threat information to the National Tsunami Warning Centres (NTWCs), which in turn are responsible for provision of detailed tsunami threat information for their coastal regions. Tsunami detection, warning and dissemination has been strengthened with TSPs incorporating several technical enhancements in their procedures and products including launching of new public website by TSP-Australia. Routine communications tests conducted every June and December ensured operational lines of communication between TSPs and the NTWC. The 2<sup>nd</sup> integrated intersessional meetings including a regional workshop on SOPs was held in June/July 2018 in Hyderabad, India. Further, the IOWave18 exercise was successfully held during 4 – 5 September 2018, followed by a post IOWave18 lessons learnt workshop in Jakarta

in November 2018. IOTWMS is continuing its work on optimal sea level and seismic networks, investigating the possibility of tsunami threat for the coastlines of the Persian/Arabian Gulf and Red Sea and coordinating the re-initiation of TSP public bulletins over GTS and the IOC public list server.

## **5. SIGNIFICANT OPERATIONAL EVENTS IN THE INTER-SESSIONAL PERIOD**

Dr McCreery initiated the discussion by mentioning the most significant earthquake and tsunami events in the last inter-sessional period for which messages were issued by the TSPs.

Mrs. Weniza briefed about the Palu and Sunda Strait events and the configuration of InaTEWS. Challenges currently being faced by InaTEWS include forecast modelling only for tectonic events, very little travel time for local source events, determination of tsunamis caused by non-tectonic events (e.g., landslides and volcanoes) and the lack of sea-level data from the open ocean for use in detecting and monitoring non-seismic tsunamis. Mr Rahmat Triyono presented the timeline of Palu-Donggala tsunami. There were 28 foreshocks starting from 2 PM local time, with the main shock of 7.7 magnitude occurring at 1702 local time. The tsunami in Palu was triggered by a landslide under the sea triggered by the earthquake. A warning message was issued within 5 minutes, and was cancelled after 25 minutes based on observing only a 6 cm wave on the Mamuju tide gauge. The tsunami wave in Palu hit within 3 minutes after the earthquake, well before the warning cancellation by BMKG. The Sunda Strait tsunami of 22 December 2018 was caused by a flank collapse of Anak Krakatau volcano. BMKG noticed anomalous sea level observations from the Serang and Lampung tide gauges of between 0.9 m and 0.28 m. No tsunami warnings were issued by BMKG since no significant earthquake was recorded prior to the event. Post-event seismic data analysis indicated an earthquake of M 3.5 concurrent to the flank collapse. BMKG is working on the feasibility of issuing tsunami warnings for volcano triggered events based on the seismic magnitude and distance from epicentre. The disadvantage of using seismic magnitudes as low as 3.5 to issue tsunami warnings is that there will be too many unnecessary warnings. Instead, the seismic information might be better used in conjunction with additional parameters such as the volcano eruption stage, open ocean water level sensors, camera observations, etc.

Mr Ardito Kodijat presented on the lessons learnt from the performance of the “last-mile” of alerting during Palu event. Eye witnesses accounts were recorded which identified several issues related to limitations of the existing warning system, failure of the warning chain, etc. The tsunami wave arrived within 3 minutes, earlier than the official warning in several near-source areas such as Wani. Electricity and communication was cut off 2 minutes after the EQ, preventing receipt of the warning. Other important issues relate to the lack of capacity at the LDMO office in terms of warning dissemination, unavailability of LDMO SOPs, lack of knowledge on warning products, and lack of human resources at the LDMO. There was a false sense of security due to the public believing that the siren would keep them safe from tsunamis. This was in spite of the fact that the siren was not tested regularly and its volume had been reduced to avoid disturbance. Further, the public misunderstood that several communication towers were sirens. Access for evacuation routes was blocked by buildings, walls and fences. Some people evacuated after the pre-shock at 3 pm, since there was past local knowledge about 1938 and 1968 tsunamis, but several people returned because there was no immediate tsunami. The community generally believed that Palu is safe from tsunamis due to the advancement of technology and since an earlier earthquake in 2005 did not generate a tsunami. Some people reported natural warning signs (bubbles, running animals, etc.). There is difference between general education material on tsunamis and the reality in the local context –

siren, water receding, etc. In summary, it was noted that a self-evacuation protocol is the key to survival in case of local tsunamis. Local past knowledge needs to be captured, and education, awareness & preparedness need to be given a high priority.

Dr Gerassimos Papadopolous made a presentation on the 25 October 2018 Mw 6.8 earthquake and tsunami in the Zakynthos region. Twenty-one tsunami warning messages were issued during 2012-2018 by National Observatory of Athens (NOA), Greece, which is one of the NEAMTWS TSPs. NOA monitors data from 155 seismic stations and 19 tide gauge stations. For the 25 October 2018 event, a message was issued in 8 minutes. Three tide gauges reported < 15 cm tsunami waves. Eye witness reports suggested about 1.5 m of runup and 40 m of inundation. Results of seismic p-wave inversion and using tide gauge records for calculation of tsunami magnitude open up new avenues for future operational warning.

Dr Schindele made a presentation on the recent earthquake and tsunami events in Loyalty Islands. In 2017, there were 6 earthquakes of  $M > 6$  in the vicinity, including the most recent event of  $M 7.5$  on 05 December 2018. All earthquakes were normal faulting and 5 of them produced minor tsunamis. The 05 December 2018 earthquake produced a local/regional tsunami measuring about about 3 metres in Loyalty Island and 1 metre in the south of Vanuatu Island.

Discussions followed on the importance of continuing the efforts in all ICGs to strengthen the end-to-end warning system based on lessons learnt from recent events.

Mr Kodijat presented a summary of the International Tsunami Survey Teams for the Palu Donggala tsunami (ITST-Palu). This was the sixth ITST facilitated by the IOC (2009 Samoa, 2010 Chile, 2011 Japan, 2012 El Salvador, 2012 Indonesia Mentawai) since the start of the ITST efforts after the 1992 Nicaragua tsunami. The collection of science data and survivor accounts immediately after destructive tsunamis has been critical to improving our mitigation of tsunami impact through better warnings, stronger buildings, and more prepared populations. The ITST-Palu was facilitated by the IOC IOTIC and ITIC at the request of the Government of Indonesia working with the Indonesian Ministry of Research, Technology and Higher Education (MORTHE). An expedited processing of the required researcher permits (taking only 3 days instead of 6 weeks), and elimination of the requirement for research entry visas was negotiated, and throughout, the IOTIC and Indonesia BMKG valuably assisted the ITST teams with their logistics. Altogether, 7 teams comprised of 87 international and Indonesia researchers, and representing 14 countries, conducted collaborative surveys. The ITST teams, led by a senior scientist with extensive experience, worked as a coordinated team, consulting and learning from each other. An overview talk was given at the Fall American Geophysical Union (AGU) meeting in December 2018. The ITST-Palu protocols included pre-field situational awareness and post-field briefs with Indonesia stakeholders, as well as information and data sharing as part of the MORTHE permit requirements. IOC ITST badges and official Indonesia research study IDs were provided, which many scientists reported as especially valuable to gain entry to tsunami- and earthquake-impacted areas, and to facilitating interviews with survivors. Several teams shared real-time or daily analyses via WhatsApp, thus enabling remote science support both from Jakarta and from their home country.

Challenges continue to be in fulfilling the post-survey requirement to provide a summary report to the Government of Indonesia because of the delay in obtaining preliminary reports from the ITST teams. It was lamented that most teams did not budget enough time in their survey for pre- and post-field briefs, which most Indonesian viewed as especially helpful in learning the impact details and understanding what happened in this complex event. Briefs that included

incoming and outgoing teams also enabled the communication of practical survey advice and still-outstanding science questions and data gaps needing to be filled. Several researchers commented that the ITST-Palu period started too late, and as a result, a lot of perishable primary data was lost because of the immediate response 'cleanup.' It was noted, however, that Palu had been MORTHE's first tsunami implementation, but for the second (Anak Krakatau), the arrangements were put into place very quickly.

The Group discussed ways in which to encourage more timely results sharing so that it could be used in immediate response decision-making, and short- and long-term recovery planning. These include special topic research journal issues and/or IOC special publications, special sessions at meetings, and/or IOC-sponsored lessons-learned workshops, and partnerships with existing science organizations such as the IUGG Tsunami Commission, to help compile all the event data (both ITST and non-ITST).

**Recommendation 1:** Appreciating the IOC-facilitated International Tsunami Survey Teams in Palu (ITST-Palu) and recognising the importance of TICs in coordinating ITSTs, requests the TOWS-WG to (i) reiterate the importance of collecting data strictly in accordance with the ITST protocols, while continuing to be respectful of the Country's needs and requirements, (ii) timely data and information sharing by the Study Teams to facilitate immediate submission of a consolidated summary report to the host country to assist with response and recovery planning and (iii) ICGs to facilitate, in coordination with existing science organisations, special sessions at meetings / workshops to promote sharing of lessons learnt and compilation of all event data.

**Recommendation 2:** IOTWMS and IOTIC explore the possibility of organising a Special Session on Lessons Learnt from the Palu and Sunda Strait tsunamis in the next inter-sessional period, subject to funding availability.

## 6. TSUNAMI GLOSSARY UPDATE

Updates to the Tsunami Glossary were discussed and accepted.

