Intergovernmental Oceanographic Commission
Reports of Governing and Major Subsidiary Bodies

Intergovernmental Coordination Group for the Tsunami and other Coastal Hazards Warning System for the Caribbean and Adjacent Regions (ICG/CARIBE-EWS)

Sixteenth Session

25–28 April 2023
San José, Costa Rica

UNESCO

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Executive Summary

The Sixteenth Session of the UNESCO-IOC Intergovernmental Coordination Group for the Tsunami and Other Coastal Hazards Warning System for the Caribbean and Adjacent Regions (ICG/CARIBE-EWS-XVI) took place on 25–28 April 2023 in San José, Costa Rica. Fifty-one (51) participants from nineteen (19) Member States and Territories and three observer organizations – the Puerto Rico Seismic Network (PRSN), the World Meteorological Organization (WMO) attended the session. The meeting was convened in a hybrid format however participation was largely in-person for the first time since 2019 and the COVID-19 pandemic. The daily interaction of experts and the building of rapport among the Member States were critical to the successful outcomes achieved.

The ICG recognized COVID-19, climate change, as well as multiple recent, ongoing, and future emergencies and disasters and their cascading effects as a manifestation of the systemic nature of risks and its impact on human and financial resources for disaster risk reduction.

The ICG noted that tsunami warning issuing time is strongly dependent on seismic and sea level station distribution and data availability.

The ICG further noted that the Pacific Tsunami Warning Center (PTWC) continues to report significant seismic station outages throughout the Caribbean and Adjacent Regions (CARIBE-EWS).

The ICG recommended that, with permission from regional seismic network operators, the Central America Tsunami Advisory Center (CATAC) acts as a regional real-time seismic data aggregator/hub for Central America, and EarthScope Data Services acts as a backup to ensure greater reliability.

The ICG additionally recommended that a study be conducted to demonstrate improvement in tsunami early warning times with two to four variations on SMART Cable designs for the CARIBE-EWS.

The ICG further recommended that Working Group 2 (WG2) on Hazard Assessment engage industry stakeholders to understand which telecommunications cables are scheduled for replacement or new installations in the CARIBE-EWS.

The ICG appreciated the planned hosting of a five-day Tides Training Course to be taught in Spanish for both oceanographic and hydrographic organizations jointly organized and funded by the International Hydrographic Organization (IHO), the International Maritime Organization (IMO), and the Intergovernmental Oceanographic Commission (IOC) of UNESCO. The training will take place 13–17 November 2023 in Costa Rica.

The ICG also appreciated US NOAA's support for the Puerto Rico Seismic Network (PRSN) to host a training workshop for GNSS network operators in the region during the second week of August 2023.

The ICG noted the lack of specifically identified and located volcanic and landslide tsunami sources for the Caribbean and/or this hazard information about those sources does not exist or is not easily accessible.

The ICG acknowledged the need to progressively include volcanic and landslide sources and to build a dataset of scenarios for the CARIBE-EWS.

The ICG recommended that ICG/CARIBE-EWS WG2 initiate contacts with the identified volcano observatories and/or institutes responsible for monitoring volcanoes threatening the CARIBE-EWS and to implement the MoU with the Volcano Observatory Notice for Tsunami Threat (VONUT).

The ICG also recommended that the list of volcanoes and volcano observatories for the CARIBE-EWS prepared by the Task Team on Tsunami Procedures for Volcanic Crises, and the VONUT which was used during CARIBE WAVE 23 exercise, be shared with the *Ad Hoc* Team on Tsunamis Generated by Volcanoes of TOWS-WG Task Team on Tsunami Watch Operations (TT-TWO).

The ICG further recommended that the Working Group on Monitoring and Detection Systems (WG1) with the Secretariat organize an Experts Meeting on "Non-Seismic Sources of Tsunamis for the Caribbean and Adjacent Regions".

The ICG encouraged the execution of a regional training on the development of Digital Elevation Models for tsunami inundation modelling.

The ICG noted that no Meeting of Expert for seismic sources has been held for the North-western Caribbean.

The ICG requested WG1 and the Secretariat to consider organizing and conducting a Meeting of Experts for Seismic Sources in the North-western Caribbean.

The ICG noted with appreciation the strong cooperation between the Caribbean Tsunami Information Centre (CTIC), the International Tsunami Information Center's Caribbean Office (ITIC-CAR), the Working Group 4 on Preparedness, Readiness and Resilience (WG4), Task Team on CARIBE WAVE, Task Team on Tsunami Ready Programme, and UNDRR for advancement of preparedness, readiness and resilience to mitigate the impacts of tsunamis and other coastal hazards in the CARIBE-EWS. Further noted that this cooperation is particularly in relation to the implementation of the Tsunami Ready programme, the dissemination and development of outreach and educational resources, and support to the United Nations Decade of Ocean Science for Sustainable Development including the work of the Tropical America and Caribbean Decade Safe Ocean Working Group.
The ICG requested CTIC in association with WG4, Task Team on Tsunami Ready Programme and Member States to determine the target number of communities in the CARIBE-EWS for Tsunami Ready recognition by 2030.

The ICG recalled that World Tsunami Awareness Day (WTAD) is celebrated annually on 5 November and **encouraged** Member States to commemorate and to share their WTAD-related activities with CTIC. **The ICG recommended** CTIC to continue engaging with UNDRR, WG4 and Member States to engage, plan and take action for WTAD 2023.

The ICG acknowledged with appreciation France, the Universidad Nacional Costa Rica (UNA), ITIC-CAR and CTIC for their contributions to the finalization of IOC Manuals And Guides, 86: "Multi-Annual Community Tsunami Exercise Programme: Guidelines for the Tsunami and Other Coastal Hazards Warning System for the Caribbean and Adjacent Regions" and its translation into French. **The ICG requested** the Secretariat to finalize the translation of Manual and Guides 86 into Spanish.

The ICG noted the 2023 update to the CARIBE-EWS Tsunami Signage Inventory and Report and its support to the implementation of the Tsunami Ready recognition programme.

The ICG requested ITIC-CAR to coordinate with the Secretariat and CTIC on posting and distribution of the current version of the CARIBE-EWS Tsunami Signage Inventory and Report and to provide an updated version for the next ICG session (ICG/CARIBE-EWS-XVII).

The ICG acknowledged the good collaboration between the CTIC, ITIC-CAR and the Task Team on CARIBE WAVE in planning, promoting, executing and evaluating the annual CARIBE WAVE Exercises.

The ICG decided that CARIBE WAVE 24 will consist of two scenarios: (i) an earthquake along the Puerto Rico Trench; and (ii) an earthquake along the North Panama Deformed Belt based on the 1882 event.

The ICG also decided that CARIBE WAVE 24 will take place on Thursday, 21 March 2024, commencing at 15:00 UTC with one dummy message and the 1st message for the scenarios shortly after according to PTWC and CATAC simulated procedures for the corresponding scenarios.

The ICG suggested that the CARIBE WAVE 25 Exercise consist of two scenarios based on: (i) The 1692 Jamaica tsunami; and (ii) The 1755 Lisbon tsunami.

The ICG recommended the Secretariat to inform the UNDRR on the date of CARIBE WAVE 24 and request the theme of the WTAD 24 six months in advance of the Exercise.

The ICG further recommended Member States to combine their selected CARIBE WAVE 24 scenario with multi-hazard events.

The ICG suggested that TT CARIBE WAVE explore opportunities to further involve tourists and tourism organizations in CARIBE WAVE Exercises, with the aim to develop guidelines/resources on involvement of tourists in preparedness and response actions.

The ICG recommended the start of CATAC's full functionality in an interim manner for the Caribbean coast of Central America, starting in June 2023 (as already decided by the Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System (ICG/PTWS-XXIX) for the Pacific coast of Central America, as from December 2021).

The ICG further recommended the consideration of Central America Tsunami Advisory Centre (CATAC) as a Tsunami Service Provider (TSP) at its 17th session in 2024 to enable the IOC Executive Council to consider the final admission of CATAC as TSP in June 2024.

The ICG also recommended the IOC Working Group on Tsunamis and Other Hazards related to Sea-Level Warning and Mitigation Systems (TOWS-WG) to identify a mechanism to cross credit other Members States assessment, preparedness and response efforts with the UNESCO-IOC Tsunami Ready programme.

The ICG decided to realign the ICG/CARIBE-EWS Working Groups (WG) around the Sendai Framework for Disaster Risk Reduction, the UN Early Warnings for All Initiative (EW4ALL) and the UN Ocean Decade Tsunami programme (ODTP) pillars, including capacity development functions for all:

WG1 on Risk Knowledge
WG2 on Detection, Analysis and Forecasting
WG3 on Warning Dissemination and Communication
WG4 on Preparedness, Response Capabilities and Resilience

The ICG urged Member States to make contributions to the IOC Special Account and provide human resources under various arrangements to support the work of the CTIC.

The ICG elected its Bureau for the period 2023–2025 with the following composition:

Mr Gerard Métayer (Haiti) – Chairperson
Ms Regina Browne (USA) – Vice-Chairperson
Mr Anthony Murillo Gutiérrez (Costa Rica) – Vice-Chairperson
Ms Marie-Noëlle Raveau (France) – Vice Chairperson

Résumé exécutif

La 16e session du Groupe intergouvernemental de coordination du système d'alerte aux tsunamis et autres risques côtiers dans la mer des Caraïbes et les régions adjacentes de l'UNESCO/COI (ICG/CARIBE-EWS-XVI) s'est tenue du 25 au 28 avril 2023 à San José (Costa Rica). Cinquante-et-un (51) participants venus de dix-neuf (19) États membres et territoires et trois organisations ayant le statut d'observateur – le Réseau sismique de Porto Rico (PRSN), l'Organisation météorologique mondiale (OMM), et le Bureau régional pour les Amériques de l'UNDRR – y ont assisté. La réunion a été organisée dans un format hybride, mais la participation s'est faite essentiellement en personne pour la première fois depuis 2019 et la pandémie de COVID-19. Les échanges quotidiens entre experts et les liens tissés entre États membres ont joué un rôle décisif dans le succès de la session.

Le GIC a reconnu que la COVID-19, le changement climatique, ainsi que les multiples situations d'urgence et catastrophes récentes, en cours et à venir et leurs effets en cascade témoignent de la nature systémique des risques et de leurs incidences sur les ressources humaines et financières disponibles aux fins de la réduction des risques de catastrophe.

Le GIC a noté que le délai avant d'émettre une alerte en cas de tsunami dépend fortement de la distribution des stations sismiques et des stations de mesure au niveau de la mer, ainsi que des données disponibles.

Le GIC a noté en outre que le Centre d'alerte aux tsunamis dans le Pacifique (PTWC) continue de signaler d'importantes coupures de courant affectant les stations sismiques dans l'ensemble des Caraïbes et des régions adjacentes (CARIBE-EWS).

Le GIC a recommandé qu'avec l'autorisation des opérateurs des réseaux sismiques régionaux, le Centre consultatif sur les tsunamis en Amérique centrale (CATAC) fasse office d'agrégateur/centre régional de données sismiques en temps réel pour l'Amérique centrale, et EarthScope Data Services joue le rôle de dispositif de secours pour garantir une fiabilité accrue.

Le GIC a par ailleurs recommandé qu'une étude soit conduite pour tester l'amélioration des temps de réaction en matière d'alertes aux tsunamis avec deux à quatre variantes de la conception des câbles SMART pour le CARIBE-EWS.

Le GIC a recommandé en outre que le Groupe de travail 2 (GT2) sur l'évaluation des dangers prenne contact avec les parties prenantes de l'industrie afin de comprendre quels câbles de télécommunications il est prévu d'installer ou de remplacer dans le CARIBE-EWS.

Le GIC s'est félicité du stage de formation sur les marées d'une durée de cinq jours, dispensé en espagnol et destiné aux organisations océanographiques et hydrographiques, qui doit être conjointement organisé et financé par l'Organisation hydrographique internationale (OHI), l'Organisation maritime internationale (OMI) et la Commission océanographique intergouvernementale (COI) de l'UNESCO. La formation aura lieu du 13 au 17 novembre 2023 au Costa Rica.

Le GIC s'est également félicité du soutien apporté par la NOAA des États-Unis au Réseau sismique de Porto Rico (PRSN) pour l'organisation d'un atelier de formation à l'intention des opérateurs de réseaux du GNSS dans la région pendant la deuxième semaine du mois d'août 2023.

Le GIC a noté l'absence d'identification et de localisation précises des sources volcaniques et de glissements de terrain susceptibles de provoquer des tsunamis dans les Caraïbes et/ou l'absence d'informations concernant ces sources ou leurs difficultés d'accès.

Le GIC a pris acte de la nécessité d'inclure progressivement les sources volcaniques et de glissements de terrain dans les inventaires et de constituer une base de données sur les scénarios possibles dans le CARIBE-EWS.

Le GIC a recommandé que le Groupe de travail 2 du GIC/CARIBE-EWS prenne contact avec les observatoires volcaniques et/ou les instituts responsables de la surveillance des volcans représentant une menace pour le CARIBE-EWS et de mettre en œuvre le mémorandum d'accord relatif aux bulletins de menace de tsunami de l'Observatoire volcanique (VONUT).

Le GIC a recommandé également qu'une liste des volcans et observatoires volcaniques intéressant le CARIBE-EWS soit établie par l'Équipe spéciale sur les exercices d'alerte aux tsunamis, et que le dispositif VONUT qui a été utilisé lors de l'exercice CARIBE WAVE 23 soit partagé avec l'équipe ad hoc sur les tsunamis d'origine volcanique de l'Équipe spéciale inter-GIC sur les opérations de veille aux tsunamis (TT-TWO) du TOWS-WG.

Le GIC a recommandé en outre que le Groupe de travail sur les systèmes de surveillance et de détection (GT1) organise avec le Secrétariat une réunion d'experts sur les « sources non sismiques de tsunamis pour les Caraïbes et les régions adjacentes ».

Le GIC a encouragé l'organisation d'une formation régionale sur l'élaboration de modèles numériques d'élévation pour la modélisation des inondations dues aux tsunamis.

Le GIC a noté qu'aucune réunion d'experts sur les sources sismiques n'a été organisée pour la partie nord-ouest des Caraïbes.

Le GIC a demandé au GT1 et au Secretariat d'envisager d'organiser et de conduire une réunion d'experts sur les sources sismiques dans la partie nord-ouest des Caraïbes.

Le GIC a noté avec satisfaction les solides relations de coopération entre le Centre d'information sur les tsunamis dans les Caraïbes (CTIC), le bureau de la région des Caraïbes du Centre international d'information sur les tsunamis (CIIT-CAR), le Groupe de travail 4 sur la préparation, la disponibilité opérationnelle et la résilience (GT4), l'Équipe spéciale chargée de l'exercice CARIBE WAVE, l'Équipe spéciale chargée du programme Tsunami Ready et l'UNDRR aux fins de l'atténuation des impacts des tsunamis et autres risques côtiers dans le CARIBE-EWS par l'amélioration de la préparation, de la disponibilité opérationnelle et de la résilience, en ce qui concerne en particulier la mise en œuvre du programme Tsunami Ready, la diffusion et la conception de matériaux de sensibilisation et de ressources éducatives, et le soutien à la Décennie des Nations Unies pour les sciences océaniques au service du développement durable, et notamment aux travaux du Groupe de travail de la Décennie sur la sécurité des océans pour l'Amérique tropicale et les Caraïbes.

Le GIC a demandé au CTIC, en association avec le Groupe de travail 4, l'Equipe spéciale sur le programme Tsunami Ready et les États membres de déterminer le nombre de communautés du CARIBE-EWS à cibler d'ici à 2030 aux fins du programme de certification Tsunami Ready.

Le GIC a rappelé que la Journée mondiale de sensibilisation aux tsunamis est célébrée chaque année le 5 novembre et **a encouragé** les États membres à organiser des activités à cet effet et à les communiquer au CTIC. **Le GIC a recommandé** au CTIC de continuer à collaborer avec l'UNDRR, le Groupe de travail 4 et les États membres pour prendre part à l'édition 2023 de la Journée mondiale et planifier et prendre des mesures à cet égard.

Le GIC a exprimé sa reconnaissance à la France, à l'Universidad Nacional Costa Rica (UNA), CIIT-CAR et le CTIC pour leur contributions à la finalisation et à la traduction en français

du document Manuels et guides de la COI, 86, « Programme pluriannuel d'exercices de préparation des communautés aux tsunamis : lignes directrices du Système d'alerte aux tsunamis et autres risques côtiers dans la mer des Caraïbes et les régions adjacentes ». **Le GIC a demandé** au Secrétariat de mener à bonne fin la traduction de ce document en espagnol.

Le GIC a pris note de la mise à jour en 2023 de l'inventaire et rapport sur la signalétique en matière de tsunamis du CARIBE-EWS et de sa contribution à la mise en œuvre du programme de certification Tsunami Ready.

Le GIC a prié le CIIT-CAR de coordonner avec le Secretariat et le CTIC la diffusion et la distribution de la version actuelle de l'inventaire et rapport sur la signalétique en matière de tsunamis du CARIBE-EWS et d'en présenter une version actualisée à sa session suivante (ICG/CARIBE-EWS-XVII).

Le GIC a pris acte des bonnes relations de collaboration entre le CTIC, le CIIT-CAR et l'Équipe spéciale chargée des exercices CARIBE WAVE aux fins de la planification, de la promotion, de l'exécution et de l'évaluation de ces exercices annuels.

Le GIC a décidé que l'exercice CARIBE WAVE 24 explorerait deux scénarios : (i) un séisme le long de la fosse de Porto Rico ; et (ii) un séisme le long de la ceinture déformée du nord du Panama, sur la base de l'événement de 1882.

Le GIC a également décidé que l'exercice CARIBE WAVE 24 aurait lieu le jeudi 21 mars 2024, et débuterait à 15 heures (UTC) par un message fictif, le premier message pour ces scénarios devant être diffusé peu de temps après, conformément aux procédures de simulation du PTWC et du CATAC pour les scénarios correspondants.

Le GIC a suggéré que l'exercice CARIBE WAVE 25 comprenne deux scénarios basés sur : (i) le tsunami de la Jamaïque de 1692 ; et (ii) le tsunami de Lisbonne de 1755.

Le GIC a recommandé que le Secrétariat informe l'UNDRR de la date de l'exercice CARIBE WAVE 24 et demandé que le thème de l'édition 2024 de la Journée mondiale de sensibilisation aux tsunamis soit communiqué six mois avant la tenue de l'exercice.

Le GIC a recommandé en outre aux États membres de combiner les scénarios sélectionnés par eux pour l'exercice CARIBE WAVE 24 avec des événements multirisques.

Le GIC a suggéré que l'Équipe spéciale chargée des exercices CARIBE WAVE étudie la possibilité d'une implication accrue des touristes et des organismes touristiques dans ces exercices, en vue de l'élaboration de lignes directrices/ressources sur la participation des touristes aux activités de préparation et d'intervention.

Le GIC a recommandé que le Centre consultatif sur les tsunamis en Amérique centrale (CATAC) fonctionne pleinement en tant que service provisoire pour la côte Caraïbe d'Amérique centrale à compter de juin 2023 (comme cela a déjà été décidé par le Groupe intergouvernemental de coordination du Système d'alerte aux tsunamis et de mitigation dans le Pacifique (ICG/PTWS-XXIX) pour la côte Pacifique de l'Amérique centrale à compter de décembre 2021).

Le GIC a recommandé en outre d'envisager que le CATAC soit désigné comme prestataire de services relatifs aux tsunamis (TSP) à sa 17e session en 2024 de façon que le Conseil exécutif de la COI puisse examiner son admission définitive à ce titre en juin 2024.

Le GIC a également recommandé que le Groupe de travail de la COI sur les systèmes d'alerte aux tsunamis et autres aléas liés au niveau de la mer, et de mitigation (TOWS-WG) identifie un mécanisme permettant de croiser les efforts des autres États membres en matière d'évaluation, de disponibilité opérationnelle et de réponse avec le programme Tsunami Ready de l'UNESCO/COI.

Le GIC a décidé de redéfinir le mandat des groupes de travail du GIC/CARIBE-EWS en fonction du Cadre de Sendai pour la réduction des risques de catastrophe, de l'Initiative des Nations Unies en faveur d'alertes précoces pour tous (EW4ALL) et des piliers du Programme relatif aux tsunamis de la Décennie de l'Océan (ODTP), y compris les fonctions de développement des capacités pour tous :

Groupe de travail 1 (GT1) : connaissance des risques

Groupe de travail 2 (GT2) : détection, analyse et prévision

Groupe de travail 3 (GT3) : diffusion des alertes et communication

Groupe de travail 4 (GT4) : préparation, capacités d'intervention et résilience.

Le GIC a prié instamment les États membres de verser des contributions au Compte spécial de la COI et de mettre à disposition des ressources humaines dans le cadre d'arrangements divers afin de soutenir les activités du CTIC.

Le GIC a élu les membres de son Bureau pour la période 2023-2025 comme suit :

M. Gérard Métayer (Haïti) – Président

Mme Regina Browne (USA) – Vice-Présidente

M. Anthony Murillo Gutiérrez (Costa Rica) – Vice-Président

Mme Marie-Noëlle Raveau (France) – Vice-Présidente

Resumen dispositivo

La 16ª reunión del Grupo Intergubernamental de Coordinación del Sistema de Alerta contra los Tsunamis y otras Amenazas Costeras en el Caribe y Regiones Adyacentes (ICG/CARIBE-EWS-XVI) de la COI-UNESCO tuvo lugar del 25 al 28 de abril de 2023 en San José (Costa Rica). Acudieron a la reunión 51 participantes de 19 Estados Miembros y territorios y de tres organizaciones observadoras, a saber, la Red Sísmica de Puerto Rico (PRSN), la Organización Meteorológica Mundial (OMM), la oficina regional de la UNDRR para las Américas y el Centro de Investigaciones Sísmicas de la Universidad de las Indias Occidentales. La reunión se realizó en formato hibrido sin embargo la participación fue mayoritariamente presencial dado que se trató de la primera reunión presencial del ICG/CARIBE-EWS desde 2019, debido a la pandemia de COVID-19, y se recordó a los representantes el importante valor de llevar a cabo el trabajo del ICG en persona. La interacción diaria de los expertos y el establecimiento de una buena relación entre los Estados Miembros fueron decisivos para los resultados positivos obtenidos.

El ICG reconoció que la COVID-19 y el cambio climático, así como las múltiples emergencias y desastres recientes, en curso y futuros y sus efectos en cadena son una muestra de la naturaleza sistémica de los riesgos y de su repercusión en los recursos humanos y financieros destinados a la reducción del riesgo de desastres.

El ICG señaló que el tiempo de emisión de la alerta contra tsunamis depende en gran medida de la distribución de las estaciones sismológicas y de medición del nivel del mar, así como de la disponibilidad de datos.

El ICG señaló también que el Centro de alerta de tsunamis en el Pacífico PTWC sigue informando de importantes interrupciones de las estaciones sismológicas en todo el Caribe y Regiones Adyacentes (CARIBE-EWS).

El ICG recomendó que, con la autorización de los operadores de las redes sismológicas regionales, el Centro de Asesoramiento sobre los Tsunamis de América Central (CATAC) desempeñe funciones de agregación y sirva de centro regional de datos sísmicos en tiempo real para América Central, y que los servicios de datos de EarthScope sirvan de apoyo para garantizar una mayor fiabilidad.

El ICG recomendó también que se realizara un estudio para demostrar la mejora de los tiempos de alerta temprana contra tsunamis, aplicando de dos a cuatro variaciones en los diseños de cable SMART para el CARIBE-EWS.

El ICG recomendó además que el Grupo de Trabajo 2 sobre Evaluación de Riesgos colaborase con las partes interesadas de la industria para recopilar información relativa a los cables de telecomunicaciones cuya sustitución está prevista o a nuevas instalaciones en el CARIBE-EWS.

El ICG valoró positivamente la celebración prevista de un curso de formación de cinco días de duración sobre mareas, que se impartirá en español para organizaciones tanto oceanográficas como hidrográficas y estará organizado y financiado conjuntamente por la Organización Hidrográfica Internacional (OHI), la Organización Marítima Internacional (OMI) y la Comisión Oceanográfica Intergubernamental (COI). La actividad de formación tendrá lugar del 13 al 17 de noviembre de 2023 en Costa Rica;

El ICG también valoró positivamente el apoyo de la NOAA estadounidense a la Red Sísmica de Puerto Rico (PRSN) para acoger un taller de formación destinado a los operadores de redes GNSS en la región durante la segunda semana de agosto de 2023.

E**l ICG señaló** la falta de fuentes concretas identificadas y localizadas de tsunamis desencadenados por erupciones volcánicas y deslizamientos de tierra en el Caribe, así como el hecho de que la información sobre riesgos acerca de esas fuentes no existe o no es de fácil acceso.

El ICG reconoció la necesidad de incluir progresivamente las fuentes de tsunamis desencadenados por erupciones volcánicas y deslizamientos de tierra, así como de elaborar un conjunto de datos para formular hipótesis para el CARIBE-EWS.

El ICG recomendó que el Grupo de Trabajo 2 del ICG/CARIBE-EWS entablara contactos con los observatorios volcánicos y los institutos responsables de la vigilancia de los volcanes que representan una amenaza para el CARIBE-EWS que han sido identificados, a fin de aplicar el memorando de entendimiento relativo a los avisos de amenaza de tsunami del Observatorio de Volcanes (VONUT).

El ICG recomendó también que la lista de volcanes y observatorios de volcanes de interés para el CARIBE-EWS preparada por el Equipo de Trabajo sobre Procedimientos relativos a los Tsunamis en casos de Crisis Volcánicas, y el mecanismo VONUT que se utilizó durante el ejercicio CARIBE WAVE 23, se comunicaran al equipo especial sobre tsunamis generados por volcanes del Equipo de Trabajo sobre Operaciones de Vigilancia de los Tsunamis (TT-TWO) del TOWS-WG.

El ICG recomendó además que el Grupo de Trabajo sobre Sistemas de Vigilancia y Detección (Grupo de Trabajo 1) organizara con la Secretaría una reunión de expertos sobre “Fuentes no sísmicas de tsunamis para el Caribe y regiones adyacentes”.

El ICG alentó la realización de un curso de formación regional sobre la elaboración de modelos digitales de elevación para llevar a cabo simulaciones de inundaciones causadas por tsunamis.

El ICG señaló que no se había celebrado ninguna reunión de expertos en fuentes sísmicas para el Caribe Noroccidental.

El ICG pidió al Grupo de Trabajo 1 y a la Secretaría que consideraran la posibilidad de organizar y celebrar una reunión de expertos sobre fuentes sísmicas en el Caribe Noroccidental.

El ICG tomó nota con reconocimiento de la estrecha cooperación entre el Centro de Información sobre los Tsunamis en el Caribe (CTIC), la Oficina en el Caribe del Centro Internacional de Información sobre los Tsunamis (ITIC-CAR), el Grupo de Trabajo 4 sobre Preparación, Disponibilidad Operacional y Resiliencia, el Equipo de Trabajo sobre CARIBE WAVE, el Equipo de Trabajo sobre el Programa Tsunami Ready y la UNDRR para fomentar la preparación, la disponibilidad operacional y la resiliencia a fin de atenuar los efectos de los tsunamis y otros peligros costeros en el CARIBE-EWS, en particular en relación con la ejecución del programa Tsunami Ready, la difusión y elaboración de recursos de divulgación y educativos, el apoyo al Decenio de las Naciones Unidas de las Ciencias Oceánicas para el Desarrollo Sostenible, incluida la labor del Grupo de Trabajo del Decenio sobre la Seguridad de los Océanos para América Tropical y el Caribe.

El ICG pidió al CTIC que, junto con el Equipo de Trabajo sobre Tsunami Ready del Grupo de Trabajo 4 y los Estados Miembros, determinara el número de comunidades en el CARIBE-EWS que podrían participar en el programa de reconocimiento Tsunami Ready en 2030.

El ICG recordó que el Día Mundial de Concienciación sobre los Tsunamis se celebra anualmente el 5 de noviembre y **alentó** a los Estados Miembros a conmemorarlo y a comunicar al CTIC sus actividades relacionadas con ese Día Mundial. **El ICG recomendó** al CTIC que siguiera colaborando con la UNDRR, el Grupo de Trabajo 4 y los Estados Miembros para que cooperen, planifiquen y tomen medidas en el marco del Día Mundial de Concienciación sobre los Tsunamis.

El ICG expresó su reconocimiento a Francia, la Universidad Nacional de Costa Rica (UNA), la ITIC-CAR y el CTIC por sus contribuciones a la ultimación de los Manuales y Guías 86 de la COI, "Programa plurianual de ejercicios comunitarios de simulación de tsunamis: Directrices para el Sistema de Alerta contra los Tsunamis y otras Amenazas Costeras en el Caribe y Regiones Adyacentes", y su traducción al francés. **El ICG pidió** a la Secretaría que concluyera la traducción de los Manuales y Guías 86 al español.

El ICG tomó nota de la actualización en 2023 del inventario e informe sobre señalización en materia de tsunamis del CARIBE-EWS y de su apoyo a la puesta en marcha del programa de reconocimiento Tsunami Ready.

El ICG pidió a la ITIC-CAR que coordinara con la Secretaría y el CTIC la publicación y distribución de la versión actual del inventario e informe sobre señalización en materia de tsunamis del CARIBE-EWS y que proporcionara una versión actualizada para la próxima reunión del Grupo (ICG/CARIBE-EWS-XVII).

El ICG reconoció la colaboración entre el CTIC, la ITIC-CAR y el Equipo de Trabajo CARIBE WAVE en la planificación, promoción, ejecución y evaluación de los ejercicios anuales de CARIBE WAVE.

El ICG decidió que en CARIBE WAVE 24 se trabajará con dos hipótesis: i) un terremoto a lo largo de la fosa oceánica de Puerto Rico; y ii) un terremoto a lo largo del Cinturón Deformado del Norte de Panamá basado en el evento de 1882.

El ICG decidió también que CARIBE WAVE 24 tendrá lugar el jueves 21 de marzo de 2024: comenzará con un mensaje ficticio a las 15:00 UTC y el primer mensaje para las hipótesis de conformidad con los procedimientos simulados del PTWC y el CATAC para las hipótesis correspondientes.

El ICG sugirió que en el ejercicio CARIBE WAVE 25 se trabajara con dos hipótesis basadas en: i) el tsunami de Jamaica de 1692; y ii) el tsunami de Lisboa de 1755.

El ICG recomendó a la Secretaría que informara a la UNDRR de la fecha en que se llevaría a cabo el CARIBE WAVE 24 y pidiera que se eligiera el tema del Día Mundial de Concienciación sobre los Tsunamis 24 seis meses antes del ejercicio.

El ICG recomendó también a los Estados Miembros que vincularan su hipótesis seleccionada para el CARIBE WAVE 24 con sucesos de peligros múltiples.

El ICG sugirió que el Equipo de Trabajo de CARIBE WAVE estudiara la manera de hacer participar en mayor medida a los turistas y a las organizaciones turísticas en los ejercicios de CARIBE WAVE, con el objetivo de elaborar directrices y recursos sobre la participación de los turistas en las acciones de preparación y respuesta.

