Intergovernmental Oceanographic Commission
Reports of Governing and Major Subsidiary Bodies

Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System (ICG/PTWS)

Twenty-ninth Session

Online
1-2 and 7-8 December 2021

UNESCO

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UNESCO 2022

IOC/ICG/PTWS-XXIX/3
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English only[1]

[1] The Executive Summary is available in French, Spanish and Russian.

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Executive summary

The Twenty-ninth Session of the Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System (ICG/PTWS-XXIX) was held online from 1 to 2 and 7 to 8 December 2021, chaired by the ICG/PTWS Chair Dr Wilfried Strauch (Nicaragua). The meeting was attended by 116 participants from 27 countries.

The **ICG established** a Task Team of the Tsunami Service Providers (TSPs) under Working Group 2 and **also established** a Task Team on UN Ocean Decade.

The **ICG recommended** that the PTWS Earthquake Source Zone be expanded to include the southernmost Atlantic seismic region to routinely provide Member States of the PTWS with information about the frequent large earthquakes from this region and any subsequent tsunami threat.

The **ICG requested** Member States Member States to share any new forms of sea level data for tsunami warning purposes in accordance with the IOC Oceanographic Data Sharing Policy.

The **ICG recommended** that Member States make data from their GNSS networks publicly available in real-time, and that all stations within 200 km of the coast are included since such inland stations also provide valuable constraints on tsunami excitation.

The **ICG decided** to carry out a tenth Exercise Pacific Wave in 2022 (PacWave 22) in the months of September through to November 2022 to support International Disaster Risk Reduction Day (13 October) and World Tsunami Awareness Day (5 November). It **further decided** that PacWave 22 will be conducted as a series of regional exercises organized through the PTWS Regional Working Groups where applicable, with support from the PTWS TSPs and ITIC, involving all PTWS countries, with one live communications test from the PTWS TSPs to Member States on 13 October 2022.

The **ICG agreed** to support a scientific meeting of experts on the New Hebrides Trench; and **further agreed** to support a scientific meeting of experts to discuss tsunami sources, hazard and risk associated with the Chile-Perú subduction zone.

The **ICG encouraged** Member States to identify the communities at risk from tsunamis where Tsunami Ready and like initiatives would be targeted and **mandated** the International Tsunami Information Centre (ITIC) to facilitate implementation of and documentation collation for UNESCO IOC Tsunami Ready Programme and other like initiatives in the PTWS.

The **ICG approved** the Pacific Tsunami Warning and Mitigation System (PTWS) Strategy 2022-2030.

The **ICG decided** to admit the start of CATAC's full functionality on the interim service as of January 17, 2022.

The **ICG decided** to include a permanent agenda item on the UN Decade of Ocean Science for Sustainable Development (2021–2030) in the Policy section of its regular meetings.

The **ICG encouraged** the JTF SMART Cable project to continue its activities to promote current and future projects for “wet demonstrators,” pilots, and operational SMART cable systems, **further encouraged** the IOC to actively participate as a full member in the JTF and **also encouraged** IOC Member States to endorse the ITU WTSA-20 SMART Resolution through their ITU focal points.

The **ICG accepted** the offer of the Government of Japan to host the 30th session in 2022.

The **ICG elected** as Chair Mr Yuji Nishimae (Japan) and Vice Chairs Dr Wilfried Strauch (Nicaragua) and Mr David Coetzee (New Zealand).

Résumé exécutif

La 29e session du Groupe intergouvernemental de coordination du Système d'alerte aux tsunamis et de mitigation dans le Pacifique (GIC/PTWS-XXIX) s'est tenue en ligne les 1er et 2 décembre et les 7 et 8 décembre 2021, sous la présidence de M. Wilfried Strauch (Nicaragua). La session a été suivie par 116 participants de 27 pays.

Le **GIC a créé** une équipe spéciale des prestataires de services relatifs aux tsunamis (TSP) dans le cadre du Groupe de travail 2 du GIC/PTWS, ainsi qu'une équipe spéciale sur la Décennie des Nations Unies pour les sciences océaniques au service du développement durable chargée en particulier du Programme relatif aux tsunamis de la Décennie de l'Océan.

Le **GIC a recommandé** l'élargissement des foyers de séismes du PTWS afin d'inclure la région sismique la plus au sud de l'Atlantique et ainsi de fournir régulièrement aux États membres du PTWS des informations sur les forts tremblements de terre qui secouent fréquemment cette région et sur les menaces de tsunami qui peuvent en découler.

Le **GIC a demandé** aux États membres de partager toute nouvelle forme de données relatives au niveau de la mer aux fins de l'alerte aux tsunamis conformément à la Politique de la COI en matière d'échange de données océanographiques (2019).

Le **GIC a recommandé** aux États membres de rendre publiques en temps réel les données de leurs réseaux du Système mondial de navigation par satellite (GNSS), et d'inclure toutes les stations situées à moins de 200 kilomètres de la côte, car ces stations situées à l'intérieur des terres fournissent également des restrictions utiles sur l'excitation des tsunamis.

Le **GIC a décidé** d'effectuer un 10e exercice Vague du Pacifique en 2022 (PacWave 22) entre septembre et novembre 2022, pour marquer la Journée internationale pour la réduction des risques de catastrophe (13 octobre) et la Journée mondiale de sensibilisation aux tsunamis (5 novembre). Il **a également décidé** que le PacWave 22 prendrait la forme d'un ensemble d'exercices régionaux organisés par l'intermédiaire des groupes de travail régionaux du PTWS, le cas échéant, avec l'aide des prestataires de services relatifs aux tsunamis (TSP) du PTWS et du Centre international d'information sur les tsunamis (CIIT). Tous les pays du PTWS y participeraient, et un test de communication en direct des TSP du PTWS vers les États membres se déroulerait le 13 octobre 2022.

Le **GIC a accepté** de soutenir une réunion scientifique d'experts sur la fosse des Nouvelles-Hébrides, et **a également accepté** de soutenir une réunion scientifique d'experts visant à examiner les sources, les dangers et les risques de tsunami en lien avec la zone de subduction Chili-Pérou.

Le **GIC a encouragé** les États membres à recenser les communautés exposées aux tsunamis auxquelles s'adressent le programme « Tsunami Ready » et des initiatives similaires, et **a chargé** le CIIT de faciliter la mise en œuvre du programme « Tsunami Ready » de la COI et d'autres initiatives similaires dans le PTWS, ainsi que la collecte de documents y afférents.

Le **GIC a approuvé** la *Stratégie du Système d'alerte aux tsunamis et de mitigation dans le Pacifique (PTWS) pour 2022-2030*.

Le **GIC a décidé** d'autoriser le Centre consultatif sur les tsunamis en Amérique centrale (CATAC) à fonctionner pleinement en tant que service provisoire à compter du 17 janvier 2022.

Le **GIC a décidé** d'inscrire un point permanent sur la Décennie des Nations Unies pour les sciences océaniques au service du développement durable (2021-2030) à l'ordre du jour de ses sessions ordinaires, dans la section consacrée aux politiques.

Le **GIC a encouragé** l'équipe spéciale mixte UIT/OMM/COI de l'initiative SMART sur les câbles à poursuivre ses activités visant à promouvoir les projets pilotes actuels et futurs de « démonstrateurs sous-marins » et les systèmes de câbles SMART opérationnels ; il **a incité** la COI à participer activement, en tant que membre à part entière de l'équipe spéciale mixte et **a encouragé** les États membres de la COI à approuver les résolutions de l'Assemblée mondiale de normalisation des télécommunications (AMNT) de l'UIT à sa 20e session concernant l'initiative SMART par l'intermédiaire de leurs points focaux au sein de l'Union internationale des télécommunications (UIT).

Le **GIC a accepté** l'offre du Gouvernement du Japon d'accueillir sa 30e session en 2022.

Le **GIC a élu** M. Yuji Nishimae (Japon) Président et MM. Wilfried Strauch (Nicaragua) et David Coetzee (Nouvelle-Zélande) Vice-Présidents du GIC/PTWS.

Resumen dispositivo

La 29ª reunión del Grupo Intergubernamental de Coordinación del Sistema de Alerta contra los Tsunamis y Atenuación de sus Efectos en el Pacífico (ICG/PTWS) se celebró en línea del 1 al 2 y del 7 al 8 de diciembre de 2021, bajo la presidencia del Dr. Wilfried Strauch (Nicaragua). Asistieron a la reunión 116 participantes de 27 países.

El **ICG creó** un equipo de tareas de los proveedores de servicios contra los tsunamis (TSP) en el marco del Grupo de Trabajo 2 del ICG/PTWS y un equipo de tareas sobre el Decenio de las Naciones Unidas de las Ciencias Oceánicas para el Desarrollo Sostenible, con especial referencia al Programa sobre los Tsunamis del Decenio del Océano.

El **ICG recomendó** que se ampliara la zona de origen de seísmos del PTWS para incluir la región sísmica más meridional del Atlántico, a fin de proporcionar con regularidad a los Estados Miembros del PTWS información sobre los seísmos de gran magnitud que se producen con frecuencia en esta región y sobre cualquier amenaza de tsunami que acarreen.

El **ICG pidió** a los Estados Miembros que compartieran cualquier nueva forma de datos sobre el nivel del mar con fines de alerta contra los tsunamis, de conformidad con la Política de intercambio de datos oceanográficos de la COI (2019).

El **ICG recomendó** que los Estados Miembros difundieran públicamente en tiempo real los datos de sus redes del Sistema Mundial de Navegación por Satélite (GNSS) y que se incluyeran todas las estaciones situadas a menos de 200 km del litoral, ya que estas estaciones interiores también proporcionan valiosos datos sobre la formación de tsunamis.

El **ICG decidió** realizar el décimo ejercicio Pacific Wave (PacWave 22) de septiembre a noviembre de 2022 en apoyo del Día Internacional para la Reducción del Riesgo de Desastres (13 de octubre) y del Día Mundial de Concienciación sobre los Tsunamis (5 de noviembre). **Decidió además** que PacWave 22 se llevaría a cabo como una serie de ejercicios regionales organizados por conducto de los grupos de trabajo regionales del PTWS, cuando proceda, con el apoyo de los proveedores de servicios sobre tsunamis (TSP) del PTWS y del Centro Internacional de Información sobre los Tsunamis (ITIC), en los que participaran todos los países del PTWS, con una prueba de comunicación en directo entre los TSP del PTWS y los Estados Miembros el 13 de octubre de 2022.

El **ICG acordó** apoyar una reunión científica de expertos sobre la fosa de las Nuevas Hébridas, y **acordó también** apoyar una reunión científica de expertos con objeto de estudiar las fuentes, el peligro y el riesgo de tsunami asociados a la zona de subducción Chile-Perú.

El **ICG alentó** a los Estados Miembros a identificar las comunidades expuestas a riesgos de tsunamis a las que se dirigirían iniciativas "Tsunami Ready" y otras similares, y **encomendó** al ITIC que facilitara la ejecución del programa "Tsunami Ready" de la COI de la UNESCO y otras iniciativas similares relacionadas con el PTWS, así como la recopilación de documentación al respecto.

El **ICG aprobó** la Estrategia del Sistema de Alerta contra los Tsunamis y Atenuación de sus Efectos en el Pacífico (PTWS) 2022-2030.

El **ICG decidió** aceptar la puesta en marcha del Centro de Asesoramiento sobre los Tsunamis de América Central (CATAC) como servicio provisional plenamente funcional a partir del 17 de enero de 2022.

El **ICG decidió** incluir en el orden del día un punto permanente sobre el Decenio de las Naciones Unidas de las Ciencias Oceánicas para el Desarrollo Sostenible (2021-2030) en la sección de política de sus reuniones ordinarias.

El **ICG alentó** al Grupo Especial Mixto UIT-OMM-COI/UNESCO que se ocupa de los cables SMART a continuar sus actividades para promover los proyectos piloto actuales y futuros de "simuladores húmedos" y sistemas de cables SMART operativos. **Alentó además** a la COI a participar activamente como miembro de pleno derecho en el Grupo Especial Mixto y **también animó** a los Estados Miembros de la COI a hacer suyas las resoluciones de la Asamblea Mundial de Normalización de las Telecomunicaciones (AMNT-20) de la UIT relativas a SMART a través de sus puntos focales en la Unión Internacional de Telecomunicaciones (UIT).

El **ICG aceptó** el ofrecimiento del Gobierno del Japón de acoger su 30ª reunión en 2022.

El **ICG eligió** al Sr. Yuji Nishimae (Japón) Presidente y al Dr. Wilfried Strauch (Nicaragua) y el Sr. David Coetzee (Nueva Zelandia) vicepresidentes del ICG/PTWS.

Рабочее резюме

Двадцать девятая сессия Межправительственной координационной группы по Системе предупреждения о цунами и смягчения их последствий в Тихом океане (ICG/PTWS-XXIX) прошла с 1 по 2, а затем с 7 по 8 декабря 2021 г. под председательством д-ра Уилфрида Штрауха (Никарагуа). В работе сессии приняли участие 116 делегатов из 27 стран.

МКГ учредила в рамках рабочей группы 2 МКГ/СПЦСТО целевую группу провайдеров данных слежения за цунами (ПДСЦ), а также целевую группу по вопросам Десятилетия ООН, посвященного науке об океане, которой поручено заниматься главным образом Программой по цунами в рамках Десятилетия науки об океане.

МКГ рекомендовала расширить район мониторинга СПЦСТО источников землетрясений, в том числе путем включения в него самой южной сейсмической области Атлантики, с тем чтобы иметь возможность регулярно информировать государства-члены СПЦСТО о происходящих в этом районе частых крупных землетрясениях и о любой связанной с ними угрозе цунами.

МКГ просила государства-члены в соответствии с Директивой МОК 2019 г. по вопросам обмена океанографическими данными обмениваться любыми новыми формами представления данных об уровне моря для целей предупреждения о цунами.

МКГ рекомендовала государствам-членам обеспечить доступность данных своих сетей ГНСС в режиме реального времени, в том числе данных всех станций, расположенных в пределах 200 км от побережья, поскольку такие станции в глубине их территории способны предоставить ценные данные об источниках возбуждения цунами.