**Recommendation 3:** Approve updates to the Tsunami Glossary

## 7. DEVELOPMENT OF KPIS IN RELATION WITH SENDAI FRAMEWORK INDICATORS

Mr David Coetzee provided a brief on the framework for future goals and performance monitoring of Tsunami Risk Reduction, Hazard Warning and Mitigation, finalised by the PTWS Task Team on Goals and Performance Indicators. This document has been shared with the other ICGs for consideration and feedback. Discussions followed on the status of similar initiatives in other ICGs for monitoring and reporting the status of their systems and relevant documentation for reporting. IOTWMS recently conducted a survey on Capacity Assessment of Tsunami Preparedness of the IOTWMS Member States using a detailed questionnaire covering all the 3 pillars. Harkunti Rahayu made a brief presentation on the preliminary results based on feedback received from 21 out of the 24 active Member States that will be used to prepare an IOTWMS Status Report, with future updates planned before each biennial ICG meeting. Implementation Plans of Caribe-EWS and NEAMTWS are in different stages of preparation. While appreciating the excellent efforts of the PTWS Task Team, it was felt that that ICGs would need further time to review the PTWS framework in light of their own initiatives. Further, a closely coordinated inter-ICG effort is required to come up with harmonised performance monitoring framework, tools/questionnaires to be used for data collection and a structure of

documentation for reporting. To facilitate this process, it was decided to constitute a joint TTDMP and TTTWO team comprising representatives from all ICGs to work in the next inter-session period and come up with recommendations to the next TOWS-WG Meeting.

**Action 1:** Appreciating the work of the PTWS Task Team on Future Goals and Performance Indicators, requests a team comprising Sarah Jane McCurrach, Yuelong Miao, Elizabeth Vanacore, Harkunti Rahayu and NEAMTWS representative/s to review the PTWS performance monitoring framework in light of similar initiatives in other ICGs and recommend harmonised performance monitoring framework, data collection tools/questionnaire and reporting formats. The team will prepare a report for the next meeting.

## **8. LOCAL SOURCE TSUNAMI STANDARD OPERATING PROCEDURES (SOPs)**

Dr Ken Gledhill introduced the topic outlining the initiative in the PTWS to come up with best practice for response to a local tsunami in terms of public education, official warning, detection and characterisation, etc. There is also a recent recommendation by the IOTWMS Steering Group following the Palu tsunami for the ICG to set up a Task Team on Tsunami Preparedness for a near-field tsunami hazard with a mandate to streamline SOPs, warning chains and assist implementation of IOTR in vulnerable communities. The group agreed on the need for ICGs to work together on this important initiative.

**Recommendation 4:** PTWS to continue work on Local Source Tsunami SOPs and share their guidance with other ICGs at the next meeting.

## **9. NATIONAL TSUNAMI WARNING CENTRE (NTWC) COMPETENCY FRAMEWORK**

Dr Gledhill provided some background on this item. Reference was made to the WMO competency framework for meteorologists and the request by some countries in the PTWS to advise on guidelines for such a competency framework for operators of National Tsunami Warning Centres. There are issues around who and how often competency certification should be accorded to the operators, and if it is best that the responsibility to maintain competency is taken by the countries themselves. Australia and Indonesia have their own competency framework for their operators. No similar work is being currently done in other ICGs. NEAMTWS has some requirements as part of their TSP accreditation process. The group agreed that common guidelines for an NTWC competency framework would be useful for all the ICGs and requested the PTWS to continue their work and share their guidance with the other ICGs.

**Recommendation 5:** PTWS to continue work on a National Tsunami Warning Centre Competency Framework and share their guidance with other ICGs at the next meeting.

## **10. PLANNING FOR OCEAN DECADE**

Dr Christa von Hillebrandt-Andrade provided a full report on this item. She recalled that in December 2017, the United Nations General Assembly proclaimed the United Nations Decade of Ocean Science for Sustainable Development (2021–2030). The UNGA Decision was the culmination of two years of preparatory work by the IOC during which MS (IOC and other interested parties) were consulted on the concept and potential value of a Decade of Ocean Science. In past meeting of TOWS, the IOC Executive Secretary briefed on the proposed decade and in 2018 informed on the UNGA decision. The endorsement by the UNGA of the Decade of Ocean Science implies an acknowledgement by the global community of the

importance, need for and role of Ocean Science, data and information exchange for sustainable development. Within the framework of Oceans, are included marginal seas and coastal waters. IOC has been tasked with the preparation of an Implementation Plan (including a Science Plan) for the Decade, in consultation with Member States, United Nations bodies, institutional partners and other relevant stakeholders.

The Decade, building on those existing efficient programmes and experiences, will develop new partnerships to provide improved ocean data and information but also a wide range of solutions to achieve ocean sustainability. This Decade of Ocean Science for Sustainable Development will provide a common framework that will ensure Ocean Science can fully support countries in the achievement of the 2030 Agenda Sustainable Development Goals (and more particularly SDG 14) and will contribute to among other UN processes, SAMOA Pathway for SIDS and the Sendai Framework for Disaster Risk Reduction. The Decade will aim to address identified knowledge gaps and strengthen the conduct of the World Ocean Assessment as well as other global and regional assessments, by providing a coordinated framework for conducting collaborative and integrated research across scientific fields. The Decade will help to mobilize partnerships and increase investment in priority areas where actions are urgently needed, like the mapping of the world oceans (Seabed 2030).

The First World Ocean Assessment concluded that “major disparities exist in the capacities around the world to undertake the marine scientific research necessary for proper management of human activities that can affect the marine environment”. Noting the disparity between scientific knowledge, reflected in the publication of papers, with a significantly higher concentration in northern countries, the Decade will seek to improve the scientific knowledge base through capacity development to regions and groups that are presently limited in capacity and capability, especially SIDS and LDCs.

The Decade will address both deep disciplinary understanding of ocean processes and solution-oriented research to generate knowledge. 6 societal outcomes have been proposed: A clean ocean, a healthy and resilient ocean, a predicted ocean, a safe ocean, a sustainable productive ocean and a transparent and accessible ocean. Many of these outcomes are directly related to the Tsunami program, in particular the outcomes of safety and transparency and accessibility (capacity building). The vision is that the Decade will be transformative and for this, the Ocean Science community (Tsunami Community) should think beyond business as usual and aspire for real change, whether that be in the level of knowledge of the science, or in the way we manage cooperation and partnerships in support of Sustainable Development and healthy Ocean and coastal communities.

A Top down approach and bottom up approach is proposed. This will foster the interaction between the scientist and the “end users”/civil society. For this a two global planning meetings will be held, between which regional meetings will be convened to allow the regional and even local definition of the outcomes and objectives, including the formulation of scientific products, activities and partnerships that could be proposed in the context of the Decade. The first Global Meeting will be held in Copenhagen on May 13-15, 2019. The participation of the Tsunami community in all these meetings will be key. To facilitate the planning process, 19 Members from six UN Regional groups were selected by IOC Officers through a broadly disseminated Call for nominations to form the Executive Planning Group. One of the members is Dr Hillebrandt-Andrade, past Chair of CARIBE EWS and member of TOWS Task Team on Disaster Management and Preparedness.

The discussion then focused on how the Tsunami Program/TOWS/the ICGs would want to participate and take advantage of this opportunity to transform the end-to-end tsunami warning system. A first comment was offered on the level of stakeholders to be contacted during the planning phase. The comment indicated that the Decade deserves a higher level of commitment including the five UN Regional Commissions (ECA, ESCAP, ECLAC, ECE and ESCWA), and similar high-level fora, which have a significant role to play in promoting sustainable development in their respective regions.

Mr Mike Angove presented a concept on ocean observations required to minimize uncertainty in global tsunami forecasts, warnings, and emergency response. He suggested that some sort of strategy could be designed to have a more detailed and quick sensing of the ocean environment, including for more rapidly constraining and measuring the tsunami source. This has become possible with the combination of emerging solid-earth and sea-level observation technologies, advanced analysis techniques, and innovative modelling and computational strategies, which increase the ability to directly measure or tightly infer tsunami sources. This means it could be possible for tsunami warning centres around the world to deliver accurate tsunami arrival, height, and inundation forecasts within minutes, not hours, of generation along the majority of the world's most exposed coastlines. With this information, emergency managers will be able to prescribe precise actions with the confidence that the forecasts will closely match observations. Communities will not have to wait through hours of uncertainty before fully comprehending the threat. A proposal was made to design and deliver simple and easy to understand flooding maps in real time that can inform local populations about impending coastal inundation threats. The "blue line", a visual product available on multiple media would tell people, based on best science and monitoring services, where to go to be safer in case of flooding.

The group reflected that building on the three pillars (hazard assessment, monitoring-warning-dissemination, and preparedness and public awareness) that have driven tsunami warning and mitigation throughout the ICGs is still a valid approach that can be extended to the Ocean Decade

**Recommendation 6:** Recognising the need to provide consolidated inputs from the IOC tsunami community into the planning and implementation of the UN Decade of Ocean Sciences for Sustainable Development and noting the progress made by the TOWS-WG so far, requests TOWS-WG to (i) identify a focussed group from within the TOWG-WG and its Task Teams to continue to advance aspirations of the tsunami community into planning of the Decade, (ii) ensure participation of TOWS-WG representatives in the global and regional planning meetings with the aim of providing inputs to the planning process and facilitate broader collaborations and (iii) request ICGs to inform Member States of the Decade during their ICG Sessions and seek inputs.