El ICG recomendó el inicio de la plena funcionalidad del CATAC de manera provisional para la costa caribeña de América Central, a partir de junio de 2023 (como ya decidió el Grupo Intergubernamental de Coordinación del Sistema de Alerta contra los Tsunamis y Atenuación

de sus Efectos en el Pacífico (ICG/PTWS-XXIX) para la costa pacífica de América Central, a partir de diciembre de 2021).

El ICG recomendó también que se considerara al Centro de Asesoramiento sobre los Tsunamis de América Central (CATAC) proveedor de servicios sobre tsunamis (TSP) en su 17ª reunión de 2024, para que el Consejo Ejecutivo de la COI pueda examinar la admisión definitiva del CATAC como TSP en junio de 2024.

El ICG recomendó además al Grupo de Trabajo sobre los Sistemas de Alerta contra los Tsunamis y Otros Peligros relacionados con el Nivel del Mar y Atenuación de sus Efectos (TOWS-WG) que definiera un mecanismo para que se pongan en común las actividades de evaluación, preparación y respuesta de otros Estados Miembros con el programa Tsunami Ready de la COI/UNESCO.

El ICG decidió reorganizar los grupos de trabajo de ICG/CARIBE-EWS en torno al Marco de Sendái para la Reducción del Riesgo de Desastres, la iniciativa Alertas Tempranas para Todos de las Naciones Unidas y los pilares del Programa de Tsunamis del Decenio del Océano (ODTP), incluidas las funciones de desarrollo de capacidades para todos:

Grupo de Trabajo 1 sobre Conocimiento del Riesgo
Grupo de Trabajo 2 sobre Detección, Análisis y Previsión
Grupo de Trabajo 3 sobre Difusión y Comunicación de Alertas
Grupo de Trabajo 4 sobre Preparación, Capacidad de Respuesta y Resiliencia

El ICG instó a los Estados Miembros a que aportaran contribuciones a la Cuenta Especial de la COI y proporcionaran recursos humanos en el marco de diversos acuerdos para apoyar la labor del CTIC.

El ICG eligió su Mesa para el periodo 2023-2025 con la siguiente composición:

Sr. Gérard Métayer (Haití) – Presidente
Sra. Regina Browne (Estados Unidos de América) – Vicepresidenta
Sr. Anthony Murillo Gutiérrez (Costa Rica) – Vicepresidente
Sra. Marie-Noëlle Raveau (Francia) – Vicepresidenta

1. WELCOME AND OPENING

1 The Sixteenth Session of the Intergovernmental Coordination Group for the Tsunami and other Coastal Hazards Warning System for the Caribbean and Adjacent Regions (ICG/CARIBE-EWS-XVI) was held from 25 to 28 April 2023 in San José, Costa Rica.

2 The Session was opened on Tuesday, 25 April 2023, under the guidance of the Chair of the ICG/CARIBE-EWS, Dr Silvia Chacon.

3 Mr Anthony Murillo Gutierrez (Costa Rica) introduced the speakers of the opening ceremony, inviting Mr Francisco Gonzalez (Rector of the Universidad Nacional Costa Rica, UNA), Mr Rafael Gutierrez (Vice-minister for the Environment of Costa Rica), Alexander Leicht (Director of the UNESCO Office in San José), and Ms Silvia Chacon (Chair) to provide opening remarks.

4 Mr Francisco Gonzalez, Rector of the UNA, provided opening remarks and warmly welcomed participants. [He recalled that 2023 marks the 50-year anniversary of UNA and highlighted the diverse subjects offered and research conducted at the university. In fact, the university currently has over 600 projects and outreach programmes. Mr Gonzalez noted specific appreciation for Dr Silvia Chacon and the Department of Physics for their internationally recognized research on tsunami and other coastal hazards detection, warning, and preparedness. The Sistema Nacional de Monitoreo de Tsunamis (SINAMOT), which is hosted at the UNA, not only provides critical research and supports data-creation, but it also engages in outreach activities for sharing and disseminating lessons learned with communities and relevant stakeholders.

5 Mr Gonzalez also drew attention to the importance of framing tsunami research, and all research conducted at the university, in the context of climate change. Climate change will have a direct and significant impact on the oceans, including sea-level and other coastal hazards. Mr Gonzalez highlighted the commitment of UNA to combatting climate change, including through selection of university projects, programmes and governance.

6 In closing, Mr Gonzalez wished the ICG representatives a fruitful and successful meeting, reiterating the importance of tsunami warning, mitigation, and preparedness not only in policy but most especially at the community level, to save lives.

7 Mr Rafael Gutierrez, Vice-minister for the Environment, also provided opening remarks and warmly welcomed participants. He expressed appreciation to the Intergovernmental Oceanographic Commission of UNESCO (UNESCO-IOC) and the participants for holding the meeting in Costa Rica given this provides an opportunity to increase visibility and awareness of tsunami and coastal hazards nationally. Mr Gutierrez began by recalling that tsunamis were not considered a significant hazard for Costa Rica until the devastating 2004 Indian Ocean tsunami which, coupled with modern technology which provides information in near real-time about tsunami events across the globe, has acted as a catalyst for tsunami awareness in Costa Rica. Mr Gutierez thanked the UNA for supporting the development of research on tsunami risk, hazard and impact in Costa Rica and across the region. Although SINAMOT is one of the main leaders of tsunami activities in Costa Rica, there has also been an increased engagement from other institutions such as the Comisión Nacional de Emergencias (CNE) of Costa Rica and many communities and local stakeholders.

8 Through the research, work and engagement of UNA, SINAMOT and Dr Silvia Chacon, Costa Rica has become a leader in tsunami early warning, mitigation and preparedness. In fact, 34 communities in Costa Rica are currently working towards tsunami preparedness. Mr Gutierrez drew particular attention to Ostional, which became the first Costa Rican community recognized as Tsunami Ready by UNESCO-IOC in 2017. He also highlighted the UNESCO

project in the UNESCO Savegre Biosphere Reserve and Manuel Antonio Park implemented in 2021 and 2022, which tackled the challenges of achieving tsunami preparedness in high-tourism areas, where developing warning and preparedness not only applies to local populations but also tourists and seasonal visitors. He noted that this is an important and relevant challenge for the Tsunami and Other Coastal Hazards Warning System for the Caribbean and Adjacent Regions (CARIBE-EWS), especially given many country economies rely on tourism. It is therefore essential to have strong and well-coordinated tsunami early warning and preparedness to mitigate these risks.

9 In closing, Mr Gutierrez highlighted once more that the tsunami hazard is a growing priority in the country and the region. He wished the ICG/CARIBE-EWS-XVI participants a fruitful discussion and encouraged them to consider how their respective research and work can be best applied to the community level, with best practices and lessons learned shared across the region.

10 Mr Alexander Leicht, Director of the UNESCO Office in San José, provided opening remarks on behalf of UNESCO. He warmly welcomed Costa Rican authorities, Delegates and Observers, noting the importance of tsunami early warning in Costa Rica.

11 Mr Leicht congratulated the ICG/CARIBE-EWS, and specifically congratulated Dr Silvia Chacón, for achieving impressive milestones and successes in developing tsunami early warning systems in the region, whilst navigating the challenging waters of the COVID-19 pandemic. He also recognized the important support of the IOC Tsunami programme Secretariat, led by Mr Bernardo Aliaga, in this process. Mr Leicht also drew attention to the significant contributions of regional academic institutions and civil protection agencies to strengthening tsunami early warning, mitigation, and preparedness in the region. In particular, he noted the expertise and contributions of the CNE in Costa Rica, SINAMOT and the Volcanological and Seismological Observatory of Costa Rica (OVSICORI), and the Centro de Coordinación para la Prevención de los Desastres en América Central y República Dominicana (CEPREDENAC) at the regional level. Given the transboundary nature of tsunamis, strong cooperation at the regional and international level are critical to an effective tsunami early warning system.

12 Mr Leicht next recalled that the UN Secretary-General, in June 2022, announced a global priority to develop Early Warning Systems for All. In addition, he highlighted that the UN Ocean Decade for Ocean Sciences for Sustainable Development 2020-30 (hereafter, UN Ocean Decade) is ongoing and has on offer many opportunities for tackling critical ocean issues. UNESCO-IOC is leading the efforts to implement the UN Ocean Decade and is also committed to advancing the 2030 Agenda SDG 14 “(Conserve and sustainably use the oceans, seas and marine resources”). The UNESCO-IOC Tsunami Ready programme is an example of critical engagement of UNESCO in addressing the threat of tsunamis. In Costa Rica, there are currently 10 Tsunami Ready communities. The UNESCO Office San Jose had the opportunity to engage in a Joint Initiative between IOC and the UNESCO Man and Biosphere (MAB) programme to strengthen coastal hazard preparedness in the Savegre Biosphere Reserve. This project not only enabled the Canton of Quepos to fulfill Tsunami Ready indicators, but also consolidated and strengthened local governance, provided the community with technical tools and updated information on coastal hazards (i.e. evacuation maps and emergency response plans) and overall improved the processes of preparedness and response to emergencies, whilst applying a multi-hazard approach.

13 In closing, Mr Leicht thanked Delegates for holding the ICG/CARIBE-EWS-XVI in Costa Rica and encouraged participants to consider best practices for further engaging and empowering local authorities and communities to implement preparedness activities. He also encouraged the Intergovernmental Coordination Group (ICG) to consider the impact of climate

change on tsunami risk, to better integrate tsunami early warning within a multi-hazard approach.

14 Dr Chacón warmly welcomed the participants. She especially expressed her appreciation for the involvement of key Costa Rica authorities, including Mr Gutierrez and Mr Gonzalez in this opening session of ICG/CARIBE-EWS-XVI.

15 Dr Chacon expressed deep thanks for the work and perseverance of Member States and Territories during the past intersessional period and through the challenges of the COVID-19 pandemic, which had lasting effects not only on the world but also tsunami coordination and preparedness activities. During this time, the ICG/CARIBE-EWS had to adapt to online meetings and remote technical support. Despite these obstacles, Member States and Territories continued to move forward with early warning, mitigation and preparedness activities; for instance, during this time several more communities achieved Tsunami Ready recognition.

16 She indicated that this Session (ICG/CARIBE-EWS-XVI) offers the opportunity to reenergize the work of Member States and Territories and further advance implementation of the tsunami programme. She highlighted that targets for the next intersessional period will be incorporating other tsunami sources into response procedures and hazard studies, maintaining and expanding station networks, innovating on methods for community engagement, incorporating social sciences and other coastal hazards into tsunami work, and overall aligning the work of ICG/CARIBE-EWS with the Ocean Decade Tsunami Programme (ODTP).

17 In closing, Dr Chacon reminded Delegates that she would be stepping down as Chair of ICG/CARIBE-EWS at the end of this Session and expressed her appreciation for her time in this leadership position.

18 Dr Chacón Barrantes declared open ICG/CARIBE-EWS-XVI.

2. ORGANIZATION OF THE SESSION

2.1 ADOPTION OF AGENDA

19 The Chairperson informed the Plenary that the agenda was discussed at the call-conference of Officers of the ICG/CARIBE-EWS 31 January and 2 February 2023, taking into account the Recommendations and instructions given at ICG/CARIBE-EWS-XV, as well as the relevant parts of the IOC Rules of Procedures.

20 **The ICG approved the Agenda** with the following change: removal of agenda item *4.1.1 Sensor Monitoring And Reliable Telecommunications (SMART) cables*, which would instead be addressed during agenda item *6.6 Report of the Task Team on UN Decade of Ocean Science for Sustainable Development*. The updated and approved Agenda is available as a Doc. ICG/CARIBE/EWS-XVI/2.1.

2.2 DESIGNATION OF THE RAPPORTEUR

21 The Chairperson requested Delegates to propose candidates for rapporteur of the meeting. As customary, the meeting was requested to choose one rapporteur for each of the languages of the meeting: English, Spanish and French.

22 Mr Anthony Murillo Gutierrez (Costa Rica) for Spanish; Mr Gérard Métayer (Haiti) and Marie-Noëlle Raveau (France) for French; and Mr Nicolas Arcos (United States of America, USA) for English, were proposed as rapporteurs.

23 **The ICG approved** the proposals and **thanked** Costa Rica, France, Haiti, and the USA for providing rapporteurs.

2.3 CONDUCT OF THE SESSION, TIMETABLE AND DOCUMENTATION

24 The Chairperson, Dr Silvia Chacon, recalled that considering ongoing challenges due to COVID-19 the Officers of the ICG/CARIBE EWS in agreement with the Secretariat decided to host this session in a hybrid format. The Secretariat then organized the session with the LingoCall platform including interpretation in English and Spanish. She noted that the session is organized for four (4) days with a half-day on 27 April 2023 dedicated to the work of Intra-sessional Working Groups (WGs). The meeting was therefore convened in hybrid format and translations were provided for English and Spanish languages.

25 She informed the Plenary that to facilitate the proceedings of the meeting a Provisional Timetable has been prepared by the Secretariat in coordination with the Chair (Doc. ICG/CARIBE EWS-XVI/2.3a). The Chairperson advised that Ms Alison Brome, Programme Officer for Tsunamis and Coastal Hazards, UNESCO-IOC and Caribbean Tsunami Information Centre (CTIC), would deputize Secretariat duties for Mr Bernardo Aliaga, Technical Secretary of the ICG/CARIBE EWS, for the first day and a half of the session.

26 Ms Alison Brome, in her capacity as deputy-representative from the Secretariat, introduced the documentation and other logistic details for the meeting. She began by indicating that the meeting website includes all the documents required for the meeting, as listed under the Provisional List of Documents (Doc. ICG/CARIBE-EWS-XVI/2.3b).

27 Ms Brome also requested that all speakers presenting reports to the plenary, including national reports, provide a succinct paragraph summarizing the main aspects of their presentation and issues for discussion, to facilitate the reporting. Member States and other Delegates were reminded that the time allocations include questions, comments, and discussion. For discussions, online participants were encouraged to raise hands or place comments and questions in the chat box. In-person participants would be provided with the opportunity for feedback followed by online delegates.

28 In order to distribute the work of the Session and facilitate the generation of recommendations and agreements, the Plenary decided to set up the following intra-sessional WGs to discuss some major issues addressed at the meeting in more detail:

- CARIBE WAVE 2024: Chair: Mr Fabio Rivera Cerdas (Costa Rica). Members: Racquel Davis (Barbados), Damien Griffith (Barbados), Ricardo Salazar (Costa Rica), Leah St Jean-Tyson (Dominica), Luis Montenegro (El Salvador), Diego Castro (Guatemala), Jose Tojil (Guatemala), Gerard Metayer (Haiti), Raphael Paris (France), Miguel Angel Reyes Martinez (Mexico), Emilio Talavera (Nicaragua), Carmen Aparicio (Panama), Eric Chichaco (Panama), Nicolas Arcos (USA), Glorymar Gomez [USA, Puerto Rico Seismic Network (PRSN)], Charles McCreery (USA), Tim Melbourne (USA), Roy Watlington [USA, United States Virgin Islands (USVI)], Antonio Aguilar (Venezuela). Secretariat support: Celine Tiffay, Project and Programme Assistant, Tsunami Resilience Section (TSR), UNESCO-IOC.
- Restructuring of ICG/CARIBE-EWS: Chair: Mike Angove (USA). Members: Silvia Chacon (Costa Rica), Anthony Murillo (Costa Rica), Paul Earle (USA), Dan McNamara (USA), Annie Zaino (USA). Secretariat support: Bernardo Aliaga, Technical Secretary of ICG/CARIBE EWS and Head of the TSR, UNESCO-IOC.
- Recommendations Committee: Chair: Ms Christa von Hillebrandt-Andrade (USA). Members: Danielle Howell (Barbados), Marie-Noelle Raveau (France), Wilfried Strauch (Nicaragua), Kenson Stoddard (St. Vincent and the Grenadines), Susan West (USA).

Secretariat support: Alison Brome, Programme Officer for Tsunamis and Coastal HazardsUNESCO-IOC and CTIC.

- Elections Committee: Chair: Ms Lorna Inniss (IOC Sub-commission for the Caribbean and Adjacent Regions, IOCARIBE). Members: Fabian Hinds (Barbados) and Denis Hunte (St. Lucia).

29 The Chairperson, Dr Silvia Chacon, recalled that these WGs will report to the Plenary and she requested for each Intersessional WG to produce recommendations for approval by the ICG or re-draft the ones presented by the intrasessional WGs and Task Teams (TTs), as needed.

30 The Chair also recalled that elections were due at the session and requested that the Secretariat recall the rules for elections of Officers. Ms. Brome advised the plenary that the positions of Chair, ICG/CARIBE EWS and the three (3) positions of Vice Chair, CARIBE EWS were now vacant and were to be filled by election for the term 2023–2025. The Secretariat also indicated that nominations for Officers were due by 23:00 UTC (17:00 Costa Rica time) on Tuesday 25 April 2023, using Forms attached to the Circular Letter 2936 (Letter of Invitation to ICG/CARIBE-EWS-XVI) and supported by two Delegations on top of the proposing Delegation.

31 Lastly, the Chairperson opened the floor for comments from delegates on the Timetable (Doc. ICG/CARIBE-EWS/2.3a).

32 **The ICG approved the timetable** with changes as decided by Delegates**.**

3. REPORT ON INTERSESSIONAL ACTIVITIES

3.1 CHAIR'S REPORT

33 Dr Silvia Chacón Barrantes (Costa Rica), the Chairperson of ICG/CARIBE-EWS, presented her report (available as a presentation).

34 Dr Chacon began by highlighting her involvement in a course organized by the United Nations Office for Disaster Risk Reduction (UNDRR) on "Measuring the Effectiveness of Multi-Hazard Early Warning Systems through the Sendai Framework Target (g) and Custom Indicators", in Trinidad and Tobago from 10-11 May 2022. This training provided capacity on applying a multi-hazard approaches and utilized effective hands-on teaching methods. Dr Chacon suggested that products and materials from this course could be useful for tsunami activities in the CARIBE-EWS region. During the event, Dr Chacon also visited the Office of Disaster Preparedness and Management of Trinidad and Tobago as well as the community of Mayaro which is considering implementing a Tsunami Ready project.

35 In her capacity as member of the Ocean Decade Tsunami Programme Scientific Committee (ODTP-SC), Dr Chacon participated in two in-person meetings of the ODTP-SC in June 2022 and January 2023 as well as two online meetings in February 2022 and September 2022. She noted that the ODTP is open to receiving project and activity proposals, with three proposals received in the last Ocean Decade Call. Dr Chacon also participated in the Working Group on Tsunamis and Other Hazards Related to Sea-Level Warning and Mitigation Systems (TOWS-WG), and specifically the Fifteenth Session held online in February 2022 (TOWS-WG-XV) and the Sixteenth Session held in person in March 2023 (TOWS-WG-XVI).

36 Dr Chacon also reported that a training for sea level operators is being jointly organized and funded by the International hydrological Organization (IHO), International Maritime

Organization (IMO) and the IOC in November 2023 in Quepos, Costa Rica. The course will be held in Spanish and is aimed at all Latin American countries, including the Caribbean.

37 In closing, Dr Chacon reported that a poster was presented at Meeting of the American Geophysical Union (AGU) in 2022 and a paper is currently under preparation about the impacts of the Hunga Tonga – Hunga Ha'apai (HTHH) event in the CARIBE-EWS region. This work was spearheaded by Ms Christa von Hillebrandt-Andrade and the International Tsunami Information Center Caribbean Office (ITIC-CAR).

38 Mr Mike Angove (USA) expressed congratulations to Dr Chacon for driving the work of the ICG/CARIBE-EWS, in her capacity as Chair, including through the challenging period of the COVID-19 pandemic.

39 Mr Fabian Hinds (Barbados) requested additional information on the planned agenda of the training for sea level operators. Dr Chacon responded that the training aims to be comprehensive and therefore will include elements of installation, maintenance, data quality control and some data processing. The training will be held over the course of one week, with one day of on-site activities.

40 Mr Eric Chichaco (Panama) requested information on accessing the poster on the impacts of HTHH in the Caribbean. Dr Chacon noted that Member States should directly contact herself or Ms Christa von Hillebrandt-Andrade (USA).

41 Ms Danielle Howell (Barbados) enquired whether the Sea Level Training, which is planned in Spanish, would also eventually be available in English. Dr Chacon responded that this training will be delivered in Spanish. Given the hands-on nature of the Sea-Level Training, simultaneous interpretation for the November 2023 in Spanish is not feasible. Dr Christa von Hillebrandt-Andrade confirmed that a few Sea Level Trainings have indeed been held in English in the past; some of these attempted a Spanish interpretation, but the feedback received was that this was not effective. As such, the MesoAmerican-Caribbean Sea Hydrographic Commission (MACHC) proposed to hold a Training solely in Spanish. Dr von Hillebrandt-Andrade also noted that, as part of the ODTP, a project on addressing the needs for capacity-building of sea level stations was submitted by the IOC Sea Level Station Monitoring Facility (SLSMF) with the University of Hawaii and the United Kingdom (UK) National Oceanographic Commission (NOC); the ICG/CARIBE-EWS could participate in this project to strengthen their own sea-level stations in the region.

42 **The ICG noted** the report of the Chairperson.

3.2 ICG/CARIBE-EWS SECRETARIAT REPORT

43 Mr Bernardo Aliaga, the Technical Secretary for ICG/CARIBE-EWS, provided the report on this agenda item (available as a presentation).

44 Mr Aliaga began by reminding Delegates that a new Technical Secretary of the ICG/CARIBE-EWS would be replacing him by the end of 2023, given that he had officially taken on a new position as Head of Section for the TSR.

45 Mr Aliaga provided an overview of the history of ICG/CARIBE-EWS and its key achievements and milestones. The ICG/CARIBE-EWS was established in 2005, in the aftermath of the deadly 2004 Indian Ocean tsunami. Mr Aliaga noted that the first Tsunami Unit at the Secretariat was composed mainly by staff seconded by organizations in Australia, Germany, Japan, and the USAUNESCO-IOC, who were also influential in support the building blocks of the ICG/CARIBE-EWS system.

46 The first ICG/CARIBE-EWS meeting took place in 2006 and the second in 2008. By 2008, there were already several ongoing projects including strengthening of the sea level network for the south Caribbean, creation of CTIC, Barbados), and implementation of the first community preparedness pilot project in two to three Member States. In 2010, ICG/CARIBE-EWS WGs met in-person for the first time. In addition, a TsunamiReady® Summit was held in Puerto Rico which recognized TsunamiReady® as an effective programme to held protect life, property and livelihood. Delegates also endorsed that TsunamiReady® be expanded to the non-USA Caribbean and recommended that IOC explore managing international licensing agreements and verification. By 2014, 15 Member States representing 17 of the 48 Member States and Territories were involved in ICG/CARIBE-EWS. Subsequent meetings of the ICG were held in 2015 (hosted in Cartagena, Colombia), 2017 (hosted in San Jose, Costa Rica) and 2018 in Curaçao (The Netherlands). The structure of WGs and TTs of ICG/CARIBE-EWS was formalized and consolidated in 2017, and the current leadership of ICG/CARIBE-EWS was elected in 2018.

47 The ICG/CARIBE-EWS is one of four ICGs, all of which have been developed through strong commitment and engagement of officers and Member States and Territories in tsunami activities, which is reflected today through an impressive global structure. The TOWS-WG and its Task Team on Disaster Management and Preparedness (TT-DMP) and Task Team on Tsunami Watch Operations (TT-TWO) were established to coordinate the work, purpose, and activities of the ICGs. Today, the structure of the Tsunami programme has been further streamlined through the ODTP. Mr Aliaga congratulated the tsunami community for building a comprehensive and visionary programme through the ODTP which builds on feasible and tested approaches coupled within an engagement in the governmental process and leveraging of new methods. Mr Aliaga noted that the growth over the years of the Tsunami programme that is coordinated by the Tsunami Resilience Section (TSR).

48 In closing, Mr Aliaga encouraged Member States and Territories to continue engaging their governments on tsunami issues to support it as a policy priority, and thereby enable continued implementation of critical early warning, mitigation, and preparedness activities.

49 Dr Silvia Chacon expressed deep appreciation for the work of Mr Aliaga as Technical Secretary of ICG/CARIBE-EWS and congratulated him on his new appointment as Head of the TSR.

50 **The ICG noted** the report of the ICG/CARIBE-EWS Secretariat.

3.3 REPORT OF THE CARIBBEAN TSUNAMI INFORMATION CENTER (CTIC)

51 Ms Alison Brome, the Programme Officer for Coastal Hazards and the CTIC, provided the report for this agenda item (available as a presentation).

52 Ms Brome began by drawing attention to the UNESCO-IOC project on “Strengthening Capacities for Tsunami Early Warning in Grenada” funded by the Government of Australia, Port of Spain Direct Aid Program (AusAid) and some funding from UNESCO-IOC. The project aims to achieve Tsunami Ready recognition for select communities in St. George’s City, Grenada. Although project implementation was delayed by senior personnel and political changes in country, the draft inundation and evacuation maps are currently under review, public consultation have been initiated, and project completion is expected by December 2023.

53 The CTIC and UNESCO-IOC are also leading implementation of a project entitled “Towards a Safer Ocean in the Caribbean through Tsunami Ready Communities”, being primarily funded by the Norwegian Agency for Development Cooperation (NORAD) with some additional funding from UNESCO-IOC. The project communities involved are: 1) Porters to Holders Hill, St. James, Barbados, 2) Port Maria, St. Mary, Jamaica, and 3) Mayora Village,

Maaro-Rio Claro County, Trinidad and Tobago. Although the project was planned for January to September 2022, it was extended to April 2023 due to challenges with procurement and finalizing the Implementing Partnership Agreement with the Government of Barbados; the project will now be completed by July 2023. At this time, awareness and education activities are ongoing, and draft inundation and evacuation maps have been completed for Barbados with support from the Coastal Zone Management Unit (CZMU). In addition, national consultants have been hired to develop or update community Emergency Operations Plans (EOPs), review existing national level Standard Operating Procedures (SOPs) and integrate community EOPs into the SOPs.

54 Another Tsunami Ready project led by UNESCO-IOC is being implemented in the Puerto Plata and Sabana Grande de Palenque in the Dominican Republic. The Tsunami Ready programme had previously been advanced in both communities through past projects. The UNESCO-IOC is currently in discussion with national and community authorities to finalize requirements including mapping and re-installation of signage. In addition, a letter of interest was received from the Municipality of Sabana Grande de Palenque.

55 Ms Brome also highlighted the work on Tsunami Ready spearheaded by ITIC-CAR and funded by United States Agency for International Development Bureau of Humanitarian Assistance (USAID/BHA). These projects are targeting communities in Dominica, Saint Lucia, and Christ Church West in Barbados. For Dominica, a draft national protocol, and an evacuation map for Calibishie are available, although the implementation process was impacted by personnel changes; nonetheless, recognition is planned by the fourth quarter of 2023. In Saint Lucia, mapping and national SOPs are currently under development, public awareness and education is ongoing, and communities participated in the CARIBE WAVE 23 Exercise. In addition, Saint Lucia has submitted an expression of interest letter to UNESCO-IOC with a proposed recognition in the second half of 2023. For the communities in Barbados, mapping has been finalized, revisions to the national plan are ongoing, signage installation is being implemented, and communities participated in the exercise CARIBE WAVE 2023. An Expression of Interest letter has also been submitted for recognition of this community.

56 Ms Brome next outlined CTIC activities relating to follow-up with and support to ICG/CARIBE-EWS WGs and TTs. During the intersessional period, CTIC supported WG4 and TT Tsunami Ready Programme to organize meetings and review and develop documents and resources. CTIC also reviewed and updated the Tsunami Ready Mapping Survey for administration to Tsunami Ready communities recognized since 2019. Digitization of this survey is to be coordinated by the TT Tsunami Ready Programme. CTIC also contributed to reviewing the CARIBE WAVE 22 and 23 Exercise Handbooks and the registration, promotion, and organization of CARIBE WAVE 22 and 23 Exercises.

57 Ms Brome next reported that CTIC undertook Phase 1 of the CTIC website update, with deployment under consideration as part of an IOC comprehensive website management strategy. In addition, support to World Tsunami Awareness Day (WTAD) 2022 was provided by contributing to the UNDRR-led creation of a video on CARIBE WAVE and Tsunami Ready in support of multi-hazard early warning systems. CTIC also promoted ocean literacy through the dissemination of public awareness and education materials to Member States, supported by ITIC-CAR.

58 Finally, Ms Brome outlined key considerations and challenges for CTIC in 2022, including based on follow-up from Recommendations of ICG/CARIBE-XV. These include the renewal of the IOC Memorandum of Understanding (MoU) with the Government of Barbados, which is due by 11 June 2023. Ms Brome also noted CTIC's financial and human resources constraints, the need to maximize opportunities for enhanced technical collaboration and resource mobilization, challenges related to the COVID-19 pandemic, and limited avenues for distributing hard copy materials. Lastly, she underlined the need for sustained preparedness

activities for tsunamis and deepening existing mechanisms and exploration of new opportunities to facilitate the integration of impacts and risks associated with other coastal hazards within ICG/CARIBE-EWS.

59 Mr Mike Angove (USA) remarked that the ITIC-CAR looks forward to continuing their support of and contributions towards the work and efforts of CTIC.

60 Ms Silvia Chacon (Chairperson) congratulated Ms Brome for her hard work and many successful outputs, noting the challenge of extensive workload for a one-person office of CTIC.

61 **The ICG noted** the report of the CTIC.

3.4 REPORTS FROM UN AND NON-UN ORGANIZATIONS

62 The Chairperson, Dr Silvia Chacon, recalled that the ICG has been successful in developing a wide and inclusive partnership policy. Several UN and non-UN organizations have accepted to become Permanent Observers to the ICG and have been invited to make statements or presentations for the benefit of the increased cooperation with the ICG.

Report from the United Nations Office for Disaster Risk Reduction (UNDRR)

63 Ms Alison Brome, Programme Officer for Coastal Hazards and CTIC, presented the report on this agenda item (available as a presentation) on behalf of UNDRR. The presentation provided was the same as provided to TOWS-WG-XVI in March 2023.

64 Ms Brome began by highlighting key activities and outputs from WTAD 22 which was focused on the theme “Early Warning Systems for All”. At the UN Ocean Conference side event (June 2022), the UN Secretary General made a Call to Action on “Early Warnings for All”, and several Member States encouraged deeper inclusion of tsunami risk into this Action Plan. This was reflected in the final version of the Action Plan, which was unveiled at COP27 in Charm-el-Cheikh; although the Plan is largely focused on climate change, tsunamis are included as part of multi-hazard risks. Key elements of the Action Plan were carried forward to WTAD 2022, notably through a high-level event on “Early Warning and Early Action Before Every Tsunami” held on 4 November 2022. In addition, a documentation entitled “Tsunami Day: Tsunami Messages: Forget Me Not” was released by UNDRR Americas Office as part of WTAD 2022. Overall, a key highlight from WTAD 2022 was its focus on connecting high level political support to citizens on the ground to drive change. The success of this objective was measured through increased activity on the UNDRR website pages with tsunami-related resources as well as WTAD hashtags (such as #TsunamiDay) trending in several countries.