МКГ постановила провести десятые учения по проверке готовности к цунами («Тихоокеанская волна-2022»), которые пройдут в сентябре-ноябре 2012 г. и будут приурочены к проведению Международного дня по уменьшению опасности стихийных бедствий (13 октября) и Всемирного дня распространения информации о проблеме цунами (5 ноября). **МКГ постановила также**, что учения «Тихоокеанская волна-2022» будут организованы в виде серии региональных учений, проведение которых обеспечат региональные рабочие группы СПЦСТО, там, где это применимо, при поддержке провайдеров данных слежения за цунами ПДСЦ/СПЦС и Международного центра информации о цунами (МЦИЦ) с участием всех стран СПЦСТО; кроме того, 13 октября 2022 г. будет проведена проверка функционирования систем оповещения с отправкой ПДСЦ/СПЦС сообщения в адрес компетентных властей государств-членов.

МКГ согласилась поддержать проведение совещания экспертов по Ново-Гебридскому желобу; а **также согласились** поддержать проведение совещания экспертов, в ходе которого будет обсуждаться проблематика очагов цунами, их вероятности и потенциальной опасности в зоне субдукции Чили-Перу.

МКГ призвала государства-члены определить территории проживания людей, подверженные риску цунами, которые будут включены в Программу сертификации готовности к цунами и другие аналогичные инициативы, а также **поручила** МЦИЦ содействовать сбору и обобщению информации об осуществлении вышеназванной программы ЮНЕСКО/МОК и других аналогичных инициатив в СПЦСТО.

МКГ утвердила *Стратегию системы предупреждения о цунами и смягчения их последствий в Тихом океане (СПЦСТО) на 2022-2030 гг.*

МКГ постановила признать начало полноценного функционирования Консультативного центра по цунами для региона Центральной Америки (КЦЦЦА) с 17 января 2022 г. в качестве временной службы.

МКГ постановила также включить в качестве постоянного пункта повестки дня своих очередных сессий вопрос о ходе проведения Десятилетия ООН, посвященного науке об океане в интересах устойчивого развития (2021-2030) в рамках раздела «Политика».

МКГ призвала Объединенную целевую группу МСЭ-ВМО-МОК по интеллектуальным кабелям продолжить работу, связанную с продвижением текущих и будущих пилотных проектов установки подводных сенсорных датчиков и интеллектуальных кабельных систем; она **призвала также** МОК активно участвовать в качестве полноправного члена в работе ОЦГ и предложила государствам – членам МОК одобрить резолюции Всемирной ассамблеи по стандартизации электросвязи МСЭ (ВАСЭ-20), касающиеся проектов интеллектуальных кабелей, через свои координационные центры МСЭ.

МКГ приняла предложение правительства Японии принять у себя тридцатую сессию МКГ/СПЦСТО в 2022 г.

МКГ избрала г-на Юдзи Нисимаэ (Япония) председателем, а д-ра Уилфрида Штрауха (Никарагуа) и г-на Дэвида Коетзи (Новая Зеландия) заместителями председателя МКГ/СПЦСТО.

1. WELCOME AND OPENING OF SESSION

1 The Twenty-Nineth Session of the Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System (ICG/PTWS-XXIX) was held on 1, 2, 7, and 8 December 2021, hosted online. The meeting was Chaired by Dr Wilfried Strauch (Nicaragua). The meeting was attended by 116 participants from 27 countries.

2 The meeting began with the viewing of videos on tsunami risk, experiences and preparedness in the Solomon Islands and the Pacific region generally. These were created for World Tsunami Awareness Day (WTAD) 2021 in the context of Tsunami Ready initiatives and the objective under the United Nations Ocean Decade Ocean Science for Sustainable Development (UN Ocean Decade) to have “100 percent of at-risk communities recognized as Tsunami Ready by 2030”.

3 Dr Wilfried Strauch, Chairperson of ICG/PTWS, opened the meeting on Wednesday, 1 December 2021 at 22:00 UTC. Dr Strauch welcomed the participants and expressed his appreciation for the 154 registrations for the meeting. He also thanked the Secretariat for their support with coordination, organization, and communication. He recalled that the last meeting (ICG/PTWS-XXVIII) was held in-person in Barceló Montelimar, Nicaragua, from 2 to 5 April 2019. He noted that despite the difficult global context during the last two years due to the ongoing Covid-19 pandemic, the Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System (ICG/PTWS) had continued to develop and implement numerous successful projects and activities. He thanked Member States, Working Groups (WGs), Task Teams (TTs) and all levels and units of the ICG/PTWS for their hard work during this time.

4 Dr Vladimir Ryabinin, Executive Secretary of the Intergovernmental Oceanographic Commission (IOC), provided welcoming remarks and recognized the important role of the tsunami community in protecting lives and livelihoods. He highlighted advances and achievements in the context of the UN Ocean Decade, which provides a historical moment for ocean science, technology, and services and sets a paradigm for ocean sciences inclusive of sustainability. Over the last decades, ocean science has continuously evolved and progressed, and now has the capacity of providing strong solutions to ocean challenges. The UN Ocean Decade provides a platform and launchpad for revolutionizing ocean sciences and transforming how the ocean community organizes itself and engages in issues; it provides a movement towards change and solutions. There are currently 31 programmes in the UN Ocean Decade, with over 350 different projects and actions. These are an unprecedented volume of initiatives. These activities cover a wide range of topics ranging from tsunamis to biodiversity and the ocean economy. It also includes innovative themes such as ocean empathy, leadership of women in ocean sciences and early career professionals. Together, this builds a human dimension to ocean sciences, enabling increasingly harmonious human-ocean relations.

5 Dr Ryabinin underlined how tsunami actions insert themselves into the UN Ocean Decade, noting that he was encouraged by the planning and mobilization occurring within the tsunami community. He specifically highlighted the initiative to develop the Tsunami Programme, as well as myriad actions to develop and improve early warning systems (EWS). He recalled the short videos on Tsunami Ready initiatives shared at the beginning of the meeting, expressing pride in what the tsunami community has already achieved.

6 Dr Ryabinin closed his statement by thanking Dr Strauch for his leadership and conviction during his tenure as Chairperson of the ICG/PTWS.

7 Dr Strauch expressed thanks for Dr Ryabinin’s intervention, and declared open the ICG/PTWS-XXIX.

2. ORGANIZATION OF THE SESSION

2.1 ADOPTION OF THE AGENDA

8 The Chairperson informed the Plenary that the Provisional Agenda (Doc. ICG/PTWS-XXIX/2.1.Prov.) was discussed at the call-conference of ICG/PTWS Steering Committee (SC) in September 2021, taking into account the Recommendations and instructions given at ICG/PTWS-XXVIII, as well as the relevant parts of the IOC Rules of Procedures.

9 Dr Wilfried Strauch offered the floor for Delegates to comment on the Provisional Agenda. Michael Angove (United States – USA) requested the addition of an agenda item for Dr Bruce Howe (USA) to report on important changes relating to the Science Monitoring and Reliable Telecommunication (SMART) cable initiative.

10 **The ICG approved** the Agenda with changes as decided by the Delegates.

2.2 DESIGNATION OF THE RAPPORTEUR(S)

11 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 and Spanish. The Chairperson also reminded the Plenary that rapporteurs are supported by the Secretariat.

12 Ms Susan West (USA) was proposed as rapporteur for English, however, no nominations were made for the rapporteur for Spanish.

13 The Chairperson requested the Secretariat follow-up internally to identify a rapporteur for Spanish.

14 **The ICG approved** the proposal for Ms West and thanked the USA for providing a rapporteur.

2.3 CONDUCT OF THE SESSION, TIMETABLE AND DOCUMENTATION

15 The Chairperson recalled that considering the ongoing travel restrictions due to Covid-19 the Officers of the ICG/PTWS in agreement with the Secretariat decided to host this session online. The Secretariat then organized the session with the Gilsama Zoom platform including interpretation in Spanish. The Chairperson noted that the online session is organized with two (2) working hours per day through four (4) days.

16 Dr Strauch also informed the ICG that in order to facilitate the proceedings of the meeting a Provisional Timetable has been prepared by the Secretariat in coordination with the Chair (document).

17 Mr Bernardo Aliaga, Technical Secretary of the ICG/PTWS, provided details on technical arrangements for the running of the meeting. Mr Aliaga indicated the following:

- ✓ All participants should have their cameras and microphones turned off for the duration of the meeting when they do not have the floor.
- ✓ Panelists should turn on their camera at least one minute before their agenda item, to allow the Gilsama Zoom team to spotlight them at the beginning of their presentation.
- ✓ In order to take the floor, participants must request the floor by raising their hand (icon available on Zoom).

- ✓ The Chairperson will request interventions from the ICG in a specific order, by first requesting interventions from Heads of Delegations, followed by Members of Delegations and Observers. If time for the item is exhausted preference will be given to Heads of Delegations.

- ✓ Participants should therefore only raise their hand when their specific group is solicited for interventions.

- ✓ If participants are experiencing technical challenges, they can ask for support in the chat. Any questions about presentations or interventions should be addressed in the Q&A.

18 The Technical Secretary next introduced the documentation and other logistical details for the meeting, indicating the following:

- ✓ The meeting website includes all the documents required for the meeting, as listed under the Provisional List of Documents (document).

- ✓ All documents and PPTs can be downloaded from the meeting website, preferably one-by-one when working with low-speed connections.

- ✓ Candidatures for elections must be submitted until the second day of the meeting by close of business. Mr Aliaga reported that one candidature for Chair and one candidature for Vice-Chair had been received thus far, and that these needed to be reviewed by the Elections Committee (see next item).

19 The Chairperson reviewed the timetable for the meeting and opened the floor for comments from delegates.

20 Michael Angove (USA) noted that the timetable for Day 2 of the meeting (2 December 2021) had an additional 15 minutes of content beyond the allotted two hours per day. The Chairperson recognized this and confirmed that Day 2 of the meeting was expected to run 15 minutes beyond the originally planned two hours.

21 **The ICG approved the timetable** with the addition of Dr Bruce Howe's presentation as decided by Delegates.

22 Dr Wilfried Strauch indicated that for the smooth running of the session and to facilitate the generation of recommendations and agreements, the ICG is asked to set up intra-sessional WGs. The Chairperson also asked Member States to nominate members to the intra-sessional WGs. These WGs are as follows:

- **Elections Committee**: Chantal Donnelly (Australia), Ken Gledhill (New Zealand) and Roberto Pineda (Panama) *Technical Secretary*: Bernardo Aliaga (IOC)
- **Recommendations Committee**: Dakui Wang (China), François Schindelé (France), Cap. Corb. SIA. I Gel. Ret. Miguel Sócrates Ibarra Fernández (México), Charles McCreery (USA) and Susan West (USA)
  Technical Secretary: Bernardo Aliaga
- **PTWS Strategy 2022-2030**: Dakui Wang (China), F. Schindelé (France), Tte. Corb. SMAM. L. Ocean. Juritzy Margarita Pérez García (México), Ken Gledhill (New Zealand), Sarah-Jayne McCurrach (New Zealand), Jaime Taoral (Panama), Efrain Villareal (Panama), Michael Angove (USA), Diego Arcas (USA)
- **PacWave 2022**: Yuelong Miao (Australia), Carolina Henriquez (Chile), Margarita Martínez (Chile), Laura González (Colombia), Jasson Pérez (Colombia), Anthony

Jamelot (France), Rodolfo Alvarado (Guatemala), David Coetzee (New Zealand), Eric Chichaco (Panama), Jorge Rodriguez (Panama), Carolina Hincapie (USA), and Christa von Hillebrandt-Andrade (USA)

- **UN Decade of Ocean Sciences for Sustainable Development and the Tsunami Programme**: Zhiguo Xu (China), Carlos Buriticá (Colombia), Silvia Chacón Barrantes (Costa Rica), Robin Yan (Guatemala), Ken Gledhill (New Zealand), Sarah-Jayne McCurrach (New Zealand), Julio Villareal (Panama), Michael Angove (USA), Bruce Howe (USA), Laura Kong (USA), and Christa von Hillebrandt-Andrade (USA), Jerome Aucan (SPC)
- **Tsunami Ready Programme**: Zongchen Wang (China), Zhiguo Xu (China), Anthony Murillo (Costa Rica), Fabio Rivera (Costa Rica), Mary Rengifo (Colombia), Anthony Jamelot (France), Luis Arriola (Guatemala), Bill Fry (New Zealand), Luis Arriola (Panama), Silka Lasso (Panama), Diego Arcas (USA), Laura Kong (USA), Elinor Lutu-McMoore (USA), and Christa von Hillebrandt (USA). *Technical Secretary*: Celine Tiffay (IOC)

23 Dr Wilfried Strauch recalled that, as customary, each of the intra-sessional WGs will report to the ICG session under their respective agenda items. He indicated that intra-sessional WGs could use GoToMeeting or TEAMS links provided by the Secretariat and asked Chairs of WGs to contact Ms Esmeralda Borja-Aviles to schedule online meetings with the above platforms (English only).

24 The Chair requested that intra-sessional WGs produce a recommendation for discussion by the ICG or re-draft recommendations included under the inter-sessional WGs and TTs reports, as needed. These recommendations will be discussed on Day 3 of the meeting (Tuesday, 7 December 2021) for endorsement by all delegates on the last day of the meeting (Wednesday, 8 December 2021).

3. REPORT ON INTERSESSIONAL ACTIVITIES

3.1. CHAIRPERSON'S REPORT

25 The Chairperson of ICG/PTWS, Dr Wilfried Strauch, presented this report, available as a Presentation.

26 The Chairperson recalled the governance structure of the ICG/PTWS, which includes the ICG/PTWS SC; WG 1 Tsunami Hazard Assessment; WG 2 Tsunami Detection, Warning and Dissemination; and WG 3 Disaster Management, Preparedness and Risk Reduction. It also includes the following regional WGs: Regional WG South East Pacific Region (WG-SEP), Regional WG Pacific Island Countries and Territories (WG-PICT), Regional WG South China Sea Region (WG-SCS), and Regional WG Central American Pacific Coast (WG-CA). The ICG/PTWS also has several TTs including the TT PacWave Exercises; the TT Future Goals and Performance Monitoring; the TT Evacuation Planning and Mapping; the WG 2 TT Enhancing Products, Minimum competency levels and TT Multi-instrument network; the WG-SCS TT Establishment of a South China Sea Tsunami Advisory Centre (SCSTAC); and the WG-CA TT Establishment of CATAC. Dr Strauch also highlighted the important role of the International Tsunami Information Centre (ITIC) within the structure and running of ICG/PTWS.

27 Dr Strauch also indicated that the principal tsunami service provider (TSP) for the ICG/PTWS is the Pacific Tsunami Warning Centre (PTWC) based in Hawaii. This TSP has a long history and significant experience with tsunami warning, having been operational since 1968. Although the PTWC is housed and maintained by the USA, it is developed and enhanced by countries worldwide and provides information internationally.