## 11. UPDATES TO AREA OF SERVICE AND EARTHQUAKE SOURCE ZONE MAPS OF THE ICGS

Dr McCreery initiated the discussion by displaying the current map of the Area of Service. Mr Harada advised of changes to be incorporated in the NWPTAC Area of Service that will now extend to 170 deg E and also cover part of Papua New Guinea and Solomon Islands in the South. It was also agreed that the Indonesian coasts of Banda sea, Java Sea and the surrounding marginal seas that are currently depicted as not covered by any regional system should be updated to represent coverage by the national Indonesian Tsunami Early Warning System (InaTEWS). This is in line with the domestic service of US NTWC for the coasts of North

America. The text box should also be updated to reflect this change. The revised map incorporating these changes is attached as Appendix 4.

Dr Miao referred to the M 6.9 earthquakes in Sumbawa region, Indonesia on 5 August and 19 August 2018 that were just outside the IOTWMS Earthquake Source Zone (ESZ), but led to TSP-Australia issuing type-2 bulletins since the events were assessed as causing potential tsunami threat to some Coastal Forecast Zones (CFZs) within the IOTWMS Area of Service (AoS). He sought clarification on the criteria used by TSPs in different ICGs for issuing messages within their AoS for earthquakes occurring in the border or outside their respective ESZ. While IOTWMS adopts a threshold of earthquake magnitude of  $\geq 8.0$ , PTWS follows a threshold of estimated wave amplitude  $> 30$  cm within the PTWS service area. It was decided that the ICGs review these criteria at their respective ICGs and adopt the most suitable threshold. Further, it was also noted that the Earthquake Source Zone maps currently do not have an overlap or a buffer at the border of 2 adjacent ICGs, that could lead to a confusion on handling of earthquake events at the border.

**Recommendation 7:** Recommend the following changes to the AoS Map:

- Extend the Area of Service of NWPTAC to 170 deg E and coverage of Papua New Guinea and the Solomon Islands in the South
- Cover the Indonesian coasts of Banda Sea, Java Sea and surrounding marginal seas by a new line to represent domestic service by the Indonesian Tsunami Early Warning System (InaTEWS) and incorporate corresponding updates in the text box.

**Recommendation 8:** IOTWMS and PTWS to review at their respective ICG meetings, the criteria for issuing messages for earthquakes in the border or outside their Earthquake Source Zones

## 12. HANDLING OF TSUNAMIS FROM NON-SEISMIC SOURCES AND NON-SUBDUCTION ZONE EARTHQUAKES

Dr McCreery recalled the extensive discussions regarding the recent Palu and Sunda Strait events in Indonesia which are believed to be triggered by submarine landslides and volcano flank collapse respectively. Discussions followed on the ongoing initiatives in US NOAA to investigate methods to address meteo-tsunamis and in the CARIBE-EWS to address tsunamis from volcanic sources and non-thrust earthquakes.

Dr Harada made a brief presentation on the trial Standard Operating Procedure of JMA for tsunami warning following a volcanic event. Japan has 111 active volcanoes and JMA is responsible for monitoring active volcanoes as well as tsunamis. The trial SOP involves (i) identifying the target coastline to be monitored based on its proximity to an island/marine volcano with certain activity level, (ii) detecting the condition of volcanic avalanche or similar phenomenon by a camera and/or closest tide gauge measured tsunami and (iii) taking the action to issue prefixed tsunami warning and/or advisory as early as possible. This method is however very challenging due to the fact that (i) volcanic avalanche is not always detectable with camera or other monitoring instruments, (ii) volume of avalanche is not certain the short time making it difficult to issue a quantitative tsunami warning and (iii) practical difficulty in continuously monitoring the tide gauges for water level variations without a noticeable trigger such as a volcanic activity.

Early warning for tsunamis generated by atypical sources (aerial landslides, submarine landslides, volcanoes) is extremely complex. The group agreed to continue efforts to explore current status and best practices for hazard assessment, monitoring and responding to tsunamis from atypical sources, and possible integration into tsunami watch operations.

**Action 2:** Recognising the Palu and Sunda Strait tsunami events as being very complex from an early warning perspective and further reiterating the increasing threat of tsunamis from near-source atypical sources (aerial landslides, submarine landslides, volcanoes), requests a team comprising Satoshi Harada, Francois Schindele, Weniza, a Representative from Italy and Representative(s) of TTDMP to explore current status and best practices for hazard assessment, monitoring and responding to tsunamis from atypical sources. The team will prepare a report for the next meeting.

**Action 3:** Mike Angove to report back to the group on the feasibility of the implementation of operational warnings for meteorological tsunamis based on outcomes of the first world conference on meteo-tsunamis scheduled in Croatia during May 2019.

**Action 4:** Elizabeth Vanacore to report back to the group on procedures for handling of non-thrust tsunamigenic events from an operational warning perspective.

### 13. PRODUCTS FOR THE MARITIME COMMUNITY

Dr Tummala briefed on the background of this agenda item. As a follow-up of actions from the last meeting of the TTTWO and the TOWS-WG, a team comprising Dr Yuelong Miao, Mr Carlos Zuniga Araya, Mr Patricio Carrasco and Dr Chip McCreery developed a draft proposal for TSP Messages to the Maritime Community, incorporating advice received from the Chair of WWNWS-SC, and in line with the Joint IMO/IHO/WMO Manual on Maritime Safety Information (Manual 53, published in 2016). This draft proposal was presented by Dr Thorkild Aarup to the meeting of the WWNWS-SC held in 2018 in Monaco. The proposal has now been finalised incorporating all comments received from WWNWS-SC (Appendix 5). It is recommended that the TOWS-WG requests the ICGs to consider the proposal for implementation in their respective basins and the IOC Secretariat to facilitate coordination with the WWNWS-SC.

**Recommendation 9:** Approve the proposal on TSP Messages for the Maritime Community and requests the ICGs to consider the proposal for implementation in their respective basins. Further, IOC Secretariat is to share the final proposal with WWNWS-SC and facilitate coordination between ICGs and the WWNWS-SC for operationalising the service.

### 14. GLOBAL PUBLIC ACCESS TO TSUNAMI THREAT INFORMATION

Dr McCreery reminded the Task Team that the original intention of this agenda was to explore the possibility of developing an integrated webpage/portal under the IOC-UNESCO tsunami programme which could have links to, or source information from all the ICG TSPs/NTWCs to provide public with an authentic and up-to-date status of tsunami warnings in different ocean basins. As a starting point, the last meeting of the TTTWO and the TOWS-WG approved a statement that could be displayed by the ICG TSPs on their public warning pages, acknowledging that their services are being provided under the IOC-UNESCO framework. Dr Tummala briefed the meeting that all the 3 TSPs (Australia, India and Indonesia) in the IOTWMS have already displayed the statement on their respective websites. The TSPs in all other ICGs are encouraged to follow.

**Recommendation 10:** Noting that TSP-Australia, TSP-Indonesia and TSP-India have already uploaded on their website, statement acknowledging that their tsunami services are provided under the IOC-UNESCO framework, recommends all other ICG TSPs to follow.

## 15. OTHER ISSUES

### 15.1. OPTIMAL DESIGN OF SEA-LEVEL NETWORKS

Dr McCreery reminded that at the last meeting of the TTTWO, a methodology for optimal design of seismic and sea level stations was finalised based on similar work done in the PTWS and NEAMTWS. Further work related to development of regional seismic and sea level network timing response maps for different ICGs did not progress during the intersessional period. Dr Aarup mentioned that this is a very important requirement for all the ICGs and requested Dr McCreery to assist with development of these maps in time for the upcoming meetings of the IOTWMS and other regional systems. It was agreed that this action will be pursued on priority.

**Action 5:** Chip McCreery to develop maps of optimal seismic and sea-level networks for the ICG/IOTWMS and other regions in time for presentation to their upcoming ICG Sessions.

### 15.2. UPDATES TO THE GLOBAL SERVICE DEFINITION DOCUMENT (GSDD)

Dr Schindele suggested several updates to the Global Service Definition Document that is maintained by the TTTWO. Some important updates include (i) adding a paragraph on non-subduction zone earthquakes in section 4, (ii) adding information on methods to compute tsunami amplitudes on the coastline in section 4.7, (iii) clarifying the responsible institutions for issuance of the All Clear in figure 5, (iv) clarifying the roles of TSPs with respect to issuing the initial message, considering the case of NEAM region, (v) initial naming convention in section 9.2, (vi) clarifying that strike slip earthquake could generate near-source tsunamis, etc. There is also a need to update the GSDD with outcomes of the recent TTTWO meetings such as the proposal on maritime bulletins, methodology for optimal design of seismic and sea level networks, updates to AoS and ESZ maps, etc. It was agreed that an updated document will be produced for consideration at the next meeting of the TTTWO.

**Action 6:** Francois Schindele and IOC Secretariat to incorporate updates to the Global Service Definition Document for consideration at the next meeting.

## 16. REVIEW OF ACTION ITEMS AND RECOMMENDATIONS TO THE TOWS-WG

### 16.1. RECOMMENDATIONS:

**Recommendation 1:** Appreciating the IOC-facilitated International Tsunami Survey Teams in Palu (ITST-Palu) and recognising the importance of TICs in coordinating ITSTs, requests the TOWS-WG to (i) reiterate the importance of collecting data strictly in accordance with the ITST protocols, (ii) timely data and information sharing by the Survey Teams to facilitate immediate submission of a consolidated summary report to the host country to assist with response and recovery planning and (iii) ICGs to facilitate, in coordination with existing science organisations, special sessions at meetings / workshops to promote sharing of lessons learnt and compilation of all event data.

**Recommendation 2:** IOTWMS and IOTIC explore the possibility of organising a Special Session on Lessons Learnt from the Palu and Sunda Strait tsunamis in the next inter-sessional period, subject to funding availability.

**Recommendation 3:** Approve updates to the Tsunami Glossary

**Recommendation 4:** PTWS to continue work on Local Source Tsunami SOPs and share their guidance with other ICGs at the next meeting.