65 Ms Brome next presented on WTAD 2023 and introduced its theme of “Fighting inequality for a resilient future”. To support and further explain this theme, UNDRR has developed six key messages and four key objectives within the theme; these will be available on the WTAD 2023website. Ms Brome also shared the request from UNDRR at TOWS-WG-XVI for UNESCO-IOC Member States to contribute best practices and resources that could be used in WTAD 2023 communications products. This could include evidence of specific risks faced by vulnerably communities or groups as well as specific action taken in countries or regions to tackle these risks. Overall, the activities of WTAD 2023 will plan to touch upon all elements of Early Warning For All including the technical and scientific, financial and political, as well as linkages with other climate disasters.

66 Activities of WTAD 2023 will include a continuation of the #GetToHighGround Campaign, which calls for a culture of tsunami and coastal hazards awareness for all people at risk. In addition, a high-level event will be held in New York, in close collaboration with UNESCO-IOC and the Government of Japan. Moreover, a social and digital activation toolkit

with social cards, customizable cards, videos, and a dedicated WTAD webpage will be available. Ms Brome also noted that videos would also be produced in collaboration with UNESCO-IOC, based on successes of past years. Lastly, Ms Brome highlighted the importance of media engagement for WTAD 2023.

67 Mr Mike Angove (USA) noted that a request to change the #GetToHighGround was raised at TOWS-WG-XVI. This was based on the challenge within some communities and countries for which high ground is not the best practice; for instance, the recommendation may be for vertical evaluation instead. Dr Chacon (Chair) confirmed that this point had been raised at TOWS-WG-XVI and heard by UNDRR.

68 Mr Mike Angove (USA) also highlighted another request brought forward at the TOWS-WG-XVI, which was for UNDRR to publish the themes of WTAD further in advance in order to integrate them into CARIBE WAVE Exercises of the same year. This would notably allow for footage and lessons learned on these themes to be easily available for use in WTAD products.

Report of EarthScope

69 Ms Annie Zaino, Manager of Network of the Americas GNSS stations in the Caribbean, Central America, and Northern South America, provided the report for this agenda item (available as a presentation).

70 Ms Zaino began by highlighting that the Incorporated Research Institutions for Seismology (IRIS) and UNAVCO have merged into a new organization called the EarthScope Consortium as of 1 January 2023. Both IRIS and UNAVCO are funded by the National Science Foundation (NSF), the former to support seismology work throughout the wider community and the latter for geodesy work. Despite this merger to EarthScope, the funding streams for the work previously undertaken by IRIS and UNAVCO will continue as previously until 2025; thus, Ms Zaino underlined that no major changes are expected in the near future in the contributions of EarthScope to the ICG/CARIBE-EWS. In fact, the merger between seismology and geodesy aspects of the NSF funded work may likely provide opportunities for greater collaboration on these themes in the region.

71 Ms Zaino also drew attention to the main work and resources provided by EarthScope which are relevant to the ICG/CARIBE-EWS. For geodesy, EarthScope importantly supports Global Positioning System (GPS)/Global Navigation Satellite System (GNSS) networks and instrument pools, including the Network of the Americas (NOTA). In terms of seismology, EarthScope has permanent seismic stations including the global seismic networks. Overall, EarthScope provides data access, products, and archiving, including for real-time streams which is particularly useful to tsunami early warning.

Report of the Puerto Rico Seismic Network (PRSN)

72 Ms Glorymar Gomez, Education Program Coordinator of the PRSN, provided the report for this agenda item (available as a presentation).

73 Ms Gomez noted that the PRSN sea level network operates seven stations in Puerto Rico, supports the National Oceanic and Atmospheric Administration (NOAA) in the maintenance of 10 additional stations, and supports the operations of five regional stations (Tortola, Santo Domingo, Barahona, Haiti and Aruba). The data are transmitted every six minutes on the Geostationary Environmental Satellite System (GOES) or via EarthWorm export modules each minute for selected stations. The data can be accessed on the homepage of the PRSN, Tides and Currents site of NOAA, and Tides online site of NOAA and the IOC SLSMF. To continue strengthening their sea level network, the PRSN aims to install two new

tide gauges—one each in Samana, Dominican Republic, and Anegada, British Virgin Islands—and reinstall the tide gauge in Isla Caja de Muertos, Puerto Rico.

74 Ms Gomez also reported that the PRSN seismic network currently has 32 seismic stations in Puerto Rico, the Virgin Islands, and the Dominican Republic. In addition, the Puerto Rico Strong Motion programme operates over 120 accelerometers, 12 of which use *SeedLink* protocol). Ms Gomez noted that the stations in Miches and Isla Saona, Dominica Republic, have been improved, a new station (strong motion seismometer) was installed in Ceiba, Puerto Rico), and two new accelerometers were installed in Villalba and Coamo, Puerto Rico. Moreover, 100 type-C are being installed in Puerto Rico, and seismic processing was upgraded to the ANSS/Jiggle. During the upcoming intersessional period, the PRSN aims to install four new seismic stations, two of which in the southwestern Puerto Rico, install two more accelerometers, and reinstall the seismic station in Aruba.

75 On the GPS/GNSS network, Ms Gomez shared that PRSN operates a network of 20 permanent high-rate stations. These stations are equipped with either a Trimble NetRs, NetR9 or Alloy GPS receiver and Choke ring antenna. In addition, 12 stations were upgraded to add RTX capabilities. Ms Gomez highlighted that this network enables continuous data which are simultaneously logged to three sessions with different sampling rates [15-sec per sample, 1-sec per sample (1 Hz), and 10-samples per second (10 Hz)]. The data is available in the EarthScope server or PRSN caster or SEEDLINK. Looking forward to next steps to enhance the GPS/GNSS network, Ms Gomez noted that PRSN plans to install four new stations in southwestern Puerto Rico (one in Vieques and others in St. Croix), implement the TEC algorithm in PRSN and conduct software upgrades.

76 Finally, relating to implementation of TsunamiReady®, Ms Gomez noted that there are 46 communities which have been recognized TsunamyReady® in Puerto Rico, with 18 TsunamiReady® supporters recognized by the USA National Weather Service. In addition, Puerto Rico has 58 Emergency Managers Weather Information Network (EMWIN) systems installed, four of which are equipped with DartCom hardware. Moreover, hundreds of NOAA radios have been distributed, updated and tested and thousands of tsunami signage have been installed and maintained; and PRSN conducts yearly workshops for emergency personnel, community leaders and Emergency Operations Center (EOC) officers. In addition, tsunami vulnerability profiles have been upgraded to use the new data from the census-2020. Regarding drills and preparedness exercises, Ms Gomez reported that there were more than 129,000 participants in the CARIBE WAVE 2023, and more than 450,000 in the ShakeOut 2022 Exercise in Puerto Rico. Finally, PRSN participated in WTAD, including through their social media which includes 632,000 Facebook followers. In closing, Ms Gomez drew attention to important upcoming activities including a GPS/GNSS course in August 2023, as well as the installation four new DartComs.

77 **The ICG noted** the report of UN and non-UN organizations.

3.5 STATUS OF OTHER ICGs

78 Dr Silvia Chacon, Chairperson of the ICG/CARIBE-EWS, provided the report on this agenda item (available as a presentation).

79 The Intergovernmental Coordination Group for the Tsunami Early Warning and Mitigation System in the North-eastern Atlantic, the Mediterranean and connected seas (ICG/NEAMTWS) held an online meeting of its Steering Committee in April 2022 and plans to hold its next ICG session (ICG/NEAMTWS-XVIII) in November 2023, following several delays linked to administrative obstacles. In addition, the UNESCO-IOC European Union Directorate-General for European Civil Protection and Humanitarian Aid Operations (DG-ECHO) 'CoastWAVE' project (full name: *"Strengthening the Resilience of Coastal Communities in the*

North-East Atlantic and Mediterranean Region to the Impact of Tsunamis and Other Sea Level Related Coastal Hazard") is being implemented in five countries of the region (Cyprus, Greece, Egypt, Malta, Morocco, Spain and Turkey). The Italian National Institute of Geophysics and Volcanology (INGV) is spearheading and testing probabilistic tsunami forecasting. Lastly, Ms Chacon remarked that the NEAMTWS region suffered a devastating earthquake on 6 February 2023 at the Türkiye and Syrian border which resulted in about 50,000 deaths and created a small tsunami (which was not deadly). Minor flooding was detected is Iskenderun due to subsidence. It was coincident with high tide and the collapse of the drainage system.

80 Regarding the ICG/IOTWMS, Ms Chacon reported that they held the Thirteenth Session of their ICG (ICG/IOTWMS-XIII) in November 2022. In addition, nine new communities have been recognized as Tsunami Ready (all of which are in Indonesia) and the ICG/IOTWMS-XIII decided to create a WG on Tsunami Ready Implementation. Ms Chacon also reported that the three IOTWMS Tsunami Service Providers (TSPs) have reported several updates. The Australian TSP has implemented Maritime products for NAVAREA coordinators, created provisions for products for non-seismic source tsunamis and noted that their SOPs for non-seismic tsunamis worked well in the context of the HTHH event. The TSPs in Indonesia and Australia are also currently developing their own SOPs for non-seismic sources, and all the TSPs have committed to assist National Tsunami Warning Centres (NTWCs) on developing SOPs for non-seismic sources.

81 Dr Chacon reported that Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System (ICG/PTWS) will hold their next session (ICG/PTWS-XXX) in September 2023 in Tonga. Relating to implementation of Tsunami Ready, there are currently 24 communities from seven Member States and Territories which have been recognized in the region. Dr Chacon also spoke about the HTHH event, drawing attention to the tsunami generating mechanisms which are still under discussion and investigation. The three key generation mechanisms that have been proposed are (1) Explosion and pyroclastic density currents (localized impact), (2) a shockwave coupled tsunami, and (3) Proudman resonance of a shockwave coupled tsunami when reaching trenches then propagating freely. This tsunami event created a challenge for the Pacific Tsunami Warning Center (PTWC) and communication and dissemination of products. As such, PTWC has since developed and is implementing a new "HTHH PTWC Interim Procedures and PTWS Products – User's Guide". Dr Chacon shared on-screen a map of tsunami observations from the HTHH event which was prepared by the International Tsunami Information Center (ITIC).

82 Several tsunami exercises and drills were held by other ICGs during the past intersessional period. The NEAMWave Exercise held a subregional exercise in 2022, the IOWAVE Exercise was held in October 2020 (with the next one planned for 2023), and the PacWave Exercise was held between September and November 2022. The latter included a subregional exercise for Pacific Island Countries and Territories on the HTHH interim procedures, for international sharing and communications. Other subregional exercises were held in Central America and the South-East Pacific.

83 Dr Chacon next shared key outcomes from discussions of the TOWS-WG-XVI held in March 2023 in Paris, France. A key issue raised was the expansion of tsunami information services to include the South Atlantic, given that this area is not currently under any ICG. The TOWS-WG agreed to further discuss this within TOWS-WG and for the Secretariat to aid exploring potential avenues for solving this issue. Other important topics discussed were the need to better include non-seismic tsunami sources as well as move towards adopting a multi-hazard early warning system.

84 Dr Chacon next highlighted the achievements of the *Ad Hoc* Team on Tsunamis Generated by Volcanoes (TGV) under the TOWS-WG. Key outputs of their work include developing a questionnaire for volcano observatories, establishing a list of volcano

observatories for volcanoes near or under the ocean, preparing a list of potentially tsunamigenic volcanoes, defining volcano monitoring requirements for tsunami warning, and issuing recommendations. The *Ad Hoc* Team has proposed the creation of Volcanic Tsunami Alert Notifications (VOTAN). These are based on the current volcano alert levels which provide information on the volcano status but do not inform about tsunami estimated time of arrival or threat level; the VOTAN would address these gaps by including information on ash dispersal, two levels of pre-eruption, ongoing eruption and eruption cessation.

85 In closing, Dr Chacon shared on the outcomes of the *Ad Hoc* Team on Meteotsunamis, also formed under TOWS-WG. She highlighted that meteotsunamis do not include tsunamis generated by shockwaves, which was a particularly relevant point for the discussions on the HTHH event. Meteotsunamis are quite common but usually not threatening, except for specific hotspots for which SOPs exist based on numerical weather predictions. This *Ad Hoc* Team provided a space to also begin considering the role of global tsunami warning services, Tsunami Service Providers, and NTWCs for early warning on meteotsunamis. The World Meteorological Organization (WMO) requested that meteotsunamis be discussed at the next meeting of the WMO-IOC Joint Collaborative Board (JCB) to clarify these roles and responsibilities and identify how best to support Member States.

86 Mr Mike Angove requested that NTWCs located in the ICG/IOTWMS and ICG/NEAMTWS regions which possess products for tsunamis generated by volcanoes share these products with the PTWC as they become availablehe). Mr Angove and Dr Chacon requested that the Secretariat follow-up on this request with other ICGs, to facilitate sharing of products with PTWC.

87 Mr Angove also remarked on the HTHH event, noting that although semantically the shockwave was not a meteotsunami, in terms of geophysics it was identical. Thus, discussions must continue to further define these events and identify where best they fit within early warning systems.

3.6 NATIONAL PROGRESS REPORTS

88 Barbados provided a written report and a presentation.

89 During the discussion, Dr Silvia Chacon (Chair) requested additional information on Barbados's activities during CARIBE WAVE 23 Exercises. Mr Hinds responded that an evacuation walk and run were conducted, with an added feature of a competition to encourage participation.

90 Mr Mike Angove (USA) noted that three of the Barbados tide gauges were not available in any shared sea-level network, including the SLSMF. Mr Hinds responded that Barbados would work to connect the data, currently available through the Barbados Meteorological Services, to the IOC SLSMF.

91 Colombia provided a written report and a presentation.

92 Costa Rica provided a written report and a presentation.

93 During the discussion, Mr Mike Angove (USA) noted the mention of vertical evacuation for some communities located in national parks and enquired about which institution or agency within Costa Rica would be tasked with building this vertical evacuation. Dr Silvia Chacon responded that the institution in charge would be the Ministry of the Environment, and within this the Costa Rican National System of Conservation Areas (SINAC). However, she noted that SINAC funding is very limited, thus constraining their ability to implement tsunami preparedness within their areas. As such, within the National University of Costa Rica (UNA)

project on building preparedness in wilderness areas in Costa Rica, the University of Costa Rica (UCR) developed the designs for vertical evacuation for SINAC. Given that the designs have already been made, SINAC is now working to identify funding for implementation of vertical evacuation structures. Dr. Chacon added that the vertical evacuation shelters would serve a double function of shelter and observatories (for birds, sloths, etc.). In closing, Mr Angove noted that the USA experiences similar challenges with funding vertical evacuation, adding that more success has occurred in schools, given that the structures can often serve multiple purposes.

94 Mr Kenson Stoddard (St. Vincent and the Grenadines) noted with appreciation the work on vertical evacuation in Costa Rica, highlighting that this type of evacuation is not currently included in tsunami plans in St. Vincent and the Grenadines. He also expressed his concern about tsunamis generated by local earthquakes, and the ability for vertical evacuation structures to withstand such events. Dr Silvia Chacon (Chair) responded that Costa Rica has a robust building code given that the country experiences many earthquakes. Thus, the vertical evacuation structures proposed in Costa Rica would likely withstand earthquake events, given their need to adhere to the building code. Mr Mike Angove (USA) suggested that Delegates contact the USA or Costa Rica for additional information on designs for robust vertical evacuation structures. He also added that earthen structures are also being considered in the USA, which are less constrained to building codes. Ms Chacon also recalled the work of ITIC on vertical evacuation, including information and lessons learned (available online).

95 Ms Leah St Jean-Tyson (Dominica) enquired about the tsunami application developed by Costa Rica, and specifically on the duration for developing it and whether it works offline. Dr Silvia Chacon (Chair) responded that development took longer than anticipated due more so to the choice of developer rather than the complexity of the project. She also noted the application was more challenging to develop for iPhone than Android, and that inclusion of evacuation routes was also particularly time-consuming. Lastly, she added that the application does not work offline.

96 Dominica, France, Guatemala, Mexico, and Nicaragua provided a written report. Guatemala and Panama provided also a presentation.

97 Dr Wilfried Strauch (Nicaragua) noted that Panama is currently sharing data from two of its Caribbean sea-gauges with PTWC and CATAC, but kindly requested that Panama also share data from its seismic stations operated by the University of Panama with PTWC and CATAC). Dr Strauch noted that CATAC is currently only receiving data from broadband stations of the Panama Canal Commission, which are insufficient to conduct certain types of analyses (e.g. Moment Tensors). Mr Eric Chichaco (Panama) noted that this issue had previously been raised and agreed to bring it forward to the Director of the Institute at the University of Panama, to hopefully overcome current administrative obstacles and enable sharing of the data from seismic stations.

98 St. Lucia provided a written report.

99 Dr Silvia Chacon (Chair) enquired whether St. Lucia is pursuing Tsunami Ready for the full island or only one community. Mr Denis Hunte (St. Lucia) responded that currently it is only being pursued for one community.

100 St. Vincent and the Grenadines provided a written report and a presentation.

101 Dr Silvia Chacon (Chair) congratulated St. Vincent and the Grenadines on the creation of their innovative video (available online). She also recognized that political will and changing political leadership are challenges to implementation of Tsunami Ready and other tsunami activities throughout the CARIBE-EWS.

102 The USA provided a written report and a presentation.

103 Venezuela provided a written report.

104 Mr Dan McNamara (USA) expressed concern that PTWC is not receiving data from Venezuelan stations but that the data is available to EarthScope and USGS. Ms Christa von Hillebrandt-Andrade (USA) noted that PTWC cannot track whether all stations with incoming data are performing correctly; as such, ITIC-CAR has been undertaking this task for the CARIBE-EWS for the past few years. However, Ms von Hillebrandt-Andrade also noted that ITIC-CAR would not be able to continue conducting this function after next year, and thus encouraged the ICG to propose an alternative at ICG/CARIBE-EWS-XVII in 2024.

105 **The ICG noted** the national progress reports from Barbados, Costa Rica, Colombia, Dominica, Guatemala, France, Mexico, Nicaragua, Panama, St. Lucia, St. Vincent and the Grenadines, the USA and Venezuela.

3.7 REPORT OF THE TSUNAMI SERVICE PROVIDER (PTWC)

106 Dr Charles McCreery, Director of the Pacific Tsunami Warning Center (PTWC), provided the report on this agenda item (available as a presentation).

107 Dr McCreery began by providing an overview of the PTWC seismic sensing network in the CARIBE-EWS region. He noted that although sufficient data is available in the region, the network could be made stronger with efforts to render more stations operational, as several need maintenance, as reflected in national progress reports under agenda item 3.6. Relating to the sea-level network, there are also some gaps in coverage which need to be addressed. He encouraged Member States to review the seismic network and sea-level network maps for further details on stations which are operational (represented by white dots).

108 Next, Dr McCreery presented on significant tsunamigenic events that have occurred since ICG/CARIBE-EWS-XV (April 2021) and for which PTWC has disseminated messages, noting that nine message events had occurred in this timeframe. The key performance indicators for these events demonstrate a specific challenge of responding to events in the Atlantic region, particularly in the North Atlantic Ridge and the South Sandwich Islands, given that seismic networks are sparse in these regions. Elapsed time of initial messages is often longer than 10 minutes. However, these areas also do not have near-field populations at risk. Relating to performance for epicenter location, only one event has been beyond the 30km target boundary.

109 Dr McCreery next elaborated on the three most notable events of the intersessional period, beginning with the 12 August 2021 South Sandwich Islands Mw 8.2 earthquake and tsunami. Although the event did not pose a significant risk for the CARIBE-EWS region, it was a very complex event that generated tsunami waves in the South Atlantic, Pacific, and Indian Ocean. Given the potential risk to the Southern Atlantic, discussions on possibly extending existing ICG services or creating a new ICG to cover the South Atlantic region have since been ongoing within ICG/PTWS and TOWS-WG. The Secretariat is currently supporting exploration of potential avenues to address this gap with relevant countries. In addition, Dr McCreery noted that events in the South Sandwich Islands only pose a minimal threat to the ICG/CARIBE-EWS countries; in the unlikely event of a Mw 8.5 earthquake, tsunami waves of 0.3 to 1 meter would only be created in Bermuda, yet such an event would be a risk for the ICG/PTWS region. A key consideration for the ICG/CARIBE-EWS therefore remains whether Member States wish to maintain the South Sandwich Islands within their earthquake source zone.

110 The second notable event was the Haiti earthquake and tsunami on 14 August 2021. The initial Information Statement for Mw 7.0 was upgraded after 50 minutes to a Threat

Message for Mw 7.2. The earthquake epicenter was on the narrow Tiburon Peninsula which meant needing to check for tsunami waves on both sides of the peninsula. Overall, the tsunami waves recorded in Haiti and Mexico were relatively small (less than 10 cm). Three messages were issued by PTWC for this event.

111 The final notable event was the HTHH volcano eruption and tsunami on 15 January 2022. Tsunami runups in Tonga were over 10 meters with tsunami waves generated and observed in all the world's ocean basins by the atmospheric disturbance. Regarding features of the event, Dr McCreery highlighted the role of atmospheric pressure, and specifically of coupling that occurred on the eastern side of the Tonga trench, thereby sending more pressure to the western Pacific. Response to the event proved challenging, although it was aided by previous work on volcano-source tsunamis in the ICG/CARIBE-EWS. Indeed, volcanic activity of La Soufrière in the Caribbean resulted in placement of triggers on nearby sea-level gauges. Due to minor volcanic activity of the HTHH volcano in the days preceding the eruption, PTWC staff had placed a trigger on the nearby Nuku'alofa gauge in Tonga. As such, PTWC was notified about the eruption about 15 minutes following the event. The HTHH event therefore demonstrated the usefulness of "triggers" for warning coastlines which are further away. The experience of the ICG/CARIBE-EWS with non-seismic generated tsunamis also contributed to identifying next steps for the HTHH event and volcanically generated tsunami events more generally. An *Ad Hoc* Team on TGV was established under TOWS-WG to further consider processes and options for monitoring these tsunami sources in the long-term.

112 Dr McCreery next shared information on updates made to the PTWC, for ICG review and approval. These proposed updates include: alphabetizing countries in the threat lists, grouping estimated times of arrival (ETA) and observations by country and territory, and indicating the type of measurement. Dr McCreery also proposed the removal of the wave period from the PTWC messages to avoid confusion with data received by NTWCs. In addition, the PTWC are suggesting for the initial threat in messages to be based on ETA and not on distance. The issue with using distance to define the threat area is that it can lead to over-warning when the earthquake has occurred in shallow water. This challenge came to light following the 28 January 2022 earthquake of Mw 7.7 located north of the Cayman Islands. The subsequent Tsunami Threat Message showed a potential threat to the Cayman Islands, Cuba, and Jamaica (based on the preliminary magnitude of 7.3). Although using an ETA approach does not address the issue of over-warning using current procedures, there may still be benefits to using this approach to set the threat limit.

113 Dr McCreery next reported that the PTWC conducted several communications tests during the intersessional period, including monthly scheduled tests which do not require a response (unless a problem is identified). However, unscheduled tests requiring a response have been halted due to PTWC staffing shortages; before recommencing, Dr McCreery suggested that these tests may be redesigned to better assess system readiness on a regular basis. For instance, the Northwest Pacific Tsunami Advisory Centre (NWPTAC) in Japan have been receiving better responses to their own tests by announcing them and conducting them during normal business hours. Although this does not test 24x7 readiness, it does ensure that communication methods are working. With the approval of ICG/CARIBE-EWS, Mr McCreery suggested that PTWC could try this method on a quarterly basis.

114 Mr Fabian Hinds (Barbados) noted that Barbados is working towards getting their sea level stations transmitting and online by end 2023 at the latest.

115 Ms Danielle Howell (Barbados) enquired how Member States should submit feedback to the PTWC monthly tests. Dr McCreery noted that no feedback is required from the monthly tests; only if a Member State is not receiving messages through the official channels designated to IOC should they flag this to the PTWC.

116 Mr Kenson Stoddard (St. Vincent and the Grenadines) enquired on three points. Firstly, he asked whether earthquake events in the South Atlantic could cause dangerous currents, even if not dangerous tsunami waves, and therefore still pose a threat to ICG/CARIBE-EWS Member States. Dr McCreery responded that PTWC does not currently include currents in their models, especially given the complexity of currents near the coast. Nonetheless, given that wave amplitudes from a South Atlantic event would be very small in the CARIBE-EWS region, the currents would likely not be threatening.

117 Mr Stoddard next enquired about the potential application of wireless emergency alerts for disseminating tsunami messages. Dr McCreery responded that these alerts are only available within the USA and that they rely on cellphone towers to be disseminated. Although these could be in theory be used to disseminate messages to cellphones nationally (instead of sub-regionally, as currently), it would be necessary to have this capability within a country.

118 Finally, Mr Stoddard enquired about different methods for receiving tsunami messages. St. Vincent and the Grenadines currently only receives messages through email and fax, which could pose a problem if Internet cables were damaged during an event. Dr McCreery responded by explaining that there is a variety of methods for receiving messages, and that redundancy is encouraged for Member States. Alternative methods include Global Telecommunication System (GTS, available from/through meteorological offices and WMO) and satellite (e.g. EMWINN, Chatty Beetle, and GeoNetCast Americas). Dr McCreery recalled that ICG/NEAMTWS reported at TOWS-WG-XVI that they are exploring a system for Europe to utilize GPS and GNSS capabilities in cellphones to receive messages. Thus, if cellphone towers were down, alerts could still be received. That would add an additional communication mechanism.

119 Ms Leah St Jean-Tyson (Dominica) enquired about where to find the Report of the *Ad Hoc* Team on TGV. Dr Chacon responded that the report is still being finalized and will be disseminated to Member States once it is published. Dr McCreery also suggested that Member States could consult the presentation from the *Ad Hoc* Team on TGV which was made to TOWS-WG-XVI (available as a presentation).

120 Mr Gérard Métayer (Haiti) mentioned that Haiti is not receiving the monthly tests from PTWC on Aeronautical Satellite Data Link (ASDL), despite submitting the appropriate forms through IOC. He noted that they had nonetheless received the CARIBE WAVE 2023 messages. Dr McCreery noted that PTWC would follow-up directly with Haiti to address this issue.

121 Mr Damien Griffith (Barbados) enquired whether the monthly tests from PTWC are also sent to Tsunami Warning Focal Point (TWFP) Alternates. Dr McCreery responded that the messages can go out to several organizations/people in a country, depending on what has been designated by the Member State. Given that these messages are based on subscription, it is important for countries to confirm what contacts and methods they have designated and update these if necessary. It is recommended to receive messages through alternative methods and to alternative places/people, for redundancy.

122 Dr Silvia Chacon (Chair) enquired about the change of criteria for distance versus time in tsunami messages and suggested that the ICG/CARIBE-EWS approve this change. Dr McCreery shared that PTWC plans to disseminate the proposed changes to Member States in May 2023, then allow for 90 or 120 days (to be confirmed) for Member States to respond with any feedback, after which if none are received, PTWC would plan to move forward with the changes to products.

123 Dr Chacon also suggested for PTWC to update their diagrams showing Key Performance Indicators (KPIs) for messages by changing the colour of the stripe (currently

red) which indicates results that are within the target of indicators, as this may be misleading and suggest it is a negative result.

3.8 REPORT OF CARIBE WAVE 2023

124 Dr Elizabeth Vanacore, Chair of the TT CARIBE WAVE, provided the report of this agenda item (available as Doc. ICG/CARIBE EWS-XVI/3.8). Dr Vanacore began by noting that, given the short timeframe since CARIBE WAVE 23, results shared at this time were only preliminary.

125 The CARIBE WAVE 23 Exercise was held on 23 March 2023 with two scenarios available for Member States: 1) Gulf of Honduras event and 2) Mount Pelée flank collapse. Forty-three Member States and Territories participated with a total of 430,000 people engaged. The participation of Member States represents a rate of 90 percent (down from 100 percent in 2022). Several institutions indicated that the overlap of CARIBE WAVE 23 with World Meteorological Day was a challenge.

126 Dr Vanacore next provided a brief summary of the timeline for preparation of CARIBE WAVE 23, beginning in November 2022 with issuance of the Circular Letter 2916 announcing the Exercise and followed in January 2023 with publishing of the Participant Handbook. Informational webinars were held in January 2023 with a focus on providing an overview of the Exercise and PTWC products. A second round of webinars took place in February 2023 which focused on updating communication methods, registering for the activity, completing the questionnaire, and uploading footage of the exercise. These webinars were available in English, Spanish and French. After the exercise, a hotwash was held on 4 April 2023 and the Exercise Evaluation Form was due for completion by 13 April 2023.

127 Dr Vanacore drew attention to important metrics and results of the Exercise from the Exercise Evaluation Form. She noted that 97 percent (compared to the goal of 100 percent) of TWFPs received the dummy message, and only 61 percent of ICG/CARIBE-EWS Member States TWFPs participated in the Exercise (down from 100 percent last year). Nonetheless, this low number may be due to current metrics only considering questionnaires received before 11 April 2023. In addition, results indicate that there was only 44 percent of community involvement in the Exercise (similar to the 43 percent in 2022); this low number may be due to continued challenges from COVID-19. Dr Vanacore also noted that tsunamizone.org was useful for collecting missing information and cross-checking information from the questionnaire. Results from tsunamizone.org and the questionnaire were mostly similar, although a few countries had discrepancies in number of participants.

128 Results from the questionnaire indicate an increase in the number of participants involved in the CARIBE WAVE Exercise (432,244 participants in 2023 compared to 413,281 participants in 2022). In terms of types of participants involved, the largest during CARIBE WAVE 23 was from K-12 schools and districts (about 264,368 people), followed by state and local governments, and colleges and universities. There was wide and increasing variety of participants involved in the Exercise. However, Dr Vanacore noted that all except one Member State reported that social scientists were not involved in CARIBE WAVE 23, highlighting a key gap to address. Another gap to fill relates to the participation of persons with disabilities which was at 25 percent for the Exercise. Relating to types of activities conducted during CARIBE WAVE 23, many conducted communications tests and tabletop exercises, although others conducted full-scale drills, amongst other activities.

129 The CARIBE WAVE 23 Exercise Evaluation Form contained 45 questions and was available from the day of the Exercise. Ninety percent of Member States and Territories submitted responses, with a total of 33 surveys completed from 43 of the 48 Member States and Territories. Results from the questionnaire demonstrate that the most common methods

for receiving the dummy message were email and fax (similar to previous years), although several countries also used GTS; however, the longest delays for receiving messages also occur with email and fax. Regarding dissemination of messages, several countries received messages from other organizations beyond the PTWC: the Dominican Republic received a message from PRSN, Guatemala and Nicaragua received a message from the Central America Tsunami Advisory Centre (CATAC), and the USVI received a message from the PRSN (emergency management SMS).

130 Results also indicated that Member States considered the PTWC message structure useful and appropriate for decision-making. Regarding information included in the test, however, Member States provided some suggestions such as standardizing wave heights in feet or meters, and further perfecting and addressing gaps relating to messages for volcano-generated tsunamis (the Mount Pelée scenario). The questionnaire also brought to light that over half of Member States do not have a response plan for volcanic events. In addition, the questionnaire highlighted that there are currently 66 communities in the CARIBE-EWS which are recognized as UNESCO-IOC Tsunami Ready or TsunamiReady®, with 71 percent of Member States (representing 87 communities) interested in implementing Tsunami Ready.