28 Dr Strauch also recalled that the last meeting of the ICG/PTWS (ICG/PTWS-XXVIII) took place 2-5 April 2019 in Nicaragua. This event was attended by 63 representatives from 21 Member States. The decisions taken at ICG/PTWS-XXVIII were as follows:

- Establishment of a WG 2 TT to propose minimum competency levels for National Tsunami Warning Centre (NTWC) operations staff,

- Establishment of a WG 2 TT to propose an optimal multi-instrument sensor network that integrates existing and emerging techniques and sensor technologies, for tsunami detection and characterization,

- Decision to organize and conduct the exercise Pacific Wave 2020 (PacWave 2020) in the months September to November 2020; to be conducted as a series of regional exercises organized through the PTWS regional WGs,

- Recommendation to Member States with global navigation satellite system (GNSS) data to investigate the means of sharing this data in real time, with a view towards and benefits of improved tsunami impact forecasts for coastlines particularly for near-field events,

- Full operation of TSP SCSTAC, from 5 November 2019,

- Trial operation of CATAC starting in August 2019.

29 The Chairperson also highlighted the context of the Covid-19 pandemic, noting that many in the tsunami community were impacted. Beyond the health impacts, this pandemic also hindered functioning of monitoring networks in several countries, although CATAC was able to continue work in-person. During this last intersessional period, many people conducted remote working and meetings and exercises were primarily carried out virtually. He expressed appreciation that, despite impacts of Covid-19, the different structures of the ICG/PTWS were able to continue working successfully. He also suggested that some of the tools and work practices developed during the pandemic will be useful to carry forward in future work practices.

30 Next, Dr Strauch underlined key progress achieved during the intersessional period including activities of TSPs and ITIC, WGs and TTs, the SC, the Working Group on Tsunamis and Other Hazards Related to Sea-Level Warning and Mitigation Systems (TOWS-WG), PacWave 2020, Tsunami Ready, expert meetings, WTAD, and the development of the Tsunami Programme within the UN Ocean Decade. All achievements and progress will be reported on in detail in subsequent agenda items.

31 Dr Strauch also recalled activities proposed by the most recent meeting of the ICG/PTWS SC from 21-23 September 2021.These activities included to:

- Identify and implement techniques to more quickly recognize and properly characterize the earthquake and tsunami threat (there special session planned for the Fall 2021 American Geophysical Union (AGU) meeting),

- Develop a technical proposal to expand the PTWS Earthquake Monitoring Zone (EMZ) to include part of the southern Atlantic Ocean that encompasses the Scotia Arc and its adjacent seismic zones,

- Recommend at the ICG/PTWS XXIX Meeting in November 2021 for CATAC to become a fully operational TSP,

- Prepare a final document for the ICG/PTWS XXIX Meeting for it to endorse CATAC as a fully operational TSP,

- TSPs will define more clearly, in their respective User Guides, procedures for issuing products when the earthquake is located outside of a TSP's coastal area of service (AoS),

- WG1 and ITIC to provide Guidelines for use of Tsunami Coastal Assessment Tool (TsuCat).

32 With regards to the TT PacWave, the SC specifically decided that the TT should compile and summarize good practices for planning, conducting and evaluating virtual exercises, and include this in the PacWave22 Exercise Manual; send further information on the PacWave informational video; explore more automatic and efficient ways to compile the information prior to October 2022; inquire about and confirm the dates of the Indian Ocean Wave Exercise (IOWave); hold the communications test of PacWave 2022 on 13 October 2022 with country reporting within ten days of the exercise; and change the current name of the TT of "PacWave 20" to "PacWave" (latter for approval at this meeting – ICG/PTWS XXIX).

33 Finally, Dr Strauch stated that one of the most significant developments in the PTWS was the start of the UN Ocean Decade and related opportunities for the region. He highlighted that the ICG/PTWS will notably contribute to the Decade Tsunami Programme through participation in the Scientific Committee. He also noted that the *ad hoc* TT on the UN Ocean Decade within ICG/PTWS will draft a recommendation for submission to this meeting, the ICG/PTWS-XXIX.

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

3.2. SECRETARIAT REPORT

35 The Technical Secretary for ICG/PTWS, Mr Bernardo Aliaga, presented the Report of the Secretariat.

36 Mr Aliaga highlighted that the ICG/PTWS and Secretariat have continued to work hard during this past, challenging, inter-sessional period. He recalled that the ICG/PTWS SC held several meetings during this time to ensure the continued smooth running of activities and projects. In addition, and in spite of the Covid-19 pandemic, every ICG/PTWS regional WG was able to hold a virtual meeting this year.

37 The Technical Secretary expressed appreciation for the work conducted by ICG/PTWS colleagues as well as their ability to maintain timelines and achieve targets despite challenges.

38 Finally, Mr Aliaga noted that any questions about the running of the meeting, intra-sessional WGs, or any other topic pertaining to the Secretariat could be addressed to him during this meeting or by email.

39 The Chair expressed thanks for the support and work of Mr Aliaga and the Secretariat during this past inter-sessional period.

40 The **ICG noted** the report of the Secretariat.

3.3. TSUNAMI SERVICES PROVIDERS REPORT

3.3.1. Pacific Tsunami Warning Centre (PTWC)

41 Dr Charles “Chip” McCreery (USA), Director of the PTWC, presented the report of the PTWC, available as a Presentation.

42 Dr McCreery began with an overview of staffing changes during the last year, noting that the PTWC had recruited a new oceanographer in January 2021 and a new geophysicist (GNSS specialist) in July 2021, but that two geophysicists left in June and August 2021. He also noted that they were still waiting to fill two positions of duty scientist. PTWC also added two new IT specialists. He next reported on the Covid-19 impact at PTWC, noting that there had not been any infections and therefore no outages of the centre or significant impacts on operations, except that in-person outreach activities had been put on hold. He also informed that no significant changes had been made to seismic and sea level data.

43 Dr McCreery next reported on the PTWC seismic network, sharing a map which identified the location of each station. He noted that some capability has been lost again in the Southwest Pacific. He also presented the sea-level sensing network (including coastal and Deep-ocean Assessment and Reporting of Tsunami (DART) gauges).

44 During the past inter-sessional period, PTWC issued 144 products for 84 events, of which 66 were informational bulletins and 18 were threat message sequences (thus, with several bulletins each). He noted that tsunamis were observed for 15 of the 18 events for which threat bulletin messages were issued, but to their knowledge no loss of life ensued. Dr McCreery highlighted key performance indicators (KPIs) for messaging during these events, noting that indicators explored elapsed time, and the difference between initial and final magnitude. With regards to the timeliness of the first message, he noted that many of the events for which the message was issued later than ten minutes after occurred in the Kermadec region, where there is a dearth of seismic stations. Regarding earthquake accuracy in terms of magnitude, he noted that PTWC initial estimates tend to be slightly higher than the final magnitude; although this is better than the alternative, the PTWC is working to rectify this bias. With regards to the depth accuracy, it is largely within the accurate range with a few outliers. Regarding location accuracy, PTWC aims to provide estimates within 30 km. Dr McCreery noted again that events that fall outside this range are located in the Kermadec region because of the scarce coverage of seismic stations as well as complex tectonics that do not fit the global velocity model. He noted that a specific regional model would be useful.

45 Dr McCreery also reported that PTWC suffered three outages during the inter-sessional period, at which point the NTWC in Alaska was warned and took over.

46 Dr McCreery also presented on the earthquake event in the South Sandwich Islands on 12 August 2021. This event included two earthquakes, although there was disagreement amongst observatories as to which had higher magnitude. The United States Geological Survey (USGS) calculated that the smaller earthquake occurred first whilst the Global Centroid Moment Tensor (CMT) Project has the smaller earthquake occurring second. Overall, the preliminary magnitude of the earthquake was significantly underestimated. Dr McCreery noted that, had there been vulnerable coastlines nearby, this event could have caused damage and casualties from a tsunami. He noted that the tsunami went far, being recorded as far as Hawaii, Alaska, South Africa and Australia. He summarized key issues related to the event as being the complex source, that the preliminary magnitude was a significant underestimate, that there is only one nearby coastal station and no deep-ocean stations. He also noted that although the PTWC issued an Information Statement for the Tsunami and Other Coastal Hazards Warning System for the Caribbean and Adjacent Regions (CARIBE-EWS), because the South Sandwich Islands fall into the PTWS Earthquake Source Zone (ESZ), the only areas potentially

at threat of a tsunami were Chile and Antarctica (both of which are in the PTWS). If a similar event occurred near a vulnerable coast the resulting no warning or under-warning could have dire consequences.

47 Based on the facts of this event, Dr McCreery recommended to identify and implement techniques to more quickly recognize and properly characterize the earthquake and tsunami threat (there will be a special session at the special Fall 2021 AGU meeting). He also recommended to include the South Sandwich Islands seismic zone in the PTWS source region. Dr McCreery noted that additional information on this proposal was in a dedicated document on the meeting website (document).

48 The PTWC also conducted several unscheduled communications tests to ensure that all countries have working communication links during the inter-sessional period, noting that the response is still insufficient, suggesting a collaboration with IOC to resolve this issue. Dr McCreery requested that MS consider whether messages by telefax were still useful and needed, considering they are expensive for the PTWC. If this method is not being employed, the PTWC would either reduce the number of places receiving telefaxes or eliminate them altogether.

49 Dr McCreery next highlighted continued enhancement efforts by the PTWC, including incorporating GNSS data and analyses for more rapid and accurate source characterization; developing a regional CMT for earthquake mechanism in 10-15 min (results have been positive and now PTWC is looking at quality control parameter); developing a common message code for PTWC and the US NTWC (original project not successful but efforts still underway); enhancing Short-term Inundation Forecasting for Tsunamis system (SIFT) to have smaller unit sources and unit sources that will be computed “on-the-fly”; and creating a training video for the CARIBE-EWS TSP products in cooperation with ITIC.

50 Dr McCreery briefly explained that, in response to the La Soufrière volcano eruption in the Caribbean, PTWC put triggers on nearby sea level stations in lieu of seismic stations, as seismic signals are not disseminated in the same way for a volcanic eruption. As such, the PTWC created capability for addressing volcanic tsunamigenic sources. He suggested that a similar approach could be developed in the Pacific region.

51 The **ICG noted** the report of the PTWC.

3.3.2. Northwest Pacific Tsunami Advisory centre (NWPTAC)

52 Dr Shinya Tsukada (Japan), Director of the Earthquake and Tsunami Observation Division of the Japan Meteorological Agency, presented the report of the Northwest Pacific Tsunami Advisory centre (NWPTAC), available as a Presentation.

53 Dr Tsukada began by noting major activities of the NWPTAC between February 2020 and November 2021, highlighting that the operation of NWPTAC has continued successfully despite the Covid-19 pandemic. On 28 February 2019, there was a full changeover to NWPTAC enhanced products made by numerical tsunami simulation including graphical products. On 5 November 2019, NWPTAC terminated its interim service for the South China Sea (SCS) region when full operation of SCSTAC began. At this time, the AoS of NWPTAC was changed accordingly. As such, the number of recipient countries changed from 16 to ten countries. On 29 October 2020, a coordination meeting of ICG/PTWS TSPs was held with PTWC, NWPTAC, SCSTAC and CATAC. In November 2020, the Japan Meteorological Agency (JMA) moved to its new building and the NWPTAC started its operations at this new building. On 14 July 2020, 15 February 2021 and 3 August 2021, the NWPTAC performed communications tests.

54 Dr Tsukada reported that during the past inter-sessional period, the NWPTAC responded to 33 events. Of these events, 16 advisory messages were issued between April 2019 and May 2020 and 17 advisory messages were issued between June 2020 and November 2021. He also presented a map of the earthquake sources of the 33 events.

55 Finally, Dr Tsukada also reported on results of communications tests conducted since 2012, noting that these usually occur biannually. He reported that approximately 70 percent of countries had sent back acknowledgements of receipt to NWPTAC and that the number of acknowledgments was increasing with support from the Secretariat and Member States.

56 The **ICG noted** the report of the NWPTAC.

3.3.3. South China Sea Tsunami Advisory centre (SCSTAC)

57 Dr Zhiguo Xu (China), National Marine Environmental Forecasting Centre (NMEFC), presented the report of SCSTAC, available as Presentation.

58 Dr Xu recalled that SCSTAC has been fully operational since 5 November 2019. He also presented a map of the existing services of the global tsunami EWS. He also recalled the AoS of the SCSTWS. According to the ICG/PTWS, it encompasses all coasts of the SCS and the adjacent Sulu Sea and Celebes Sea, separated by Palawan and the Sulu Archipelago from north to south respectively. Nine nations are included in this area: Brunei, Cambodia, China, Indonesia, Malaysia, Philippines, Singapore, Thailand and Vietnam.

59 Dr Xu highlighted that the role of SCSTAC includes the acquisition of earthquake information, sea level monitoring, a tsunami scenario database, tsunami parallel modelling, a tsunami analysis tool, and the production and dissemination of information and products. According to SCSTAC's Standard Operating Procedures (SOPs), SCSTAC must produce tsunami products for earthquakes equal to or above Mw6.0 in the SCS region. These products include tsunami information and a tsunami threat message.

60 Dr Xu indicated that between June 2020 and September 2021, SCSTAC issued 13 tsunami bulletins, noting that most earthquakes were located in the eastern area of the SCS. He also stated that SCSTAC KPIs were evaluated for full operation, noting that all targets had been reached. The only KPI that was not confirmed was the accuracy of the estimated time of arrival and amplitudes of the tsunamis actually triggered; this is because no earthquake of Mw7.1 or higher occurred in SCSTAC's AoS during this time, thus the KPI could not be tested.

61 He also noted that a new and updated website was available for SCSTAC, where additional information can be found. In addition, Dr Xu reported that SCSTAC had developed a tsunami warning decision supporting system based on Python to improve their tsunami warning capability. Key features of this system include real-time monitoring, receiving and processing of seismic and sea level data; a tsunami scenario database; Graphic Processing Unit (GPU) parallel tsunami numerical simulation; automatic generation and release of tsunami warning products; an integrated decision support system for tsunami warning; and a user-friendly, comprehensive, well-maintained and open-source software. The software will be upgraded by the end of 2021.

62 With regard to tsunami warning capacity enhancement, SCSTAC has extended tsunami warning technological support to the backup SCSTAC (BSCSTAC) in Hong Kong, as well as to the tsunami warning system in Macau. For instance, technical staff from SCSTAC installed a tsunami simulation system in Macau. The BSCSTAC was created with the Hong Kong Observatory (HKO). In addition, a backup tsunami warning system was installed in Huairou District Beijing, China, in order to implement independent function backup and the synchronization, though not dependence, of data.