**Recommendation 5:** PTWS to continue work on National Tsunami Warning Centre Competency Framework and share their guidance with other ICGs at the next meeting.

**Recommendation 6:** Recognising the need to provide consolidated inputs from the IOC tsunami community into the planning and implementation of the UN Decade of Ocean Sciences for Sustainable Development and noting the progress made by the TOWS-WG so far, requests TOWS-WG to (i) identify a focussed group from within the TOWS-WG and its Task Teams to continue to advance aspirations of the tsunami community into planning of the Decade, (ii) ensure participation of TOWS-WG representatives in the global and regional planning meetings with the aim of providing inputs to the planning process and facilitate broader collaborations and (iii) request ICGs to inform Member States of the Decade during their ICG Sessions and seek inputs.

**Recommendation 7:** Approve the following changes to the AoS Map:

- Extend the coverage of NWPTAC to 170 deg E and coverage of Papua New Guinea and the Solomon Islands in the South.
- Cover the Indonesian coasts of Banda Sea, Java Sea and surrounding marginal seas by a new line to represent domestic service by the Indonesian Tsunami Early Warning System (InaTEWS) and incorporate corresponding updates in the text box.

**Recommendation 8:** IOTWMS and PTWS to review at their respective ICG meetings, the criteria for issuing messages for earthquakes in the border or outside their Earthquake Source Zones

**Recommendation 9:** Approve the proposal on TSP Messages for the Maritime Community and requests the ICGs to consider the proposal for implementation in their respective basins. Further, IOC Secretariat is to share the final proposal with WWNWS-SC and facilitate coordination between ICGs and the WWNWS-SC for operationalising the service.

**Recommendation 10:** Noting that TSP-Australia, TSP-Indonesia and TSP-India have already uploaded on their website, statement acknowledging that their tsunami services are provided under the IOC-UNESCO framework, recommends all other ICG TSPs to follow.

**Recommendation 11:** Extend the tenure of the Task Team on Tsunami Watch Operations for a further term with the same Terms of Reference

## **16.2. ACTIONS:**

**Action 1:** Appreciating the work of the PTWS Task Team on Future Goals and Performance Indicators, requests a team comprising Sarah Jane McCurrach, Yuelong Miao, Elizabeth Vanacore, Harkunti Rahayu and NEAMTWS representative/s to review the PTWS performance

monitoring framework in light of similar initiatives in other ICGs and recommend harmonised performance monitoring framework, data collection tools/questionnaire and reporting formats. The team will prepare a report for the next meeting.

**Action 2:** Recognising the Palu and Sunda Strait tsunami events as being very complex from an early warning perspective and further reiterating the increasing threat of tsunamis from near-source atypical sources (aerial landslides, submarine landslides, volcanoes), requests a team comprising Satoshi Harada, Francois Schindele, Weniza, Representative from Italy and Representative/(s) of TTDMP to explore current status and best practices for hazard assessment, monitoring and responding to atypical tsunamis. The team will prepare a report for the next meeting.

**Action 3:** Mike Angove to report back to the group on feasibility of the implementation of operational warnings for meteorological tsunamis based on outcomes of the first world conference on meteotsunamis scheduled in Croatia during May 2019.

**Action 4:** Elizabeth Vanacore to report back to the group on procedures for handling of non-thrust tsunamigenic events from an operational warning perspective.

**Action 5:** Chip McCreery to develop maps of optimal seismic and sea-level networks for the ICG/IOTWMS and other regions in time for presentation to their upcoming ICG Sessions.

**Action 6:** Francois Schindele and IOC Secretariat to incorporate updates to the Global Service Definition Document for consideration at the next meeting.

## **17. CLOSE OF MEETING**

Dr McCreery closed the meeting at 05:30 pm and thanked the participants for their contribution to a highly productive meeting.

APPENDIX 1

**Meeting of the TOWS-WG Inter-ICG Task Team on Tsunami Watch Operations**

**Intergovernmental Oceanographic Commission, UNESCO**

19–20 February 2019, Paris, France

**Provisional Agenda and Timetable**

**Task Team Members:**

Charles McCreery, Pacific Tsunami Warning Center (NOAA, Hawaii, USA) – ICG/PTWS

Satoshi Harada, Japan Meteorological Agency (Japan) – ICG/PTWS

Francois Schindele, Centre d'alerte aux tsunamis (France) – ICG/NEAMTWS

Fernando Carrilho, Portugese Sea and Atmosphere Institute (Portugal) – ICG/NEAMTWS

Elizabeth Vanacore, Seismologist, Puerto Rico Seismic Network (Puerto Rico) – ICG/CARIBEEWS

Wilfried Strauch, INETER (Nicaragua) – ICG/CARIBEEWS

Mohammad Sadly, BMKG (Indonesia) – ICG/IOTWMS

Yuelong Miao, Bureau of Meteorology (Australia) – ICG/IOTWMS

**Day 1: Tuesday, 19 February 2019**

Item	Time	Topic	Reference	Lead
1	0900-0915	<b>Opening and Session Organization</b> <ul style="list-style-type: none"> <li>• Registration</li> <li>• Overview of meeting logistics, introduction of participants, review of the agenda, etc.</li> </ul>		Chip McCreery
2	0915-0945	<b>Review of Action Items from the Previous Meeting</b>	<a href="#">Summary Report, TOWS-WG, Eleventh Meeting, Annex IV, Section 13.2, page 33</a>	Chip McCreery ICG-Representatives
3	0945-1015	<b>Review the Status of Implementation of the TOWS-WG Requests to the TTTWO</b>	Summary Report, TOWS-WG, Eleventh Meeting, Annex II, page 14	Chip McCreery ICG-Representatives
4	1015-1115	<b>Tsunami Watch Operations - Current Status and Plans in all ICGs</b>		ICG-Representatives
1115 - 1130 Break				

5	1130-1300	<b>Significant Operational Events Since Last Meeting</b>		Joint Session with TTDMP
13:00 – 14:00 Lunch				
6	1400-1430	<b>Tsunami Glossary Update</b>	<a href="#">Updates to Tsunami Glossary, 2019</a>	Joint Session with TTDMP
7	1430-1515	<b>Development of KPIs in relation with Sendai Framework Indicators</b>	Summary Report, TOWS-WG, Eleventh Meeting, Annex II, page14, Annex IV, page 28	Joint Session with TTDMP
1515 – 1530 Break				
Item	Time	Topic	Reference	Lead
8	1530-1630	<b>Local Source Tsunami SOPs</b> – best practice for warning and response		Joint Session with TTDMP
9	1630-1700	<b>NTWC Competency Framework</b>		Joint Session with TTDMP
End of Day 1				

**Day 2: Wednesday, 20 February 2019**

Item	Time	Topic	Reference	Lead
10	0900-1000	<b>Planning for the Ocean Decade</b>		Joint Session with TTDMP
11	1000-1100	<b>Updates to Area of Coverage and ESZ Maps of the ICGs</b>	Summary Report, TOWS-WG, Eleventh Meeting, Annex IV, page 32, page 38	ICG-Representatives
1100 – 1115 Break				
12	1115-1200	<b>Handling of Tsunamis from Non-Seismic Sources and Non-subduction Zone Earthquakes</b>	Summary Report, TOWS-WG, Eleventh Meeting, Annex IV, Section 9, page 30	ICG-Representatives
13	1200-1300	<b>Products for Maritime Community</b>	Summary Report, TOWS-WG, Eleventh Meeting, Annex IV, Section10, page 31 <a href="#">TSP Messages for the Maritime Community – A proposal to the WWNWS-SC</a>	ICG-representatives
1300 – 1400 Lunch				
14	1400 - 1430	<b>Global Public Access to Tsunami Threat Information</b>	Summary Report, TOWS-WG, Eleventh Meeting, Annex IV, Section11, page 31	Chip McCreery
15	1430-1530	<b>Other Issues</b> <ul style="list-style-type: none"> <li>• Optimal Design of Sea-level networks</li> <li>• Updates to the GSSD</li> </ul>	Summary Report, TOWS-WG, Eleventh Meeting, Annex IV, Section12, page 31-32	ICG-Representatives
1530 – 1600 Break				

16	1600-1700	<b>Recommendations and Actions for Reporting to the TOWS-WG Conclusion</b>		Chip McCreery IOC- Representative
Meeting Close				