131 Dr Vanacore also reviewed the status of sea level stations during CARIBE WAVE 23, noting that the PTWC provided simulated forecasted maximum wave heights for 65 stations in the CARIBE-EWS region. However, only about 61 percent of the sea level stations were online on the IOC SLMF during the Exercise period. In addition, only two Deep-ocean Assessment and Reporting of Tsunamis (DART) buoys of the seven in the region were streaming data during the Exercise.

132 The media arrangements for CARIBE WAVE 23 included a hashtag tracker to monitor #CaribeWave and #CaribeWave23 from 28 February to 30 March 2023. Results show that social media outlets posts reached over 1.8 million people worldwide.

133 The Hotwash for CARIBE WAVE 23 was held on 4 April 2023 to enable Member States and Territories to provide feedback on the Exercise. Some of the feedback was on the successful execution of tsunami evacuations in schools and businesses. Participants to the Hotwash also reported that the Exercise helped Emergency Managers to identify the need for redundant communication and to adjust their SOPs. Future CARIBE WAVE Exercises were also discussed, with some countries suggesting the use of another volcano-generated tsunami scenario, a historical tsunami such as the 1692 Port Royal event, and other scenarios from the Northwest Caribbean.

134 In closing, Dr Vanacore reviewed the current membership of the TT CARIBE WAVE, and specifically expressed appreciation for the contributions of ITIT-CAR, CTIC, and the Secretariat. She also recommended that a representative from tsunamizone.org and a social scientist be added to the membership of the TT. Finally, Dr Vanacore noted that an article on the history of CARIBE WAVE Exercises is available online.

135 Dr Silvia Chacon expressed deep appreciation for the work of Dr Vanacore as Chair of the TT over the past seven (7) years. She also enquired whether the TT had received specific feedback about the Mount Pelée scenario. Dr Vanacore confirmed that there were specific questions about the volcano scenario in the questionnaire. The main comment from Member States was that the products for volcanoes differed from those for earthquakes and were sometimes lacking in information that was normally available.

136 Ms Christa von Hillebrandt-Andrade (USA) reflected on the increase in participation and attention to CARIBE WAVE Exercises over the years and thanked Member States and Territories for their continued dedication. She also encouraged WGs and TTs to review and

consider the extensive information available from CARIBE WAVE 23 when carrying out their activities.

137 Mr Kenson Stoddard (St. Vincent and the Grenadines) expressed appreciation for the support of ITIC-CAR and CTIC in running CARIBE WAVE 23. He also commented that email messages are difficult to interpret and enquired whether these could be updated to highlight key information. He also suggested that a training be held about interpreting messages. Dr Vanacore suggested that a social scientist could explore ways to address this challenge through messaging and training. Dr Charles McCreery (USA) responded that PTWC could explore ways to potentially add clarity to messages, especially about specific regions affected. Ms Christa von Hillebrandt-Andrade (USA) noted that Colombia, Guatemala, and Barbados have developed automatic systems that pull out relevant information from the email messages.

138 Mr Anthony Murillo (Costa Rica) commented that neither of the two scenarios of CARIBE WAVE 23 were applicable to certain communities on the Caribbean coast of Costa Rica. He therefore suggested that the CARIBE WAVE Exercises revert to including three scenarios instead of two scenarios.

139 **The ICG noted** the report of the CARIBE WAVE 2023.

4. WORKING GROUP PROGRESS REPORTS

4.1 PROGRESS REPORT OF WORKING GROUP 1 ON MONITORING AND DETECTION SYSTEMS

140 Dr Daniel McNamara, Chair of Working Group 1 (WG1), provided the report of this agenda item (available as a presentation).

141 Dr McNamara recalled the Terms of Reference and membership of WG1 and highlighted updates to their Factsheet. Given current expertise of WG, Dr McNamara recommended that new United States Geological Survey (USGS) Global Seismographic Network and EarthScope Seismic representatives be identified to participate in WG1.

142 With regards to the ICG/CARIBE-EWS seismic network, Dr McNamara reported that major seismic station outages have continued in 2022. He specifically highlighted the challenges posed by the COVID-19 pandemic and associated restrictions on travel for repairing and maintaining stations. Dr McNamara noted significant challenges with the network in Central America, and specifically in Honduras, Nicaragua, Costa Rica, and Panama. Gaps in coverage have also been reported in Haiti, Venezuela, and Trinidad and Tobago. Dr McNamara noted that challenges with stations are not only related to outages, but also sometimes to out-of-date information (as occurred for an obsolete station code in Puerto Rico). Despite these gaps, many stations remain operational, and Dr McNamara specifically highlighted Puerto Rico as having a high density of operational stations. The end of travel restrictions related to the COVID-19 pandemic has also enabled installation of some new real-time seismic stations in the region, including in Puerto Rico, Colombia, and the USVI.

143 Dr McNamara next provided updates on passed recommendations for WG1 on the seismic network, including ongoing efforts to identify inconsistencies between EarthScope, PRSN, PTWC, and USGS National Earthquake Information Centre where relevant, and to explore the availability of new seismic stations and Raspberry Shakes at IRIS/EarthScope. A small number of Raspberry Shakes are currently available, but none are relevant to the ICG/CARIBE-EWS. Dr McNamara suggested that the cost of direct real-time feeds to NOAA be explored, noting that he had received an informal quote from Raspberry Shakes which proposed an offer of $1/channel/month. He added that Raspberry Shake would be willing to stream directly to warning centres, although they are not supported by all regional operators.

In addition, Dr McNamara recalled his recommendation made at previous meetings to explore the use of sea-floor cable instrumentation and SMART repeater technology (this item is also discussed under agenda item 6.1).

144 Dr McNamara next reported on the status of the sea-level network, highlighting that the number of stations has slightly increased in 2022, although not all added stations are currently operational in the SLSMF and Tide Tool. Although new stations were installed in 2022 in Chateau Belair (St. Vincent), Cayman, Colombia and Puerto Rico, significant station outages are ongoing, especially on the Caribbean coast of Central America as well as in Haiti, Jamaica, St Martin, and Barbados. In addition, most NOAA DART gauges are still not operational, although two NOAA DART gauges are back online in the northeastern Caribbean region. Dr McNamara also shared that the UK National Oceanography Centre (NOC) has produced a maintenance manual for their tide gauge operators and encouraged WG1 to support the use of this manual in the CARIBE-EWS. Several other recommendations about the sea-level network remain pending since 2021, although WG1 and ITIC have created a survey for sea-level network operator status updates with the goal of improving the uptime of the sea-level network, as well as for Member States that have non-operational stations to inform the Secretariat of their plans or needs for repair.

145 Ms Zaino next provided an update on the status of the 80 stations under the NOTA GNSS network in the CARIBE-EWS region, available to NOAA tsunami warning centres from UNAVCO/EarthScope. Fifty-four stations are online and have been updated to real-time data streaming, with other which are real-time capable but currently offline. There are also 10 additional stations that are operational though not real-time capable. Ms Zaino reported that significant fieldwork was conducted from March 2022 to April 2023 which led to an increase in network uptime from 45 to 80 percent. In addition, upgrades to communications infrastructure supported efforts towards real-time streaming. The successful fieldwork was due to the network being well-funded, strong partnerships with local agencies, and over 20 visits by UNAVCO/EarthScope engineers. Nonetheless, ongoing challenges include geopolitical and safety restrictions for site visits, aging infrastructure and environmental conditions. WG1 also plans to support the upgrade of 11 stations to real-time during the next intersessional period.

146 Regarding recommendations from the ICG/CARIBE-XV for the GNSS network, WG1 plans to support the GNSS network operators workshop organized by the PRSN in 2023 and specifically invite Tim Dittman to discuss GNSS-R for tsunami detection. Ms Zaino also encouraged regional network operators to contribute their real-time data streams to EarthScope, to support EarthScope in channeling all tsunami monitoring across the region.

147 Ms Lorna Inniss (IOCARIBE) enquired why no GNSS station was installed in Barbados. Ms Zaino responded that there is currently no funding to add additional stations, although also agreed it would be favourable to add one in Barbados.

148 Dr Charles McCreery (USA) enquired about the minimum magnitude for G-fast software to work with this density of GNSS stations. Dr McNamara responded that it would need to be for large magnitude events (above M=6). He added that seismic stations allow for this minimum magnitude to be lowered.

149 Dr Christa von Hillebrandt-Andrade (USA) commented that the PTWC will continue to provide the monthly maps on status of seismic and sea level data, and ITIC-CAR and WG1 will support their distribution. The ITIC-CAR will continue to prepare reports on the status of seismic and sea-level data at different centres. However, she requested that WG1 review the effectiveness of this current reporting mechanism to fill in the gaps in observations and propose a new model moving forward without ITIC-CAR at ICG/CARIBE-EWS-XVII.

150 **The ICG noted** the report of WG1 and **adopted** Recommendation ICG/CARIBE-EWS-XV.1.

4.2 PROGRESS REPORT OF WORKING GROUP 2 ON HAZARD ASSESSMENT

151 Mr Nicolas Arcos (USA), Chair of Working Group 2 (WG2), provided the report on this agenda item (available as a presentation).

152 Mr Nic Arcos reported on the activities of WG2, beginning with a brief overview of the WG2 Fact Sheet, membership, and Terms of Reference. During the past intersessional period, WG2 held two virtual meetings (on 7 December 2021 and on 31 August 2022) and members have further discussed key topics through email threads. There are currently 31 members of the WG, including five invited experts; Dr Arcos noted that membership should be updated.

153 Regarding the recommendation of ICG/CARIBE-EWS-XV to provide access to and/or compile non-seismic sources, Mr Arcos reported that WG2 had decided on the process for selecting scenarios. The initial focus will be on publications/reports that include numerical simulations. In addition, identifying sources that need to be simulated would also benefit a future gap analysis. He noted that public reports sponsored by national agencies should be considered equal to peer-reviewed publications as they undergo significant expert review. Other scenarios including unpublished work and Masters report can also be considered after acceptance by WG2. It is important to consider both local and regional scenarios. Mr Arcos clarified that it is within the mandate of WG2 to propose scenarios for Meetings of Experts, but not to run simulations. In addition, he highlighted the need to identify individuals with expertise outside of WG2 and suggested making a recommendation at ICG/CARIBE-EWS-XVI for other WGs and Member States to provide experts willing to contribute time and/or resources.

154 In terms of next steps, WG2 has also begun compiling a list of non-seismic sources already available in the literature (and including numerical simulations) and a list of non-seismic sources discussed during a 2019 Meeting of Expert on Tsunami Sources in the Lesser Antilles (IOC/2020/WR/291). To date, 35 modeled scenarios have been identified for possible use and 15 scenarios have been identified for future modelling. Mr Arcos highlighted that WG2 will also begin the process of enlisting volunteers with modelling experience to assist getting files prepared for display on CATSAM.

155 The CATSAM viewer (available here) has been updated, including by adding the Kick'em Jenny landslide scenario (from Harbitz et al., 2012[2]), scenarios and their associated fault planes and sources from the 2019 Meeting of Expert on Tsunami Sources in the Lesser Antilles and CARIBE WAVE 22 scenarios (North Panama Deformed Belt and Western Muertos trough). In addition, a Tsunami Ready layer was removed at the request of ITIC given that a Tsunami Ready interactive map is now available, and that data was not up to date. CATSAM also experienced some challenges which have since been rectified, including related to displaying IOC tide gauge stations. A new release of the Tsunami Coastal Assessment Tool (TsuCAT)—TsuCAT 4.3—was launched in January 2023 through ITIC. Key features of the new release include updated PTWC text messages, updated regional seismic sources in catalog (with the Lesser Antilles), and improved security, installation, and proxy configuration.

156 Mr Arcos also provided an update on the Recommendation from ICG/CARIBE-EWS-XV to develop a "roadmap" about uploading elevation data to the Caribbean Marine Atlas (CMA). He reported that WG2 has developed a guide for this (available as a document) and encouraged Member States to upload their data, or at minimum to upload details on the data

[2] C.B. Harbitz, S. Glimsdal, S. Bazin, N. Zamora, F. Løvholt, H. Bungum, H. Smebye, P. Gauer, O. Kjekstad, Tsunami hazard in the Caribbean: Regional exposure derived from credible worst case scenarios,Continental Shelf Research, Volume 38, 2012, Pages 1-23, ISSN 0278-4343, https://doi.org/10.1016/j.csr.2012.02.006.

available. Mr Arcos also informed Member States that a proposal for a digital elevation modelling training was put forward at the ICG/CARIBE-EWS Officers meeting in January/February 2023, with an updated version presented to this ICG for consideration (available as a document).

157 Next, Mr Arcos reported that the ETOPO Global Relief Model had also been updated, with the current version, ETOPO 2022, available in Ice Surface and Bedrock versions which portray either the top layer of the ice sheets covering Greenland and Antarctica, or the bedrock below. The most significant improvements which are relevant to the CARIBE-EWS region include the 4x higher spatial resolution (15 arc-sec compared to 1 arc-minute), the improved global bathymetry (mostly from GEBCO 2022) and the improved global topography with reduced elevation bias from vegetation/buildings (mostly from FABDEM, which is a Forest And Buildings removed Copernicus digital elevation model). Mr Arcos noted that despite improvements, challenges remain to remove elevation biases. He also suggested that makers of this tool be invited to speak at ICGs or communicate on this in other ways.

158 Lastly, Mr Arcos reported on a recommendation made by ICG/CARIBE-EWS-XV to re-open the survey on tsunami evacuation mapping. However, Member States indicated that this would be a burden considering the number of existing surveys. As such, WG2 suggested to edit and amend National Reports to include questions on evacuation mapping and signage, so that these themes are addressed on a systematic and annual basis. In addition, WG4 noted an overlap of these questions with those in the CARIBE WAVE questionnaire, reflecting concerns of duplication. However, the National Reports and CARIBE WAVE questionnaire are sometimes not answered by the same national agency. At the ICG/CARIBE-EWS Officers Meeting in June 2022, it was agreed that the TT Performance Monitoring and KPIs support streamlining of efforts to avoid duplication.

159 In closing, Mr Arcos highlighted that the priority for WG2 during the next intersessional period would be to hold in-person activities such as a Meeting of Experts on non-seismic sources and a regional digital elevation model (DEM) training.

160 Mr Mike Angove (USA) congratulated WG2 for their important work and enquired whether the identification of at-risk communities in the CARIBE-EWS region would be included in the purpose of WG2 (making reference to the UN Ocean Decade target of “100 percent of communities at risk to be prepared for and resilient to tsunamis by 2030”). Mr Arcos agreed that WG2 would provide a useful space for, if not identifying communities at risk, at least providing guidance on how these can and should be identified.

161 Ms Christa von Hillebrandt-Andrade (USA) noted that there has not yet been a Meeting of Experts for the Northwest Caribbean and suggested the ICG supports this and encouraged Member States to propose funding towards this.

162 **The ICG noted** the report of WG2 and **adopted** Recommendation ICG/CARIBE-EWS-XVI.2.

4.3 PROGRESS REPORT OF WORKING GROUP 3 ON TSUNAMI RELATED SERVICES

163 Mr Emilio Talavera, Chair of WG3, provided the report of this agenda item (available as a presentation). He began by recalling the purpose, function, and membership of the WG as defined in its Terms of References. He also remarked that he had been Chair of WG3 since 2018, and that new leadership would therefore need to be elected at this ICG Session.

164 Mr Talavera indicated that WG3 activities have been severely affected by the COVID-19 pandemic. The ability of WG3 to engage in information dissemination has been

compromised due to challenges with dissemination systems which have reduced their information transmission capacity. He noted that WG3 has focused on dissemination of information and warnings through e-mail messaging services and the Internet.

165 Echoing recommendations made to previous ICGs, Mr Talavera strongly suggested that countries continue to diversity their means of receiving communications and move away from reliance on a single method. Mr Talavera also recalled other key recommendations from ICG/CARIBE-EWS including that countries review the proposal for the use of social network applications and other web-based digital media, for the dissemination of educational and public awareness messages, for community preparation, and for the dissemination of messages from an emergency. These means should also be used in national and international tests and exercises, as an alternative means of communication. Mr Talavera recommended to conduct an analysis or survey of states requiring GOES satellite system upgrades and assess their future applicability. In addition, that Member States document and share their experiences regarding current communication problems (in terms of means and technologies for communications, or in terms of messages and types of messages received and given), about possible solutions and best practices for addressing them, to serve as a reference to the rest of the countries in the region. Finally, Mr Talavera recommended that initiatives regarding applications of new technology applications such as web 2.0 or others be resumed to facilitate the dissemination of information in case of tsunami emergencies and that Member States update their memberships in WG3.

166 In closing, Mr Talavera noted that, given continued challenges with COVID-19, a new WG 3 Workplan should be established for the next intersessional period to be agreed upon at ICG/CARIBE-EWS-XVII.

167 Dr Silvia Chacon (Chair) highlighted the key challenge for WG3 to consider best methods to innovate on dissemination of products.

168 The **ICG noted** the report of Working Group 3 and noted there were no new recommendations.

4.3.1 Leveraging Common Alerting Protocols (CAPs) for tsunami early warning

169 Mr Vicente Vasquez Granda (WMO) provided the report on this agenda item (available as a presentation).

170 Mr Vasquez remarked that Common Alerting Protocols (CAPs) are critical to effective early warning, including for tsunamis, given that it allows for quick dissemination of messages over multiple alerting channels, platforms and devices. It provides critical information about hazards including location, magnitude, and potential impacts to a wide range of stakeholders. The WMO register of alerting authorities validates and only supports the dissemination of authoritative multi-hazard alerts. Mr Vasquez provided two examples of tsunami CAPs (one for the 2022 HTHH event and another for the 2023 Curaçao event).

171 Next, Mr Vasquez highlighted the central place of tsunami CAPs within the UN Early Warning For All (EW4ALL) Initiative. Indeed, tsunami CAPs support WMO members in improving their disaster risk reduction and response capabilities, and they are therefore promoted as a WMO minimum standard for dissemination of warning, including in EW4ALL.

172 Dr Charles McCreery (USA) enquired whether it was acceptable for PTWC to issue warnings via CAP even though PTWC is not an “authoritative source”. Mr Vasquez responded that PTWC can still disseminate CAPs but would be considered another source of CAPs given that WMO only disseminates CAPs from authoritative sources; nonetheless, using CAPs would still be beneficial given it would use the same language, and allow for increased visibility of the

approach. Mr Vasquez also encouraged Member States and Territories to engage in the process of implementing CAPs and registering as a WMO authoritative source.

173 Dr Wilfried Strauch (Nicaragua) noted that Japan had supported implementation of a Digital TV system using the Japanese norm in all Central American countries (except Panama), which allows for the transmission of messages through TV. JICA is also considering include CAPs in this system within the next year, which would allow for testing of CAP for tsunami early warning in the region.

4.4 PROGRESS REPORT OF WORKING GROUP 4 ON PREPAREDNESS, READINESS AND RESILIENCE

174 Ms Christa von Hillebrandt Andrade (US), Chair of WG4, provided the report for this agenda item (available as a report and a presentation).

175 Ms Christa von Hillebrandt-Andrade began by recalling the membership, purpose and functions, and current workplan of the WG and noting that the WG4 Factsheet had been updated (available as a document). There are currently 24 members of the WG, although with varying degrees of engagements. During the intersessional period, WG4 held two virtual meetings and conducted other business through email. Ms von Hillebrandt-Andrade drew attention to the need to change WG leadership at this ICG Session due to expiration or non-renewal of terms for Chairs and Vice-Chairs.

176 Ms von Hillebrandt-Andrade reported on the status of actions of WG4, highlighting publication of Manuals and Guides 86, *Multi-annual community tsunami exercise programme: guidelines for the tsunami and other coastal hazards warning system for the Caribbean and Adjacent Regions*. It is currently available in English and French, with the Spanish still pending. She also noted discussions on holding a workshop based on Manual and Guides 86 to promote the use of the document and its proposed approach, suggested for June 2023.

177 Relating to the requests to WG4 to provide guidance on tools and resources used for inventory of installed signage, Ms von Hillebrandt-Andrade reported that the ICG/CARIBE-EWS Tsunami Signage Inventory had been updated in 2023 to include traditional signage, alternative public display of tsunami hazard information and previous event signs. Currently, 66 percent of Member States and Territories have contributed to the inventory (up from 50 percent in 2021). Based on the CARIBE WAVE 23 questionnaire, many Member States and Territories do not have tsunami signage, or only have a certain type of signage. In addition, of those with signage, most are only community specific and very few have country-wide signage.

178 Ms von Hillebrandt-Andrade recalled that another part of WG4's mandate is to support WTAD, and thus engage with UNDRR and CTIC on relevant activities. This had been performed with the context of WTAD 2021 and WTAD 2022, notably with support to the creation of videos showcasing Tsunami Ready communities, key Caribbean donors and partnerships, and preparing for risks in the Caribbean through CARIBE WAVE Exercises. Ms von Hillebrandt-Andrade noted the change in logo for WTAD.

179 Ms von Hillebrandt-Andrade and Ms Alison Brome (CTIC) also represented WG4 at the TT-DMP Session in February 2023. A key discussion point was OTGA virtual trainings. TOWS-WG requested the Secretariat to facilitate the finalization of the OTGA basic tsunami training materials as soon as possible. In addition, the Tsunami Ready training module should be finalized by June 2023; once finalized, WG4 could support testing and evaluation of the module. Another key point of discussion during TOWS-WG was the UN Ocean Decade and its objective for "100 percent of communities at risk to be prepared for and resilient to tsunamis by 2030".

180 Ms von Hillebrandt-Andrade also reported that WG4 is aiding the update of CTIC flyers, through support from ITIC-CAR and USAID/BHA funding for Tsunami Ready. In addition, she reminded Member States that the order form for ITIC materials is available and coordinated through ITIC-CAR.

181 Next, Ms von Hillebrandt-Andrade briefly summarized other activities and tasks undertaken by WG4 during the past intersessional period, including reviewing and considering the results of the CARIBE WAVE 22 and 23 questionnaire; being involved in UN Ocean Decade activities [e.g. the Ocean Decade Sage Ocean Laboratory; planning for and formulation of the "Integrating Coastal Hazards Early Warning Systems and Services in the Tropical Americas and Caribbean" (iCHEWS) project]. Another activity was the update of the article database on the social dimension of disaster risk reduction in the Caribbean and adjacent regions (available as a document). She noted that during CARIBE WAVE Exercises, the engagement of social scientist is highly encouraged; however, only six social scientists participated in 2021, 12 in 2022, and one in 2023. It is therefore important to continue working on inclusive engagement to further advance on tsunami risk perception.

182 In closing, Ms von Hillebrandt-Andrade outlined key considerations, challenges, and opportunities for WG4. Principal challenges included COVID-19, other hazards and disasters and all related cascading effects on human and financial resources, especially for disaster risk managements offices; lack of financial resources to implement actions; limited engagement of members in WG activities; and lack of availability of ITIC education and outreach materials in languages other than Spanish and English. She also noted the challenge of the low frequency and high impact nature of tsunamis to maintain interest, thus underlining the importance of social science work on risk perception. In terms of opportunities, WG4 notably strives to maximize those provided by CARIBE WAVE, WTAD and Tsunami Ready to advance tsunami preparedness, readiness and resilience.

183 Mr Kenson Stoddard (St Vincent and the Grenadines) enquired about the possibility of streamlining CARIBE WAVE and WTAD events. Ms von Hillebrandt-Andrade responded that it would be effective and beneficial to streamline and link both events, including by reducing workload. She specifically highlighted the opportunity of adapting CARIBE WAVE Exercises to the themes of WTAD of the same year.

184 Following on the discussion about CARIBE WAVE and WTAD, Ms Danielle Howell (Barbados) noted that the timeframe of seven months between both events provides sufficient opportunity to capitalize on footage and results from CARIBE WAVE for WTAD. It also allows countries to potentially showcase improvements achieved in this time based on results of the CARIBE WAVE Exercise. Ms von Hillebrandt-Andrade agreed with this proposed approach, noting this would also be able to feed into high-level UNDRR events. In addition, she highlighted that the challenge with linking CARIBE WAVE and WTAD remains given that WTAD themes are currently published by UNDRR after CARIBE WAVE; TOWS-WG-XVI requested that UNDRR share themes further in advance.

185 Mr Eric Chichaco (Panama) enquired on the effectiveness of the CARIBE WAVE questionnaires for WG4. Ms von Hillebrandt-Andrade responded that these questionnaires are useful for identifying baselines and gaps; however, they should be further utilized, not only by WG4 but also other WGs to inform direction of activities.

186 **The ICG noted** the report of WG4 and **adopted** Recommendation ICG/CARIBE-EWS-XVI.4.

5. SPECIAL INVITED LECTURES: COMMUNITY BASED TSUNAMI AND OTHER COASTAL HAZARDS WARNING SYSTEM

5.1 TSUNAMI READY COMMUNITIES IN COSTA RICA

187 Dr Silvia Chacon (Chair), Mr Fabio Rivera (UNA/SINAMOT), and Mr Ricardo Cruz Salazar (CNE), representatives from the host country, Costa Rica, provided a report on the implementation of the UNESCO-IOC Tsunami Ready programme in Costa Rica (available as a presentation).

5.2 TSUNAMI READY CEREMONIES

188 Tsunami Ready recognition ceremonies were held for representatives from the communities of Titives and Dominical, Dominicalito and Baru, all from Costa Rica. The ceremony was presided by the Chair, Dr Silvia Chacon, and attended by representatives from CNE, UNA/SINAMOT, UNESCO San José, and tnational authorities. About 20 representatives from communities were present in person during the ceremonies.

6. POLICY MATTERS

5.1 EXERCISE CARIBE WAVE 2024

189 Dr Elisabeth Vanacore, Chair of the TT CARIBE WAVE, provided the report for this agenda item (available as a presentation).

190 Dr Vanacore presented on provisional ideas and plans for CARIBE WAVE 24. Based on the coverage of past CARIBE WAVE Exercises, Dr Vanacore identified a clear gap in the region of the Puerto Rico Trench. Through results from the CARIBE WAVE 23 questionnaire, other scenario suggestions for CARIBE WAVE 24 included an Aruba event, the 1692 Port Royal event, the 1918 Puerto Rico event, distant-source tsunamis (e.g. 1755 Portugal event, Cumbre Vieja/La Palma event, South Sandwich Islands event), and non-seismic source tsunamis (e.g. Kick'em Jenny). Relating to the date and time of CARIBE WAVE 24, Dr Vanacore encouraged Member States to consider whether to maintain the start time of 1400 UTC or instead hold an Exercise at night/during off hours. Relating to dates, she noted the Exercise should be held in March 2024 and recalled the challenge of CARIBE WAVE 23 overlapping with World Meteorological Day.

191 In closing, Dr Vanacore mentioned that ITIC-CAR, as part of USAID/BHA Tsunami Ready funding, has proposed a workshop on Manuals and Guides 86 with a hybrid meeting of TT CARIBE WAVE (tentatively for the week of 12 June 2023 in Barbados).

192 Mr Fabio Rivera then provided the report of the intrasessional WG to the Plenary including proposed scenarios and date for the exercise (available as a presentation).

193 During the discussion, Ms Christa von Hillebrandt-Andrade (USA) inquired whether the proposed focus on tourists was just for CARIBE WAVE 24 or for CARIBE WAVE Exercises in general. Mr Favio Rivera (Costa Rica) responded that it was a general recommendation for all CARIBE WAVE Exercises, given that these exercises often struggle with including tourists yet they are an important at-risk group. Dr. Chacon (Costa Rica) added that a discussion within the intrasessional WG had also touched on potentially moving the date/time of CARIBE WAVE Exercises to be more inclusive of tourists to weekends or holidays; however, this was not encouraged given that any shift would likely reduce participation of the general population, which remain the key target.

194 Mr Eric Chichaco (Panama) encouraged that an emphasis on including people with disabilities should be put forward in recommendations for future CARIBE WAVE Exercises, even if it is not the theme of the Exercise or WTAD, given they remain an important vulnerable group.

195 Ms Christa von Hillebrandt-Andrade (USA) recalled the importance of better coordination between CARIBE WAVE and WTAD, thus between IOC and WTAD. Mr Bernardo Aliaga also reminded Delegates that 2024 would mark the 20th anniversary of the deadly 2004 Indian Ocean tsunami. UNESCO-IOC-IOC will be supporting commemoration activities between November 2023 and March 2024, including a day dedicated to tsunami science during the 57th session of the Executive Council, an international tsunami symposium in December 2024, and WTAD 2024 activities. In addition, UNESCO-IOC is working to launch a Tsunami Survivors project, which would include portraits and interviews with survivors, to be shared in exhibitions worldwide. Mr Aliaga therefore encouraged Member States of the IOC/CARIBE-EWS to begin planning their own activities bearing in mind this context and potential opportunities for showcasing tsunami science and preparedness in the CARIBE-EWS region. Dr. Silvia Chacon noted that survivor-based projects would be challenging for the ICG/CARIBE-EWS, given the limited number of recent events; nonetheless, she encouraged Member States to reflect on how best to engage with these themes and activities in coming months.

196 **The ICG noted** the report of TT CARIBE WAVE and **adopted** Recommendation ICG/CARIBE-EWS-XVI.5.

5.2 REPORT OF THE CENTRAL AMERICA TSUNAMI ADVISORY CENTRE (CATAC)

197 Dr Wilfried Strauch, Senior Advisor of the Instituto Nicaraguense de Estudios Territoriales (INETER), provided the report on this agenda item (available as presentation).

198 Dr Strauch began by expressing deep appreciation to Mr Bernardo Aliaga, Technical Secretary of ICG/CARIBE-EWS, for his continued support in developing CATAC. He also expressed appreciation to JICA, which supported the establishment of CATAC through capacity-building of staff and implementation of software.

199 Dr Strauch recalled the emergence of CATAC. The 1992 Nicaragua tsunami acted as a catalyst for tsunami early warning leading to Nicaragua joining ICG/PTWS in 1993. In 1996, a NTWC was established in Nicaragua (the first in Central America) and by 2003, CEPREDENAC published a Decision to develop a regional tsunami warning system, which the ICG/PTWS Regional WG for Central America (ICG/PTWS-WG-CA) agreed to support. At subsequent sessions of the ICG/PTWS-WG-CA, Nicaragua offered to host a regional TSP, and the creation of CATAC was accepted by the ICG/PTWS, ICG/CARIBE-EWS and the IOC Assembly in 2015. The CATAC was established in 2016 and hosted by INETER. In 2019, the CATAC reinforcement project was completed with Japan and ICG/PTWS and ICG/CARIBE-EWS accepted experimental operation of CATAC. In December 2021, ICG/PTWS-XXIV accepted the full operation of CATAC in an interim mode. Dr Strauch expressed his hope that the ICG/CARIBE-EWS would approve CATAC as an interim provider, with a timeline for full service, during this Session (ICG/CARIBE-EWS-XVI).