63 SCSTAC has also developed a new tsunami generation model, which has 2D depth-averaged shallow water equations in vector invariant form, unstructured hexagonal mesh generation algorithm by Spherical Centroidal Voronoi Tessellations (SCVT), finite volume discretization, third order/fourth order Runge – Kutta scheme, Arakawa C-grid, global and regional simulation ability, and is GPU-accelerated.

64 Dr Xu reported on communications tests conducted on 28 January and 28 May 2021, noting that six Member States had responded to the dummy information. He thanked the Secretariat and Member States for their coordination. He also noted that SCSTAC conducted the 2020 PacWave Exercise, using the dummy information to test communications.

65 SCSTAC has also conducted technical training activities since June 2020, including related to seismic analysis (earthquake location/magnitude/depth, operation seismic monitoring system, and rapid characterization of tsunami source), sea level data analysis (detect, confirm and refine tsunami waves), tsunami forecasting with Tsunami Travel Time (TTT) and Cornell Multi-grid Coupled Tsunami Model (COMCOT), message dissemination and routine drills. In addition, SCSTAC has also participated in several meetings including two PTWS SC meetings, the WG-SCS meeting in September 2021, and an international workshop in Qingdao, China.

66 Finally, Dr Xu spoke about future plans for the SCSTAC, including participating in in ICG/PTWS-XXIX, performing communications tests, conducting an online training workshop on tsunami forecasting and risk assessment for tsunami warning operators in the SCS region (December 2021, hosted by China), and providing opportunities for in-person education, outreach and training activities in the region. He noted that the latter would be dependent on the Covid-19 pandemic.

67 The **ICG noted** the report of the SCSTAC.

3.4. REPORT FROM THE INTERNATIONAL TSUNAMI INFORMATION CENTRE (ITIC)

68 Dr Laura Kong, Director of ITIC, presented the report of ITIC, available as a Presentation.

69 Dr Kong recalled that ITIC was established in 1965 under IOC-IV.6 and is hosted by the USA. She also recalled that the purpose of the ITIC is to support IOC Member States, including with technical improvements for TW (timely accurate), capacity building, awareness, event and post-tsunami data collection. She also shared current leadership and membership of ITIC, noting the recent addition of Ms Carolina Hincapie-Cardenas (oceanographer). She also highlighted that, effective 1 September 2020, the Caribbean Tsunami Warning Programme became the Caribbean ITIC Office (ITIC-CAR). This change is to provide better support to the Caribbean Tsunami Information Centre (CTIC) and CARIBE-EWS, and provide more seamless interaction for countries that have both Pacific and Caribbean coasts.

70 Dr Kong next recalled the mandate of ITIC, including to monitor and recommend improvements through improved warning and response to events and development of tsunami warning decision support tools; to assist in establishing national and regional systems, including through capacity building and training, IOC Wave Exercises, and the UN Ocean Decade; to create, compile, and share information resources for preparedness and education, including guides, manuals, best practices, and awareness materials; and to collect, compile, and share information resources on historical tsunamis, including through a database, global and regional hazard, and post-event surveys.

71 She reported on the tsunami event that occurred on 4 March 2021 triggered by three shallow earthquakes in the Tonga-Kermadec Trench, north of New Zealand) with Mw7.3,

Mw7.4, and Mw8.1, respectively. The Mw8.1 earthquake triggered a tsunami observed locally and across the Pacific Basin. A hotwash on this topic was held virtually on 17 March 2021, joined by 67 participants, including 14 expert panelists, representing 27 countries and 1 regional organization.

72 The feedback session allowed for identifying gaps and priorities in terms of webinars and trainings. The meeting found that moving towards online and hybrid formats for webinars and trainings was favoured to complement on-site efforts.

73 Dr Kong next highlighted the decision-support tools supported and distributed by ITIC, including Listserv, the Tsunami Bulletin Board, real-time earthquake display and sealevel monitoring, the tide tool, the IOC sea level monitoring website, TTT software, tsunami historical database online and offline, and hazard assessment tools such as ComMIT/MOST (OTGA TEMPP hybrid in 2022-2023) and TsuCAT 4.3.

74 Dr Kong reported on capacity-building initiatives from 2019 to 2021, noting that the Covid-19 pandemic impeded travel and that ITIC has only been pivoting into online or hybrid formats as of 2021. In 2019, capacity-building was conducted on Caribbean SOPS, end-to-end and SOPs (Colombia), global end-to-end and SOPs (Hawaii, USA), end-to-end and SOPs (Papua New Guinea), TEMPP 1 on inundation modelling and mapping (PICT), NTWC competency pilot (Tonga). In 2020, the Tsunami Warning Centre (TWC) operations took place in Indonesia. In 2021, ITIC has been working with the Ocean Teacher Global Academy (OTGA) to develop virtual trainings. In addition, ITIC supported three online trainings in the Solomon Islands, Fiji, and Vanuatu. ITIC is also looking to organize International Training Programmes (ITP) in Hawaii in person in 2022 after it was postponed in 2020.

75 With regards to the OTGA online trainings, two courses are currently under development: “Tsunami awareness” and “Tsunami Ready”. In 2022, courses that were originally taught in person will be moved online, including the “Tsunami EWS”, the “TEMPP: Tsunami Evacuation Maps, Plans and Procedures” and the “Tsunami Warning and Emergency Response SOPs” courses.

76 Dr Kong noted that capacity-building through online trainings is being supplemented through a video, produced in collaboration with the PTWC, that presents tsunami enhanced products. Shorter informational videos have also been created, including “Get Pacific Tsunami Ready Shout Out” videos for the Western, PICT, and Eastern Pacific as part of WTAD, and a video on the PacWave Exercise. In addition, several videos are planned for 2022 including on “TWC Operation: What happens at PTWC during an event”, “Tsunami Forecasting”, and the Caribbean Wave Exercise (CARIBE WAVE).

77 Dr Kong also reported that ITIC has been actively involved in the PacWave 2020 Exercise; the CARIBE Wave 2021 Exercise; published an article in the ECO Magazine, UN Decade Special Issue, on PacWave Exercises between 2006 and 2020; and supported the global harmonization of post-exercise evaluations [TOWS-WG TT Disaster Management and Preparedness (DMP)].

78 Dr Kong also highlighted the strong effort from the Pacific and Caribbean regarding the UN Ocean Decade, including with regards to advancing tsunami detection and supporting cables initiatives and SMART cable pilots. In addition, funding has been acquired from the United States Agency for International Development (USAID) to develop Tsunami Ready in Fiji, Marshall Islands (Majuro), Micronesia, (Pohnpei, Chuuk, Yap) and Palau, and in the Caribbean in Dominica, St Lucia, and Barbados. Continued support to and collaboration with OTGA will also contribute to UN Ocean Decade efforts.

79 Regarding Tsunami Ready, Dr Kong added that ITIC is hosting the Tsunami Ready website which will have an interactive map (available from December 2021) and other resources and materials (tsunamiready.org). In addition, an interactive map is being developed by IOC Tsunami Unit (TSU).

80 ITIC has also developed compilations of best practices for vertical evacuation (117 references), and marine preparedness for ports and harbours (100 references), the latter two of which are available on the ITIC website. In addition, ITIC has supported the creation of the *Multi-Annual Community Tsunami Exercise Programme Guidelines* (Manuals and Guides, 86) for the CARIBE-EWS (*in press*). With regards to tsunami awareness materials, new ITIC-National Centres for Environmental Information (NCEI) tsunami hazard posters have been printed and ITIC has also produced new regional posters. In addition, the Tsunami Glossary 2019 will be updated in 2022 (currently taking inputs and comments), a Tsunami Warning! Comic was created, and ITIC has several materials available in Spanish.

81 Dr Kong concluded by highlighting the high degree of collaboration and cooperation enabled by ITIC, specifically sharing the tsunami events time-lapse animation (1850 to present) developed with NCEI. This is an educational tool linked to the NCEI database, and also mobile-friendly

82 The **ICG noted** the report of ITIC.

3.5. WORKING GROUPS AND TASK TEAMS REPORTS

3.5.1 Working group 1: Understanding Tsunami Risk

83 Ms Sarah-Jayne McCurrach (New Zealand) and Dr Diego Arcas (USA) presented the report of WG 1, available as a Presentation.

84 Ms McCurrach began by recalling the Terms of Reference of WG 1. Despite some limitations due to the Covid-19 pandemic, key activities had been developed including the aassessment of implications for ICG/PTWS-WG1 from the new PTWS Strategy; the assessment of implications for ICG/PTWS-WG1 from outcomes for the ICG/PTWS-XXIX Future Goals and Performance Monitoring Report; a Meeting of experts in Tsunami Sources and Risks in the Colombia/Ecuador Subduction Zone (Guayaquil, Ecuador, 2019; IOC Workshop Reports, 295); DART buoys; updates on Tsunami Vertical Evacuation; an update to TsuCat (TsuCat Version 4.2); and the assessment of implications for ICG/PTWS-WG1 of the UN Ocean Decade.

85 Dr Arcas provided details on the Meeting of Experts held in Ecuador. At this workshop, a total of six rupture segments were identified with magnitudes varying between Mw7.9 and Mw8.7. The six rupture segments are Norte, Buenaventura, Galera II / Esmeraldas, Galera I / Pedernales, Isla Plata, and Salinas. Sources were parametrized and recorded in the IOC and TsuCat and the NCEI database. Preliminary tsunami impacts from each source were computed in deep water and reflected in the report.

86 Dr Arcas next reported on TsuCat Version 4.2, noting that updates had been made to PTWC messages to include enhanced graphical products, hill-shading and grouping of expected wave arrival times, by country. In addition, this update allows for downloading of the entire tsunami source catalogue online and editing the dialogue of the requested epicentre. In addition, application improvements and bug fixes have been made, including to show ‘best’ source in very large events.

87 Updates relating to DART buoys have also been achieved during the past inter-sessional period. WG 1 worked with New Zealand to analyse data captured on their new DART

network (DART 4G) from the Kermadec Earthquakes on 5 March 2021. These earthquakes were a series of tsunamigenic earthquakes ranging in magnitude from Mw7.2 to Mw8.1. The DART buoys enabled scientists to accurately predict wave forecasts. In addition, the NOAA Pacific Marine Environmental Laboratory (PMEL) has also continued to work with Chile and recently supported the Hydrographic and Oceanographic Service of the Chilean Navy (SHOA) in acquiring DART metadata as a proxy for the National DART Buoy Centre. Due to the increased use of DART, PMEL are working on setting up a Web Portal for DART metadata updates.

88 Tim Melbourne (New Zealand) enquired about the possibility of including the New Britain Trench within the Workshop of experts on the New Hebrides Trench. Ms McCurrach responded that this is discussed in the WG 1 report.

89 The **ICG noted** the report of WG 1 and **approved** Recommendation ICG/PTWS-XXIX.1 and Recommendation ICG/PTWS-XXIX.2.

3.5.2 Working Group 2

90 Dr Charles “Chip” McCreery, Director of the PTWC, presented the report of WG 2, available as a Presentation.

91 Dr McCreery recalled the Terms of Reference of WG 2, noting that much of this work is carried out in the course of regular business by Member States and their NTWCs and related agencies, as well as by the TSPs through exercises, communication tests, monitoring warning components, and developing and maintaining documentation. Some specific work was identified to be carried out by three WG 2 TTs: TT Seismic Data Sharing in the South West Pacific, TT Minimum Competency Levels for NTWC Operational Staff, and TT Integrated PTWS Sensor Networks for Tsunami Detection and Characterization.

92 Dr McCreery shared the Terms of Reference of the TT on Seismic Data Sharing in the Southwest Pacific, noting that WG 2 had not received specific updates from this TT to share at this meeting. Dr McCreery presented data from the Oceania Regional Seismic NETwork (ORSNET) on seismic stations in the region, noting that there are still significant gaps that affect the rapid detection and characterization of earthquakes in the Southwest Pacific. Recalling the PTWC report, Dr McCreery highlighted that these gaps are affecting response times in the region. As such, the work of the TT needs to continue.

93 Dr McCreery next presented the Terms of Reference of the TT on Minimum Competency Levels for NTWC Operational Staff. A draft document, “NTWC Competency Framework”, was produced and distributed at ICG/PTWS-XXVIII and is available on the website of that meeting [document] for use by Member States. The document has not been revised further.

94 Dr McCreery presented the Terms of Reference of the TT on Integrated PTWS Sensor Networks for Tsunami Detection and Characterization, noting that this TT had been the most active during the past inter-sessional period. Key activities developed by this TT include implementing a framework for risk-based assessment of multi-sensor PTWS network early warning potential; and having all standard subduction zone sources relatively well sampled by the global weak motion seismic array (Regional w-phase solutions with reasonable uncertainties should be possible in all areas). In addition, GNSS inversion-based tsunami early warning was assessed with stations currently openly available for streaming, those that have “reported” in the last year (considered active) and all stations that have reported data in the past. Assuming real-time availability of active stations that have reported within the last year, GNSS coverage is typically sufficient for GNSS based local early warning in North and Central America, central Japan, New Zealand and Chile. The remainder of the circumpacific lacks

sufficient density of proximal GNSS stations for reliable GNSS-based tsunami early warning. Finally, where proposed, especially when deployed parallel to subduction zones, submarine SMART cables present a viable data platform to support future generations of local TEW. Dr McCreery noted that further details on the work of this TT would be provided during a dedicated agenda item later in the meeting.

95 Dr McCreery identified unfinished WG 2 tasks from recommendation of ICG/PTWS-XXVIII, including to revise the Operational User's Guide for the PTWS (IOC Technical Series, 87), revise all TSP User Guides with a similar structure and format to be agreed upon by WG 2, review and approve all the revised TSP User Guides, and review and provide any update to the document "Local-Source Tsunami Response Best Practice".

96 Dr McCreery next suggested that the ICG consider expanding the PTWS earthquake source map and zone to cover the Scotia Arc in the Southern Atlantic Ocean. He noted that this would not necessarily exclude it from the Caribbean source zone.

97 Robert Greenwood, Joint Australian Tsunami Warning Centre (JATWC) enquired whether there was a two-tier earthquake source zone for the PTWS, for instance, with Mw6.5+ in the area shown plus Mw8.0+ earthquakes outside of it, similar to the earthquake source zone map of IOTWMS. Dr McCreery confirmed that the PTWS already has the flexibility to issue messages for earthquakes outside of the earthquake sources zone if the earthquake is likely to produce an amplitude above 3 metres in the PTWS coastal zone service area or if the earthquake will likely create a reasonable serious concern of tsunami threat (even below a 3-metre amplitude). As such, it is possible to cover earthquakes outside the zone without having to expand the earthquake zone itself. However, in the case of the Southern Atlantic, although it is currently part of the CARIBE-EWS earthquake source zone, models suggest it poses a greater and more imminent threat to the PTWS, hence the suggestion to include this area within the PTWS earthquake source zone.