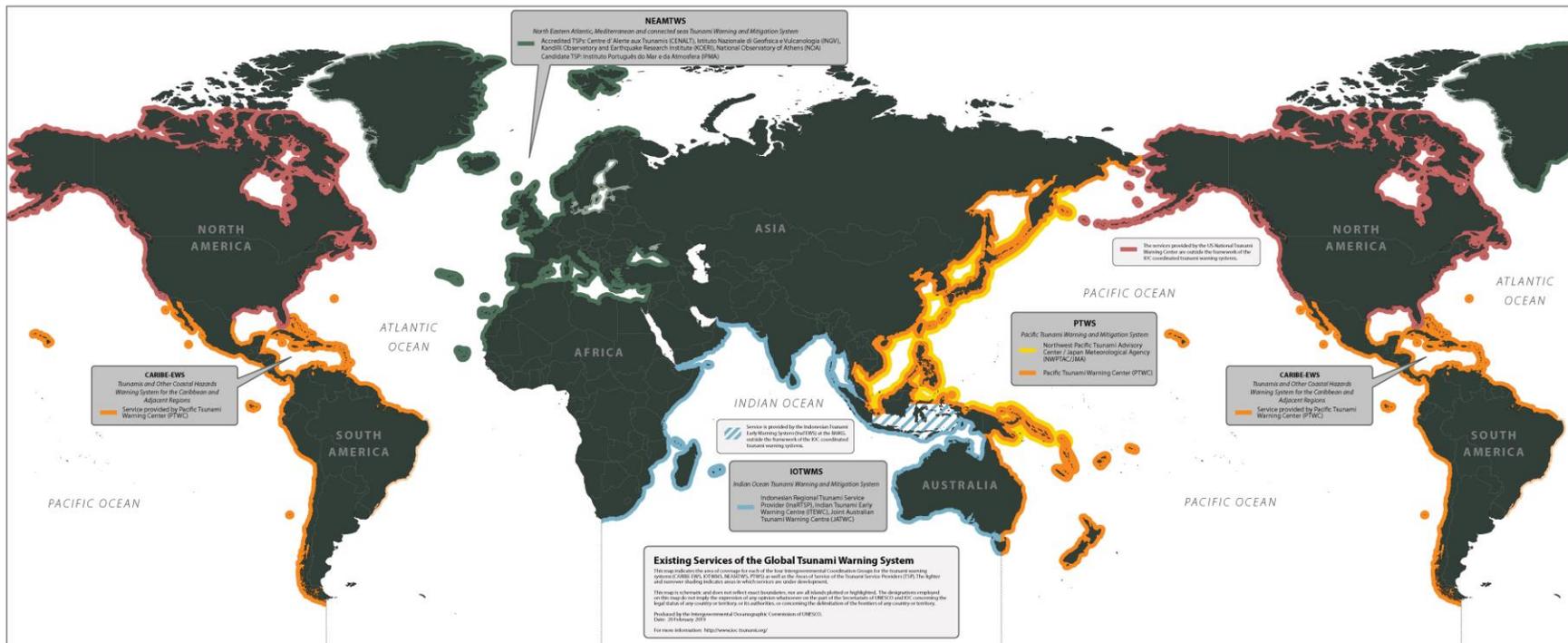


APPENDIX 3

**Meeting of the TOWS-WG Inter-ICG Task Team on Tsunami Watch Operations**

19–20 February 2019, Paris, France

**Revised Area of Service Map**



The map shown in this Appendix indicates the area of coverage for each of the four Intergovernmental Coordination Groups for the tsunami warning systems in the Caribbean (CARIBE-EWS), Indian Ocean (IOTWMS), NE Atlantic, Mediterranean & connected seas (NEAMTWS), and the Pacific (PTWS). In addition, the map also shows Areas of Service of the Tsunami Service Providers (TSP).

## APPENDIX 4

### **Intergovernmental Oceanographic Commission of UNESCO**

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

#### **Tsunami Service Provider Messages for the Maritime Community**

#### **A Proposal to the World-Wide Navigational Warning Service Sub-Committee (WWNWS-SC)**

**29 January 2019**

The following is an initial proposal for the format, content, and dissemination of messages with tsunami guidance specifically for ships on the high seas from the Tsunami Service Providers (TSPs) of the four Tsunami Warning Systems operated by the Intergovernmental Oceanographic Commission (IOC) of UNESCO. This proposal was generated in response to discussions between representatives of the International Hydrographic Organization (IHO) and the IOC to improve the accuracy and consistency of messages issued by the NAVAREA coordinators for tsunami events. This proposal incorporates feedback received from the 10<sup>th</sup> session of the WWNWS-SC held in Monaco during 27-31 August 2018.

1. Messages would be created and disseminated only for potential and confirmed tsunami occurrences when forecast amplitudes at any coast within a TSP's service area exceed pre-defined threat threshold (typically 0.3 meters), the minimum coastal amplitude considered to be a hazard.
2. Messages would be disseminated by each TSP by email to those NAVAREA coordinators who subscribe for receiving tsunami threat information within that TSP's service area, based on the IOC Area of Service Map. (Please refer to Appendix 3 for the Area of Service Map. Note that multiple TSPs cover some NAVAREAs and each TSP covers multiple NAVAREAs. In case of multiple TSPs covering same NAVAREAs, the NAVAREA coordinator may note that threat assessment could differ from one TSP to the other and hence is advised to use the "worst-case" in formulating maritime safety messages).
3. The initial TSP maritime message would be issued to NAVAREA coordinators when the TSP issues its initial quantitative coastal forecast for the Member States within its IOC System. This is usually within 30 minutes of the earthquake that generated the tsunami. Note that a TSP may issue a qualitative advisory product to Member States preceding the initial quantitative coastal forecast products.
4. An additional TSP maritime message would be issued only if the forecast significantly changes.
5. One message would be issued indicating the final handling of the event by the TSP, usually when the threat has passed everywhere in the service area. However, the

hazard may continue along some coasts and that status must be determined by local authorities.

6. NAVAREA coordinators would have the responsibility for turning TSP messages into maritime safety messages issued via SafetyNet to ships at sea.

**Message Format and Content**

The format and content of the proposed TSP messages generally follows the guidance given in the Manual on Maritime Safety Information – IHO Publication 53 (January 2016 Edition) in order that the conversion by NAVAREA coordinators to a maritime safety message be as simple as possible.

Message Element	Element Description	TSP Content	Queries	Summary of Clarifications by WWNWS-SC and TTTWO
1	NAVAREA name	NAVAREA having coasts with tsunami forecast amplitude exceeding the pre-defined threat threshold (typically 0.3 meter)	Can one message apply to more than one NAVAREA?	There is no need to put the NAVAREA name or number on the message(s) provided. The NAVAREA Coordinator for the area affected by the Tsunami Warning will provide this information. If the Tsunami Warning applies to more than one NAVAREA, the NAVAREA Coordinator understands the need to forward this information to the adjacent NAVAREA(s) that may be affected. While NAVAREA Coordinators are responsible for passing information to other affected NAVAREAs, there should not be a reliance upon this to receive tsunami warnings. All NAVAREA Coordinators should be responsible for subscribing to the warning service appropriate to their AOR, in reference to the IOC AoS map in Appendix 3. For example, the coverage map clearly shows that PTWS is the warning service that provides alerts to NAVAREA XIV, so it should be the responsibility of the NAVAREA XIV Coordinator to subscribed

				to alerts from this service.
2	General Area	Name of the general area forecast to be affected by the tsunami	Need to identify or create a standard area naming scheme for ocean areas.	Not mandatory for TSPs to use a standard naming scheme for General Area. They can describe in general terms which broad area the bulletin applies to (eg. Indian Ocean / Western Indian Ocean/ Eastern Indian Ocean / etc.). The NAVAREA Coordinator will refer to the chart coverage for the affected area(s) by the event and will utilize the naming convention found on those applicable charts, as appropriate.
3	Locality	Not Used		
4	Chart Number	Not Used		
5	Key Subject	Type of Tsunami Message (Confirmed Threat/Cancellation/etc.), issuing centre and issuing time. A likely or confirmed tsunami, with key information about the source - usually an earthquake (lat/lon, region name, origin time).		
6	Geographical Region	Names of countries/Islands (from a standard list) in NAVAREA with coasts forecast to have hazardous tsunami waves.	Need standard list of key harbors and their names.	It would be better to list only the names of Countries/Islands as standard text (not graphical) products. TSPs can provide a geographic region name for the area affected, if desired. Additionally, they can provide key harbor names for the area effected, but it is not necessary to use a standardized list of key harbor names for the area. The NAVAREA Coordinator will refer to the chart coverage for the affected area(s) by the event and will utilize the naming convention found on those applicable charts, as appropriate.
7	Amplifying Remarks	Tsunami impact on ships in shallow waters. Consult		

		local authorities of destination.		
8	Cancellation Details	Indicate if final message and that continuing hazard possible. Must be evaluated locally.		

### ***Example Proposed TSP Maritime Messages***

#### **Example 1 – A TSP initial message for a tsunami affecting 3 NAVAREAs**

NAVAREA XI, NAVAREA XIII, NAVAREA X

NORTHEAST PACIFIC COASTS

TSUNAMI THREAT MESSAGE [or whatever the correct term will be] ISSUED BY PACIFIC TSUNAMI WARNING CENTRE [fill in name of the issuing TSP] in support of the UNESCO/IOC PACIFIC TSUNAMI WARNING AND MITIGATION SYSTEM [fill in name of the regional system] AT DDHHMM UTC MMM YY. [This clearly identifies that the message has been issued by the recognised expert]

A TSUNAMI HAS BEEN GENERATED BY A MAGNITUDE 8.4 EARTHQUAKE THAT OCCURRED IN VICINITY OF [Position] DD-MM N/S DDD-MM E/W, THE RYUKYU ISLANDS DDHHMM UTC MMM YY [this is the date/time of the earthquake, rather than the originating message]

HAZARDOUS TSUNAMI WAVES ARE FORECAST FOR SOME COASTS OF JAPAN, THE PHILIPPINES, AND INDONESIA [from a list of countries/islands]

TSUNAMI WAVES ARE NOT A HAZARD TO SHIPS IN DEEP WATER BUT CAN CAUSE STRONG CURRENTS AND RAPID SEA LEVEL CHANGES IN SHALLOW WATER, AS WELL AS INUNDATION OF THE COAST. SHIPS APPROACHING THE COAST SHOULD CONSULT LOCAL AUTHORITIES REGARDING LOCAL CONDITIONS AND ADVICES.