200 The CATAC area of service includes the Pacific and Caribbean coast of Central America; its monitoring area is larger and includes wider areas of both the Pacific and Caribbean. CATAC relies on 300 seismic stations in Central America and 200 global seismic stations via IRIS. There are two watchstanders that work 24/7, from a group of 16 watchstanders. Seismological processing is conducted with SeisComP PRO. Tsunami evaluation is done with a database and using SeisComP TOAST (Tsunami Observation and Simulation Terminal) for real-time simulation. CATAC sends an initial alert message within two

minutes of an earthquake. A tsunami parameter message is disseminated less than 10 minutes after the earthquake. These messages are addressed to 11 monitoring/scientific institutions, PTWC, NTWCs, nine civil protection agencies and one regional coordinating body (CEPREDENAC).

201 CATAC's seismic station network was primarily strengthened through a project to establish and expand the network of seismic stations in Nicaragua, El Salvador, Costa Rica and Guatemala (implemented from 2021 to 2022). New accelerographs were installed with 25 in Nicaragua, 25 in El Salvador, 17 in Guatemala, and four in Costa Rica. This has enabled the reduction of the detection and localization time of earthquakes, improved quality of results, provided the ability to calculate very fast Moment Tensor (and magnitude) of strong earthquakes with local stations (not saturated) and enabled the creation of Shakemaps and seismic impact recording in major installations. Dr Strauch next drew attention to the relative dearth of sea level stations in Central America, with many stations currently offline. This is due to the high environmental risk at the coast (e.g. ships passing, storms and waves), the prioritization of seismic stations over sea-level stations, and the expensive nature of installing, maintaining, and repairing sea-level stations.

202 Dr Strauch encouraged Member States to explore the CATAC website, which includes critical information (e.g. earthquake viewer, seismic station viewer, etc.), tools (e.g. GAPS seismological processing, etc.) and documentation (e.g. JICA project materials, CATAC User Guide, Central American regional simulation exercise, etc.). The purpose of the website is not only to provide all relevant and useful materials, but also to ensure transparency of CATAC.

203 CATAC relies on three main systems for operations: SeisComP, a tsunami databased, and TOAST. SeisComP provides automatic and interactive seismological processing, enables calculation of the Momentum Tensor from which Magnitude Mw is derived, and sends seismological and tsunami messages (on a seismological basis). The tsunami database contains pre-calculated solutions, although Dr Strauch noted that CATAC was currently not utilizing the database due to bugs which need to be addressed. Lastly, TOAST is used for numerical tsunami simulation, sending of simulation product messages, arrival times, and amplitudes, as well as processing of tide gauge records.

204 Dr Strauch next reviewed CATAC's fulfillment of TSP KPIs, noting that CATAC satisfies all those for earthquake and threat assessment. He particularly highlighted that the required ten-minute elapsed time of the first earthquake bulletin for the TSP area of service (when no coordination is required between TSPs) is performed by CATAC within two minutes. For KPIs pertaining to the TSP functional status, Dr Strauch reported that CATAC satisfies all requirements. In terms of tsunamigenic potential, CATAC has adopted similar seismological parameters as other TSPs worldwide.

205 CATAC has developed capacities to process different types of tsunamigenic earthquakes. For instance, CATAC processed seismic data and disseminated products informally (via email or WhatsApp) for five earthquake with Mw>7. CATAC successfully processed all events, with the exception of the 2021 Haiti earthquake for which processing was inhibited by the lack of nearby non-saturated stations. CATAC also have been using M<7 earthquake to further test their processing capabilities. Dr Strauch also noted that Central America is vulnerable to slow earthquakes, with two recent examples of the 1992 Nicaragua event and the 2012 El Salvador/Nicaragua event. The possibility of tsunamis generated by slow earthquake means CATAC needs to use very fast methods for determining the true Mw magnitude (CATAC uses SCMTV module interactively and SCAUTOMT automatically). In fact, the Second Central America regional tsunami exercise (November 2020) was based on the scenario of a slow earthquake. Dr Strauch shared that CATAC aims to also work to identify coastal areas with a reduced time of possible first impact by local tsunamis, as this is a critical risk for Central America. Potential source areas for local tsunamis include the Motagua fault

(north of Honduras) and the Gulf of Fonseca. Areas in Central America that are particularly at risk of local tsunamis are the islands north of Honduras, San Juan del Norte in Nicaragua, Limon in Costa Rica, and the Panama Canal.

206 Despites CATAC's strong processing ability, Dr Strauch shared that it will to be further accelerated by using data from near accelerograph stations, limiting the distance of stations to be used for the first message, optimizing the configuration of tsunami simulations in SeisComP module TOAST. To optimize processing of earthquakes, a project is being implemented at CATAC and in Central America by the Sistemas de Alerta Temprana de Terremotos en Nicaragua y Centroamérica (EWARNICA) and the Alerta Temprana de Terremotos en América Central (ATTAC). It will upgrade the accelerometer stations installed in 2021, establish earthquake early warning in the region, apply methods of earthquake source estimation with the FINDER module, and develop methods to transmit warning messages massively to the general population.

207 In order to disseminate information about CATAC products and their applications, CATAC has developed strong linkages with civil protection agencies in Central America and is striving to further deepen these relationships through closer cooperation with CEPREDENAC. For instance, the CATAC webinar in June 2023 will support CEPREDENAC's third regional exercise. In advance of this activity, CATAC has also already conducted 15 webinars (since January 2023) with regional civil protection agencies about CATAC products. These webinars provided an opportunity to identify gaps and challenges with CATAC, including the need to update and increase the CATAC contact list, use social media for the dissemination of messages, and revise national SOPs to make adequate use of CATAC products.

208 Relating to plans for the upcoming intersessional period, a new project on regional capacity building will be implemented between 2023 and 2026, funded by JICA. It will include a yearly in-person capacity activity at INETER with CATAC users, online meetings and visits to user institutions, as well as funding for software licenses (SeisComP 5) and equipment. Other activities in 2023 will focus on updating the CATAC User Guide and message formats, to be presented at ICG/PTWS-XXX in September 2023 in Tonga. CATAC will also support the regional CEPREDENAC exercise in June 2023, PacWave 23 between September and November 2023, and CARIBE WAVE activities in 2024. In addition, CATAC will deepen its cooperation with the Ministry of Environment and Natural Resources of El Salvador (MARN) with the aim to establish it as a back-up to CATAC. Lastly, Dr Strauch shared that INETER is preparing a project proposal for the Government of Nicaragua, to request funding for the period 2024-2026 for CATAC data centre, and for software licenses and IT hardware.

209 Mr Eric Chichaco (Panama) requested clarification on the difference between CATAC products and other TSP (specifically PTWC) products. Dr Strauch responded that what distinguishes CATAC is its ability to process information quickly, deliver information in Spanish, and account for local conditions (e.g. for local tsunamis).

210 Mr Mike Angove (USA) congratulated INETER and specifically Dr Strauch for CATAC. However, following from the above comment, he remarked that quick enough coordination between PTWC and CATAC for providing extreme near field information and messaging is unlikely. It is more realistic to consider that Member States will need to make their own assessments, in real-time, of very local contexts and risks. Nonetheless, the work of CATAC is crucial for providing messages quickly, but not to the extent that it can deliver such specific local information.

211 Mr Angove also remarked that, when CATAC was first conceptualised in 2016, its planned structure was different to the one that exists today. As such, Mr Angove suggested and Mr Aliaga, Technical Secretary of the ICG/CARIBE-EWS, agreed to update the definition of TSP as currently defined under the Tsunami Watch Operations. Global Service Definition

Document IOC Technical Series, 130. Mr Aliaga added that these updates should be reflected in the planned updates to the Tsunami Ready Glossary.

212 Mr Gérard Métayer (Haiti) enquired whether CATAC can issue messages for distant tsunamis. Dr Strauch responded that although CATAC can detect earthquakes globally, it does not publish modelling and messages for these as it does not utilize many stations beyond the scope of Central America. Nonetheless, CATAC may increase its ability to model for wider regions, such as the Caribbean, in the future.

213 **The ICG noted** the report of CATAC and **adopted** Recommendation ICG/CARIBE-EWS-XVI.7.

5.3 REPORT OF THE TASK TEAM ON TSUNAMI READY PROGRAMME

214 Mr Fabian Hinds (Barbados), Co-Chair of the Task Team on Tsunami Ready Programme, provided the report for this agenda item (available as a document and a presentation).

215 Mr Hinds began by sharing the process of reestablishing the TT, including establishing communication amongst Co-Chairs and members, networking with CTIC and UNESCO-IOC, reviewing supporting documents, and confirming TT membership. He also shared the current membership list, noted the update of the TT Factsheet, and outlined the roles and responsibilities of the TT.

216 The TT Tsunami Ready Programme was invited to participate as Observers to two meetings of ICG/CARIBE-EWS Regional Tsunami Ready Programme Board (RTRPB): one for the British Virgin Islands (2 November 2021) and one for Saint Kitts and Nevis (4 February 2022). These meetings provided insight into the process of reviewing progress made towards achieving Tsunami Ready indicators and determining eligibility of communities for recognition.

217 Mr Hinds next reported on meetings of the TT Tsunami Ready Programme that were held on 18 May 2022 and 7 July 2022. During these meetings, the TT worked to finalize their draft Terms of Reference and refine the questionnaire/evaluation instrument. Both documents are available for submission at ICG/CARIBE-EWS-XVI. The decision to develop the Terms of Reference was because one had not previously been prepared and they would provide clarity regarding the composition and responsibilities of the TT. Mr Hinds encouraged National Tsunami Ready Boards (NTRPB) to coordinate with the TT for the implementation of the questionnaire/evaluation instrument.

218 Mr Hinds provided a brief overview of the Terms of Reference document, noting that meetings of the TT would be held virtually as often as is required for the purposes of executing its mandate. A quorum will be achieved when the number of members present are equivalent to 50 percent or greater of the membership. In addition, the Chairmanship of the TT would be shared between the co-chairs, or by one of the co-chairs where the other is unavailable. The co-chairs would be responsible for the conduct of the meetings, ensuring that an accurate record of the discussions and decisions of each meeting is prepared and forwarded to all members, and ensuring that there is adequate follow-up on the undertakings of the TT.

219 In closing, Mr Hinds outlined next steps for the TT Tsunami Ready Programme, including renewal of membership and implementation of their workplan, as set out under the Terms of Reference.

220 Mr Mike Angove (USA) suggested that the TT Tsunami Ready Programme reach out to Dr Laura Kong (ITIC), in her capacity as Chair of the Tsunami Ready Coalition, for any support, information or resources.

221 Ms Christa von Hillebrandt-Andrade (USA) suggested that a connection be made between TT Tsunami Ready Programme and TT CARIBE WAVE, given that CARIBE WAVE questionnaires provide information on Member State progress towards and goals for Tsunami Ready. This would support metrics for measuring the achievement of the UN Ocean Decade objective of "100 percent of communities at risk to be prepared for and resilient to tsunamis by 2030" by helping to identify target communities in the CARIBE-EWS region. Mr Hinds responded that this objective fits into the TT workplan and objectives. Moreover, the need to have more information from countries aligns with the TT's aim to have wider and more diverse membership from the ICG/CARIBE-EWS.

222 **The ICG noted** the report of the TT on Tsunami Ready Programme.

5.4 REPORT OF THE TASK TEAM ON TSUNAMI PROCEDURES FOR VOLCANIC CRISES

223 Ms Christa von Hillebrandt-Andrade (USA) provided the report for this agenda item (available as a document and a presentation) on behalf of Ms Valerie Clouard (France), Chair of the TT Tsunami Procedures for Volcanic Crises.

224 Ms von Hillebrandt-Andrade began by providing an overview of the membership and leadership of the TT, noting the presence of the Chairs of WG1 through WG4, the Chair of ICG/CARIBE-EWS, the Technical Secretary of ICG/CARIBE-EWS, the Director of PTWC, and participants from volcano observatories in the region.

225 Ms von Hillebrandt-Andrade reflected on the structure of the tsunami warning system established in the ICG/CARIBE. She highlighted that monitoring network operators have focused on seismic, sea-level and GPS data in the past. A key consideration of the TT on tsunami procedures for volcanic crises has therefore been on how to integrate monitoring of volcano activities, and beyond this how to integrate it in the rest of the upstream and downstream alerts and warnings (e.g. at TSP, TWFP, NTWCs, and down to the level of communities). In addition to formal pathways for warning, natural warning signs for communities are also an important element of the Caribbean system; integrating natural warnings of volcanic activity and its risk for tsunamis is therefore also critical. Ms von Hillebrandt-Andrade recognized that alerting on tsunamis generated by volcanoes is complex due to the several generation mechanisms from volcanoes (e.g. eruption, landslide, collapse, pyroclastic flows, etc.). Thus, tsunami services provided for volcano-generated tsunami events need to consider these specificities.

226 Ms von Hillebrandt-Andrade recalled that the TT was established following the volcanic unrest of Kick'em Jenny volcano during the week of 13 July 2015, which prompted a discussion at ICG/CARIBE-EWS-XI about the potential for tsunami waves created by volcanic crises. The ICG/CARIBE-EWS-XI decided to establish a designated TT to identify procedures to follow for volcanic crises and suggested that the ICG identify volcano observatories as the primary entities responsible for determining the potential of a volcano-induced tsunami threat. Subsequently the ICG decided to include a volcano-source scenario in CARIBE WAVE 19, to test tsunami response to such an event within the constraints of the CARIBE-EWS early warning system at the time. This provided the PTWC with the opportunity to test experimental volcano products. Ms von Hillebrandt-Andrade noted that this scenario assumed M 6.1 seismic activity associated with the volcanic eruption at Kick'em Jenny, which is particularly high and unlikely to occur, but was chosen for the purpose of the exercise. The ICG chose to include another volcano-source scenario in CARIBE WAVE 23 to further test products.

227 During the past intersessional period, the TT Tsunami Procedures for Volcanic Crises has worked to develop standard and formatted messages which could be issued by volcano observatories and/or institutes responsible for monitoring tsunamis in the case of a potential

tsunamigenic event. In addition, it has been drafting a MoU that could be signed between TSPs and volcano observatories and/or institutes responsible for monitoring volcanoes. It also collaborated with the TT CARIBE WAVE to prepare the Mount Pelée flank collapse scenario for CARIBE WAVE 2023.

228 Recent volcanic crises in the Caribbean show that there are two different cases where the TSP needs to issue messages towards the NTWC: 1) If volcanic activity is showing phenomena potentially tsunamigenic or if a tsunami is observed, and 2) if there is an escalation of volcanic activity, to be able to advise Member States. In both cases, information originates from volcano observatories. Ms von Hillebrandt-Andrade remarked that constraints on these bulletins are standard formatted information, basic information on the volcano, and information on the potential of occurring tsunami.

229 The bulletins created by the TT for volcano-generated tsunami for volcano observatories to send to TSPs are called Volcano Observatory Notice for Tsunami Threat (VONUT) messages. These messages would contain some pre-filled information about the date/time, contacts, the name of the volcano, the area/regional descriptor, and the summit elevation. It would also have a volcanic activity summary, which is a concise statement that describes the activity of the volcano and, if possible, time of eruption. They are based on data collected by volcano observatories (volcanic activity and sea level) and provide a volcanic alert level. The four alert levels are: 1) Background activity, 2) Above Background, 3) Escalation of parameters, and 4) Eruption imminent/ongoing. If the TSP receives a VONUT with alert level 2 or 3, it will closely monitor the sea level stations near the volcano. If it receives a message with a level 4 alert, it will issue a tsunami threat statement, and NTWCs will then consider issuing their own warning message to activate local and national public alert systems.

230 During CARIBE WAVE 23, two VONUT messages were issued by the Volcanological and Seismological Observatory of Martinique (OVSM). The first was issued 30 minutes before the beginning of the exercise (simulated the change in volcanic activity level from orange to red) and a second was issued five minutes before the beginning of the exercise (to inform the TSP that a large dome collapse has reached the Caribbean Sea). Critical feedback received by Member States from this exercise scenario included a remark that in the message from TSPs a link to a direct source of information (e.g. volcano observatory website) should be added; given that this information is provided in VONUT messages, it should also be provided in TSP messages.

231 In closing, Ms von Hillebrandt-Andrade thanked the ICG/CARIBE-EWS and specifically, Dr Valérie Clouard, for being forward-thinking with addressing the threat of volcano-generated tsunamis before any other ICG. In fact, some of the approaches developed within ICG/CARIBE-EWS (i.e. arming sea-level stations) were used to respond to the 2022 HTHH event.

232 Ms Leah St Jean-Tyson (Dominica) expressed appreciation for the work of the TT, which is particularly relevant to Dominica given that the island is surrounded by nine volcanoes. She noted that the threat of volcano-generated tsunamis is often the main concern expressed by the public during tsunami evacuation mapping workshops. In closing, she encouraged the ICG to continue their important work on volcano-generated tsunamis.

233 **The ICG noted** the report of the Task Team on Tsunami Procedures for Volcanic Crises and **adopted** Recommendation ICG/CARIBE EWS-XVI.6.

5.5 REPORT OF THE TASK TEAM ON TSUNAMI EVACUATION MAPPING

234 Mr Norwin Acosta (Nicaragua), Chair of the Task Team on Tsunami Evacuation Mapping, provided the report for this agenda item (available as a presentation).

235 Mr Acosta recalled that the objectives of the TT are to create easily manageable and accessible tools for institutions in charge of disaster management and to support public access to tsunami evacuation maps via web or mobile. He also noted that evacuation maps primarily illustrate evacuation areas, safe zones, meeting points, evacuation routes, locations and buildings of interest, and information relating to emergency management. This information is important, both for the population and for decision-makers to create effective contingency and emergency plans in the event of a tsunami.

236 To address challenges of availability, quality, structure, accessibility and sharing of spatial information, it is important to develop a clear infrastructure for spatial data. It is also important for spatial data to be shared, where possible, not just nationally but also regionally, to support sharing of best practices, lessons learned, and considering that tsunamis are transboundary hazards. Mr Acosta reported that the TT has therefore been investigating open-source tools which could allow for having a shared system where spatial data from all ICG/CARIBE-EWS countries would be available, within the necessary limitations.

237 He reported on the evolution of Geographic Information Services, particularly in relation to mapping with paper and digital formats. These systems are tools that integrate various components which allow for the organization, storage, manipulation, analysis and modeling of large amounts of real-world spatial data. They include social-cultural, economic and environmental dimensions which can inform effective decision-making. Geographic Information Services therefore meet several of the target criteria outlined above. They allow for standardized publication of spatial data through visualization, download, coverage or location services. In addition, geographic web services allow for spatial data of an organization to be displayed on any computer or mobile device. This type of service, known as Web Map Services (WMS), generates a digital image as a representation of the geographic information stored in a database, adapted for display on screen; thus, is enables digital mapping. He highlighted a map tool developed at the University of Puerto Rico in which all mapping for evacuation maps were included.

238 Mr Acosta therefore suggested that the ICG/CARIBE-EWS consider creating a WMS for tsunami evacuation maps which would be administered via a Web interface through open-source server which would support WMS services. The system would support multiple map configuration management as well as vector and raster layers (GEOJSON, GEOTIFF). It would allow for displaying different versions of maps (e.g. only roads, or with a satellite view layer, etc.), which could be adapted to the purpose of the map. Mr Acosta shared on-screen an image of a potential user login, highlighting the ability to a user to create and use catalogues for different types of information and data. This allows for simple and clear availability of access to data in a streamlined way. In closing, Mr Acosta underlined that WMS is also useful because it does not require an additional server, but rather is stored online; this improves the performance of the viewer and allows for maps to be viewed through different platforms (e.g. phone, computer, etc.).

239 Dr Silvia Chacon (Chair) remarked that WMS is useful for tsunami evacuation mapping because evacuation mapping is dynamic; maps need to be updated over time. However, having several different paper versions of maps can be confusing for communities. Through an online tool, maps and data can therefore more easily be updated to avoid confusion. Mr Acosta agreed and added that information about the date/time when data was collected, as well as the context in which data was collected, should be included on any online data portal for evacuation maps.

240 **The ICG noted** the report of the TT on Tsunami Evacuation Mapping.

5.6 UNITED NATIONS DECADE OF OCEAN SCIENCE FOR SUSTAINABLE DEVELOPMENT

241 Mr Mike Angove (USA), Ms Mary Rengifo (Colombia), Dr Silvia Chacon (Costa Rica), Dr Matt Fouch (USA), and Dr Chris Moore (USA) provided the report on this agenda item (available as a presentation).

Introduction on the UN Decade of Ocean Science for Sustainable Development

242 Mr Angove began by sharing an overview of the membership and purpose of the ODTP-SC. He also recalled the two targets of the ODTP which are: (1) To develop the warning systems' capability to issue actionable and timely tsunami warnings for tsunamis from all identified sources to 100% of coasts at risk" and (2) 100% of communities at risk be prepared and resilient to tsunamis by 2030 through programmes like the UNESCO-IOC Tsunami Ready Recognition Programme". He specifically highlighted the importance of balancing the improving of detection and data systems, coupled with strengthening preparedness and awareness.

243 Mr Angove next outlined the main elements from the 10-year draft Research, Development and Implementation Plan (hereafter ODTP Implementation Plan) being developed by the ODTP, drawing particular attention to the first element of the Plan on "Tsunami risk knowledge" which presents a key challenge for the ICG/CARIBE-EWS with its diversity of tsunami sources and myriad risks. Relating to the fourth element of the ODTP, which focuses on preparedness and response capabilities, Mr Angove recognized the ICG/CARIBE-EWS's strong track record, including through the implementation of the first Tsunami Ready pilot projects. Mr Angove specifically highlighted the impressive preparedness advances of Costa Rica, notably laid out in agenda item 5.1.

244 Mr Angove next elaborated on the "Capacity development" element of the ODTP Implementation Plan, underlining the crucial role of capacity-building throughout the entirety of tsunami early warning systems. In addition, he remarked that capacity should be spread evenly across communities, countries, and globally, to ensure effective early warning for all. Mr Angove also expanded on the "Governance" element of the ODPT Implementation Plan which considers how the tsunami programme structure (especially ICGs and Member States) can leverage priorities, ideas, capabilities and sometimes resources to meet the objectives of the ODTP. Mr Angove highlighted that a proposal was being put forward for the ICG/CARIBE-EWS to restructure its WGs and TTs to better align with the ODTP and thus more effectively meet its targets. In closing, Mr Angove encouraged Member States to find linkages between their national tsunami warning programmes and the ODTP, for the latter to support and streamline national efforts and activities.

245 Mr Kenson Stoddard (St. Vincent and the Grenadines) enquired about the source mechanisms of the HTHH tsunami event, highlighting that challenge of correctly detecting and forecasting events given each is unique. Mr Angove agreed that detection, analysis and forecasting of events is a critical gap in the global tsunami warning system, especially for non-seismic source events. Mr Chris Moore provided additional information on the HTHH event, noting that it involved an atmospheric wave that not only forced the tsunami away from the volcano but also directly into unconnected ocean basins. As such, the NOAA Pacific Marnie Environmental Laboratory (PMEL) is considering options for source-agnostic approaches, including using optimized sensors to detect tsunamis based on waves and not sources.

ICG/CARIBE-EWS Regional Implementation Plan

246 Ms Mary Rengifo (Colombia) spoke about regional implementation of the ODTP Plan in the ICG/CARIBE-EWS, specifically focusing on how the ODTP objectives align with the global KPIs.

247 Ms Rengifo began by noting that the work to develop global KPIs predates the ODTP. As such, the TT Performance Monitoring and KPIs has examined how the global KPIs, and specifically the sub-objectives and targets, can be distributed among the new aspirational goals of the ODTP. Ms Rengifo noted that although the distribution of targets sometimes diverged, many of the goals and objectives of the global KPIs and the ODTP converged. Ms Rengifo also shared on-screen the updated matrixes the ICG/CARIBE-EWS divided into the ODTP objectives. She briefly outlined key elements for each objective, noting for instance that detection, analysis, and forecast had been grouped with warning dissemination and communication to adapt the ICG/CARIBE-EWS priorities and structure.

Tsunami Risk Knowledge

248 Dr Silvia Chacon (Costa Rica) provided a brief breakdown of key challenges, solutions and goals under each ODTP objective of “Tsunami Risk Knowledge”. Dr Chacon began by noting the challenges associated with defining inundation areas, flow depths and arrival times of tsunamis. The ICG/CARIBE-EWS has worked to address these challenges, importantly through Meeting of Experts. Other solutions to further expand on include densifying sea-level networks and preforming paleo-tsunami studies and historical data research, as well as identify funding for further capacity-building coupled with hiring of staff. Specific goals under this Objective of the ODTP include having a catalogue of historical tsunamis, a databased of tsunami source scenarios, coastal digital elevation data. Each country should also have access tsunami numerical models by 2026, at least one person for tsunami modelling by 2025, and a defined inundation area for chosen communities by 2026.

249 Ms Chacon next elaborated on challenges related to identifying critical infrastructure, vulnerable groups, economic assets, and the built and natural environment. In order to achieve goals related to defining vulnerability and exposure, there is a critical need for multistakeholder resources (trained staff and funding) and coordination. In order to better define capacity to respond in the ICG/CARIBE-EWS, Ms Chacon highlighted the need for Member States to establish a strategy and identify funding for Member States to bridge haps on legal frameworks, on institutional frameworks and on EWS. Ms Chacon next noted that, to define a methodology to calculate risk, the ICG/CARIBE-EWS need to develop methodologies for tsunami risk assessments and develop supporting guidance. Lastly, Ms Chacon shared that for the ICG/CARIBE-EWS to effectively use results from Tsunami Risk Assessments, Member States would need resources and coordination in order to conduct the assessments but also develop tsunami risk reduction tools according to the results.

Tsunami detection, analysis and forecasting

250 Mr Mike Angove (USA) provided a brief explanation of on the second objective of ODTP on “Tsunami detection, analysis and forecasting”. He highlighted that the main goal was build off the legacy of seismic wave form analysis as a proxy for tsunamis and towards examining the tsunami and tsunami waves themselves. Mr Angove noted that the main challenge under this objective is to not only address seismic-source tsunamis, including potentially through a source-agnostic instrument grid.

A. SMART repeaters on subsea cables

251 Dr Matt Fouch (USA) provided a review of the purpose and applications of SMART repeaters on subsea cables for tsunami early warning.

252 Dr Fouch began with a brief overview on SMART repeaters, noting that subsea fiber comprises 95 percent of international internet traffic and that repeaters (amplifiers) are located every 60-100 km along the cable. There are currently about 20,000 repeaters on the sea floor, but less that 0.1 percent are used for anything besides carrying data: thus, these repeaters present a virtually untapped opportunity for science and monitoring capabilities. Dr Fouch therefore explained that SMART cables aim to leverage the existing commercial cable infrastructure but add sensors (pressure, temperature, and seismic) on the repeaters (with power and communications already provided). There is currently a UN multi-agency Joint Task Force leading the adoption push for SMART technology, and Portugal will likely be the first country to implement the technology. A smaller cable is also being installed between New Caledonia and Vanuatu. Dr Fouch noted that a critical element to implementation of SMART cables is that fiber cable suppliers agree to adopt the required technology.

253 Next, Dr Fouch provided an example of a possible SMART cable concept and map for the CARIBE-EWS region. He noted that some older cables in the region are scheduled for replacement in 2-7 years, which would provide an opportunity to include SMART repeaters and therefore enhance the ICG/CARIBE-EWS's seismic and tsunami detection capabilities, improve societal resilience, and protect/harden telecom infrastructure. Dr Fouch noted that a lost opportunity is a cable in the northwest Caribbean which is about to be replaced (without SMART technology), due to be finalized in 2026.

254 Dr Chacon (Chair) thanked Dr Fouch for informing on SMART cables and noted with appreciation the opportunity presented by these cables for tsunami early warning in the ICG/CARIBE-EWS.

255 Dr Wilfried Strauch (Nicaragua) enquired about cables along the Pacific coast of Central America, given the Dr Fouch's map had only illustrated through within the Caribbean and some Atlantic area. Dr Fouch noted that these were not included in the presentation due focus on the CARIBE-EWS region and limited time but confirmed these should be studied and considered for SMART technology. Mr Mike Angove (USA) also noted that cables along the Pacific coast of Central America would be further discussed at ICG/PTWS-XXX.

256 Mr Fabian Hinds remarked on the proximity of some existing subsea cables to Caribbean Member State islands and highlighted the potential opportunity of these countries having access to the data from the cables to support decision-making. Dr Fouch responded that this would depend on Member States or groups of Member States determining SMART cables as a priority and identifying funding. He also suggested Member States contact Dr Bruce Howe for additional information. Finally, he emphasized that Member States should begin discussions on SMART cables now for cables to be implemented in 5-10 years, warning that the process for discussion and funding would likely be timely.

257 Mr Gérard Métayer (Haiti) enquired whether PTWC can reduce time of issuing messages with SMART cables. Dr Fouch responded that it could in theory reduce time, including by detecting pressure waves. Dr Charles McCreery (USA) and Mr Mike Angove (USA) confirmed SMART cables would support, if not shorten time for issuing messages, at least greatly support time to initial detection and validation.

B. Tsunami detection with DART buoys

258 Mr Chris Moore presented on potential opportunities for improved tsunami detection in the region, including through a source-agnostic approach.

259 Mr Moore began by summarizing the existing tsunami detection array for the ICG/CARIBE-EWS, highlighting the placement of DART buoys. Based on the existing network of DART buoys, Mr Moore considered what an optimized sensor placement for DART buoys would be in order to reach the ODPT 10-minute detection goal, based on a source-agnostic approach. Currently, the only areas that meet close to 10-minute detection target are around the Puerto Rico Trench and Aruba. Mr Moore reported that, in order to meet the ODTP goal and if detection were solely based on DART buoys, a total of 61 DART buoys would be required in the CARIBE-EWS region. He also emphasized that if tsunami early warning systems were to only rely on DART buoys, they would always require a second sensor for good source characterization. Thus, in order to be source agnostic, sufficient information about the tsunami wave would need to be available to pinpoint the source. In addition, Mr Moore also presented a scenario for DART buoy placement if other sensors such as SMART cables, GNSS sensors, and high frequency radar, etc. were also involved. In this scenario, with the addition of just one SMART cable, the number of required DART buoys for 10-minute detection fell to 49 buoys.

260 Next, Mr Moore expanded on the opportunity presented by GNSS sensors to offset gaps from DARTs or other sensors. He specifically highlighted the joint effort between NOAA, the National Aeronautics and Space Administration (NASA), and academia on GNSS, notably to on the GFAST developed at the University of Washington as part of California Earthquake Early Warning system. GFAST is able to deliver a preliminary magnitude estimate in 90 seconds but requires three sensors within a 60km radius. Although this density would not be necessary in oceans for tsunami detection, Mr Moore noted that using results from GFAST, the Short-term Inundation Forecasting for Tsunamis system (SIFT) can produce on-the-fly forecast runs (and this technology will soon be implemented at PTWC).

261 Mr Charles McCreery (USA) remarked that another advantage of the strengthened sensor network (with DART buoys and/or SMART cables) will be the ability to cancel out events, thus not give a warning, for those events that are on the margin of potential risk. This will therefore avoid false alarms, which are costly and can diminish credibility.

<u>Tsunami warning and communication, and preparedness and response</u>

262 Ms Christa von Hillebrandt-Andrade (USA) began by outlining the key elements of tsunami warning dissemination and communication, emphasizing the importance of building redundancy in communication methods, and having appropriate communications tools and products to ensure tsunami warnings are disseminated equitably and effectively to all populations at risk. She also underlined that warning dissemination and communication is the responsibility of Member States, with specific criteria to fulfil explained in the ODTP Implementation Plan.