98 The **ICG noted** the report of WG 2 and **approved** Recommendation ICG/PTWS-XXIX.3.

3.5.2.1 TT on the Integrated PTWS Sensor Networks for Tsunami Detection and Characterization

99 Dr Bill Fry (New Zealand) presented the report of the TT, available as a Presentation.

100 Dr Fry recalled that the activities of this TT are driven by the target set out in the article Angove et al, "Ocean Observations Required to Minimize Uncertainty in Global Tsunami Forecasts, Warnings, and Emergency Response", 2019 *Frontiers on Ocean Science,* to produce a good early warning within ten minutes and tsunami cancellation after 45 minutes. By analysing how to reach these targets, it became clear that producing an early warning within ten minutes was contingent on understanding the earthquake source. In addition, most of the data that underpins cancellation involves observing the tsunami wave, thus data available at coastal tide gauges, submarine DART pressure sensors or submarine SMART cables.

101 Dr Fry noted that it is important to factor in spatial and temporal sensitivity in data, which is the distance from an earthquake or tsunami source or time from origin at which these data will inform original data. The latter is the time from origin at which these data can provide information. Dr Fry noted that GNSS, natural warning, and strong motion seismic data are all effective within the first ten-minute time window. W-Phase is effective from approximately 15 to 25 minutes, with DART observations useful from 25 minutes onwards.

102 The TT also combined this approach to a risk-based principle. The database of tsunami sources was linked to a database of exposed or vulnerable coastal populations in the Pacific

basin. This database was assessed against the 10-minute and 45-minute criteria for GNSS inversion, seismic inversion, and early warning based on GNSS, on seismic recordings, or ocean bottom pressure recordings. Based on this analysis, a map was created to highlight areas around the Pacific basin for which GNSS is a suitable option for warning within ten minutes. Dr Fry noted that a key conclusion of the analyses is that it is critically important to ensure open access of GNSS data for international tsunami early warning as well as to support a framework where their data is accessible in real time. He also noted that not only coastal GNSS stations are useful, but also stations that are as far out as 200 km have information relevant to ocean forecasting.

103 Dr Fry summarised the findings of the TT with a map illustrating regions of the Pacific basin for which seismic, geodetic, and SMART cable infrastructure supports the achievement of tsunami EWS targets, those for which it does not, and those for which progress in the SMART cable initiatives will enable achievement of targets. Based on this map, Dr Fry identified areas which are able to provide the 10-minute warning and 45-minute cancellation. Dr Fry also noted that this map may not be entirely reflective as some areas have access to data that is not openly accessible.

104 Dr Fry noted that the TT intends to have a report prepared on this topic within the next six months approximately.

105 The USA expressed appreciation for the high-quality analysis and outputs of the TT.

106 The **ICG noted** the report of WG 2 TT and **approved** a specific section of Recommendation ICG/PTWS-XXIX.3.

3.5.2.2 Presentation on SMART cables

107 Dr Bruce Howe (USA) presented the report on SMART cables, available as a Presentation.

108 Dr Howe began by highlighting connections between SMART, the tsunami community, and IOC, specifically noting the following players: ITU/WMO/UNESCO/IOC Joint Task Force; UNESCO/IOC ICG/PTWS, ICG/NEAMTWS, ICG/IOTWMS, and ICG/CARIBE-EWS; UNESCO/IOC Global Ocean Observing System (GOOS) and the UN Ocean Decade. Dr Howe also recalled IOC Decision A-31/3.4.1 on Warning Mitigation Systems for Ocean Hazards (July 2021) which highlighted deployment of new technologies to address observational gaps that cannot be covered by existing networks embracing, including “the widespread implementation of scientific instrumentation on deep-ocean telecommunications cables as developed by the ITU/WMO/UNESCO-IOC Joint Task Force (JFT) SMART Subsea Cables effort”.

109 Dr Howe next recalled the purpose of the SMART Subsea Cables Initiative. The idea is to share submarine telecommunication cable infrastructure with science and early warning. These cables enable data to be collected on bottom temperature, pressure, and seismic acceleration. SMART cables also provide many societal benefits by offering information on climate change including ocean temperature and circulation with direct impact on societies; sea level rise including hazard for coasts, islands, and cities; disaster risk reduction (DRR) including tsunamis and earthquake monitoring throughout ocean basins and coastal margins; and societal connectivity by enabling progress with resilient and sustainable telecommunications infrastructure. The SMART Cables Initiative directly works towards achieving several global frameworks, including Sustainable Development Goal (SDG) 13 on climate, SDG 14 on oceans, SDG 9 and SDG 11 on infrastructure, and the UNDRR Sendai Framework for Disaster Risk Reduction (SFDRR). With regards to the UN Ocean Decade, SMART cables will support the “Safe Ocean”, “Predicted Ocean” and “Accessible Ocean”

societal goals, including by contributing to stronger EWS and sustainable ocean observing system.

110 Dr Howe next reported on several SMART systems that are in the process of or will be deployed, including the CAM2 (2022), Wet Demo (2022), and Medusa (2024-2025) in Europe. In the Pacific, a Vanuatu-New Caledonia SMART system has been proposed with partial funding acquired; project Koete has been proposed in the Perth-Darwin-Malaysia region with funds currently being raised; and implementation of a SMART system in the New Zealand-Chatham Islands region is currently under government review. In addition, a large Antarctic-New Zealand system has been suggested, Chile has recently announced the installation of a cable from Chile to Antarctica (King George Island), and an Arctic system with SMART capability has been proposed between Japan and Europe. Additionally, Indonesia is undertaking in-country development of SMART cables.

111 Dr Howe also reported that the Moore Foundation has approved an award to support the development of SMART cables with the objectives to lay the groundwork for science and early warning use by simulations of the observing system before deployment, data analysis after deployment, and sustained scientific operation. It will also aim to apply results to the modest-scale 300 km Vanuatu-New Caledonia system and extract scientific results from this active tectonic subduction zone and dynamic ocean region, to demonstrate SMART earthquake and tsunami early warning. The award also seeks to establish the international project office for JFT Scientific Monitoring And Reliable Telecommunications cables to facilitate adoption of scientific sensors in all new telecommunications cables to reach a global scale.

112 Dr Howe concluded that SMART systems are becoming a reality and early systems will set valuable precedents, catalyse other related activity, and lay the foundation for more complex systems in the future. With regards to the UN Ocean Decade, SMART provides the perfect example of the role of the blue economy and maximizes societal benefits from submarine cables. With regards to ICG/PTWS, WG 2 and its TTs continue to work together on SMART, although there is a need to coordinate these activities with other ICGs and internationally. With regards to the PTWS Strategy 2022-2030, it is essential that multi-hazard risk modelling be improved (time, distance, populations, infrastructure) and that observational requirements be refined. Finally, within the UN Ocean Decade Tsunami Programme, SMART will be participating as an endorsed project, affiliated with the Tsunami Programme and GOOS.

113 Dr Strauch (Nicaragua) enquired about the possibility of installing SMART cables in Central America (CA). Dr Howe responded that they continue to look out for systems that are being implemented with telecommunications infrastructure, as SMART would be working with these initiatives. Thus, it is a question of finding a suitable partner in telecommunications as well as funding.

114 Mr Yuji Nishimae (Japan) enquired about data exchange and open access, referencing the IOC Oceanographic Data Exchange Policy (IOC Resolution XXII-6). He specifically asked whether this data policy was applied to data such as GNSS and SMART. Dr Howe responded that, from the SMART perspective, it is the intention to conform, as much as possible, to these standards. However, in practice, it depends on the provenance of funding and what Member States agree individually. He also noted that SMART would be actively working with IOC on this matter, and that it may eventually influence which regions are funded (i.e. areas that would be willing to render the data public). Mr Aliaga, the Technical Secretary, recalled the Second International Coordination Meeting for the Development of a Tsunami Warning and Mitigation System for the Indian Ocean, Grand Baie, Mauritius, 14–16 April 2005 (IOC Workshop Report, 198) where this data policy was important to achieve the establishment of the Intergovernmental Coordination Group for the Indian Ocean Tsunami Warning System. He noted that the IOC Oceanographic Data Exchange Policy is due to be reviewed in 2022-2023.

He also noted that the original understanding of the policy was that it covered geophysical data.

115 The USA expressed appreciation for the extensive work and progress towards SMART cable systems by the TT.

116 The **ICG noted** the report of WG 2 TT and **approved** a specific section of Recommendation ICG/PTWS-XXIX.3.

3.5.3 Working Group 3

117 Mr David Coetzee (New Zealand) presented the report of WG 3, available as a document. Mr Coetzee began by recalling the Terms of Reference of WG 3.

118 With regards to the WG 3 mandate to facilitate in collaboration with TOWS-WG TT DMP and organizations such as UNDRR, the exchange of experiences and information on risk reduction and preparedness actions, and matters related to disaster management, several activities were undertaken during the intersessional period. WG 3 continued to play an active role in the TOWS-WG TT DMP with a Chair of the TT and contribution of the Director of ITIC. WG 3 also contributed to the TOWS-WG submission of the Tsunami Programme to the UN Ocean Decade as well as participated in the WMO Regional Association V (South-West Pacific) Ocean Side Event to discuss synergies between the IOC Tsunami Ready Programme and the WMO Weather Ready Nations Programme. In addition, the Director of ITIC continued to participate in the International Union of Geodesy and Geophysics (IUGG) Joint Tsunami Commission (JTC), including as Chairs to the JTC WG on Science-based Tsunami Warning, with members of the WG on Tsunami Terminology which contributes to the Tsunami Glossary updates.

119 Regarding the WG 3 mandate to promote preparedness in coastal communities through education and awareness products and campaigns, WG 3 was involved in WTAD, providing support to two regional Pacific seminars and videos on Tsunami Ready as well as providing support to UNDRR in creating videos on Tsunami Ready and tsunami risk mitigation in the Pacific. In addition, with regards to the PacWave 20 and 22 exercises, the ICG/PTWS agreed in 2020 to reduced objectives. Finally, ITIC has continued to update its global and regional awareness products and to create new ones during the last inter-sessional period.

120 Relating to the WG 3 mandate to facilitate training on SOPs, Mr Coetzee reported that WG 3's efforts were hindered by restrictions from the Covid-19 pandemic. Nonetheless, the full list of ITIC trainings provided in 2019 and 2020 as well as requested and planned trainings for 2020 and 2021 is provided in the WG 3 report. Between 2005 and 2020, ITIC has provided over 130 trainings. In addition, ITIC is supporting OTGA as a designated Specialized Training Centre for Tsunamis, with regards to training in tsunami awareness (2021 Q3), tsunami EWS (2021/2022), TWCs and Tsunami Emergency Response SOPs (2022), TEMPP (2022/2023), and NTWC competencies (2023). In addition, ITIC and Indonesia Agency for Meteorological, Climatological and Geophysics (BMKG) are developing standard training courses that can be delivered online or in hybrid formats.

121 With regards to the WG 3 mandate, and currently important focal point, to facilitate the piloting of Tsunami Ready, WG 3 has continued to participate in the development the IOC Tsunami Ready Guidelines, currently under preparation for publication. The WG has continued to facilitate the piloting of Tsunami Ready, with ITIC providing important support across the ICG. For instance, ITIC is providing funding to assist the Marshall Islands, Micronesia, and Palau in achieving Tsunami Ready over the next few years. Mr Coetzee also recalled the target set by the IOC under the Ocean Decade Tsunami Programme: "100 percent communities at

risk of tsunami are Tsunami Ready by 2030". Mr Coetzee noted that WG 3 will participate in the establishment of an international coalition of stakeholders to help achieve this goal.

122 Mr Coetzee reported on the current status of Tsunami Ready in the PTWS. There are 14 communities that have completed and been recognised for Tsunami Ready, spread across six countries. In addition, 28 communities in 10 countries have planned or are in the process of Tsunami Ready. The Covid-19 pandemic and related impacts in communities caused disruptions and delays. In addition, Mr Coetzee reported that, because additional communities are compliant to Tsunami Ready indicators and standards, without having gone through the IOC Tsunami Ready process, WG 3 encouraged Member States to apply the Tsunami Ready "test" to evaluate whether a community is compliant, and to provide the data to WG 3. Mr Coetzee also suggested that ITIC coordinate this process.

123 With regards to the WG 3 mandate to develop and promote best practice preparedness material, programmes and assessment tools, WG 3 developed guidelines on tsunami warning during Covid-19. In addition, TsuCat 4.2 was developed and made available in 2021. Finally, at the request of the TOWS-WG TT DMP, the ITIC compiled global best practices in tsunami-resistant building design and vertical evacuation guidance (117 references from 15 countries, with 79 references from the Pacific) and marine port guidance (99 references, with 92 references from the Pacific).

124 Regarding the WG 3 mandate to promote tsunami risk reduction theory and practice, a draft PTWS Strategy 2022-2030 was developed. Mr Coetzee recalled that, in 2019, the ICG/PTWS tasked the WG 3 Chair with the development of the draft strategy. Drafts were presented to the SC in 2020 and 2021. The WG 1 Co-Chair, Ms McCurrach, assisted greatly with this task and led the draft that will be presented to this meeting under agenda item 4.4.

125 Japan briefly introduced the tsunami flag which is a new method of visual notification of tsunami warning in coastal areas in Japan.

126 Dr Laura Kong (ITIC-US) invited ICG members that may have input on how the tsunami ready "test" should be conducted to join the intra-sessional WG on the subject.

127 The **ICG noted** the report of WG 3 and **approved** Recommendation ICG/PTWS-XXIX.4.

3.5.4 Regional WG-SCS

128 Mr S.T. Chan presented the report of the WG-SCS, available as a document and a presentation.

129 Mr Chan reported that, during the intersessional period, two sessions of the WG-SCS were held online. The Ninth Session was held from 27-28 August 2020 and attended by seven countries, NWPTAC, PTWC, and the Indian Ocean Tsunami Information Centre (IOTIC). The Tenth Session was held on 28 and 30 September 2021 and was attended by eight countries and NWPTAC.