#### **Example 2 – A TSP final message for a tsunami affecting 3 NAVAREAs**

NAVAREA XI, NAVAREA XIII, NAVAREA X

NORTHEAST PACIFIC COASTS

TSUNAMI CANCELLATION MESSAGE [or whatever the correct term will be] ISSUED BY PACIFIC TSUNAMI WARNING CENTRE [fill in name of the issuing TSP] in support of the UNESCO/IOC PACIFIC TSUNAMI WARNING AND MITIGATION SYSTEM [fill in name of the regional system] AT DDHHMM UTC MMM YY. [This clearly identifies that the message has been issued by the recognised expert]

THE THREAT HAS NOW LARGELY PASSED FOR THE TSUNAMI GENERATED BY A MAGNITUDE 8.4 EARTHQUAKE THAT OCCURRED IN VICINITY OF [Position] DD-MM N/S DDD-MM E/W, THE RYUKYU ISLANDS DDHHMM UTC MMM YY [this is the date/time of the earthquake, rather than the originating message]

HOWEVER, SHIPS APPROACHING THE COAST SHOULD STILL CONSULT LOCAL AUTHORITIES REGARDING LOCAL CONDITIONS AND ADVICES.

ANNEX V

LIST OF PARTICIPANTS

**TOWS-WG-XII**

Mr Michael ANGOVE  
Director, NOAA Tsunami Program  
National Weather Service/National Oceanic  
Atmospheric Administration  
1325 East-West Highway  
Silver Spring MD 20910  
United States  
Tel: 301-713-1858X106  
Email: [michael.angove@noaa.gov](mailto:michael.angove@noaa.gov)

Mr David COETZEE  
Manager, Capability & Operations / National  
Controller  
New Zealand Ministry of Civil Defence &  
Emergency Management  
New Zealand Ministry of Civil Defence &  
Emergency Management  
PO Box 5010 Wellington 6045  
New Zealand  
Tel: +64 (4) 495 6806  
Fax: +64 (4) 473 7369  
Email: [david.coetzee@dpmc.govt.nz](mailto:david.coetzee@dpmc.govt.nz)

Dr Silvia CHACON BARRANTES  
Professor and Researcher  
Sistema Nacional de Monitoreo de Tsunamis  
(SINAMOT)  
Universidad Nacional, Campus Omar Dengo  
Heredia  
Costa Rica  
Email: [silviach@una.ac.cr](mailto:silviach@una.ac.cr)

Mr Cyrille HONORÉ  
Weather and Disaster Risk Reduction Services  
Department  
World Meteorological Organization (WMO)  
7bis, avenue de la Paix  
Case postale 2300  
Geneva 1211  
Switzerland  
Email: [chonore@wmo.int](mailto:chonore@wmo.int)

Dr Charles (Chip) MCCREERY  
Director PTWC  
Pacific Tsunami Warning Center  
1845 Wasp Blvd., Bldg 176,  
Honolulu, HI 96818  
United States  
Tel: 808-689-8207 x301  
Fax: 808-689-4543  
Email: [charles.mccreery@noaa.gov](mailto:charles.mccreery@noaa.gov)

Dr Gerassimos PAPADOPOULOS  
Research Director  
Institute of Geodynamics, National  
Observatory of Athens  
P.O. Box 20048  
11810 Athens  
Greece  
Tel: +30-210-3490165  
Fax: +30-210-3490165  
Email: [papadop@gein.noa.gr](mailto:papadop@gein.noa.gr)

Dr Alexander POSTNOV (Chair)  
Deputy Director  
Federal Service for Hydrometeorology and  
Environmental Monitoring, Moscow  
State Oceanographic Institute  
6, Kropotkiyskiy Lane  
MOSCOW  
Russian Federation  
119034  
Tel: +7 499 246 01 67  
Fax: +7 499 246 72 88  
Email: [a\\_postnov@mail.ru](mailto:a_postnov@mail.ru)

Dr Wilfried STRAUCH  
Advisor on Earth Sciences  
Instituto Nicaragüense de Estudios  
Territoriales  
Frente Hospital Solidaridad.  
Managua 2110  
Nicaragua  
Tel: +505 89 24 62 34  
Email: [wilfried.strauch@yahoo.com](mailto:wilfried.strauch@yahoo.com)

Mr David THOMAS  
Chief, Information and Telecommunication  
System Division  
World Meteorological Organization  
7bis, avenue de la Paix  
Case Postale 2300  
1211 Geneva  
Switzerland  
Tel: +41 22 730 8241  
Fax: +41 22 730 8021  
Email: [DThomas@wmo.int](mailto:DThomas@wmo.int)

Ms Christa VON HILLEBRANDT-ANDRADE  
Manager and Researcher  
NOAA NWS Caribbean Tsunami Warning  
Program  
Mayaguez Puerto Rico 00680  
United States  
Tel: 1-787-249-8307  
Fax: 1-787-265-1684  
Email: [christa.vonh@noaa.gov](mailto:christa.vonh@noaa.gov)

## OBSERVERS

Ms Alison BROME  
Director  
Tsunami Information Centre  
Caribbean Tsunami Information Centre  
Building #30 Warrens Industrial Park,  
Warrens, St. Michael  
Bridgetown BB22026  
Barbados  
Email: [a.brome@unesco.org](mailto:a.brome@unesco.org)

Mr Fernando CARRILHO  
Head of Geophysics Division  
Instituto Português do Mar e da Atmosfera, I. P.  
Instituto Português do Mar e da Atmosfera  
Rua C - Aeroporto de Lisboa  
Lisbon 1749-077  
Portugal  
Email: [fernando.carrilho@meteo.pt](mailto:fernando.carrilho@meteo.pt)

Dr Ken GLEDHILL  
GeoNet Project Director  
GNS Science – Te Pu Ao  
Lower Hutt P.O. Box 30-368  
New Zealand  
Email: [K.Gledhill@gns.cri.nz](mailto:K.Gledhill@gns.cri.nz)

Mr Satoshi HARADA  
Senior Coordinator for International  
Earthquake and Tsunami Information  
Earthquake and Tsunami Observation Division  
Japan Meteorological Agency  
1-3-4 Otemachi Chiyoda-ku  
Tokyo 100-8122  
Japan  
Email: [sharada@met.kishou.go.jp](mailto:sharada@met.kishou.go.jp)

Dr 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  
Fax: 1-808-725-6055  
Email: [laura.kong@noaa.gov](mailto:laura.kong@noaa.gov)

Ms Brigitte LEONI  
United Nations International Strategy on  
Disaster Reduction  
UNISDR  
9-11 Rue de Varembe  
Geneva CH 1202  
Switzerland  
Email: [leonib@un.org](mailto:leonib@un.org)

Dr Yuelong MIAO  
Manager for Tsunami and Storm Surge  
Warning Services  
Public Safety Program, National Forecast  
Services Group  
Bureau of Meteorology, Melbourne  
700 Collins Street, Docklands  
Melbourne VIC 3001  
Australia  
Email: [y.miao@bom.gov.au](mailto:y.miao@bom.gov.au)

Dr Harkunti RAHAYU  
Institut Teknologi Bandung (Bandung Institute  
of Technology)  
Campus  
Jl. Ganesha no. 10  
Bandung West Java 40132  
Indonesia  
Email: [harkunti\\_rahayu@yahoo.com](mailto:harkunti_rahayu@yahoo.com)

Dr François SCHINDELÉ  
Commissariat à l'énergie atomique CEA/DAM  
Ile de France (Essonne)  
CEA/DIF/DASE  
Bruyères-le-Châtel  
91297 Arpajon  
France  
Tel: (33 1) 69 26 50 63  
Fax: (33 1) 69 26 70 23  
Email: [francois.schindele@gmail.com](mailto:francois.schindele@gmail.com)

Ms Ioanna TRIANTAFYLLOU  
MSc ASTARTE project  
Institute of Geodynamics, National  
Observatory of Athens  
P.O. Box 20048  
Athens 11810  
Greece  
Email: [ioannatriantafyllou@yahoo.gr](mailto:ioannatriantafyllou@yahoo.gr)

Mr Rahmat TRIYONO  
Head of Earthquake and Tsunami Centre  
Indonesian Agency for Meteorology,  
Climatology and Geophysics (BMKG)  
Jl. Angkasa 1 No.2  
DKI Jakarta 10610  
Indonesia  
Email: [rahmat.triyono@gmail.com](mailto:rahmat.triyono@gmail.com)

Dr Elizabeth VANACORE  
Red Sismica de Puerto Rico  
Universidad de Puerto Rico  
Mayaguez Puerto Rico Call Box 9000  
USA  
Email: [elizabeth.vanacore@upr.edu](mailto:elizabeth.vanacore@upr.edu)

Mrs WENIZA  
Head of Tsunami Mitigation Sub Division  
Indonesian Agency for Meteorology,  
Climatology and Geophysics (BMKG)

Jl. Angkasa 1 No.2  
Kemayoran  
Jakarta Pusat Jakarta 10720  
Indonesia  
Email: [weniza@bmgk.go.id](mailto:weniza@bmgk.go.id)

Mr Amir YAHAV  
Director, National Doctrine, Training, Exercises  
Division  
National Emergency Management Authority  
(NEMA)  
20<sup>th</sup> Haarbaa st.  
Tel Aviv  
Israel  
Tel: 972-36977236  
Email: [Av\\_y@hotmail.com](mailto:Av_y@hotmail.com)

### **IOC/TSU SECRETARIAT**

Dr Thorkild AARUP  
Intergovernmental Oceanographic  
Commission  
UNESCO  
1 rue Miollis  
F-75732 Paris cedex 15  
France  
Tel: +33 (0) 145 684019  
Fax: +33 (0) 145 685812  
Email: [t.aarup@unesco.org](mailto:t.aarup@unesco.org)