263 Next Ms von Hillebrandt-Andrade expanded on the three pillars included under the ODTP fourth objective on “preparedness and response”. The first pillar focuses on risk perception, which should be conducted with support from social scientists. The second pillar focuses on the core of preparedness and response, including most importantly through the UNESCO-IOC Tsunami Ready programme, which sets out specific indicators and approaches. However, Ms von Hillebrandt-Andrade warned that the UNESCO-IOC Tsunami Ready programme should be used as a complement to existing programmes; for instance, she recalled the need to identify a mechanism for recognizing communities that fulfil preparedness and response criteria but which have not gone through the UNESCO-IOC Tsunami Ready process. Finally, Ms von Hillebrandt-Andrade highlighted the third pillar of mitigation, which

focuses on technical, infrastructure and nature-based solutions to mitigate impacts from tsunamis.

264 In closing, Ms von Hillebrandt-Andrade recognized that the ODTP should not be considered in a silo, but rather within a network and framework of other relevant and important projects such as the IOCARIBE-endorsed Ocean Decade project (iCHEWS)—which includes Tsunami Ready as a best practice—as well as the Sendai Framework and its updated strategy for the Americas and the Caribbean. Finally, the UN EW4ALL Initiative offers a global framework for early warning system coverage by the end of 2027.

Re-alignment of ICG/CARIBE-EWS

265 Dr Silvia Chacon (Chair) presented a proposal for re-alignment of ICG/CARIBE WGs and TTs to better match the structure and approach of the ODTP, and by extension other key frameworks outlined above. The proposal formed the basis of Appendix I of Recommendation ICG/CARIBE EWS-XVI.5.

266 **The ICG noted** the report on the UN Ocean Decade Tsunami Programme (ODTP) and **adopted** Recommendation ICG/CARIBE-EWS-XVI.8.

5.7 REPORT OF THE TASK TEAM ON FUTURE GOALS AND PERFORMANCE INDICATORS

267 Ms Mary Rengifo (Colombia), Chair of the Task Team on Future Goals and Performance Indicators, provided the report on this agenda item (available as a presentation).

268 The ICG/CARIBE-EWS Implementation Plan has 47 goals, 13 of which for WG1 on “Monitoring and detection systems”, 14 for WG2 on “Hazard and risk assessment”, eight for WG3 on “Tsunami related services”, and 12 for WG4 on “Preparedness, readiness and resilience”. According to previous reports (2018, 2019, and 2021), 25 percent, equivalent to 12 goals have been completed, 32 percent are in progress, and 43 percent are pending development of activities. Ms Rengifo noted that this status would be updated based on reports from WGs, given that so far, an update had only been received from WG2.

269 Pertaining to goals related to monitoring and detection systems (WG1), seven goals have pending, four have ongoing, and two have completed activities. Regarding the status of hazard and risk assessments (WG2), five goals had been completed, four goals are in progress, and five goals have activities pending. Goals relating to Tsunami Services (WG3) present a challenge with only one goal completed, four goals in progress, and three pending. Relating to public awareness, education and resilience (WG4), four goals have been completed, three are in progress, and five are pending.

270 Ms Rengifo noted the importance of reviewing the progress of each WG against the ICG/CARIBE-EWS Implementation Plan, but also the new 10-year Research, Development, and Implementation Plan of the ODTP, as well as global tsunami KPIs. As such, Ms Rengifo recommended that each ICG/CARIBE-EWS WG restructure their implementation plan to better align with the ODTP, which would allow for better prioritization of activities. Other important global goals and performance monitoring indicators which any new structure of ICG/CARIBE-EWS WGs should strive to align with are the Sendai Framework for Disaster Risk Reduction 2015-2030, the IOC Tsunami Programme, and the UNESCO-IOC Tsunami Ready programme.

271 Ms Rengifo next provided a brief overview of the global KPI framework developed by the inter-ICG TT Future Goals and Performance Indicators, noting that it come before and therefore does not perfectly align with the ODTP. There are five goals under the global framework: 1) Understanding and managing tsunami hazard and risk (which has 11 indicators),

2) Tsunami detection, warning and dissemination, 3) Enhancing tsunami preparedness for effective community response (which has 10 indicators), 4) Tsunami event response and recovery (which has six indicators), and 5) Global ocean coordination, cooperation and partnerships (which has six indicators). Next, Ms Rengifo shared on-screen an image of the performance monitoring matrix for each goal, highlighting that results are measured through four metrics: 0-25 percent, 25-50 percent, 50-75 percent, and 75-100 percent. Based on information submitted by Member States, this online matrix should calculate the status of implementation automatically. Through this matrix, the TT expects to monitor and evaluate activities against the global KPI framework, provide yearly reports to ICG Sessions, prioritize actions to improve tsunami risk management in each ICG, and participate in TOWS-WG Sessions for global basin assessments, and identification of gaps, opportunities and improvements within the tsunami programme.

272 In closing, Ms Rengifo outlined ongoing activities of the TT Future Goals and Key Performance Indicators include coordination with UNESCO-IOC to develop Terms of References for the web-portal for the global KPIs matrix as well as the development of a questionnaire to be published in the web-portal. Based on current discussions with UNESCO-IOC, the web-portal will be hosted on the IOC website, have algorithm functionality, provide real-time graphs, be fair and ethical, and be easy, accessible, and simple (yet comprehensive).

273 Mr Mike Angove (USA) noted several parallels between the work of the TT and the ODTP. The ODTP will therefore be reaching out to the TT to identify and capture key elements to be preserved in the ODTP, whilst removing excessive tracking, in order to develop a cohesive monitoring system. It is important to standardize our work and how we measure it.

274 Ms Christa von Hillebrandt-Andrade (USA) noted that the ICG/CARIBE-EWS currently has several types of reporting: the CARIBE WAVE questionnaire, the global KPI matrix, and national reports. She enquired whether the global KPI matrix would aim to substitute national reports or rather be an additional report. Ms Rengifo confirmed that the TT expects the global KPI matrix to replace national reports.

275 **The ICG noted** the report of the TT Future Goals and KPIs and **adopted** Recommendation ICG/CARIBE-EWS-XVI.5.

7. PROGRAMME AND BUDGET FOR 2023–2024

276 This agenda item was introduced by the Technical Secretary, Mr Aliaga, who reported on the status of regular funding from UNESCO for the Tsunami programme and, in particular, for ICG/CARIBE-EWS.

277 Mr Aliaga explained that the budget for the next biennium (2024-2025), under the Draft Programme and Budget 42C/5, is currently being negotiated. He therefore presented on the potential funding scenarios that could be expected in this next biennium:

- Base case scenario: there is an increase of funding for IOC
- Zero nominal growth scenario: The budget is impacted but only with modest reductions, which would be mitigated with the return of staffing funds associated to a management position that was not approved in the previous biennium.

278 Mr Aliaga noted that under the base case scenario, ICG/CARIBE-EWS would likely experience an increase of 40,000 to 60,000 USD. If the Zero nominal growth scenario occurs, the ICG/CARIBE-EWS should barely be impacted.

279 In addition, Mr Aliaga shared that a Draft Resolution was submitted to the Executive Board 216 (Urgent requirement for increased and more stable resources to the

Intergovernmental Oceanographic Commission (IOC) (216 EX/44; 216 EX/PG/1.INF.3; 216 EX/DG.INF Rev.), including by several Member States in the CARIBE-EWS (Panama, St. Lucia, St. Vincent and the Grenadines, and the UK), with the following request:

(a) "an increase in the [IOC's] share of the UNESCO regular budget of [1%] to ensure it has adequate human and financial resources in order to fully implement its responsibilities;

(b) that for UNESCO's regular budget for 2024–2025 (42 C/5), this increase be identified within existing regular budget resources".

280 Mr Eric Chichaco (Panama) requested more clarity on the process for consideration of the above-mentioned resolution by UNESCO. Mr Aliaga explained that UNESCO's Executive Board (at its 216th session in April 2023) would discuss both the budget proposals and the specific resolution submitted by Member States. Following this Session, the UNESCO Director General will instruct the reorganization of the budget for the 42 C/5. The UNESCO Team charged with making these changes will then have four months to reorganize the budget, to be presented at the Executive Borad 217 In November 2023 for approval.

281 **The ICG noted** the report of the Technical Secretary.

8. NEXT SESSIONS

8.1. CONFIRMATION OF DATE AND PLACE OF ICG/CARIBE-EWS-XVII

282 The Chairperson, Dr Silvia Chacon, recalled that Haiti had indicated their interest in hosting the 15th Session of ICG/CARIBE-EWS but that due to the COVID-19 pandemic, this Session was organized as an online session. Dr Chacon also recalled that Aruba and Cuba had indicated that they would consider hosting the 16th/17th Sessions, noting that Cuba confirmed at ICG/CARIBE-EWS-XIV its proposal and intent to host ICG/CARIBE-EWS-XVI; however, due to the pandemic and other logistical reasons these sessions did not occur as planned. Dr Chacon-Barrantes also advised of Costa Rica's willingness to host this 16th Session at late notice and noted that Barbados has also indicated some interest in hosting a future session of the ICG/CARIBE-EWS.

283 Dr Chacon Barrantes invited representatives of Haiti, Cuba, Aruba and Barbados to indicate their willingness to host the ICG/CARIBE-EWS-XVII in 2024. Mr Gerard Metayer (Haiti) responded that due to the current political and social situation in Haiti, it would no longer be available to host ICG/CARIBE-EWS-XVII. In addition, Mr Fabian Hinds (Barbados) remarked that the possibility of hosting ICG/CARIBE-EWS-XVII was still being discussed internally within relevant institutions in Barbados, and therefore could not be confirmed at this time. Dr Chacon noted that representatives from Aruba and Cuba were not present.

284 Ms Regina Browne (USA, USVI) enquired about the requirements for hosting of an ICG/CARIBE-EWS Session. Mr Aliaga highlighted key technical requirements (venue, audiovisual equipment, etc.) as well as traditional elements of the meeting (e.g. field trip and welcome dinner). Mr Mike Angove (USA) and Dr Silvia Chacon (Chair) further noted the challenge posed by Host Country Agreements (HCAs), which need to be anticipated and negotiated well in advance. Furthermore, they noted that HCAs are constraining and often dissuade or inhibit Member States from putting forward nominations to host meetings. In response, Ms Lorna Inniss (IOCARIBE) encouraged Member State representatives attending IOC and UNESCO meetings to report on this challenge, to potentially motivate changing of the HCA requirements and approach.

285 Ms Christa von Hillebrandt-Andrade (USA) also encouraged Member State representatives to reach out to their respective national Delegates within UNESCO, not only

to report on challenges of HCAs but also to strengthen linkages within UNESCO about tsunamis. For instance, engagement with the Barbados UNESCO representative was a critical step to establishing CTIC.

286 Given that no Member State confirmed interest for hosting of ICG/CARIBE-EWS-XVI, Dr Chacon requested the Secretariat to follow-up to request nominations for hosting of the ICG/CARIBE-EWS-XVII.

287 **Action:** The Secretariat will reach out to Barbados, Cuba, and Aruba during the second half of 2023 to explore hosting opportunities, as well as request nominations from any and all ICG/CARIBE-EWS Member State for hosting of ICG/CARIBE-EWS-XVII.

288 Regarding dates of ICG/CARIBE-EWS-XVII, the Chairperson, Dr Silvia Chacon suggested that May 2024 may be more convenient than April 2024. Mr Bernardo Aliaga, Technical Secretary, confirmed that it would be feasible to hold ICG/CARIBE-EWS-XVII in early May 2024, given that there would be no IOCARIBE meeting and noting that the Ocean Conference is scheduled for early June 2024.

289 The participants agreed to hold ICG/CARIBE-EWS-XVI the week of 6–10 May 2024, with specific dates to be confirmed by the Secretariat.

8.2. TARGET DATE FOR ICG/CARIBE-EWS-XVIII

290 The Chairperson, Dr Silvia Chacon, reported that Aruba, Barbados, Cuba, and Haiti had previously indicated their willingness to host ICG/CARIBE-EWS-XVII. However, based on the comments by representatives from Barbados and Haiti under agenda item 7.1 and noting that representatives from Aruba and Cuba were not present, Dr Chacon noted requested the Secretariat to follow-up to request nominations for hosting of the ICG/CARIBE-EWS-XVIII.

291 **Action:** The Secretariat will reach out to Barbados, Cuba, and Aruba during the second half of 2023 to explore hosting opportunities, as well as request nominations from any and all ICG/CARIBE-EWS Member State for hosting of ICG/CARIBE-EWS-XVIII.

292 No provisional dates were set for ICG/CARIBE-EWS-XVIII.

9. ELECTIONS

293 The ICG/CARIBE-EWS was requested to elect one Chairperson and three Vice-Chairpersons to act as Officers of the ICG for the two-year intersessional period (2023–2025), who would represent the oversight body of the ICG during intersessional periods.

294 The Chairperson of the Intrasessional Elections Committee, Ms Lorna Inniss (IOCARIBE), addressed the Session and introduced this agenda item. She informed attending Delegates that elections should follow the established IOC Rules of Procedure and briefly reviewed the procedure to be followed. She also noted that current Officers have been in place beyond the usual length of time due to the COVID-19 pandemic and related challenges with holding in-person meetings.

295 The Elections Committee met on Thursday, 27 April 2018 and verified the nominations for the ICG/CARIBE-EWS Board of Officers for the intersessional period 2023-2025. In accordance with the Rules of Procedure, the Committee received from the Secretariat the following documents:

- Forms A and C for the nomination of Chair of the ICG
- Forms B and C for the nominations of the 3 Vice Chairs

296 With respect to the election documents, countries indicated that Form C, requiring the submission of curricula vitae, had not been sent with the other nomination forms. Nevertheless, this was rectified the first day of the meeting. As required by the Rules, each nomination received was also seconded by two other Member States. The deadline for receiving nominations and associated full documentation was Tuesday 25 April at 17.00 hrs (local time).

297 The Chairman of the Elections Committee reported that one nomination for Chair and three nominations for Vice-Chairs were received by the Secretariat and reviewed and accepted by the Elections Committee. The nominatios received were the following e:

- Mr Gérard Métayer (Haiti) for Chairperson, *seconded by the USA and Costa Rica,*
- Ms Regina Browne (USA) for Vice-Chairperson, *seconded by Mexico and Costa Rica,*
- Mr Anthony Murillo Gutierrez (Costa Rica) for Vice-Chairperson, *seconded by France and the USA,*
- Ms Marie-Noëlle Raveau (France) for Vice Chairperson, *seconded by Costa Rica and USA.*

298 Mr Gérard Métayer (Haiti) were elected by acclamation as Chairperson for the period 2023−2025. Ms Regina Browne (USA), Mr Anthony Murillo Gutierrez (Costa Rica) and Ms Marie-Noëlle Raveau (France) were elected as Vice-chairs of the ICG/CARIBE-EWS for the period 2023−2025 by acclamation (Rule 38.2).

10. ANY OTHER BUSINESS

299 Mr Chris Moore (USA) provided a report about TsuCAT (available as a presentation).

300 Mr Moore informed Delegates that a new version of TsuCAT (TsuCAT 4.3) has been developed and was launched in February 2023. Some of the key changes made were to update the PTWC message feature to include exercise injects (there is now an option to generate an Excel spreadsheet of injects to react to when testing SOPs), the NCEI tsunami event database and runup database, and the security system. In addition, Mr Moore noted that PTWC messages are now password protected; to access the feature, users should contact ITIC or PMEL. Lastly, TsuCAT now includes new seismic expert sources from the Meeting of Expert for the Lesser Antilles (IOC/2020/WR/291) and the Meeting of Experts for Colombia/Ecuador (IOC/2021/WR/295 Rev.).

301 Mr Moore next reminded colleagues of the purpose of TsuCAT, noting that it was built to provide countries with capacities to assess tsunami hazard. Thus, the tool is aimed at country agencies with tsunami hazard assessment, warning and emergency response responsibilities. Its main features include a database of approximately 5400 earthquake scenarios and exercise messages and injects. Mr Moore also drew attention to the fact that TsuCAT has an offline version—thus no internet is required. Mr Moore also pointed to the feature for overlay of additional data layers (in shapefile format) in TsuCAT; this can be used for instance to add additional runup information, evacuation maps, etc.

302 The TsuCAT can be used as a tool for multiple purposes, including for hazard assessments to conduct a study to determine worst case or likely impact to a country's coast from different scenarios. It can also be used for exercise development (e.g. to decide which scenario to use, or to generate PTWC exercise messages) and response planning to develop tsunami SOPs. Mr Moore also noted that it can be utilized for warning decision making by estimating a tsunami impact using the nearest similar scenario during a real events; however, this approach is not necessarily recommended given that it is scenario-based and not based on real parameters.

303 Relating to the generation of exercise messages with injects, Mr Moore noted that these are created based on the pre-computed database of scenarios. In addition, injects also enable customization and are provided in Excel format.

304 In closing, Mr Moore noted that Users pamphlet for TsuCAT is currently being reviewed, and that a User's Guide is available under the "help" section of the software. There is currently no course available on TsuCAT (although it is fairly simple to use without guidance).

305 Ms Silvia Chacon (Chair) recognized the usefulness of TsuCAT for exercise planning, and other assessment, preparedness and response activities.

306 Ms Leah St Jean-Tyson (Dominica) noted interest in using TsuCAT.

11. ADOPTION OF DECISIONS AND RECOMMENDATIONS

307 Based on the reports of the WGs and discussions during the Session, the ICG adopted eight (8) Recommendations (Annex II).

308 **The ICG decided** the following leadership for WGs:

- Working Group 1 on Risk Knowledge:
  - Chair: Frederic Dondin (France, 2023 –)
  - Vice-Chair: Raphael Paris (France, 2023 –)
- Working Group 2 on Tsunami Detection, Analysis and Forecasting:
  - Chair: Elizabeth Vanacore (USA, 2023 –)
  - Vice-Chair (Tsunami Source Identification and Characterization): Dan McNamara (USA, 2023 –)
  - Vice-Chair (Tsunami Detection): Gloria Romero (Venezuela, 2023 –)
  - Vice-Chair (Tsunami Forecasting): Chris Moore (USA, 2023 –)
- Working Group 3 on Tsunami Warning Dissemination and Communication:
  - Chair: Christa von Hillebrandt-Andrade (USA, 2023 –)
  - Vice-Chair: Susan Hodge (Anguilla, 2023 –)
- Working Group 4 on Preparedness and Response Capabilities:
  - Chair: Silvia Chacon (Costa Rica, 2023 –)
  - Vice-Chair (Preparedness and Response Capabilities): Jacob Ngumbah (St Kitts and Nevis, 2023 –)
  - Vice-Chair (Mitigation): Stacey Edwards (Seismic Research Center (SRC), 2023 –)
  - Vice-Chair (Tsunami Ready): Fabian Hinds (Barbados, 2023 –)

309 **The ICG decided** on the continuation of the following Task Team:

- Task Team CARIBE WAVE
  - Chair: Glorymar Gomez (USA, PRSN, 2023 –)
  - Vice-Chair: Antonio Aguilar (Venezuela, 2023 –)

12. CLOSE OF SESSION

310 The Chair, Dr Chacón Barrantes, thanked the Plenary, WGs, TTs and intra-sessional WGs for their involvement and contributions during the three days of the Session and the whole intersessional period. She also gave a special congratulations to the newly elected Officers of the ICG/CARIBE-EWS. In closing, she expressed appreciation for all members of the ICG/CARIBE-EWS for their support and hard work during her time as Chair of the ICG/CARIBE-EWS.

311 The Delegates thanked the Chair and the Secretariat for the success of the Session. They also expressed a specific appreciation to Dr Chacon for her hard work, time and devotion in her role as Chair of the ICG/CARIBE-EWS during the last five years.

312 Mr Gérard Métayer (newly elected Chair for 2023–2025), Ms Regina Browne (newly elected Vice-Chair for 2023–2025), Mr Anthony Murillo (newly elected Vice-Chair for 2023–2025), and Ms Marie-Noëlle Raveau (newly elected Vice-Chair for 2023–2025) also expressed their thanks to members of the ICG/CARIBE-EWS for confirming their election as new Officers. They expressed enthusiasm for the important activities of ICG/CARIBE-EWS during the upcoming intersessional period and thanks for the motivation and dedication of all participants during the meeting.

313 **The Group thanked** the Chair for the success of the Session.

314 The Chair closed the session at 17:20 (UTC-6) on Friday 28 April 2023.

ANNEX I

PROVISIONAL AGENDA

1. WELCOME AND OPENING

1.1. DR SILVIA CHACON-BARRANTES, ICG/CARIBE-EWS CHAIR

1.2. WELCOME BY INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION OF UNESCO

2. ORGANIZATION OF THE SESSION

2.1. ADOPTION OF AGENDA

2.2. DESIGNATION OF THE RAPPORTEUR(s)

2.3. CONDUCT OF THE SESSION, TIMETABLE AND DOCUMENTATION

3. REPORT ON INTERSESSIONAL ACTIVITIES

3.1. CHAIR'S REPORT

3.2. CARIBE-EWS SECRETARIAT REPORT

3.3. REPORT OF THE CARIBBEAN TSUNAMI INFORMATION CENTER (CTIC)

3.4. REPORTS FROM UN AND NON-UN ORGANISATIONS

3.4.1. World Tsunami Awareness Day (WTAD)

3.5. STATUS OF OTHER ICGs

3.6. NATIONAL PROGRESS REPORTS

3.7. TSUNAMI SERVICES PROVIDER REPORT (PTWC)

3.8. REPORT OF CARIBE WAVE 2023

4. WORKING GROUP PROGRESS REPORTS

4.1. WORKING GROUP 1: MONITORING AND DETECTION SYSTEMS

4.2. WORKING GROUP 2: HAZARD ASSESSMENT

4.3. WORKING GROUP 3: TSUNAMI RELATED SERVICES

4.3.1. Leveraging Common Alerting Protocol (CAP) in Tsunami Early Warning

4.4. WORKING GROUP 4: PREPAREDNESS, READINESS AND RESILIENCE

5. SPECIAL INVITED LECTURES: COMMUNITY BASED TSUNAMI AND OTHER COASTAL HAZARDS WARNING SYSTEM

5.1. COSTA RICA PRESENTATION ON TSUNAMI READY COMMUNITIES

6. POLICY MATTERS

6.1. EXERCISE CARIBE WAVE 2024

6.2. CENTRAL AMERICA TSUNAMI ADVISORY CENTER (CATAC)

6.3. REPORT OF THE TASK TEAM ON TSUNAMI READY PROGRAMME

6.4. REPORT OF THE TASK TEAM ON TSUNAMI PROCEDURES FOR VOLCANIC CRISES

6.5. REPORT OF THE TASK TEAM ON TSUNAMI EVACUATION MAPPING

6.6. REPORT OF THE TASK TEAM ON UN DECADE OF OCEAN SCIENCE FOR SUSTAINABLE DEVELOPMENT

7. PROGRAMME AND BUDGET FOR 2024–2025

8. NEXT SESSIONS

8.1. CONFIRMATION OF DATE AND PLACE OF ICG/CARIBE EWS-XVII

8.2. TARGET DATE FOR ICG/CARIBE EWS-XVIII

9. ELECTIONS

10. ANY OTHER BUSINESS

11. ADOPTION OF DECISIONS AND RECOMMENDATIONS

12. CLOSE OF THE SESSION

ANNEX II

RECOMMENDATIONS

Recommendation ICG/CARIBE-EWS-XVI.1

Tsunami Detection, Analysis and Forecasting

The Intergovernmental Coordination Group for the Tsunami and Other Coastal Hazards Warning System for the Caribbean and Adjacent Regions (ICG/CARIBE-EWS),

Considering the report of former Working Group (WG) 1 on Monitoring and Detection Systems and having reviewed the status of the observational data availability in the Caribbean and Adjacent Regions;

Appreciates the International Tsunami Information Center Caribbean Office (ITIC-CAR) of the National Oceanographic and Atmospheric Agency (NOAA) and the Pacific Tsunami Warning Center (PTWC) for improving the processing and continued reporting on the status of seismic and sea level stations;

Requests WG2 on Tsunami Detection, Analysis and Forecasting to review the status and effectiveness of the current reporting mechanism and propose at the Seventeenth Session of IGC/CARIBE-EWS (ICG/CARIBE-EWS-XVII) a model moving forward without ITIC-CAR support.

Notes that tsunami warning issuing time is strongly dependent on seismic and sea level station distribution and data availability;

Further Notes that PTWC continues to report significant seismic station outages throughout the Caribbean and Adjacent Regions (CARIBE-EWS),

Requests that PTWC conducts a study to quantify the impact of outages on tsunami detection and messaging performance;

Recommends that the ITIC-CAR conducts a survey, with WG2 of alternate real-time stations available in the region that are currently not streaming to the PTWC.

Notes the challenges of maintaining real-time data connections to the PTWC;

Recommends that, with permission from regional seismic network operators, the Central America Tsunami Advisory Center (CATAC) acts as a regional real-time seismic data aggregator/hub for Central America, and EarthScope Data Services act as a backup in order to ensure greater reliability;

Also recommends exploring the possibility of densifying seismic network instrumentation with new sea-floor cable technologies [Sensor Monitoring And Reliable Telecommunications (SMART)];

Further recommends a complete review and update of seismic meta-data and IP addresses at PTWC and national tsunami warning centres (NTWCs) to identify problem stations;

Notes that in the aftermath of the 2010 Haiti earthquake, Canada installed and operated a network of seismic stations in the country;

Further Notes the lack of seismic data availability for the 2021 Haiti earthquake;

Encourages the Secretariat with WG2 to explore with Canada opportunities to support Haiti in capacity-building by installing, repairing, and maintaining seismic instrumentation;

Notes the rapid deployment of sea-level monitoring instrumentation in response to the tsunami hazard posed by the eruptive activity and potential pyroclastic flows of La Soufrière Volcano on Saint Vincent and Mt Pelée on Martinique;

Further Notes that a high percentage of the stations in the CARIBE-EWS sea level network are currently non-operational and therefore can delay the proper assessment of tsunami events and the issuance of timely and accurate tsunami alerts;

Appreciates the planned hosting of a five day Tides Training Course to be taught in Spanish for both oceanographic and hydrographic organizations jointly organized and funded by the International Hydrographic Organization (IHO), the International Maritime Organization (IMO), and the Intergovernmental Oceanographic Commission (IOC). The dates for this training will be 13-17 November 2023 and the venue will be located in Costa Rica;

Urges Member States and operators of sea level stations contributing to ICG/CARIBE-EWS to maintain their sea-level stations in an operational status, regularly review and update the status of its stations in the IOC Sea Level Monitoring Facility, and inform ITIC-CAR and the Secretariat on plans for repair;

Recommends a survey of sea-level network stations status updates by WG2 and ITIC-CAR with the goal of improving the uptime of sea-level network.

Encourages NOAA to rapidly repair two Deep-ocean Assessment and Reporting of Tsunami (DART) buoys that stopped transmitting data in 2022;

Recommends that seismic and sea-level network operators seriously consider the experience from Hurricanes Harvey, Irma, Maria and Nate to increase the resilience of sea-level facilities to powerful hurricanes;

Notes the dynamic range of seismometers is limited and may not accurately record the full extent of ground shaking for large magnitude earthquakes at near-source distances,

Further Notes that Global navigation satellite system (GNSS) instrumentation has no issue with limited dynamic range and can therefore record strong ground displacement of large magnitude earthquakes at near-source distances;

Recognizes the efforts of UNAVCO/EarthScope to repair damaged stations and upgrade communications systems to increase the availability of high rate (1 Hz), real-time GNSS data to improve earthquake and tsunamis detection and assessment;

Appreciates NOAA support for the Puerto Rico Seismic Network (PRSN) to host a training workshop for GNSS network operators in the region during the second week of August 2023;

Recommends that Member States add and upgrade the GNSS stations needed to achieve earthquake detection requirements with sufficient redundancy;

Recommends that the PTWC continue to explore, develop and implement integrated seismic and GNSS systems for rapid earthquake source parameters estimation;

Further Recommends that PTWC supports the continuation of GNSS integration into real-time tsunami monitoring systems with annual updates from NOAA on the progress of the system.

Financial Implications: None

Recommendation ICG/CARIBE-EWS-XVI.2

Risk Knowledge

The Intergovernmental Coordination Group for the Tsunami and Other Coastal Hazards Warning System for the Caribbean and Adjacent Regions (ICG/CARIBE-EWS),

Considering the report of the former WG2 on Tsunami Hazard Assessment,

Acknowledges the addition of over 35 scenarios to the CARIBE-EWS Sources and Models (CATSAM) interface;

Appreciates the significant contributions of former WG2 members and invited experts, specifically from Global Tsunami Model – Norwegian Geotechnical Institute and Differential Equations, Numerical Analysis and Applications (EDANYA) Group from the University of Malaga;

Recognizes the efforts of the NOAA/IOC International Tsunami Information Center (ITIC) to include CATSAM scenarios in the Tsunami Coastal Assessment Tool (TsuCAT),

Requests Task Team (TT) CARIBE WAVE to provide WG1 with the parameters, including associated files (e.g. shapefiles, geotiff, etc.) of the corresponding scenarios, for future CARIBE WAVE exercises once they are available.

Notes the lack of specifically identified volcanic and landslide tsunami sources for the CARIBE-EWS and/or that they are not easily accessible;

Acknowledges the need to progressively include volcanic and landslide sources and to build a dataset of scenarios for the CARIBE-EWS;

Recommends WG1 with the Secretariat to organize an Experts Meetings on “Non-Seismic Sources of Tsunamis for the Caribbean and Adjacent Regions”.

Further Notes the initial work of former WG2 to provide access to and/or compile non-seismic sources;

Recommends WG1 compile and prioritize a list of non-seismic sources and encourages models of scenarios to be available, when possible.

Urges Member States to nominate members with modelling experience to assist to get files prepared for display on CATSAM;

Encourages the ongoing maintenance and updating of CATSAM;

Acknowledges the former WG2 completion of a Guide on uploading elevation data to Caribbean Marine Atlas (CMA);

Recognizes the need for adequate local bathymetric and topographic data to perform tsunami numerical modelling and obtain tsunami inundation and evacuation maps;

Notes the elevation data sharing challenges in the CARIBE-EWS;

Encourages Member States to upload their elevation data or, at a minimum, provide status of the available data (e.g. extent, resolution, access, etc.);

Notes the release of the global relief model ETOPO 2022 which includes improved global topography with reduced elevation bias from vegetation/buildings;

Further Notes the recent development of a Digital Elevation Model (DEM) Training Proposal;

Encourages the execution of a regional training on the development of DEMs for tsunami inundation modelling;

Noting that no Meeting of Experts for seismic sources has been held for the Northwest Caribbean;

Requests WG1 and the Secretariat to consider organizing and conducting a Meeting of Experts for Seismic Sources in the Northwest Caribbean;

Further Request the Secretariat to identify funding for the proposed Meeting of Experts.