130 Mr Chan also highlighted that SCSTAC has been in full operation since November 2019 and has since responded to 26 earthquake events and issued a total of 28 tsunami bulletins to Member States. SCSTAC organized the second SCSTAC international staff programme in 2019, with three tsunami operators from Indonesia, Malaysia and Vietnam at the centre for two months. However, the programme has been suspended due to Covid-19. In addition, an IOC SCS training for seismic and sea level operators was held in Hangzhou, China, from 21-25 October 2019 and included trainees from Brunei, China, Indonesia, the Philippines, Malaysia,

and Vietnam. Another online training workshop is being organized on strengthening SOPs for seismic data and tsunami warning from 9-10 December 2021, hosted by NMEFC, China.

131 During the last two Sessions of the WG-SCS, a number of issues were raised. A question was raised about TSPs with NWPTAC specifically questioning the necessity of NWPTAC and SCSTAC issuing tsunami advisories for large earthquakes occurring outside of their Areas of Service. It was noted that discussion is ongoing among TSPs, although TSPs have agreed to clarify procedures for this in their respective User Guides.

132 Mr Chan also reported that enhancing exchange of data was another key topic of the intersessional period, noting that the WG-SCS recognized the paucity of seismic and sea level stations close to major tsunami sources within the SCS region. As such, Member States are encouraged to share more data to further enhance tsunami warning capability in the SCS region, especially in the Sulu Sea, Celebes Sea, and North Borneo.

133 Mr Chan also highlighted that SCSTAC is working with the HKO to establish the Backup SCSTAC (BSCSTAC) to be hosted at the HKO Headquarters in Hong Kong and manned around the clock by duty officers. Mr Chan also set out the implementation plan for BSCSTAC, highlighting that the centre is due to start trial operation in the first half of 2022. The activation and operation of the centre is scheduled for the last quarter of 2022.

134 The **ICG noted** the report of WG-SCS.

3.5.5 Regional WG Central America

135 Ms Griselda Marroquin presented her report, available as a Presentation.

136 Ms Marroquin reported on the PacWave 20 regional exercise, noting that CATAC prepared a Manual for the exercise (Ejercicio Tsunami-CA 20, Ejercicio de respuesta en caso de tsunami para América Central: terremoto lento y tsunami frente al Golfo de Fonseca, 11 de noviembre de 2020, volumen 1: manual para participantes, IOC Technical Series, 156). The selected scenario was a slow earthquake of Mw7.8 near the Gulf of Fonseca; a slow earthquake was selected because, historically, these have generated larger tsunamis than expected (e.g. in 1992 and 2012). For the most part, countries only conducted a tabletop exercise due to limitations from the Covid-19 pandemic, although Costa Rica also involved two communities.

137 Ms Marroquin also reported that several CA countries took part in activities for WTAD. El Salvador held a workshop to train local observers on marine threats in November 2019, in which approximately 70 observers participated. In addition, a tsunami warning simulation exercise was held virtually on 5 November 2021, with the participation of the Ministry of Environment and Natural Resources (MARN) and civil protection. In Costa Rica, talks on tsunamis took place through Facebook Live in 2020. In 2021, UNA launched a web application entitled “Costa Segura” and pre-launched the catalog of historical tsunamis. Nicaragua conduced a tabletop exercise and CATAC disseminated dummy messages to countries in the CA region throughout 2020 and 2021. Panamá celebrated WTAD by holding virtual talks and exhibits on tsunamis.

138 During the last intersessional period, several countries also organized simulations at the domestic level to test their response capabilities. In August 2020 and 2021, Costa Rica held national drills and conducted remote tabletop exercises with coastal communities through Teams and Zoom. El Salvador held a national earthquake evacuation drill (12 October 2021) coordinated by the Ministry of the Interior. The drill involved about 136 hospitals, 260 health units, 168 city halls, 3695 public educational centres, 336 private educational centres, 12 non-

governmental organizations, 249 public institutions, 65 private companies and 124 units of the national civil police. Finally, Nicaragua held annual multi-hazard exercises in 2020 and 2021.

139 Ms Marroquin reported on the progress of Tsunami Ready in CA, noting that between 2019 and 2021, IOC recognized ten communities as Tsunami Ready (including three communities acknowledged in 2017): two in Guatemala, one in Honduras, two in El Salvador, two in Nicaragua and three in Costa Rica. In addition, 15 other communities are in the process of becoming Tsunami Ready. These achievements have been attained through support and projects by TEMPP, DIPECHO, USAID-OFTA and others, as well as support from the Sistema Nacional de Monitoreo de Tsunamis (SINAMOT) of the Universidad Nacional Costa Rica (UNA) and the Comisión Nacional de Emergencias (CNE) in Costa Rica.

140 Countries in CA have also strengthened their monitoring and outreach capabilities. Guatemala has built new offices and equipment for monitoring and conducted internal restructuring of personnel to address the issue of tsunamis in a more systematic and effective way. El Salvador has prepared and pre-calculated tsunami scenarios, including 561 scenarios for earthquakes with Mw7.0-8.0. They have also developed an application that connects the tsunami database to results of the automatic earthquake locator (SEISCOMP) to visualize the expected wave height and arrival times. El Savador has also developed the first early warning prototype for earthquakes Early Warning in Nicaragua and Central America (EWARNICA) project and conducted alert emission tests using digital television and emergency warning broadcasting system (EWBS) receivers.

141 In Nicaragua, the civil defense installed an additional 40 sirens in communities of the Caribbean coast in 2021. Along with the 60 sirens already in place since 2015, Nicaragua now has a total of 100 sirens for tsunami warning and other emergencies. In addition, an EWS display has been installed in the disaster operation centre (CODE) of the civil defense. Lastly, a tsunami hazard map application for smartphones was created. In the event of a tsunami alert, the user can find out their location, the situation of the threat of flooding and the evacuation routes.

142 In Costa Rica, SINAMOT has developed an application for smartphones that sends notifications in case of a tsunami report and highlights evacuation routes. The CNE's Multi-hazard Monitoring Centre now has a computer dedicated to the California Integrated Seismic Network (CISN) application for seismic monitoring.

143 Overall, 71 new accelerometers have been installed in CA, including 17 in Guatemala, 25 in El Salvador, 25 in Nicaragua, and four in Costa Rica. This reduces the detection and location time of earthquakes and information from these is shared with CATAC and throughout the region. These achievements were part of the EWARNICA (2016-2021) project with the financial support from the Swiss Agency for Development and Cooperation (COSUDE) and coordination from the Swiss Seismological Service.

144 Ms Marroquin highlighted ongoing or upcoming projects, including project S15 in Guatemala for the acquisition of seismic equipment, created and financed by Instituto Nacional de Sismología, Vulcanología, Meteorología e Hidrología de Guatemala (INSIVUMEH); phase 2 of the project for development of capacities in analysis of earthquakes and tsunamis in El Salvador (2021-2023), with the technical and financial support of the Japan International Cooperation Agency (JICA); and a project for the purchase of tide gauge equipment and sirens for tsunami EWS in Panama with their Ministry of the Environment. In addition, Nicaragua will be developing the use of digital TV and EWBS receivers for early warning of earthquakes and other phenomena (2021-2022), with the participation of 80 institutions in Managua. This would function for sites on the Pacific coast for tsunami warning. This project is being implemented with the support of JICA and the Ministry of Internal Affairs and Communications (Japan) and cooperation with Switzerland. Nicaragua will also continue establishing CATAC. Finally, Costa

Rica will be implementing the second stage of the Tsunami Evacuation Maps project; continuing to implement a pilot project for coastal hazard preparedness of Biosphere Reserve sites through a TSU/Man and Biosphere (MAB) Joint Initiative; and compiling material for the commemoration of the 1992 tsunami in Nicaragua and its impact on Costa Rica.

145 Finally, Ms Marroquin also reported that the WG-CA held their Fifth meeting on 15 November 2021, as which time the Group agreed to recommend to the ICG/PTWS-XXIX the full functionality of CATAC as of 10 January 2022. This recommendation builds on the progress made by CATAC, including doubling the number of staff with 24/7 shifts; finalising the tsunami database; improving the accuracy and speed of processing earthquakes and tsunamis; optimizing configuration of the TOAST module for tsunami simulation in its SeisComP system; creating a website; and preparing a CATAC User Guide.

146 The Vice-Chairperson, Mr Yuji Nishimae (Japan), suggested that the use of Global Telecommunication System (GTS) and the provision of an English format to CATAC communications be added to the recommendations. In addition, Japan requested that clarification be provided on the start date of CATAC, recalling that according to formal processes it needs formal approval from ICG/CARIBE-EWS and IOC, which would delay the start date. Dr Strauch agreed with the suggestions and noted that the planned start date of CATAC is 17 January 2022, even though official recognition by IOC may not be granted by then.

147 The USA expressed support for his recommendation and suggested that labelling the interim status of CATAC whilst it awaits full approval from ICG/PTWS and IOC is a potential solution.

148 The **ICG noted** the report of WG-CA and **approved** Recommendation ICG/PTWS-XXIX.5.

3.5.6 Regional WG Pacific Island Countries and Territories

149 Mr Matthew Moihoi (Papua New Guinea) presented the report, available as a Presentation.

150 Mr Moihoi recalled the Terms of Reference of the WG. He also noted that during the intersessional period, the Eighth Meeting of the WG-PICT was held online on 1 April 2021, and included the election of new WG-PICT officers with Ms Esline Garaebiti as Chair and himself, Mr Matthew Moihoi, as Vice-Chair. The meeting noted that post event hot wash/debrief should include the following: Review the hot wash/debrief and survey applicability and guidelines; develop hot wash/debrief templates; set format and structure for national and regional Hot wash/debrief; and hold online seminars on forecasting to minimize confusion. The WG-PICT Terms of Reference were also slightly updated. In addition, the review of tsunami warning and response SOPs for Fiji, Solomon Islands, and Vanuatu were completed

151 The **ICG noted** the report of WG-PICT

3.5.7 Regional WG South East Pacific

152 Ms Mary Rengifo (Colombia) presented the report for WG-SEP, available as a document.

153 Ms Rengifo reported on activities conducted in 2019, which included five virtual meetings held on 4 June, 12 July, 10 September, 10 October, and 27 November. A regional tabletop exercise was also conducted on 26 September 2019 using the scenario of an offshore earthquake north of Chile of Mw9.1. The countries which participated were Chile, Colombia,

Ecuador and Peru. In addition, the first meeting of WG-SEP was held in Bogotá, Colombia, from 29-31 October 2019. At this time, the regional South East Pacific (SEP) Communication Protocol was updated, a WG-SEP logo was agreed upon, and the schedule for upcoming activities was agreed upon.

154 Ms Rengifo next shared that between June and November 2020, four virtual meetings were held on 10 June, 18 August, 21 September, and 24 November. Originally, a meeting was also scheduled for March 2020 but was cancelled due to the pandemic. In addition, three regional exercises were conducted on 28 February, 26 August, and 20 October, the latter of which were conducted in hybrid formats due to the pandemic. Although a fourth exercise was originally planned, it was postponed due to the pandemic. The countries which participated in these exercises included Chile, Colombia, Ecuador and Perú.

155 Ms Rengifo reported that PacWave20 was conducted on 22 October 2020 using the Tonga scenario and was developed as a communications test, although in Chile and Colombia it also involved coordination with disaster risk management offices.

156 The Second WG-SEP session was held virtually in October 2020, during which results from activities performed in 2020 were reviewed, activities for 2021 were agreed upon, and a workshop on TsuCat was held. In addition, the "Tsunamis Pacífico Sudeste" website has been updated (available here). For WTAD 2020, WG-SEP participated in the regional webinar for the SEP and CA held on 10 November 2020.

157 Ms Rengifo next reported on activities between January and September 2021, including six virtual meetings held on 13 January, 12 March, 17 March, 5 April, 6 May, and 19 August. WG-SEP also participated in the hotwash for the Kermadec Islands event on 18 March 2021 and participated in preparing the report on SMART cables for ICGPTWS-XXIX (this report is currently in the process of being translated). The Third Meeting of WG-SEP was held virtually from 9-11 November 2021, at which time activities for 2022 were agreed upon. WG-SEP also provided short clips for a WTAD 2021 videos on Tsunami Ready. Four regional exercises were also conducted on 28 January, 22 May, 26 August, and 28 October 2021.

158 Ms Rengifo next set out upcoming activities including preparing Navarea bulletins template, conducting two large-scale regional exercise (include PacWave 2022), conducting monthly communications tests, holding the Fourth Meeting of WG-SEP in November 2022 (virtually), organizing two capacity-building workshops, and finalising the SMART cables report in ICG/PTWS-XXX.

159 The **ICG noted** the report of WG-SEP.

3.5.8 Report of TT on Future Goals and Performance Monitoring

160 Ms Sarah-Jayne McCurrach (New Zealand), Chair of the TT on Future Goals and Performance Monitoring, presented the report, available as a document.

161 Ms McCurrach noted that a report on the 2018 survey was presented at the PTWS XXVIII session. She recalled the purpose for creating the TT and highlighted its Terms of Reference. The framework developed by the TT was endorsed by the PTWS SC. Ms McCurrach set out key elements of the framework including that it was designed to ensure performance of PTWS TSPs, NTWCs, and Tsunami National Contacts (TNCs), was sustainable, achievable and adequately monitored; that it builds on strategic objectives of the PTWS; that it aligns with the PTWS Strategy 2022−2030, priorities for action and global targets of SFDRR 2015-2030, and international best practice; that it contributes to the Executive Council decision EC-LI/3.3. She underlined that ICG-PTWS WGs and TTs are expected to

monitor and evaluate against this framework and provide yearly reports via the annual ICG meeting structures.

162 Ms McCurrach recalled that the PTWS Framework for Future Goals and Performance Monitoring was finalized in 2018. At this time, 26 countries completed the first performance assessment round, although only about 54 percent of PTWS countries participated. This was reported to the SC at ICG/PTWS-XXVIII.

163 Ms McCurrach next set out key intersessional activities of the TT, emphasizing that the Covid-19 pandemic impacted their ability to effectively monitor progress since 2018 and that the next in-country reporting is anticipated to be carried out in 2022 (see section 4 of the report). She also highlighted that the TT is working to develop an IOC global performance monitoring framework based on the PTWS framework that was used in 2018. The intention of this came from the report of TOWS-WG TT DMP (February 2019). The work to develop this framework is ongoing and aims to develop KPIs harmonized with goals and actions of the SFDRR. The work involves reviewing the current PTWS performance monitoring framework and comparing this with other, similar ICG initiatives, and producing a consistent global performance monitoring framework, which includes data collection tools/questionnaire and reporting formats.