Mr Bernardo ALIAGA ROSSEL  
Programme Specialist, Tsunami Unit  
Intergovernmental Oceanographic  
Commission of UNESCO  
7 Place de Fontenoy  
75732 Paris Cedex 07, France  
France  
Tel: +33 1 45 68 39 80  
Fax: +33 1 45 68 50 10  
Email: [b.aliaga@unesco.org](mailto:b.aliaga@unesco.org)

Mr Denis CHANG SENG  
Programme Specialist (Ocean Science Section  
and Tsunami Unit)  
Intergovernmental Oceanographic  
Commission of UNESCO  
7 Place de Fontenoy  
75732 Paris Cedex 07, France  
France  
Tel: +33 1 45 68 39 52  
Fax: +33 1 45 68 50 10  
Email: [d.chang-seng@unesco.org](mailto:d.chang-seng@unesco.org)

Mr Ardito M. KODIJAT  
Head, Indian Ocean Tsunami Information  
Centre  
UNESCO Office in Jakarta  
Jl. Galuh II no 5  
Kebayoran Baru  
Jakarta Selatan 12110

DKI  
Indonesia  
Tel: +62-21-7399818 Ext 878  
Fax: +62-21-72796489  
Email: [a.kodijat@unesco.org](mailto:a.kodijat@unesco.org)

Dr Srinivasa Kumar TUMMALA  
Head, UNESCO/IOC IOTWMS Secretariat  
ICG/IOTWMS Secretariat  
UNESCO IOC Perth Regional Programme  
Office  
West Perth, Western Australia 6872  
Australia  
Tel: +61 892260191  
Email: [sk.tummala@unesco.org](mailto:sk.tummala@unesco.org)

Mr Jiuta KOROVULAVULA  
National Professional Officer (IOC)  
UNESCO Office in Apia  
Suva  
Fiji  
Tel: +679 9704863  
Email: [j.korovulavula@unesco.org](mailto:j.korovulavula@unesco.org)

Ms Eunmi Kim  
Intern, IOC  
Email: [eu.kim@unesco.org](mailto:eu.kim@unesco.org)

### **INTER-ICG TASK TEAM ON DISASTER MANAGEMENT & PREPAREDNESS**

#### **CHAIR OF TASK TEAM**

Mr David COETZEE  
Manager, Capability & Operations / National  
Controller  
New Zealand Ministry of Civil Defence &  
Emergency Management  
New Zealand Ministry of Civil Defence &  
Emergency Management  
PO Box 5010  
Wellington 6045  
New Zealand  
Tel: +64 (4) 495 6806  
Fax: +64 (4) 473 7369  
Email: [david.coetzee@dpmc.govt.nz](mailto:david.coetzee@dpmc.govt.nz)

#### **TASK TEAM MEMBERS**

Ms Alison BROME  
Director  
Tsunami Information Centre  
Caribbean Tsunami Information Centre  
Building #30 Warrens Industrial Park,  
Warrens, St. Michael  
Bridgetown BB22026  
Barbados  
Email: [a.brome@unesco.org](mailto:a.brome@unesco.org)

Dr Silvia CHACON BARRANTES  
Professor and Researcher  
Sistema Nacional de Monitoreo de Tsunamis  
(SINAMOT)  
Universidad Nacional, Campus Omar Dengo  
Heredia  
Costa Rica  
Email: [silviach@una.ac.cr](mailto:silviach@una.ac.cr)

Mr Ardito M. KODIJAT  
Head of the Indian Ocean Tsunami Information  
Centre  
UNESCO Office in Jakarta  
Jl. Galuh II no 5  
Kebayoran Baru  
Jakarta Selatan 12110  
DKI  
Indonesia  
Tel: +62-21-7399818 Ext 878  
Fax: +62-21-72796489  
Email: [a.kodijat@unesco.org](mailto:a.kodijat@unesco.org)

Dr 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  
Fax: 1-808-725-6055  
Email: [laura.kong@noaa.gov](mailto:laura.kong@noaa.gov)

Dr Harkunti RAHAYU  
Institut Teknologi Bandung (Bandung Institute  
of Technology)  
Campus  
Jl. Ganesha no. 10  
Bandung West Java 40132  
Indonesia  
Email: [harkunti\\_rahayu@yahoo.com](mailto:harkunti_rahayu@yahoo.com)

Ms Marzia SANTINI  
Italian Civil Protection, Roma  
Roma  
Italy  
Tel: 00390668204558  
Email: [marzia.santini@protezionecivile.it](mailto:marzia.santini@protezionecivile.it)

Ms Christa VON HILLEBRANDT-ANDRADE  
Manager and Researcher  
NOAA NWS Caribbean Tsunami Warning  
Program  
Mayaguez Puerto Rico 00680  
United States  
Tel: 1-787-249-8307  
Fax: 1-787-265-1684  
Email: [christa.vonh@noaa.gov](mailto:christa.vonh@noaa.gov)

Mr Amir YAHAV  
Director, National Doctrine, Training, Exercises  
Division / National Emergency Management  
Authority (NEMA)  
20th Haarbaa st.  
Tel Aviv  
Israel  
Tel: 972-36977236  
Email: [Av\\_y@hotmail.com](mailto:Av_y@hotmail.com)

#### **OBSERVERS**

Dr Gerassimos PAPADOPOULOS  
Research Director  
Institute of Geodynamics, National  
Observatory of Athens  
P.O. Box 20048  
11810 Athens  
Greece  
Tel: +30-210-3490165  
Fax: +30-210-3490165  
Email: [papadop@gein.noa.gr](mailto:papadop@gein.noa.gr)

Ms Ioanna TRIANTAFYLLOU  
PhD Candidate  
Institute of Geodynamics,  
National Observatory of Athens  
P.O. Box 20048  
11810 Athens  
Greece  
Email: [ioannatriantafyllou@yahoo.gr](mailto:ioannatriantafyllou@yahoo.gr)

#### **IOC/TSU SECRETARIAT**

Mr Bernardo ALIAGA ROSSEL  
Programme Specialist, Tsunami Unit  
Intergovernmental Oceanographic  
Commission of UNESCO  
7 Place de Fontenoy  
75732 Paris Cedex 07, France  
France  
Tel: +33 1 45 68 39 80  
Fax: +33 1 45 68 50 10  
Email: [b.aliaga@unesco.org](mailto:b.aliaga@unesco.org)

Mr Denis CHANG SENG  
Programme Specialist (Ocean Science Section  
and Tsunami Unit)  
Intergovernmental Oceanographic  
Commission of UNESCO  
7 Place de Fontenoy  
75732 Paris Cedex 07, France  
France  
Tel: +33 1 45 68 39 52  
Fax: +33 1 45 68 50 10  
Email: [d.chang-seng@unesco.org](mailto:d.chang-seng@unesco.org)

Mr Jiuta KOROVLAVULA  
National Professional Officer (IOC)  
UNESCO Office in Apia

Suva  
Fiji  
Tel: +679 9704863  
Email: [j.korovulavula@unesco.org](mailto:j.korovulavula@unesco.org)

Ms Eunmi Kim  
Intern, IOC  
Intergovernmental Oceanographic Commission of  
UNESCO  
7 Place de Fontenoy  
75732 Paris Cedex 07, France  
France  
Email: [eu.kim@unesco.org](mailto:eu.kim@unesco.org)

#### **INTER-ICG TASK TEAM ON TSUNAMI WATCH OPERATIONS**

##### **CHAIR OF TASK TEAM**

Dr Charles (Chip) MCCREERY  
Director PTWC  
Pacific Tsunami Warning Center  
1845 Wasp Blvd., Bldg 176,  
Honolulu, HI 96818  
United States  
Tel: 808-725-6300  
Email: [charles.mccreery@noaa.gov](mailto:charles.mccreery@noaa.gov)

##### **TASK TEAM MEMBERS**

Mr Fernando CARRILHO  
Head of Geophysics Division  
Instituto Português do Mar e da Atmosfera, I. P.  
Rua C - Aeroporto de Lisboa  
Lisbon 1749-077  
Portugal  
Email: [fernando.carrilho@meteo.pt](mailto:fernando.carrilho@meteo.pt)

Mr Satoshi HARADA  
Senior Coordinator for International  
Earthquake and Tsunami Information  
Earthquake and Tsunami Observation Division  
Japan Meteorological Agency, Tokyo  
1-3-4 Otemachi Chiyoda-ku  
Tokyo Tokyo 100-8122  
Japan  
Tel: +81(0)3 3284 1743  
Email: [sharada@met.kishou.go.jp](mailto:sharada@met.kishou.go.jp)

Dr Yuelong MIAO  
Manager for Tsunami and Storm Surge  
Warning Services  
Public Safety Program, National Forecast  
Services Group  
Bureau of Meteorology, Melbourne  
700 Collins Street, Docklands  
Melbourne VIC 3001  
Australia  
Tel: +61 3 9669 4110  
Email: [y.miao@bom.gov.au](mailto:y.miao@bom.gov.au)

Dr François SCHINDELÉ  
International expert  
CEA/DIF/DASE  
Bruyères le Châtel  
91297 ARPAJON Cedex  
France  
Tel: +33 1 69 26 50 63  
Email: [francois.schindele@gmail.com](mailto:francois.schindele@gmail.com)

Dr Wilfried STRAUCH  
Advisor on Earth Sciences  
Instituto Nicaragüense de Estudios  
Territoriales  
Frente Hospital Solidaridad.  
Managua 2110  
Nicaragua  
Tel: +505 89 24 62 34  
Email: [wilfried.strauch@yahoo.com](mailto:wilfried.strauch@yahoo.com)