Financial Implications: None

Recommendation ICG/CARIBE-EWS-XVI.3

Preparedness, Readiness and Resilience and the Caribbean Tsunami Information Center (CTIC)

The Intergovernmental Coordination Group for the Tsunami and Other Coastal Hazards Warning System for the Caribbean and Adjacent Regions (ICG/CARIBE-EWS),

Considering the reports of the Caribbean Tsunami Information Center (CTIC), the United Nations Office for Disaster Risk Reduction (UNDRR), WG4, the Task Team (TT) on Tsunami Ready and Tsunami Evacuation Maps; and the progress of inventories on Tsunami Signage and Social Science;

Notes with appreciation the strong cooperation between the CTIC, ITIC-CAR, WG4, TT CARIBE WAVE, TT Tsunami Ready and UNDRR for advancement of preparedness, readiness and resilience to mitigate the impacts of tsunamis and other coastal hazards in the CARIBE-EWS, particularly in relation to the implementation of the Tsunami Ready programme, the dissemination and development of outreach and educational resources, support to the United Nations Decade of Ocean Science for Sustainable Development including the work of the Tropical America and Caribbean Decade Safe Ocean Working Group.

Requests the WG4 Subgroup on Tsunami Ready with CTIC and ITIC-CAR to administer the Tsunami Ready evaluation survey for Tsunami Ready communities recognized since 2019;

Further requests CTIC with WG4 Subgroup on Tsunami Ready and Member States determine the target number of communities in the CARIBE-EWS for Tsunami Ready recognition by 2030;

Recalls that World Tsunami Awareness Day (WTAD) is celebrated annually on 5 November;

Notes the 2023 theme for the WTAD is “Fighting Inequality for a Resilient Future” which complemented CARIBE WAVE 2023 efforts;

Further notes the potential need for adaptation of the #GetToHighGround campaign dependent on Member State specifications;

Acknowledges the leadership of CTIC in organizing activities leading to increased participation and visibility of WTAD in 2021 and 2022;

Encourages Member States to commemorate WTAD and to share their activities with CTIC;

Recommends CTIC to continue engaging with UNDRR, WG4 and Member States to engage, plan and take action for WTAD 2023;

Recognizes the current work of the CTIC on the review and development of framework and partnership agreements, particularly with regional organizations;

Recommends that the CTIC continues to pursue the formalization of agreements to provide a sustainable framework for technical cooperation;

Acknowledges with appreciation France, the Universidad Nacional Costa Rica (UNA), ITIC-CAR and CTIC for their contributions to the finalization of Manual and Guide 86: Multi-annual community tsunami exercise programme: guidelines for the tsunami and other coastal hazards warning system for the Caribbean and Adjacent Regions and its translation into French;

Requests the Secretariat to finalize the translation of Manual and Guides 86 into Spanish=;

Notes that a training on Manual and Guides 86 is proposed for the CARIBE-EWS to be co-organized by CTIC and ITIC-CAR with funding from the United States Agency for International Development Bureau of Humanitarian Assistance (USAID/BHA) as part of Tsunami Ready projects;

Notes the 2023 update to the CARIBE EWS Tsunami Signage Inventory and Report and its support to the implementation of the Tsunami Ready recognition programme;

Further Notes that 32 of the 48 Member States and Territories of ICG/CARIBE-EWS have contributed examples of the signage used;

Reminds Member States to develop and maintain an inventory of the signage installed in the country in coordination with relevant stakeholders and authorities;

Requests Member States to review and provide updates to the ITIC-CAR, including the location, metadata, artwork and photographs of installed signs for inclusion in the signage database;

Requests ITIC-CAR to coordinate with the Secretariat and CTIC on posting and distribution of the current version of the CARIBE EWS Tsunami Signage Inventory and Report and provide an updated version for ICG/CARIBE-EWS-XVII.

Notes the importance of social sciences to understand and support tsunami risk perception for greater and more inclusive participation of Member States in tsunami awareness, preparedness, response and resilience activities;

Appreciates the updates made by ITIC-CAR to the CARIBE-EWS social science database;

Recommends that WG4 engage social scientists for a tsunami risk perception study in the CARIBE-EWS;

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

Further notes that the Working Group on Tsunamis and Other Hazards (TOWS-WG) has recommended that the Secretariat facilitates the finalization of the OTGA basic tsunami training materials as soon as possible;

Recommends that once the modules are available, WG4 facilitates the testing and use of the trainings;

Notes the development of the Terms of Reference for the former TT Tsunami Ready, now WG4 Subgroup on Tsunami Ready;

Recommends that the workplan of the WG4 Subgroup on Tsunami Ready be implemented and evaluated during the next intersessional period;

Recognizes COVID-19, climate change as well as multiple recent, ongoing and future emergencies and disasters and their cascading effects as a manifestation of the systemic nature of risks, and its impact on human and financial resources for disaster risk reduction;

Urges the Secretariat to work with the ICG/CARIBE-EWS Officers to develop a strategic plan to mobilize funding and in-kind support for tsunami preparedness, response and resilience activities with a particular focus for least developed countries (LDCs) and small island developing states (SIDS);

Further Urges Member States to make contributions to the IOC Special Account and provide human resources under various arrangements to support the work of the CTIC;

Recognizes the importance of understanding the current state of evacuation mapping and planning processes;

Notes that the National Reports and CARIBE WAVE questionnaires request evacuation mapping and signage information yet are, in some cases, filled out by different agencies;

Request WG4 with TT CARIBE WAVE and the Secretariat to facilitate alignment and harmonization between survey efforts to avoid overloading Member States with work and considering resource limitations.

Financial Implications: None

Recommendation ICG/CARIBE-EWS-XVI.4

Exercise Caribe Wave

The Intergovernmental Coordination Group for the Tsunami and Other Coastal Hazards Warning System for the Caribbean and Adjacent Regions (ICG/CARIBE-EWS),

Notes the successful conduct of the CARIBE WAVE 22 Exercise with the participation of 100 percent of the Member States and Territories and over 410,000 people engaged;

Notes the successful conduct of the CARIBE WAVE 23 Exercise with the participation of 90 percent of the Member States and Territories and over 780,000 people engaged;

Further notes that several institutions indicated that their participation was limited because CARIBE WAVE 2023 was held the same day as World Meteorology Day;

Congratulates all the Member States and Territories for promoting, coordinating, participating in and providing feedback on the CARIBE WAVE 22 and CARIBE WAVE 23 exercises;

Congratulates the ITIC CAR, PRSN, CTIC and UNA for publication of the article "CARIBE WAVE: A Decade of Exercises for Validating Tsunami Preparedness in the Caribbean and Adjacent Regions" in the Bulletin of the Seismological Society of America (2023);

Appreciates the ITIC CAR for their support in generating CARIBE WAVE 23 Handbook and overall coordination of the exercise;

Also appreciates the PTWC and CATAC for generating and disseminating simulated products for the CARIBE WAVE 22 and 23 exercises;

Further appreciates the United States Geological Survey (USGS) for their support in generating simulated ShakeMap and PAGER products for the CARIBE WAVE 22 and 23 exercises;

Also appreciates the work of the Task Team Tsunami Ready (now dissolved and integrated to WG4), UNESCO-IOC Tsunami Ready programme and US TsunamiReady® Communities for encouraging participation in the CARIBE WAVE Exercise and synergetic activities increasing tsunami awareness in the region;

Further appreciates the University of Southern California (USC) and its funding agencies for making available for registration TsunamiZone.org;

Acknowledges the good collaboration between the CTIC, ITIC-CAR and the TT CARIBE WAVE in planning, promoting, executing and evaluating the annual CARIBE WAVE Exercises.

Instructs the CTIC to identify actions arising from CARIBE WAVE Exercise 2022 and 2023 and coordinate with corresponding WGs and TTs follow-up actions;

Decides that CARIBE WAVE 24 will consist of two scenarios: 1) An earthquake along the Puerto Rico Trench and 2) An earthquake along the North Panama Deformed Belt based on the 1882 event;

Also Decides that CARIBE WAVE 24 will take place on Thursday, 21 March 2024, commencing at 15:00 UTC with one dummy message, and the 1st message for the scenarios shortly after according to PTWC and CATAC simulated procedures for the corresponding scenarios;

Recommends following a similar timetable and metrics on CARIBE WAVE 24 and that preparatory and hotwash webinars follow the same or similar process as used in previous exercises;

Further recommends that the registration process remains at www.tsunamizone.org and requests USC to provide a training on the registration system.

Recalls the importance of including vulnerable and marginalized groups, including persons with disabilities, in CARIBE WAVE 24;

Recommends the Secretariat to inform the UNDRR on the date of CARIBE WAVE 24 and request the theme of the WTAD 24 six months in advance of the Exercise;

Further recommends that TT CARIBE WAVE considers the theme of WTAD 2024 in conducting and reporting of the Exercise, if available.

Acknowledges that the TT CARIBE WAVE uses CATSAM to decide future scenarios;

Recommends that TT CARIBE WAVE assist WG1 in prioritizing of scenarios to be included in CATSAM;

Further Recommends Member States consider alternative dates (within a week of the Exercise date) for running of CARIBE WAVE 24, if the agreed date is not feasible, and that information on conducting the exercise on alternative dates be shared in the CARIBE WAVE 2024 Exercise Handbook;

Further Recommends Member States to combine their selected CARIBE WAVE 24 scenario with multi-hazard events;

Additionally Recommends that TT CARIBE WAVE review and update the CARIBE WAVE post-exercise questionnaire;

Suggests that TT CARIBE WAVE explore opportunities to further involve tourists and tourism organizations in CARIBE WAVE Exercises, with the aim to develop guidelines/resources on involvement of tourists in preparedness and response actions;

Recommends that the TT CARIBE WAVE hold an in-person meeting in 2023 to discuss the CARIBE WAVE questionnaires, and opportunities for integrating gradual flexibility in CARIBE WAVE Exercises and synergies with the Tsunami Ready programme.

Suggests that the CARIBE WAVE 25 Exercise consist of two scenarios based on 1) The 1692 Jamaica tsunami, and 2) The 1755 Lisbon tsunami;

Recommends TT CARIBE WAVE to explore the possibility of gradually increasing the level of difficulty for future CARIBE WAVE Exercises (e.g. hours, weekends, holidays).

Financial Implications: None

Recommendation ICG/CARIBE-EWS-XVI.5

Governance

The Intergovernmental Coordination Group for the Tsunami and Other Coastal Hazards Warning System for the Caribbean and Adjacent Regions (ICG/CARIBE-EWS),

Notes the Regional Action Plan for the Implementation of the Sendai Framework for Disaster Risk Reduction 2015-2030 in the Americas and the Caribbean and the 2023 updates**;**

Also Notes the UN Early Warnings for All Initiative (EW4ALL) launched in November 2022;

Additionally Notes the endorsement of the UN Ocean Decade Tsunami Programme (ODTP) and draft 10-year Research, Development and Implementation Plan;

Recognizes that the Sendai Framework for Disaster Risk Reduction, the EW4ALL and the ODTP all have the following pillars: Tsunami risk knowledge, Detection and forecasting, Warning communication and Preparedness and response, underpinned by Capacity building and Governance;

Decides to realign the ICG/CARIBE-EWS Working Groups (WG) around these pillars, including capacity development functions for all and as described in Appendix I:

- WG1 on Risk Knowledge
- WG2 on Detection, Analysis and Forecasting
- WG3 on Warning Dissemination and Communication
- WG4 on Preparedness, Response Capabilities and Resilience

Further decides to not renew the Task Team (TT) Tsunami Ready, TT Tsunami procedures for volcanic sources, TT Future goals and key performance indicators (KPIs), TT Evacuation mapping and TT UN Ocean Decade, as their tasks have been completed or integrated into the new WG structure;

Further decides that the TT CARIBE WAVE be renewed.

Considering the TOWS-WG recommendation to establish a common and harmonized system for future goals and for monitoring the performance of all ICGs engaged in Tsunami Warning and Mitigation Systems;

Recognizing the work in formulating the framework of KPIs by the *Ad Hoc* Task Team on KPIs under the TT DMP TT, integrated by members of ICG/PTWS, ICG/IOTWMS, ICG/NEAMTWS, and ICG/CARIBE EWS;

Noting the global contributions in the development of the draft 10-year Research, Development and Implementation Plan;

Considering the work advanced in the reviewing of the ICG/CARIBE-EWS Implementation Plan;

Recommends modifying the Implementation Plan considering the final version of the ODTP draft 10-year Research, Development and Implementation Plan and the global framework of KPIs.

Emphasizes the importance of active engagement of all Officers and Members in the WG activities;

Urges Member States to nominate Officers and Members to actively engage in the WG;

Decides that membership of WGs be renewed annually based on active participation, to be decided by the leaders of the WGs.

Acknowledges the relevance of the ICG/PTWS Regional Working Group for Central America (WG-CA) to the ICG/CARIBE EWS;

Recommends that the ICG/PTWS-WG-CA report in ICG/CARIBE-EWS Sessions.

Financial Implications: None

Recommendation ICG/CARIBE-EWS-XVI.6

Tsunami Procedures for Volcanic Crises

The Intergovernmental Coordination Group for the Tsunami and Other Coastal Hazards Warning System for the Caribbean and Adjacent Regions (ICG/CARIBE-EWS),

Considering the report of the Task Team (TT) on Tsunami Procedures for Volcanic Crises;

Notes the list of potentially threatening volcanoes and the list of volcano observatories and/or institutes responsible for monitoring volcanoes for the CARIBE-EWS drafted by the TT;

Further Notes the Memorandum of Understanding (MoU) drafted by the TT to be used between the Tsunami Service Provider (TSP) and the volcano observatories and/or institutes responsible for monitoring volcanoes;

Recognizes the use of Volcano Notice for Tsunami Threat (VONUT) during CARIBE WAVE 23 between the Volcano Observatory of Martinique and the PTWC as TSP;

Suggests that TSP include the VONUT messages in their procedures to activate their alert system;

Recommends that ICG/CARIBE-EWS WG2 initiate contacts with the identified volcano observatories and/or institutes responsible for monitoring volcanoes threatening the CARIBE-EWS, to implement the MoU of the VONUT.

Notes the 2020-2021 eruption of the La Soufrière volcano in Saint Vincent and the Grenadines, La Palma eruption in 2021, the increasing level of volcanic activity at La Soufrière in Guadeloupe, and the Hunga Tonga - Hunga Ha'apai eruption and tsunami in 2022;

Recommends that WG1 monitor and assess sea level stations around active volcanoes and advise on the installation of sea level stations around volcanoes when volcanic activity increases;

Further recommends that WG1 continues its evaluation and actions towards the use of GNSS-R in real-time for volcano monitoring;

Further recommends that WG4 help improve public awareness on tsunamis generated by volcanic activity.

Notes the interest expressed by Member States to continue using volcano sources for CARIBE WAVE Exercises,

Considers the on-going implementation of communication procedures between PTWC, NTWCs and volcano observatories and/or institutes responsible for monitoring volcanoes,

Acknowledges the on-going changes made by PTWC and NTWCs to modify its procedures to activate its alert system in case of non-seismic event and its experimental text products;

Recommends that volcanic eruptions and/or landslides be used as scenarios for future CARIBE WAVE Exercises.

Appreciates the work of the members of the *Ad Hoc* Team on Tsunamis generated by volcanoes (TGV) and their organizations for their contributions;

Considering the report of the *Ad Hoc* Team on TGV presented at TOWS-WG-XVI in March 2023;

Recommends that the list of volcanoes and volcano observatories for the CARIBE-EWS prepared by the TT on Tsunami Procedures for Volcanic Crises ,and the VONUT which was used during CARIBE WAVE 23, be shared with the *Ad Hoc* Team on TGV Team of TOWS-WG TT on Tsunami Watch Operations (TT-TWO).

Financial Implications: None

Recommendation ICG/CARIBE-EWS-XVI.7

Central America Tsunami Advisory Center

The Intergovernmental Coordination Group for the for the Tsunami and Other Coastal Hazards Warning System for the Caribbean and Adjacent Regions (ICG/CARIBE-EWS),

Notes the report and advances of CATAC

Recommends the start of CATAC's full functionality in an interim manner for the Caribbean coast of Central America, starting in June 2023 (as already decided by ICG/PTWS XXIX for the Pacific coast of Central America, as from December 2021)

Notes that CATAC will update its Users Guide, taking into account the new processing methods, messaging formats and channels.

Notes that CATAC will present the updated User´s Guide to WG-CA and ICG/PTWS XXXI in Sep 2023 for consideration for implementation for the Pacific coast of Central America.

Further notes CATAC will present the updated users guide at the ICG/CARIBE-EWS-XVII.

Notes that the CARIBE EWS XI in 2016 approved Technical, Logistical and Administrative Requirements of a Regional Tsunami Service Provider for CARIBE EWS which defines TSPs as centers that provide services to the whole CARIBE EWS region.

Further Notes the Tsunami Watch Operations Global Service Definition Document (2016, TS 130)

Recommends WG3 to review and revise Technical, Logistical and Administrative Requirements of a Regional Tsunami Service Provider for CARIBE EWS and report to the ICG/CARIBE-EWS-XVII

Further Recommends the consideration of CATAC as a TSP in its XVII Session in 2024 to enable the IOC Executive Council to consider the final admission of CATAC as TSP in June 2024.

Financial Implications: None

Recommendation ICG/CARIBE-EWS-XVI.8

UN Ocean Decade Tsunami Programme (UNODTP)

The Intergovernmental Coordination Group for the Tsunami and Other Coastal Hazards Warning System for the Caribbean and Adjacent Regions (ICG/CARIBE-EWS),

Recognizes that the UN Ocean Decade is an opportunity to develop and enhance partnerships and collaborations with stakeholders from other coastal hazards in the CARIBE-EWS;

Recommends that WG2 establish an ICG/CARIBE-EWS Tsunami Test Bed for improved observations;

Additionally Recommends that a study be conducted to demonstrate improvement in tsunami early warning times with two to four variations on SMART Cable designs for the CARIBE-EWS;

Further Recommends that WG2 on tsunami detection, analysis and forecasting engage industry stakeholders to understand which telecommunications cables are scheduled for replacement or new installations in the CARIBE-EWS.

Notes the establishment of the UNESCO-IOC Tsunami Ready Coalition;

Requests the Coalition to identify potential sources of funding and strategy for scaling up the UNESCO-IOC Tsunami Ready programme in the CARIBE-EWS.

Notes that within the CARIBE EWS there are Member States with efforts that align with the Guidelines for the Tsunami Ready programme;

Recommends TOWS-WG to identify a mechanism to cross credit other Members States assessment, preparedness and response efforts with the UNESCO-IOC Tsunami Ready programme.

Financial Implications: None

Appendix I

WG 1: Risk Knowledge
Purpose: To advise the ICG on the identification and characterization of the risk associated with tsunami and other coastal hazards, and their assessment and required modeling.
Chair: Frederic Dondin (France)
Vice-Chair: Raphaël Paris (France)
Tasks:

- Review and evaluate required methods and data sets, including bathymetry and coastal topography for determining coastal hazards.
- Advise the Member States on the requirements for operating the appropriate models for risk assessment.
- Advise and build capacity for risk assessments and their interpretation.

- Present a progress report based on the Key Performance Indicators related to the United Nations (UN) Ocean Decade Tsunami Programme (ODTP)
- Advise and seek advice from Member States about other coastal hazards that can be included into the warning system.
- Promote the sharing of experience and expertise, and capacity building essential to effective tsunami risk knowledge.

WG2: Tsunami Detection, Analysis and Forecasting

Purpose: To review and recommend to the ICG priorities and actions required to ensure and enhance existing capabilities as well as explore new technologies to improve tsunami detection and forecasting capability.

Chair: Elizabeth Vanacore (USA)
Vice Chairs for Subgroups:

1. Tsunami Source Identification and Characterization (Dan McNamara, USA)
2. Tsunami Detection (Gloria Romero, Venezuela)
3. Tsunami Forecasting (Chris Moore, USA)

Tasks:
General:

- Support the operations of a fully interoperable regional tsunami warning system.
- Support and integrate the work of the subgroups.
- Present a progress report based on the Key Performance Indicators related to the UN ODTP.
- Establish strategies to enhance the warning system by including the detection, analysis and forecasting of other coastal hazards.
- Promote the sharing of experience and expertise, and capacity building essential to effective tsunami source characterization, detection and forecasting.

2.1 Tsunami Source Detection, Identification and Characterization

- Ensure the effectiveness of the observational system by promoting the open exchange of seismic and other relevant data in real time.
- Advise member states on the monitoring and detection capabilities of tsunamigenic sources needed for operating national tsunami warning centres.
- Assure the compliance with the agreed standards for the detection systems.

2.2 Tsunami Wave Detection

- Ensure the effectiveness of the observational system by promoting the open exchange of sea level data in real time.
- Advise member states on the tsunami monitoring and detection capabilities needed for operating national tsunami warning centres.
- Assure the compliance with the agreed standards for the tsunami detection systems.

2.3 Tsunami Forecasting

- Define the operational requirements for the monitoring and forecasting systems.
- Provide guidance on tsunami forecasting tools to TSPs, NTWCs and provide actionable information to emergency managers.
- Explore, experiment and test novel approaches for tsunami forecasting

WG3: Tsunami Warning Dissemination and Communication

Purpose: To examine current and developing capacities and advise the ICG about the definition and composition of early warnings and tsunami products and the methods and best practices for effective end-to-end dissemination and communication.

Chair: Christa von Hillebrandt-Andrade (USA)
Vice-Chair: Susan Hodge (Anguilla)

Tasks:

- Explore and document the dissemination capabilities and existing alert guidance in the countries of the region.
- Identify the difficulties and challenges existing in the region that hinder the impact of "end to end" dissemination and communication of early warnings.
- Establish strategies for the development and implementation of methods and technologies to strengthen the interaction with the media and dissemination of early warnings within the countries of the region.
- Evaluate communication tests and tsunami exercises, in order to identify weaknesses and make recommendations to help strengthen these delivery systems.
- Create communication protocol and standardized information identifying the minimum acceptable levels for communication and dissemination of tsunami early warning in all countries for approval by the IGC.
- Provide feedback to the Tsunami Service Providers on its products and communication procedures.
- Serve as a reviewing and approving body for proposed changes to TSP products for the CARIBE-EWS, or determine if proposed changes warrant going to the ICG for review and approval.
- Present a progress report based on the Key Performance Indicators related to the UN ODTP
- Promote the sharing of experience and expertise, and capacity building essential to effective tsunami warning dissemination and communication

WG4: Preparedness and Response Capabilities
Purpose: To advise and recommend to the ICG strategies to enhance awareness, education, preparedness, response capabilities and mitigation and to develop the necessary recommendations, tools and procedures.
Chair: Silvia Chacon (Costa Rica)
Vice Chairs for Subgroups:

1. Preparedness and Response capabilities (Jacob Ngumbah, St Kitts and Nevis)
2. Mitigation (Stacey Edwards, SRC)
3. Tsunami Ready (Fabian Hinds, Barbados)

Tasks

General

- Consider UN Ocean Decade Tsunami Programme and other relevant decade actions, the Regional Action Plan for the Implementation of the Sendai Framework for Disaster Risk Reduction 2015-2030 in the Americas and the Caribbean and the UN Early Warnings for All Initiative (EW4ALL)
- Present a progress report based on the Key Performance Indicators related to the UN ODTP
- Support the development of guidelines and capacity development on preparedness, response and recovery planning for Member States, communities and organizations, which should include sharing of training and evacuation best practices.

4.1 Preparedness and Response capabilities

- Identify the public awareness and education strategies and tools that the Member States can integrate into their risk reduction and emergency management programs.
- To closely cooperate with the Caribbean Tsunami Information Centre (CTIC) in carrying out its mandate and in the implementation of its program.

4.2 Mitigation

- Identify mitigation best practices related to plans, structural and nature-based solutions

- Advise Member States on measures to minimize impacts to critical infrastructure and marine assets from tsunamis and other coastal hazards.
- Identify and employ strategies to support mainstreaming disaster risk reduction into urban planning

4.3 Tsunami Ready

- Identify and employ strategies to ensure 100% of at-risk communities achieve UNESCO/IOC Tsunami Ready recognition
  Support and provide guidance to the CARIBE EWS in the implementation of the UNESCO IOC Tsunami Ready Recognition Programme.
- Develop an evaluation instrument aimed at measuring the effectiveness of UNESCO IOC Tsunami Ready Recognition Programme in recognized communities.
- Implement the evaluation instrument and analyze its findings in collaboration with ITIC-CAR and CTIC.
- Facilitate Member States to conduct pre- and post-evaluation instruments to measure the social impact of UNESCO IOC Tsunami Ready Recognition Programme.
- Assist CTIC, in association with member states, in determining the target number of communities pursuing the Tsunami Ready Recognition.

Task Team on CARIBE WAVE (retained)
Terms of References modeled after previous CARIBE WAVE Task Teams.

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Vice-Chair: Antonio Aguilar (Venezuela)

ANNEX III

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ANNEX IV

PHOTOS OF PARTICIPANTS

Photo 1. ICG/CARIBE-EWS-XVI in person participants

Photo 2. ICG/CARIBE-EWS newly elected Officers (Chairs and Vice-Chairs)

Photo 3. Tsunami Ready reognition ceremony

Photo 4. Tsunami Ready reognition ceremony

ANNEX V

LIST OF ACRONYMS

AGU	American Geophysical Union
ATTAC	Alerta Temprana de Terremotos en América Central
AusAid	Australian Aid
BHA	Bureau of Humanitarian Assistance (of USAID)
CAP	Common Alerting Protocol
CARIBE-EWS	Tsunami and Other Coastal Hazards Warning System for the Caribbean and Adjacent Regions
CARIBE WAVE	Caribbean Wave Exercise
CATAC	Central America Tsunami Advisory Centre
CDEMA	Caribbean Disaster Emergency Management Agency
CEPREDENAC	Centro de Coordinación para la Prevención de los Desastres en América Central y República Dominicana
CMA	Caribbean Marine Atlas
CNE	Comisión Nacional de Emergencias (Costa Rica)
CTIC	Caribbean Tsunami Information Center
CZMU	Coastal Zone Management Unit (of Barbados)
DART	Deep-ocean Assessment and Reporting of Tsunami
DEM	Digital Elevation Model
DG-ECHO	Directorate-General for European Civil Protection and Humanitarian Aid Operations (of the European Commission)
EMWIN	Emergency Managers Weather Information Network
EOP	Emergency Operation Plan
ETA	estimated time of arrival
EW4ALL	UN Early Warning For All Initiative
EWARNICA	Sistemas de Alerta Temprana de Terremotos en Nicaragua y Centroamérica
GNSS	Global Navigation Satellite System
GNSS-R	Global Navigation Satellite System-Reflectometry
GOES	Geostationary Environmental Satellite System
GPS	Global Positioning System
GTS	Global Telecommunication System
HCA	Host Country Agreement
HTHH	Hunga Tonga – Hunga Ha'apai
ICG	Intergovernmental Coordination Group

ICG/CARIBE-EWS	Intergovernmental Coordination Group for the Tsunami and other Coastal Hazards Warning System for the Caribbean and Adjacent Regions
ICG/IOTWMS	Intergovernmental Coordination Group for the Indian Ocean Tsunami Warning and Mitigation System
ICG/NEAMTWS	Intergovernmental Coordination Group for the Tsunami Early Warning and Mitigation System in the North-eastern Atlantic, the Mediterranean and Connected Seas
ICG/PTWS	Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System
ICG/PTWS-WG-CA	Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System Regional Working Group for Central America
iCHEWS	Integrating Coastal Hazards Early Warning Systems and Services in the Tropical Americas and Caribbean
INETER	Instituto Nicaraguense de Estudios Territoriales (Nicaragua)
IHO	International Hydrographic Organization
IMO	International Maritime Organization
INGV	National Institute of Geophysics and Volcanology (of Italy)
IOC	Intergovernmental Oceanographic Commission (UNESCO)
IOCARIBE	IOC Sub-Commission for the Caribbean and Adjacent Regions
IOTWMS	Indian Ocean Tsunami Warning and Mitigation System
IOWAVE	Indian Ocean Wave Exercise
IRIS	Incorporated Research Institutions for Seismology
ITIC	International Tsunami Information Centre
ITIC-CAR	International Tsunami Information Centre Caribbean Office
JCB	WMO-IOC Joint Collaborative Board
JICA	Japan International Cooperation Agency
KPIs	Key Performance Indicators
MAB	Man and Biosphere programme (of UNESCO)
MACHC	Meso American-Caribbean Sea Hydrographic Commission
MARN	Ministry of Environment and Natural Resources (of El Salvador)
MoU	Memorandum of Understanding
NASA	National Aeronautics and Space Administration
NAVAREA	Navigational Area (within the World Wide Navigational Service)
NEAMWave	ICG/NEAMTWS Tsunami Exercise
NOAA	National Oceanic and Atmospheric Administration (of USA)
NOC	National Oceanography Centre (of the UK)

NORAD	Norwegian Agency for Development Cooperation
NOTA	Network of the Americas
NSF	National Science Foundation
NTRPB	National Tsunami Ready Board
NTWC	National Tsunami Warning Center
ODTP	Ocean Decade Tsunami Programme
ODTP-SC	Ocean Decade Tsunami Programme Scientific Committee
OTGA	Ocean Teacher Global Academy
OVSICORI	Volcanological and Seismological Observatory (Costa Rica)
PMEL	Pacific Marine Environmental Laboratory (NOAA, US)
PRSN	Puerto Rico Seismic Network
PTWC	Pacific Tsunami Warning Center
RTRPB	Regional Tsunami Ready Board
SDG	Sustainable Development Goals
SIFT	Short-term Inundation Forecasting for Tsunamis system
SINAMOT	Sistema Nacional de Monitoreo de Tsunamis
SLSMF	IOC Sea Level Station Monitoring Facility
SMART	Science Monitoring and Reliable Telecommunications
SOP	Standard Operating Procedures
SRC	Seismic Research Centre (of the University of the West Indies)
TGV	Tsunamis generated by volcanoes
TOAST	Tsunami Observation and Simulation Terminal
TOWS-WG	Working Group on Tsunamis and Other Hazards Related to Sea-Level Warning and Mitigation Systems
TSP	Tsunami Service Provider
TSR	Tsunami Resilience Section of UNESCO-IOC (formerly the Tsunami Unit, TSU)
TsuCAT	Tsunami Coastal Assessment Tool
TT	Task Team
TT-DMP	Task Team on Disaster Management and Preparedness
TT-TWO	Task Team on Tsunami Watch Operations
TWFP	Tsunami Warning Focal Point
UK	United Kingdom of Great Britain and Northern Ireland
UN	United Nations
UNA	Universidad Nacional Costa Rica
UNAVCO	NAVCO, Inc. (independent, non-profit corporation]

UNESCO	United Nations Educational, Scientific and Cultural Organization
UNDRR	United Nations Office for Disaster Risk Reduction
USA	United States of America
USAID	United States Agency for International Development
USGS	United States Geological Survey
USVI	United States Virgin Islands
VONUT	Volcano Observatory Notice for Tsunami Threat
VOTAN	Volcanic Tsunami Alert Notifications
WG	Working Group
WMO	World Meteorological Organization
WMS	Web Map Service
WTAD	World Tsunami Awareness Day