164 Ms McCurrach next highlighted the five frameworks or programmes which the new framework should align with: the SFDRR, the United Nations Decade of Ocean Sciences for Sustainable Development – A Safe Ocean, the IOC Tsunami Programme, Tsunami Ready, and the ICG/PTWS Strategy 2022-2030. The TT has specifically been considering how reporting on these frameworks can occur at the global level in to be more effective and avoid double-reporting.

165 The TT set out three goals: 1) Understanding tsunami hazard and risk and tsunami monitoring, detection and warning, 2) Tsunami preparedness including public education and community engagement, and 3) International coordination and cooperation (SC, WGs and TT's only). The TT also set out key expectations including to monitor and evaluate against this framework; provide yearly reports via the annual ICG meeting structures; participate in TOW-WG meetings on global basin assessments, detailing gaps, opportunities and improvements in regard to their evaluation against the framework; and align all activities with the UN Ocean Decade.

166 Ms McCurrach noted that the surveying for national, ICG and global reporting will be conducted through a web-based portal, hosted on the IOC site, will enable real-time graphs, and will be fair, accessible and comprehensive.

167 Ms McCurrach set out the timeline for delivery on a global framework, noting that the TT will develop measures for each target by 17 December 2021. Next, the TT will develop guidance, templates, and online portal requirements by January 2022. Finally, the TT will prepare a report for the TOWS-WG meeting (February 2022) which will summarise the work that the TT has completed as well as the proposed Global KPI Framework, an assessment table, a request for funding to develop a suitable online reporting template, and further recommendations for endorsement and publication.

168 Lastly, Ms McCurrach presented the TT's recommendations, specifically highlighting two options for follow-up on countries survey to be considered by Member States: 1) Agree to the development of a shorter survey that includes questions on Covid-19, to be completed by Members States and the PTWS in January 2022, or 2) Endorse the global framework and wait until this is finalised for the next performance monitoring of the PTWS.

169 The USA enquired whether the results and feedback from the first round of surveys were available. Ms McCurrach responded that a first analysis of the responses received for the first round is available in the report here.

170 The **ICG noted** the report of WG-PICT and **approved** Recommendation ICG/PTWS-XXIX.6.

3.6. REPORT OF PACWAVE EXERCISE 2020

171 Mr Emilio Talavera (Nicaragua), Co-Chair of the TT on PacWave, presented the report of PacWave Exercise 20, available as Document.

172 Mr Talavera recalled the leadership and membership of the TT on PacWave, noting that Ms Margarita Martinez (Chile) had been integrated as Co-Chair. Due to the Covid-19 pandemic, the scope of PacWave20 was limited compared to previous exercises. Several MS were not able to dedicate sufficient resources to the exercise given the pandemic. In this context, the ICG/PTWS SC recommended that PacWave 20 only test objectives (a) Communication test and (d) CATAC regional exercise. Other activities were encouraged but at the discretion of the country. As such, the exercise consisted of a communications test (5 November 2020) and the CATAC regional exercise (11 November 2020). A SEP regional exercise (22 October 2020) was also conducted according to Objective (c).

173 Mr Talavera summarized the timeline and process for PacWave20, noting that the exercise was announced through Circular Letter 2812 (21 October 2020), the Exercise Manual (IOC TS 155) was shared on 22 October 2020, two webinars were conducted on 28 and 29 October 2020, evaluation forms were available from November to 21 December 2020, and a draft summary report was prepared for September 2021 and will be circulated at ICG/PTWS-XXIX. Mr Talavera underlined that only 24 countries submitted evaluation forms, even though many more received the communications test. The report of PacWave 20 is due to be published in January 2022. Multiple methods were used to communicate this exercise, including the PacWave 20 website (www.pacwave.info), Twitter, and a Hashtag (#PacWave20).

174 For the communications test, PTWS TSPs (PTWC, NWPTAC, SCSTAC and CATAC) issued a communication to Member States Tsunami Warning Focal Point (TWFPs) and NTWCs through various methods.

175 The SEP exercise was conducted without external involvement and involved Chile, Colombia, Ecuador and Peru TWC. The role of PTWC was played by Peru. The exercise scenario consisted of a Mw8.8 earthquake north of Tonga. A total of 40-50 messages were disseminated over six hours. During this time, sea-level stations and DART buoys were monitored and regional coordination procedures were improved. The TsuCat tsunami coastal assessment tool was used during this exercise. This tool allows countries to choose their own scenario and conduct their own exercises using the PTWC public text and enhanced graphical products. A report was disseminated and is available on the PacWave website.

176 Regarding the CATAC regional exercise, it was hosted by Nicaragua Instituto Nicaragüense de Estudios Territoriales (INETER) and the scenario consisted of a slow earthquake and tsunami off the coast of Fonseca. They used TOAST as a way to provide modelling information, forecast, and help countries with decision-making. The countries from the Pacific and Caribbean coasts participated, including Guatemala, El Salvador, Honduras, Nicaragua, Costa Rica, and Panama. This was the second CATAC regional exercise, the first of which occurred on 19 August 2019. This second exercise further developed existing services and products.

177 Several countries also conducted national exercises, including Fiji, Tuvalu and Vanuatu who conducted full-scale exercises, as well as Colombia and Russia.

178 Mr Talavera reported on findings from the communications test, noting that the live communications test from TSPs to TWFPs (Objective A) was successful. PTWC, NWPTAC and SCSTAC dummy messages were received in a timely manner by email and 35 percent received them by GTS. Due to the pandemic, many countries did not test national communication and coordination (Objective B) or national readiness (Objective C) within their country. For countries that did hold national exercises, the majority disseminated the warning message to emergency services and other national and local government agencies. The warning message was usually disseminated by email or SMS, although social media methods of dissemination were also used, and nearly all these communication methods were considered timely and effective. All indicated that the NTWC/national disaster management office were accurate and clear.

179 With regards to readiness (Objective B), Mr Talavera reported that whilst most respondents indicated their country has mass coastal evacuation plans, only 27 percent have tsunami evacuation routes and maps for all tsunami-vulnerable communities. In addition, only 13 percent undertook community evacuation. Nearly all have developed and disseminated tsunami-related public education and awareness materials, but only 33 percent have tsunami curriculum programmes in place for all levels of education.

180 With regards to regional planning (Objectives C and D), few countries tested regional communication and cooperation between countries due to the pandemic. With regards to the CATAC regional exercise, respondents indicated that text and graphical products from CATAC were understood and useful, and assisted with decision-making. In addition, although few countries tested regional communication and cooperation between countries, those who did reported that exercise planning, conduct, format and style were very satisfactory; exercise documents and website were useful and detailed, and about half used TsuCat for exercise planning and hazard assessment.

181 Mr Talavera concluded that overall, the PacWave 2020 exercise was successful, with highlights including choice of scenarios available, and the opportunity to test response procedures, SOPs and communication methods. Several respondents highlighted the enthusiasm of participants, whilst others noted that key stakeholders were not present. Mr Talavera identified several gaps and opportunities to improve on, including coordinating with other ICG exercises to avoid overlap, more proactive engagement with stakeholders earlier in the planning process, and creating guidelines for conducting virtual exercises, review tsunami reporting formats (wave height vs tsunami amplitude), and additional forecast points requested by French Polynesia. In addition, for the tsunami evaluation process, suggested improvements include providing a copy of the completed evaluation form after submission and providing options to skip sections.

182 The **ICG noted** the report of the PACWAVE EXERCISE 2020.

4. POLICY MATTERS

4.1. TSUNAMI READY PILOT PROGRAMME

183 Dr Laura Kong, Director of ITIC, presented the report, available as a Presentation.

184 Dr Kong recalled the proposed structure of the UN Decade Tsunami Programme, its objectives to seek major advances in science and preparedness, and its goal towards resilience. Under this programme, new observational and analysis technologies will move from a high-uncertainty assumption-based capability to a low-uncertainty dynamic-based capability.

Communities will respond to tsunami threats by combining 1) Accurate real-time impact forecasts with 2) Deep community preparedness. This allows for tsunami disaster impacts to be minimized, enabling rapid restoration of critical infrastructure and services. Overall, comprehensive institutional and community preparedness and capacity building efforts will be aimed at achieving IOC Tsunami Ready designation across all socio-economic categories.

185 The main societal outcome of the UN Ocean Decade that pertains to the Tsunami Programme is the “Safe Oceans” outcome. Within this, the proposed outcome of the Tsunami Programme is to “Make 100 percent of communities at risk of tsunami prepared for and resilient to tsunamis by 2030”. To achieve this, there has been a request to establish a Tsunami Coalition to collaborate with critical UN stakeholders, civil protection, and others with the objective of raising the profile of the programme and facilitating resourcing. Capacity development will also be increase through OTGA, which provides key training and curricula.

186 Dr Kong next went through the Tsunami Ready indicators which provide a strategy and framework for the Tsunami Programme. There are three categories of indicators which are “assessment”, “preparedness” and “response”, with a total of 12 indicators. The framework of this programme provides harmonized global guidelines through IOC Tsunami Ready as well as a performance-based community recognition.

187 Dr Kong next highlighted the success of the “Tsunami Ready Shout-Outs”, noting that there were 36 contributions from 26 countries and four organizations. She shared on-screen videos for the Eastern Pacific, Pacific Islands and Western Pacific “Shout-Outs”.

188 Dr Kong highlighted the governance of the Tsunami Decade. She recalled that the TOWS-WG decided on the ‘A Safe Ocean’ societal outcome’ aim to make 100 percent of communities at risk of tsunami prepared for and resilient to tsunamis by 2030 through the Tsunami Ready Programme and other initiatives. It also adopted the Tsunami Ready Guidelines (IOC Technical Series 74, in press) as an international standard for evidence-based community preparedness. It agreed to enhance access and capacity development (high-resolution digital elevation model, tsunami sources) for inundation modelling/evacuation mapping; and to enhance integration to minimize disaster impacts, including through rapid restoration of socioeconomic activities and critical infrastructure services. The TOWS-WG also encouraged the use of best practices in engineering design and construction of evacuation shelters, especially against local tsunamis; and the use of IOTIC-compiled school disaster risk reduction and preparedness materials.

189 The TOWS-WG recommendations to ICGs, adopted during the IOC XXXI Assembly (2021), are to:

- Continue IOC - UNDRR WTAD strong collaboration,
- Urgently complete IOC Technical Series 74 Tsunami Ready recognition programme indicators / guidelines for widespread distribution,
- Include Local Tsunami Source SOPs as an important component of Tsunami Ready programme,
- Develop standardized trainings (online or in person) in particular through OTGA,
- For the next Tsunami Symposium, incorporate diversity in organizing committee (including all regions); venue for hybrid meeting to enable most people to successfully engage, explore funding.

190 Dr Kong next identified key milestones of the Tsunami Ready pilot programme, including the adoption of the Tsunami Ready Guidelines (IOC Manuals and Guides, 74) as an international standard for evidence-based community preparedness at a global level; the establishment of the Tsunami Ready programme process in upcoming meeting recommendations such as the ICG/PTWS-XXIX recommendation, the TOWS-WG approval on TT DMP recommendation (February 2022), and the IOC Executive Council approval (June 2022); and the deployment of the official Tsunami Ready programme in 2022.

191 Dr Kong noted that at the global level, it is the Tsunami Information Centres (TICs) that support facilitation of Tsunami Ready Guidelines. In addition, a Tsunami Ready website (here) has been established to provide supplementary support.

192 Dr Kong next underlined the key actions for the ICG/PTWS-XXIX with regards to the Tsunami Ready programme, including ensuring Tsunami Ready alignment with other PTWS and IOC documents; endorsing the establishment of the Tsunami Ready programme (from the pilot programme); and enabling PTWS support (including resources such as people, tools, and funding).

193 The **ICG noted** the report on Tsunami Ready.

4.2. PACIFIC EXERCISE 2022

194 Dr Laura Kong, Director of ITIC, presented the report on PacWave 22, available as a Presentation.

195 Dr Kong noted that, due to the Covid-19 pandemic, the scope of PacWave20 was limited compared to previous exercises. It only tested two of the four key objectives: (a) Communications test, and (d) CATAC regional exercise. The exercise therefore consisted of a communications test (5 November 2020), SEP regional exercise (22 October 2020) and the CATAC regional exercise (11 November 2020). Other activities were encouraged but were at the discretion of each country.

196 Dr Kong recalled that the SC (September 2021), approved the TT PacWave Exercise and approved PacWave22 to be conducted using the same objectives, following the same format and conducted as the original PacWave20. The SC also requested the TT to compile and summarize good practices for planning, conducting, and evaluating virtual exercises, and include this in an exercise manual; the post-exercise evaluation reporting for the PTWS Communications Test to be conducted earlier to accommodate reporting to ICG/PTWS-XXX (November 2022); and to explore more automatic and efficient ways to compile information prior to October 2022.

197 Dr Kong presented the PacWave 2022 exercise aims and objectives, highlighting that the exercise shall be conducted with the aim to test PTWS TSP arrangements, and country preparedness arrangements and operational procedures to respond to and recover from a destructive tsunami. It will also be conducted with the following objectives: to test communications from the PTWS TSPs to TWFPs and NTWCs; to test national communication and cooperation, and readiness within the country; to test regional communication and cooperation between Member States; and to support the development of tsunami procedures and products by the CATAC.

198 Dr Kong reported that the SC agreed that PacWave 2022 will be conducted from September to November 2022, with one live communications test from PTWS TSPs to Member States on 13 October 2022. Countries must report their test results within ten days pf the exercise. She noted that 13 October 2022 is the International DRR Day. The SC also requested that during PacWave 2022, Member States consider conducting for situations based on

limitations derived from the Covid-19 pandemic, such as the absence of warning centre duty officer(s), requirements for virtual exercises, and/or evacuations/sheltering considering physical distancing practices.

199 Dr Kong informed that PacWave 22 shall be announced by the IOC to Member States at least 240 days in advance of the exercise date. The exercise manual will include information on each regional exercise; inform Member States on the availability of exercise products for their region, including instructions to Member States regarding the distribution dates; and include instructions to Member States regarding their participation and the evaluation instrument be prepared with content and structure similar to what was prepared for previous Pacific-wide exercises, but considering lessons learned on conducting exercises in a pandemic context, and any need to collect other additional information. The manual will be distributed by the IOC to Member States at least 180 days in advance of exercise date, and will include the compilation and summary of good practices for planning, conducting, and evaluating virtual exercises. Finally, the manual will include guidance on the use of TsuCAT for planning and response, including the development of exercise scenarios. The results of the communications test will be reported at ICG/PTWS-XXX (November 2022). Participating Member States will be asked to complete and return the evaluation instrument no more than 21 days following the exercise.