Dr Elizabeth VANACORE  
Red Sismica de Puerto Rico  
Universidad de Puerto Rico  
Mayaguez Puerto Rico Call Box 9000  
United States  
Email: [elizabeth.vanacore@upr.edu](mailto:elizabeth.vanacore@upr.edu)

##### **OBSERVERS**

Mr 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  
Email: [michael.angove@noaa.gov](mailto:michael.angove@noaa.gov)

Dr Ken GLEDHILL  
GeoNet Project Director  
GNS Science – Te Pu Ao  
Lower Hutt P.O. Box 30-368  
New Zealand  
Tel: 64-4-5704848  
Fax: 64-4-5704600  
Email: [K.Gledhill@gns.cri.nz](mailto:K.Gledhill@gns.cri.nz)

Mr Rahmat TRIYONO  
Head of Earthquake and Tsunami Centre  
Indonesian Agency for Meteorology,  
Climatology and Geophysics (BMKG)  
Jl. Angkasa 1 No.2  
DKI Jakarta 10610  
Indonesia  
Email: [rahmat.triyono@gmail.com](mailto:rahmat.triyono@gmail.com)

Mrs WENIZA  
Head of Tsunami Mitigation Sub Division  
Indonesian Agency for Meteorology,  
Climatology and Geophysics (BMKG)  
Jl. Angkasa 1 No.2  
Kemayoran  
Jakarta Pusat Jakarta 10720  
Indonesia  
Tel: +6281-215556615  
Email: [weniza@bmkg.go.id](mailto:weniza@bmkg.go.id)

**IOC/TSU SECRETARIAT**

Dr Thorkild AARUP  
Intergovernmental Oceanographic  
Commission  
UNESCO  
1 rue Miollis  
F-75732 Paris cedex 15  
France  
Tel: +33 (0) 145 684019  
Fax: +33 (0) 145 685812  
Email: [t.aarup@unesco.org](mailto:t.aarup@unesco.org)

Dr Srinivasa Kumar TUMMALA  
Head, UNESCO/IOC IOTWMS Secretariat  
ICG/IOTWMS Secretariat  
UNESCO IOC Perth Regional Programme  
Office  
West Perth, Western Australia 6872  
Australia  
Tel: +61 892260191  
Email: [sk.tummala@unesco.org](mailto:sk.tummala@unesco.org)

ANNEX VI

**LIST OF ACRONYMS**

<b>AoS</b>	Area of Service
<b>BMKG</b>	Indonesian Agency for Meteorological, Climatological and Geophysics
<b>BPBD</b>	Badan Penanggulangan Bencana Daerah (Local Disaster Management Agency)
<b>CAP</b>	Common Alert Protocol
<b>CATAC</b>	Central America Tsunami Advisory Center
<b>CARIBE-EWS</b>	Tsunami and Other Coastal Hazards Warning System for the Caribbean and Adjacent Regions
<b>CARIBE WAVE</b>	Caribbean Wave Exercise
<b>CENALT</b>	CENtre d'Alerte aux Tsunamis, France
<b>CIFDP</b>	Coastal Inundation Forecasting Demonstration Project
<b>CMT</b>	Centroid Moment Tensor
<b>COIIS</b>	Commission for Observation, Infrastructure, and Information Systems (WMO)
<b>CTIC</b>	Caribbean Tsunami Information Center
<b>CTSP</b>	Candidate Tsunami Service Provider
<b>CTWP</b>	Caribbean Tsunami Warning Programme
<b>DART</b>	Deep-ocean Assessment and Reporting of Tsunamis
<b>DBCP</b>	Data Buoy Cooperation Panel
<b>DRR</b>	Disaster Risk Reduction
<b>ESZ</b>	Earthquake Source Zone
<b>EC</b>	Executive Council
<b>GNSS</b>	Global Navigation Satellite System
<b>GOOS</b>	Global Ocean Observing System (IOC)
<b>GSSD</b>	Global Service Definition Document
<b>GTS</b>	Global Telecommunication System (WMO)
<b>ICG</b>	Intergovernmental Coordination Group

<b>ICG/CARIBE-EWS</b>	Intergovernmental Coordination Group for the Tsunami and Other Coastal Hazards Warning System for the Caribbean and Adjacent Regions
<b>ICG/IOTWMS</b>	Intergovernmental Coordination Group for the Indian Ocean Tsunami Warning and Mitigation System
<b>ICG/NEAMTWS</b>	Intergovernmental Coordination Group for the Tsunami Early Warning and Mitigation System in the North-Eastern Atlantic, the Mediterranean and Connected Seas
<b>ICG/PTWS</b>	Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System
<b>IHO</b>	International Hydrographic Organization
<b>IMO</b>	the International Maritime Organization
<b>InaTEWS</b>	Indonesian Tsunami Early Warning System
<b>INGV</b>	Istituto Nazionale di Geofisica e Vulcanologia, Italy
<b>IOC</b>	Intergovernmental Oceanographic Commission
<b>IOTIC</b>	Indian Ocean Tsunami Information Centre
<b>IOTR</b>	Indian Ocean Tsunami Ready
<b>IOTWMS</b>	Indian Ocean Tsunami Warning and Mitigation System
<b>IOWave</b>	Indian Ocean Wave Exercise
<b>IPMA</b>	Instituto Português do Mar e da Atmosfera
<b>ITB</b>	Institut Teknologi Bandung
<b>ITEWC</b>	Indian Tsunami Early Warning Centre
<b>ITIC</b>	International Tsunami Information Center
<b>ITP</b>	ITIC Training Programme
<b>ITST</b>	International Tsunami Survey Team
<b>IUGG</b>	International Union of Geodesy and Geophysics
<b>JATWC</b>	Joint Australian Tsunami Warning Centre
<b>JCOMM</b>	Joint Technical Commission for Oceanography and Marine Meteorology
<b>JICA</b>	Japan International Cooperation Agency
<b>JMA</b>	Japan Meteorological Agency

<b>JRC</b>	Joint Research Centre
<b>KOERI</b>	Kandilli Observatory and Earthquake Research, Turkey
<b>KPI</b>	Key Performance Indicators
<b>LDMO</b>	Local Disaster Management Office
<b>M</b>	Magnitude
<b>M<sub>w</sub></b>	Moment Magnitude
<b>MFIT</b>	Malaysia Fund in Trust
<b>MHEWS</b>	Multi-Hazard Early Warning Systems
<b>MORTHE</b>	Ministry of Research, Technology and Higher Education, Indonesia
<b>NEAMTIC</b>	Tsunami Information Centre for the North-Eastern Atlantic, the Mediterranean and Connected Seas
<b>NOA</b>	National Observatory of Athens, Greece
<b>NOAA</b>	National Oceanic and Atmospheric Administration
<b>NTWC</b>	National Tsunami Warning Center
<b>NWPTAC</b>	North West Pacific Tsunami Advisory Center
<b>ORSNET</b>	Oceania Regional Seismic Network Project
<b>PacWave</b>	Pacific Wave Exercise
<b>PTWC</b>	Pacific Tsunami Warning Centre
<b>PTWS</b>	Pacific Tsunami Warning and Mitigation System
<b>RIFT</b>	Real-time Inundation Forecasting of Tsunamis
<b>SAMOA</b>	SIDS Accelerated Modalities Of Action
<b>SC</b>	Steering Committee
<b>SCSTAC</b>	South China Sea Tsunami Advisory Centre
<b>SDG</b>	Sustainable Development Goals
<b>SFSPA</b>	Services & Forecast Systems Programme Area (JCOMM)
<b>SIDS</b>	Small Island developing States
<b>SOP</b>	Standard Operating Procedure
<b>TEMPP</b>	Tsunami Evacuation Maps, Plans and Procedures

<b>TIC</b>	Tsunami Information Centres
<b>TNC</b>	Tsunami National Contact
<b>TOAST</b>	Tsunami Observation and Simulation Terminal
<b>TOR</b>	Terms of Reference
<b>TOWS-WG</b>	Working Group on Tsunamis and Other Hazards Related to Sea-Level Warning and Mitigation Systems
<b>TSP</b>	Tsunami Service Provider
<b>TSU</b>	Tsunami Unit
<b>TT</b>	Task Team
<b>TTDMP</b>	Task Team on Disaster Management and Preparedness
<b>TTT</b>	Tsunami Travel Time
<b>TTTRP</b>	Task Team on Tsunami Recognition Programme
<b>TTTWO</b>	Task Team on Tsunami Watch Operations
<b>TWFP</b>	Tsunami Warning Focal Point
<b>UNDP</b>	United Nations Development Programme
<b>UNESCAP</b>	UN Economic and Social Commission for Asia and the Pacific
<b>UNESCO</b>	United Nations Educational, Scientific and Cultural Organization
<b>UNGA</b>	United Nations General Assembly
<b>UNISDR</b>	United Nations Office for Disaster Risk Reduction
<b>USAID/OFDA</b>	United States Agency for International Development/Office of U.S. Foreign Disaster Assistance
<b>USGS</b>	United States Geological Survey
<b>WG</b>	Working Group
<b>WIS</b>	WMO Information System
<b>WMO</b>	World Meteorological Organization
<b>WTAD</b>	World Tsunami Awareness Day
<b>WWNWS-SC</b>	World-wide Navigational Warning Service Sub-Committee

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 CO<sub>2</sub> 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 CO<sub>2</sub> 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 CO2 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 CO<sub>2</sub> 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 CO<sub>2</sub> 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**)