In this Series *Languages*

Reports of Governing and Major Subsidiary Bodies, which was initiated at the beginning of 1984, the reports of the following meetings have already been issued:

1.	Eleventh Session of the Working Committee on international Oceanographic Data Exchange	E, F, S, R
2.	Seventeenth Session of the Executive Council	E , F, S, R,Ar
3.	Fourth Session of the Working Committee for Training, Education and Mutual Assistance	E, F, S, R
4.	Fifth Session of the Working Committee for the Global Investigation of Pollution in the Marine Environment	E, F, S, R
5.	First Session of the IOC Sub-Commission for the Caribbean and Adjacent Regions	E, F, S
6.	Third Session of the *ad hoc* Task team to Study the Implications, for the Commission, of the UN Convention on the Law of the Sea and the New Ocean Regime	E, F, S, R
7.	First Session of the Programme Group on Ocean Processes and Climate	E, F, S, R
8.	Eighteenth Session of the Executive Council	E, F, S, R, Ar
9.	Thirteenth Session of the Assembly	E, F, S, R, Ar
10.	Tenth Session of the International Co-ordination Group for the Tsunami Warning System in the Pacific	
11.	Nineteenth Session of the Executive Council, Paris, 1986	E, F, S, R, Ar
12.	Sixth Session of the IOC Scientific Committee for the Global Investigation of Pollution in the Marine Environment	E, F, S
13.	Twelfth Session of the IOC Working Committee on International Oceanographic Data Exchange	E, F, S, R
14.	Second Session of the IOC Sub-Commission for the Caribbean and Adjacent Regions, Havana, 1986	E, F, S
15.	First Session of the IOC Regional Committee for the Central Eastern Atlantic, Praia, 1987	E, F, S
16.	Second Session of the IOC Programme Group on Ocean Processes and Climate	E, F, S
17.	Twentieth Session of the Executive Council, Paris, 1987	E, F, S, R, Ar
18.	Fourteenth Session of the Assembly, Paris, 1987	E, F, S, R, Ar
19.	Fifth Session of the IOC Regional Committee for the Southern Ocean	E, F, S, R
20.	Eleventh Session of the International Co-ordination Group for the Tsunami Warning System in the Pacific, Beijing, 1987	E, F, S, R
21.	Second Session of the IOC Regional Committee for the Co-operative Investigation in the North and Central Western Indian Ocean, Arusha, 1987	E, F
22.	Fourth Session of the IOC Regional Committee for the Western Pacific, Bangkok, 1987	E only
23.	Twenty-first Session of the Executive Council, Paris, 1988	E, F, S, R
24.	Twenty-second Session of the Executive Council, Paris, 1989	E, F, S, R
25.	Fifteenth Session of the Assembly, Paris, 1989	E, F, S, R
26.	Third Session of the IOC Committee on Ocean Processes and Climate, Paris, 1989	E, F, S, R
27.	Twelfth Session of the International Co-ordination Group for the Tsunami Warning System in the Pacific, Novosibirski, 1989	E, F, S, R
28.	Third Session of the Sub-Commission for the Caribbean and Adjacent Regions, Caracas, 1989	E, S
29.	First Session of the IOC Sub-Commission for the Western Pacific, Hangzhou, 1990	E only
30.	Fifth Session of the IOC Regional Committee for the Western Pacific, Hangzhou, 1990	E only
31.	Twenty-third Session of the Executive Council, Paris, 1990	E, F, S, R
32.	Thirteenth Session of the IOC Committee on International Oceanographic Data and Information Exchange, New York, 1990	E only
33.	Seventh Session of the IOC Committee for the Global Investigation of Pollution in the Marine Environment, Paris, 1991	E, F, S, R
34.	Fifth Session of the IOC Committee for Training, Education and Mutual Assistance in Marine Sciences, Paris, 1991	E, F, S, R
35.	Fourth Session of the IOC Committee on Ocean Processes and Climate, Paris, 1991	E, F, S, R
36.	Twenty-fourth Session of the Executive Council, Paris, 1991	E, F, S, R
37.	Sixteenth Session of the Assembly, Paris, 1991	E, F, S, R, Ar
38.	Thirteenth Session of the International Co-ordination Group for the Tsunami Warning System in the Pacific, Baja California, 1991	E, F, S, R
39.	Second Session of the IOC-WMO Intergovernmental WOCE Panel, Paris, 1992	E only
40.	Twenty-fifth Session of the Executive Council, Paris, 1992	E, F, S, R
41.	Fifth Session of the IOC Committee on Ocean Processes and Climate, Paris, 1992	E, F, S, R
42.	Second Session of the IOC Regional Committee for the Central Eastern Atlantic, Lagos, 1990	E, F
43.	First Session of the Joint IOC-UNEP Intergovernmental Panel for the Global Investigation of Pollution in the Marine Environment, Paris, 1992	E, F, S, R
44.	First Session of the IOC-FAO Intergovernmental Panel on Harmful Algal Blooms, Paris, 1992	E, F, S
45.	Fourteenth Session of the IOC Committee on International Oceanographic Data and Information Exchange, Paris, 1992	E, F, S, R
46.	Third Session of the IOC Regional Committee for the Co-operative Investigation in the North and Central Western Indian Ocean, Vascoas, 1992	E, F
47.	Second Session of the IOC Sub-Commission for the Western Pacific, Bangkok, 1993	E only
48.	Fourth Session of the IOC Sub-Cornmission for the Caribbean and Adjacent Regions, Veracruz, 1992	E, S
49.	Third Session of the IOC Regional Committee for the Central Eastern Atlantic, Dakar, 1993	E, F
50.	First Session of the IOC Committee for the Global Ocean Observing System, Paris, 1993	E, F, S, R
51.	Twenty-sixth Session of the Executive Council, Paris, 1993	E, F, S, R
52.	Seventeenth Session of the Assembly, Paris, 1993	E, F, S, R
53.	Fourteenth Session of the International Co-ordination Group for the Tsunami Warning System in the Pacific, Tokyo, 1993	E, F, S, R
54.	Second Session of the IOC-FAO Intergovernmental Panel on Harmful Algal Blooms, Paris, 1993	E, F, S
55.	Twenty-seventh Session of the Executive Council, Paris, 1994	E, F, S, R
56.	First Planning Session of the IOC-WMO-UNEP Committee for the Global Ocean Observing System, Melbourne, 1994	E, F, S, R
57.	Eighth Session of the IOC-UNEP-IMO Committee for the Global Investigation of Pollution in the Marine Environment, San José, Costa Rica, 1994	E, F, S
58.	Twenty-eighth Session of the Executive Council, Paris, 1995	E, F, S, R
59.	Eighteenth Session of the Assembly, Paris, 1995	E, F, S, R
60.	Second Session of the IOC-WMO-UNEP Committee for the Global Ocean Observing System, Paris, 1995	E, F, S, R

61.	Third Session of the IOC-WMO Intergovernmental WOCE Panel, Paris, 1995	E only
62.	Fifteenth Session of the International Co-ordination Group for the Tsunami Warning System in the Pacific, Papetee, 1995	E, F, S, R
63.	Third Session of the IOC-FAO Intergovernmental Panel on Harmful Algal Blooms, Paris, 1995	E, F, S
64.	Fifteenth Session of the IOC Committee on International Oceanographic Data and Information Exchange	E, F, S, R
65.	Second Planning Session of the IOC-WMO-UNEP Committee for the Global Ocean Observing System, Paris, 1995	E only
66.	Third Session of the IOC Sub-Commission for the Western Pacific, Tokyo, 1996	E only
67.	Fifth Session of the IOC Sub-Commission for the Caribbean and Adjacent Regions, Christ Church, 1995	E, S
68.	Intergovernmental Meeting on the IOC Black Sea Regional Programme in Marine Sciences and Services	E, R
69.	Fourth Session of the IOC Regional Committee for the Central Eastern Atlantic, Las Palmas, 1995	E, F, S
70.	Twenty-ninth Session of the Executive Council, Paris, 1996	E, F, S, R
71.	Sixth Session for the IOC Regional Committee for the Southern Ocean and the First Southern Ocean Forum, Bremerhaven, 1996	E, F, S,
72.	IOC Black Sea Regional Committee, First Session, Varna, 1996	E, R
73.	IOC Regional Committee for the Co-operative Investigation in the North and Central Western Indian Ocean, Fourth Session, Mombasa, 1997	E, F
74.	Nineteenth Session of the Assembly, Paris, 1997	E, F, S, R
75.	Third Session of the IOC-WMO-UNEP Committee for the Global Ocean Observing System, Paris, 1997	E, F, S, R
76.	Thirtieth Session of the Executive Council, Paris, 1997	E, F, S, R
77.	Second Session of the IOC Regional Committee for the Central Indian Ocean, Goa, 1996	E only
78.	Sixteenth Session of the International Co-ordination Group for the Tsunami Warning System in the Pacific, Lima, 1997	E, F, S, R
79.	Thirty-first Session of the Executive Council, Paris, 1998	E, F, S, R
80.	Thirty-second Session of the Executive Council, Paris, 1999	E, F, S, R
81.	Second Session of the IOC Black Sea Regional Committee, Istanbul, 1999	E only
82.	Twentieth Session of the Assembly, Paris, 1999	E, F, S, R
83.	Fourth Session of the IOC-WMO-UNEP Committee for the Global Ocean Observing System, Paris, 1999	E, F, S, R
84.	Seventeenth Session of the International Coordination Group for the Tsunami Warning System in the Pacific, Seoul, 1999	E, F, S, R
85.	Fourth Session of the IOC Sub-Commission for the Western Pacific, Seoul, 1999	E only
86.	Thirty-third Session of the Executive Council, Paris, 2000	E, F, S, R
87.	Thirty-fourth Session of the Executive Council, Paris, 2001	E, F, S, R
88.	Extraordinary Session of the Executive Council, Paris, 2001	E, F, S, R
89.	Sixth Session of the IOC Sub-Commission for the Caribbean and Adjacent Regions, San José, 1999	E only
90.	Twenty-first Session of the Assembly, Paris, 2001	E, F, S, R
91.	Thirty-fifth Session of the Executive Council, Paris, 2002	E, F, S, R
92.	Sixteenth Session of the IOC Committee on International Oceanographic Data and Information Exchange, Lisbon, 2000	E, F, S, R
93.	Eighteenth Session of the International Coordination Group for the Tsunami Warning System in the Pacific, Cartagena, 2001	E, F, S, R
94.	Fifth Session of the IOC-WMO-UNEP Committee for the Global Ocean Observing System, Paris, 2001	E, F, S, R
95.	Seventh Session of the IOC Sub-commission for the Caribbean and Adjacent Regions (IOCARIBE), Mexico, 2002	E, S
96.	Fifth Session of the IOC Sub-Commission for the Western Pacific, Australia, 2002	E only
97.	Thirty-sixth Session of the Executive Council, Paris, 2003	E, F, S, R
98.	Twenty-second Session of the Assembly, Paris, 2003	E, F, S, R
99.	Fifth Session of the IOC Regional Committee for the Co-operative Investigation in the North and Central Western Indian Ocean, Kenya, 2002 (* Executive Summary available separately in E, F, S & R)	E*
100.	Sixth Session of the IOC Intergovernmental Panel on Harmful Algal Blooms, St. Petersburg (USA), 2002 (* Executive Summary available separately in E, F, S & R)	E*
101.	Seventeenth Session of the IOC Committee on International Oceanographic Data and Information Exchange, Paris, 2003 (* Executive Summary available separately in E, F, S & R)	E*
102.	Sixth Session of the IOC-WMO-UNEP Committee for the Global Ocean Observing System, Paris, 2003 (* Executive Summary available separately in E, F, S & R)	E*
103.	Nineteenth Session of the International Coordination Group for the Tsunami Warning System in the Pacific, Wellington, New Zealand, 2003 (* Executive Summary available separately in E, F, S & R)	E*
104.	Third Session of the IOC Regional Committee for the Central Indian Ocean, Tehran, Islamic Republic of Iran, 21-23 February 2000	E only
105.	Thirty-seventh Session of the Executive Council, Paris, 2004	E, F, S, R
106.	Seventh Session of the IOC-WMO-UNEP Committee for the Global Ocean Observing System, Paris, 2005 (* Executive Summary available separately in E, F, S & R); and Extraordinary Session, Paris, 20 June 2005	E*
107.	First Session of the Intergovernmental Coordination Group for the Indian Ocean Tsunami Warning and Mitigation System (ICG/IOTWS), Perth, Australia, 3–5 August 2005	E only
108.	Twentieth Session of the Intergovernmental Coordination Group for the Tsunami Warning System in the Pacific, Viña del Mar, Chile, 3–7 October 2005 (* Executive Summary available separately in E, F, S & R)	E*
109.	Twenty-Third Session of the Assembly, Paris, 21–30 June 2005	E, F, S, R
110.	First Session of the Intergovernmental Coordination Group for the Tsunami Early Warning and Mitigation System in the North Eastern Atlantic, the Mediterranean and Connected Seas (ICG/NEAMTWS), Rome, Italy, 21–22 November 2005	E only
111.	Eighth Session of the IOC Sub-commission for the Caribbean and Adjacent Regions (IOCARIBE), Recife, Brazil, 14–17 April 2004 (* Executive Summary available separately in E, F, S & R)	E*
112.	First Session of the Intergovernmental Coordination Group for the Tsunami and other Coastal Hazards Warning System for the Caribbean Sea and Adjacent Regions (ICG/CARIBE-EWS), Bridgetown, Barbados, 10–12 January 2006	E only
113.	Ninth Session of the IOC Sub-Commission for the Caribbean and Adjacent Regions (IOCARIBE), Cartagena de Indias, Colombia, 19–22 April 2006 (* Executive Summary available separately in E, F, S & R)	E S*

114.	Second Session of the Intergovernmental Coordination Group for the Indian Ocean Tsunami Warning and Mitigation System (ICG/IOTWS), Hyderabad, India, 14–16 December 2005	E only
115.	Second Session of the WMO-IOC Joint Technical Commission for Oceanography and Marine Meteorology, Halifax, Canada, 19–27 September 2005 (Abridged final report with resolutions and recommendations)	E, F, R, S
116.	Sixth Session of the IOC Regional Committee for the Western Indian Ocean (IOCWIO), Maputo, Mozambique, 2–4 November 2005 (* Executive Summary available separately in E, F, S & R)	E*
117.	Fourth Session of the IOC Regional Committee for the Central Indian Ocean, Colombo, Sri Lanka 8–10 December 2005 (* Executive Summary available separately in E, F, S & R)	E*
118.	Thirty-eighth Session of the Executive Council, Paris, 20 June 2005 (Electronic copy only)	E, F, R, S
119.	Thirty-ninth Session of the Executive Council, Paris, 21–28 June 2006	E, F, R, S
120.	Third Session of the Intergovernmental Coordination Group for the Indian Ocean Tsunami Warning and Mitigation System (ICG/IOTWS), Bali, Indonesia, 31 July–2 August 2006 (*Executive Summary available separately in E,F,S & R)	E*
121.	Second Session of the Intergovernmental Coordination Group for the Tsunami Early Warning and Mitigation System in the North Eastern Atlantic, the Mediterranean and Connected Seas (ICG/NEAMTWS), Nice, France, 22–24 May 2006	E only
122.	Seventh Session of the IOC Intergovernmental Panel on Harmful Algal Blooms, Paris, France, 16–18 March 2005 (* Executive Summary available separately in E, F, S & R)	E*
123.	Fourth Session of the Intergovernmental Coordination Group for the Indian Ocean Tsunami Warning and Mitigation System (ICG/IOTWS-IV), Mombasa, Kenya, 30 February-2 March 2007 (* Executive Summary available separately in E, F, S & R)	E*
124.	Nineteenth Session of the IOC Committee on International Oceanographic Data and Information Exchange, Trieste, Italy, 12–16 March 2007 (* Executive Summary available separately in E, F, S & R)	E*
125.	Third Session of the Intergovernmental Coordination Group for the Tsunami Early Warning and Mitigation System in the North Eastern Atlantic, the Mediterranean and Connected Seas, Bonn, Germany, 7–9 February 2007 (* Executive Summary available separately in E, F, S & R)	E*
126.	Second Session of the Intergovernmental Coordination Group for the Tsunami and other Coastal Hazards Warning System for the Caribbean Sea and Adjacent Regions, Cumaná, Venezuela, 15–19 January 2007 (* Executive Summary available separately in E, F, S & R)	E*
127.	Twenty-first Session of the Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System, Melbourne, Australia, 3–5 May 2006 (* Executive Summary available separately in E, F, S & R)	E*
128.	Twenty-fourth Session of the Assembly, Paris, 19–28 June 2007	E, F, S, R
129.	Fourth Session of the Intergovernmental Coordination Group for the Tsunami Early Warning and Mitigation System in the North Eastern Atlantic, the Mediterranean and Connected Seas, Lisbon, Portugal, 21–23 November 2007 (* Executive Summary available separately in E, F, S & R)	E*
130.	Twenty-second Session of the Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System, Guayaquil, Ecuador, 17–21 September 2007 (* Executive Summary available in E, F, S & R included)	E*
131.	Forty-first Session of the Executive Council, Paris, 24 June–1 July 2008	E, F, R, S
132.	Third Session of the Intergovernmental Coordination Group for the Tsunami and other Coastal Hazards Warning System for the Caribbean Sea and Adjacent Regions, Panama City, Panama, 12–14 March 2008 (* Executive Summary available separately in E, F, S & R)	E*
133.	Eighth Session of the IOC Intergovernmental Panel on Harmful Algal Blooms, Paris, France, 17–20 April 2007 (* Executive Summary available separately in E, F, S & R)	E*
134.	Twenty-third Session of the Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System, Apia, Samoa, 16–18 February 2009 (*Executive Summary available separately in E, F, S & R)	E*
135.	Twentieth Session of the IOC Committee on International Oceanographic Data and Information Exchange, Beijing, China, 4–8 May 2009 (*Executive Summary available separately in E, F, S & R)	E*
136.	Tenth Session of the IOC Sub-Commission for the Caribbean and Adjacent Regions (IOCARIBE), Puerto La Cruz, Bolivarian Republic of Venezuela, 22–25 October 2008 (*Executive Summary available separately in E, F, S & R)	E, S*
137.	Seventh Session of the IOC Sub-Commission for the Western Pacific (WESTPAC-VII), Sabah, Malaysia, 26–29 May 2008 (*Executive Summary available separately in E, F, S & R)	E*
138.	Ninth Session of the IOC-WMO-UNEP Committee for the Global Ocean Observing System, Paris, France, 10–12 June 2009 (* Executive Summary available separately in E, F, S & R);	E*
139.	Fifth Session of the Intergovernmental Coordination Group for the Tsunami Early Warning and Mitigation System in the North Eastern Atlantic, the Mediterranean and Connected Seas, Athens, Greece, 3–5 November 2008 (* Executive Summary available separately in E, F, S & R)	E*
140.	Fourth Session of the Intergovernmental Coordination Group for the Tsunami and other Coastal Hazards Warning System for the Caribbean Sea and Adjacent Regions, Fort-de-France, Martinique, France, 2–4 June 2009 (* Executive Summary available separately in E, F, S & R)	E*
141.	Twenty-fifth Session of the Assembly, Paris, 16–25 June 2009	E, F, R, S
142.	Third Session of the Joint WMO-IOC Technical Commission for Oceanography and Marine Meteorology, Marrakesh, Morocco, 4–11 November 2009	E, F, R, S
143.	Ninth Session of the IOC Intergovernmental Panel on Harmful Algal Blooms, Paris, France, 22–24 April 2009 (* Executive Summary available separately in E, F, S & R)	E*
144.	Fifth Session of the Intergovernmental Coordination Group for the Tsunami and other Coastal Hazards Warning System for the Caribbean Sea and Adjacent Regions, Managua, Nicaragua, 15–17 March 2010 (* Executive Summary available in E, F, S & R)	E*
145.	Sixth Session of the IOC Regional Committee for the Central and Eastern Atlantic Ocean, Accra, Ghana, 28–30 March 2010 (* Executive Summary available in E, F, S & R)	E*
146.	Forty-second Session of the Executive Council; Paris, 15, 19 & 20 June 2009	E, F, R, S
147.	Forty-third Session of the Executive Council; Paris, 8–16 June 2010	E, F, R, S
148.	Sixth Session of the Intergovernmental Coordination Group for the Tsunami Early Warning and Mitigation System in the North Eastern Atlantic, the Mediterranean and Connected Seas, Istanbul, Turkey, 11–13 November 2009 (* Executive Summary available separately in Ar, E, F, S & R)	E*
149.	Seventh Session of the Intergovernmental Coordination Group for the Tsunami Early Warning and Mitigation System in the North Eastern Atlantic, the Mediterranean and Connected Seas, Paris, France, 23–25 November 2010 (* Executive Summary available separately in Ar, E, F, S & R)	E*
150.	Sixth Session of the Intergovernmental Coordination Group for the Tsunami and other Coastal Hazards Warning System for the Caribbean Sea and Adjacent Regions, Santo Domingo, Dominican Republic, 26–29 April 2011 (* Executive Summary available in E, F, S & R)	E*

151.	Twenty-fourth Session of the Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System, Beijing, China, 24–27 May 2011 (*Executive Summary in E, F, S & R included)	E*
152.	Twenty-first Session of the IOC Committee on International Oceanographic Data and Information Exchange, Liège, Belgium, 23–26 March 2011 (*Executive Summary available separately in E, F, S & R)	E*
153.	Eighth Session of the IOC Sub-Commission for the Western Pacific (WESTPAC-VIII), Bali, Indonesia, 10–13 May 2010 (*Executive Summary available separately in E, F, S & R)	E*
154.	Tenth IOC Intergovernmental Panel on Harmful Algal Blooms, Paris, France, 12–14 April 2011 (* Executive Summary available separately in E, F, S & R)	E*
155.	Forty-fifth Session of the Executive Council, Paris, 26–28 June 2012 (* Decisions available in E, F, S & R)	E*
156.	Seventh Session of the Intergovernmental Coordination Group for the Tsunami and other Coastal Hazards Warning System for the Caribbean Sea and Adjacent Regions, Willemstad, Curacao, 2–4 April 2012 (*Executive Summary available in E, F, S & R)	E*
157.	Eleventh Session of the IOC Sub-Commission for the Caribbean and Adjacent Regions (IOCARIBE), Miami, USA, 17–20 May 2011 (*Executive Summary available separately in E & S)	E, S*
158.	Eight Session of the Intergovernmental Coordination Group for the Tsunami and Other Coastal Hazards Warning System for the Caribbean and Adjacent Regions (ICG/CARIBE EWS-VIII), Trinidad & Tobago, 29 April–1 May 2013 (*Executive Summary available in E, F, S & R)	E*
159.	Twenty-seventh Session of the Assembly, Paris, 26 June–5 July 2013 and Forty-sixth Session of the Executive Council, Paris, 25 June 2013	E, F, R, S
160.	Twenty-fifth Session of the Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System (ICG/PTWS), Vladivostok, Russian Federation, 9–11 September 2013 (*Executive Summary in E, F & R)	E*
161.	Ninth Session of the Intergovernmental Coordination Group for the Tsunami and Other Coastal Hazards Warning System for the Caribbean and Adjacent Regions, US Virgin Islands, 13-15 May 2014 (*Executive Summary available in E, F, S & R)	E*
162.	Forty-seventh Session of the Executive Council, Paris, 1–4 July 2014 (* Decisions available in E, F, S & R)	E*
163.	Ninth Session of the IOC Sub-Commission of the Western Pacific (WESTPAC-IX), Busan, Republic of Korea, 9–12 May 2012	E
164.	Eleventh Session of the Intergovernmental Coordination Group for the Tsunami Early Warning and Mitigation System in the North Eastern Atlantic, the Mediterranean and Connected Seas, 12–14 November 2014, Nicosia, Cyprus (*Executive Summary available in E, F, S & R)	E*
165.	Twenty-sixth Session of the Intergovernmental Coordination Group for the for the Pacific Tsunami Warning and Mitigation System (ICG/PTWS-XXVI), Hawaii, USA, 22–24 April 2015 (*Executive Summary available in E, F, S & R)	E*
166.	Tenth Session of the Intergovernmental Coordination Group for the Tsunami and Other Coastal Hazards Warning System for the Caribbean and Adjacent Regions (ICG/CARIBE-EWS), Philipsburg, Sint Maarten, Kingdom of the Netherlands, 19–21 May 2015 (*Executive Summary available in E, F, S & R)	E*
167.	Tenth Session of the IOC Sub-Commission of the Western Pacific (WESTPAC-X), Phuket, Thailand, 12–15 May 2015	E
168.	Twenty-eighth Session of the Assembly, Paris, 18–25 June 2015	
169.	Twelfth 12th Session of the Intergovernmental Coordination Group for the Tsunami Early Warning and Mitigation System in the North-eastern Atlantic, the Mediterranean and Connected Seas (ICG/NEAMTWS-XII), Dublin, Ireland, 16-18 November 2015 (*Executive Summary available in E, F, S & R)	E*
170.	Eleventh Session of the Intergovernmental Coordination Group for the Tsunami and Other Coastal Hazards Warning System for the Caribbean and Adjacent Regions (ICG/CARIBE EWS-XI), Cartagena, Colombia, 5-7 April 2016 (*Executive Summary available in E, F, S & R)	E*
171.	Tenth Session of the Intergovernmental Coordination Group for the Indian Ocean Tsunami Warning and Mitigation System (ICG/IOTWS), Muscat, Oman, 24–26 March 2015	E*
172.	Forty-ninth Session of the Executive Council, Paris, 7–10 June 2016 (* Decisions available in E, F, S & R)	E*
173.	Thirteenth Session of the Intergovernmental Coordination Group for the Tsunami and Other Coastal Hazards Warning System for the Caribbean and Adjacent Regions, Bucharest, Romania, 26–28 September 2016 (*Executive Summary available in E, F, S & R)	E*
174.	Twenty-seventh Session of the Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System (ICG/PTWS-XXVII), Tahiti, France, 28-31 March 2017 (*Executive Summary available in E, F, S & R)	E*
175.	Twelfth Session of the Intergovernmental Coordination Group for the Tsunami and other Coastal Hazards Warning System for the Caribbean and Adjacent Regions (ICG/CARIBE-EWS), Puntarenas, Costa Rica, 10–12 May 2017 (*Executive Summary available in E, F, S & R)	E*
176.	Eleventh Session of the Intergovernmental Coordination Group for the Indian Ocean Tsunami Warning and Mitigation System (ICG/IOTWMS), Putrajaya, Malaysia, 18–20 April 2017 (*Executive Summary available in E, F, S & R)	E*
177.	Fourteenth Session of the Intergovernmental Coordination Group for the Tsunami Early Warning and Mitigation System in the North-eastern Atlantic, the Mediterranean and connected seas (ICG/NEAMTWS), Lisbon, Portugal, 21–23 November 2017 (*Executive Summary available in E, F, S & R)	E*
178.	Twenty-ninth Session of the Assembly, Paris, 21–29 June 2017 and Fiftieth Session of the Executive Council, Paris, 20 June 2017 (*Executive Summary available in E, F, S & R)	E*
179.	Thirteenth Session of the Intergovernmental Coordination Group for the Tsunami and Other Coastal Hazards Warning System for the Caribbean and Adjacent Regions (ICG/CARIBE EWS-XIII), Curaçao, 23–27 April 2018 (*Executive Summary available in E, F, S & R)	E*
180.	Twenty-fifth Session of the IOC Committee on International Oceanographic Data and Information Exchange, Tokyo, 2019 (* Executive Summary available separately in E, F, S & R)	E*
181.	Fifteenth Session of the Intergovernmental Coordination Group for the Tsunami Early Warning and Mitigation System in the North-Eastern Atlantic, the Mediterranean and Connected Seas (ICG/NEAMTWS), Paris, France, 26–28 November 2018 (*Executive Summary available in E, F, S & R)	E*
182.	Twelfth Session of the Intergovernmental Coordination Group for the Indian Ocean Tsunami Warning and Mitigation System (ICG/IOTWMS), Kish, Islamic Republic of Iran, 9–12 March 2019 (*Executive Summary available in E, F, S, R)	E*
183.	Twenty-eighth Session of the Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System (ICG/PTWS-XXVIII), Montelimar, Nicaragua, 2–5 April 2019 (*Executive Summary available in E, F, S & R)	E*
184.	Fourteenth session of the Intergovernmental Coordination Group for the Tsunami and other Coastal Hazards Warning System for the Caribbean and Adjacent Regions (ICG/CARIBE-EWS-XIV/3), Punta Leona, Costa Rica, 8–11 April 2019 (*Executive Summary available in E, F, S & R)	E*
185.	Fifth Session of the Intergovernmental Coordination Group for the Indian Ocean Tsunami Warning and Mitigation System (ICG/IOTWS-V/3), Putrajaya, Malaysia, 8–10 April 2008	E

186.	Sixth Session of the Intergovernmental Coordination Group for the Indian Ocean Tsunami Warning and Mitigation System (ICG/IOTWS-VI/3), Hyderabad, India, 7–9 April 2009	E
187.	Eighth Session of the Intergovernmental Coordination Group for the Indian Ocean Tsunami Warning and Mitigation System (ICG/IOTWS-VIII/3), Melbourne, Australia, 3–6 May 2011	E
188.	Fifty-first Session of the Executive Council, Paris, 3–6 July 2018 (* Decisions available in E, F, S & R)	E*
189.	Sixteenth Session of the Intergovernmental Coordination Group for the Tsunami Early Warning and Mitigation System in the North-Eastern Atlantic, the Mediterranean and Connected Seas (ICG/NEAMTWS), Cannes, France, 2-4 December 2019 (* Executive Summary available in E, F, S & R)	E*
190.	Fifteenth Session of the Intergovernmental Coordination Group for the Tsunami and Other Coastal Hazards Warning System for the Caribbean and Adjacent Regions (ICG/CARIBE EWS-XV), 27–29 April 2021 (online) (* Executive Summary available in E, F, S & R)	E*
191.	Twenty-ninth Session of the Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System (ICG/PTWS-XXIX), Online,1–2 and 7–8 December 2021 (*Executive Summary available in E, F, S & R)	E*
192.	Thirtieth Session of the IOC Assembly, Paris, 26 June–4 July 2019 and Fifty-second session of the IOC Executive Council, Paris, 25 June 2019 (*Summary report available in E, F, S & R)	E*
193.	Fifty-third Session of the Executive Council, Online, 3–9 February 2021 (* Decisions available in E, F, S & R)	E*
194.	Thirty-first Session of the IOC Assembly, Online, 14–25 June-2021	E F S R
195.	Tenth Session of the International Co-ordinating Group for the Tsunami Warning System in the Pacific, Sidney, Canada, 1–3 August 1985	E
196.	Inter-Sessional Meeting of the Intergovernmental Coordination Group for the Indian Ocean Tsunami Warning and Mitigation System (ICG/IOTWMS), online, 23–24 November 2021	E
197.	Twenty-ninth Session of the Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System (ICG/PTWS), 1–2 & 7–8 December 2021 (online)	E*
198.	Sixteenth Session of the Intergovernmental Coordination Group for the Tsunami and other Coastal Hazards Warning System for the Caribbean and Adjacent Regions (ICG/CARIBE-EWS), San José, Costa Rica, 25–28 April 2023	E (summary in F & S)