200 Dr Kong summarized that in the upcoming months, the TT on PacWave will therefore provide the Exercise Manual; prepare the Summary Report for the exercise, compiling a list of recommendations and the list of actions from the findings for consideration by the ICG/PTWS-XXX; and provide guidance for conducting the next PacWave, tentatively planned for 2024.

201 Dr Kong next reported on the leadership and membership of the TT on PacWave, noting that she is stepping down from her leadership position and that Ms Margarita Martinez (Chile) and Mr Emilio Talavera (Nicaragua) are proposed as co-chairs of the TT. She also recalled that members of the TT are invited to join from the ICG/PTWS Member States and regional WGs, Secretariat of the Pacific Community (SPC), PTWC, NWPTAC, SCSTAC and CATAC.

202 Finally, Dr Kong highlighted that a PacWave informational video is in the process of being made with support of ITIC, IOC, the USA and Chile. This video will set out what PacWave is, why it is important, and what it does. It will include interview narratives from IOC, ITIC, PTWC, NWPTAC, Chile, the Philippines and El Salvador; visuals of previous PacWave and other exercises; and a Pacific Tsunami Ready shot-out. The video will likely be finalized by 7-8 December 2021.

203 The **ICG noted** the Report on PacWave22 and **decided** to carry out a tenth Exercise Pacific Wave in 2022 (PacWave 22) in the months of September through to November 2022, with one live communications test from PTWS TSPs to Member States on 13 October 2022.

4.3. CATAC

204 Dr Wilfried Strauch, Chairperson of ICG/PTWS, presented the report for CATAC, available as a Presentation.

205 Dr Strauch recalled that the creation of CATAC was accepted by ICG/PTWS, ICG/CARIBE-EWS and the IOC Assembly in 2015. In 2019, the CATAC reinforcement project was completed with Japan and ICG/PTWS and ICG/CARIBE-EWS accepted experimental operation of CATAC.

206 CATAC relies on 300 seismic stations in CA and 200 global seismic stations via Incorporated Research Institutions for Seismology (IRIS). There are two watchstander 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 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, NTWC, nine civil protection agencies and one regional coordinating body (CEPREDENAC).

207 Dr Strauch indicated the CATAC AoS and area of monitoring. He identified the location of seismic stations in and around CA used by CATAC, noting insufficiencies in Honduras, Panama, and Costa Rica. Indeed, in Honduras only three of the 14 stations are in operation due to Covid-19, only ten of the 22 stations of the Universidad de Costa Rica (UCR) in Costa Rica are functional, and Panama only has one station.

208 A project was launched in 2021 to establish new seismic stations in Nicaragua, El Salvador, Costa Rica and Guatemala. New accelerographs are being installed with 25 in Nicaragua, 25 in El Salvador, 17 in Guatemala, and four in Costa Rica. This will enable reduction of the time needed for detecting and locating earthquakes, improved quality of results, the ability to calculate very fast Moment Tensor (and magnitude) of strong earthquakes with local stations (not saturated), and enable the creation of Shakemaps (Shakemaps) and seismic impact recording in major installations.

209 Dr Strauch next recalled the capacity requirements for TSPs, noting that CATAC fulfills the following requirements:

- Access to real time data sources and capability to produce standardized seismic/sea level parameters,
- Appropriate historical database of earthquakes and tsunamis,
- Maintain or have access to benchmark, pre-calculated numerical model scenarios,
- Revise advisories in light of additional seismic and sea level data,
- Provide timely and effective tsunami advisories to respective NTWCs/TWFPs – in CA,
- Adequately trained and experienced staff, utilities, and resources to operate functionally 24 hours per day, seven days per week (24/7),
- Adequate infrastructure and back-up facilities to continue operating during power cuts and national emergencies such as all critical equipment on 30-minutes UPS, generator or alternative power backup (with one day of back-up capability), all critical equipment operating in duplicate and all critical communications circuits with backup.

210 With regards to the requirement for dissemination of tsunami forecast information freely and timely to NTWCs/TWFPs on the GTS and Internet and all other possible means of communication, Dr Strauch noted that the GTS is currently in preparation and will be available by January 2022. Regarding the requirement to provide products in globally standard formats, CATAC is currently disseminating products in simplified regional formats in Spanish, as this is considered more understandable, especially for civil protection agencies. Finally, relating to the requirement for staff to be able to communicate in English, Dr Strauch reported that this is fulfilled with 16 of the 19 staff being fluent in English.

211 Dr Strauch next reported on CATAC 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 AoS (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 will likely satisfy all requirements, although no large earthquakes have occurred within CA to test all KPIs. CATAC has also experienced some communications disruptions.

Dr Strauch presented the personnel employed by CATAC. He also noted appreciation cooperation with CA scientific bodies, including Nicaragua INETER; the MARN and General Directorate of the Environmental Observatory (MARN-DGOA); the INSIVUMEH; the Honduras Comisión Permanente de Emergencias (COPECO) and UNAH University; the Costa Rica SINAMOT, the Observatorio Vulcanológico y Sismológico de Costa Rica (OVSICORI), and UCR; and the Panama Institute of Geosciences of the University of Panama (IGC-UPA), Panama Canal, and Ángel Rodríguez. He highlighted that the purpose of CATAC is notably to support national institutions in their national tsunami warning.

212 The main systems used by CATAC are SeisComP for automatic seismic processing, interactive seismic processing, calculation of the Momentum Tensor from which magnitude is derived, and sending seismological and tsunami messages (on seismological basis). There is also a tsunami database with pre-calculated solutions. Finally, TOAST is used for numerical tsunami simulation; sending of simulation product messages, arrival times and amplitudes; and processing of tide gauge records.

213 Dr Strauch next set out the tsunamigenic potential adopted by CATAC, noting that it was identical to other PTWS TSPs based on seismological parameters. He also presented the criteria for different types of newsletters including seismological information, tsunami information, and tsunami hazard messages. Dr Strauch briefly showed maps of seismic catalogues, tsunami source descriptions, and based on historical tsunami databases.

214 Dr Strauch next presented a detailed timeline of the creation of CATAC during its pilot phase (2019-2021). During this time, only seismological messages were routinely sent. Tsunami advisory was conducted in a less formal manner via social media communications with alert recipients in the region immediately after the earthquake. In the experimental phase, CATAC achieved several advances, including doubling of the 24/7 shift staff, employing two people per shift, and staff training.

215 The accuracy and speed of earthquake and tsunami processing in general was improved. Experience was gained with the processing of strong earthquakes that occurred in the region, including five earthquakes with magnitudes greater than Mw7, eight earthquakes with between Mw6.5 and Mw7, and a large number of earthquakes with less than Mw6.5. Areas have been identified where local tsunamis can impact in less than ten minutes after the earthquake or tsunami generation. Thus, CATAC was dedicated to accelerating the processing of earthquakes and tsunamis. To reduce the processing time and improve the reliability of the products, a series of concrete measures were taken, including greatly densifying the seismic networks in Nicaragua, El Salvador, and Guatemala through the EWARNICA project with Switzerland, while improving the accuracy of earthquake locations. With the CATAC earthquake early warning methods, CATAC obtains a first location and magnitude of the earthquakes occurring in CA within a few seconds after the start of the event and also accelerated the calculations of the Moment Tensor and the Mw magnitude. CATAC finalized the development of its tsunami database, which yields tsunami parameters within a few seconds after establishing earthquake parameters.

216 Moment Tensor calculation was optimized (with the SCAUTOMT and SCMTV modules of SeisComP), allowing the use of data from accelerographic stations that are not saturated by strong shaking near the epicenter. Results are provided rapidly, with focal parameters of the earthquake and magnitude provided within less than ten minutes, which accelerates the tsunami simulation in real-time and the generation of tsunami products. CATAC also optimized the configuration of the TOAST module for tsunami simulation in its SeisComP system.

217 CATAC also worked to improve the rapid dissemination of products in Nicaragua and other CA countries. It cooperated with various foreign and national entities to develop and introduce methods for mass dissemination of earthquake and tsunami warning messages. In Nicaragua, the dissemination of messages via digital television has started. Through the EWARNICA project, CATAC also promoted the application of this method in other countries of the region in the coming years.

218 In Nicaragua, 20 additional sirens were installed in communities along the Caribbean coast. Together with the 60 sirens already in place since 2015, Nicaragua now has a total of 80 of these devices for tsunami warning and other emergencies. Thus, the vast majority of the entire population under tsunami danger can receive CATAC warnings by this means. The installation of sirens has also begun in the other CA countries. CATAC has also worked on the development of other methods for sending messages to the population through social networks, smartphone applications and direct communication between computers. An experimental phone application developed by CATAC allows the user located in a community on the Pacific coast to know the status of the tsunami warning and evacuation routes.

219 In addition, CATAC has established its website, which provides information on earthquakes and tsunamis for the target audience of CATAC products and for the general public. CATAC, in cooperation with Switzerland, also developed the Shakemaps website of strong earthquakes recorded by CATAC that shows the impact of earthquakes, which is important when assessing the situation of coastal populations after an event.

220 As CATAC can be temporarily affected by adverse circumstances and lose its ability to work partially or completely, a closer cooperation with MARN/El Salvador was developed with the objective of having MARN act as a backup for CATAC.

221 In addition, CATAC with other seismological institutions in CA and Spanish universities is preparing a new project to investigate seismic hazard and crustal structure in northern CA. Particular studies were proposed that will have beneficial results in the medium term for tsunami warning (e.g. a regional model of seismic velocities, and improvement of the seismic monitoring of Honduras).

222 CATAC is preparing the use of GPS/GNSS in the process of seismological monitoring and characterization of large earthquakes. In 2021, Nicaragua established real-time transmission of high frequency data sampling from 25 GPS/GNSS stations to CATAC, retransmitted these data to UNAVCO and is working to implement software that allows the data to be used routinely.

223 Dr Strauch underlined that CATAC is working to ensure its sustainability and impact through several means, including creating documentation to facilitate integration of CATAC and the earthquake warning system in INETER´s institutional structure, to ensure sustainability according to the proposals of the joint project with JICA. It also ensures sustainability by promoting CATAC´s integration into the SICA system as a regional early warning agency, sharing through relevant CA scientific institutions data in sufficient quality and quantity for the rapid processing of earthquakes and tsunamis from seismic, accelerographic, tide gauges and GNSS stations. CATAC also works towards sustainability by supporting scientific institutions relevant to seismology and tsunami in CA to increase their level of cooperation and integration to take optimal advantage of all capabilities. CATAC also will support civil protection agencies of the CA countries to take advantage of new forms of alert dissemination to rapidly send alerts based on CATAC´s advisory to the population at risk. Joint seismology studies will also be conducted to improve seismic wave velocity and attenuation models within the frame of regional and international projects.

224 Dr Strauch presented the recommendation to ICG/PTWS-XXIX for CATAC, to, in concordance with the decision of the ICG/PTWS WG-CA in its meeting on 15 November 2021, admit the start of CATAC's full functionality as of 17 January 2022.

225 The USA congratulated Dr Strauch and CATAC on setting up a new TSP for the PTWS region. The USA also enquired whether CATAC will cover the Pacific and Caribbean coasts of CA from its onset in 2022. The USA also enquired whether CATAC is intending to use the WMO headers to disseminate GTS information and suggested that, even before GTS is used, that CATAC consider sharing its alert products with other PTWS TSPs.

226 Dr Strauch responded that CATAC will indeed cover the Pacific and Caribbean coasts from the onset of its full operation, noting that due to a higher density of stations in CA compared to the Caribbean region, there will be shorter timings for sending messages in the former. With regards to the use of GTS, Dr Strauch explained that CATAC intends to first send email communications, and during this time work with the Nicaragua Meteorology Service to set up GTS communications.

227 The USA emphasized that additional cooperation between TSPs should be sought to develop capability, suggesting that a TT focused on coordination and standardization of TSPs be developed. The USA notably recalled a similar suggested made by PTWC (specifically, Dr McCreery) earlier in the meeting. The USA also expressed appreciation and acquiescence with Dr Strauch's suggestion to first pursue communication by email, suggesting that TSPs be copied in these emails. Dr Strauch noted that email communications is already under way with Mexico, with a request made to Columbia.

228 Japan recalled the support from JICA in setting up CATAC and expressed its congratulations to CATAC for developing into a new PTWS TSP.

229 The USA enquired whether the endorsement process of CATAC had already been pursued within the ICG/CARIBE-EWS. Dr Strauch responded that it had not, with CATAC having wanted to begin with endorsement from the ICG/PTWS.

230 The ICG/PTWS Technical Secretary, Mr Bernardo Aliaga, recalled that formal endorsement is also required from the IOC Executive Council or IOC Assembly and proposed that CATAC begin formal full operation immediately after the IOC Executive Council meeting in 2022.

231 The **ICG approved** Recommendation ICG/PTWS-XXIX.6.

4.4. PTWS STRATEGY 2022-2030

232 Ms Sarah-Jayne McCurrach (New Zealand) presented the PTWS 2022-2030 Strategy report, available as a Presentation and as a document.

233 Ms McCurrach recalled the timeline for creating the PTWS 2022-2030 Strategy, noting that it was prepared per recommendation ICG/PTWS-XXVIII.3 which requested development of "a draft PTWS Medium-Term Strategy for 2022-2029 to be discussed by the PTWS SC in 2020, and approved by the next ICG/PTWS session in 2021. The draft Medium-Term Strategy for 2022-2029 should take in account the SFDRR, KPI process and the PTWS drivers of the UN Decade of Ocean Science for Sustainable Development." The PTWS SC reviewed a first draft of the document, and the final draft is now available for endorsement by ICG/PTWS XXIX.

234 Ms McCurrach provided an overview of key changes, amendments and additions to the Strategy. She began by sharing the structure of the PTWS Strategy 2022-2030. The purpose of the Strategy is to provide a structured pathway for governance and co-ordination of the

PTWS. The Strategy, under the leadership of IOC and the ICG/PTWS, will drive the work programme of PTWS and keep the region accountable. This will be done through a SC to provide guidance, WGs aligned with the objectives of the Strategy to deliver on programmes of work, and TTs to work on specific projects.

235 Ms McCurrach set out the mission, vision, and goal for the PTWS. These will be achieved through delivering on the following objectives: Understanding and managing tsunami risk and hazard; tsunami detection, warning and dissemination; enhancing tsunami preparedness for effective community response; and international coordination and cooperation and partnership.

236 Ms McCurrach highlighted that a change from previous drafts was the inclusion of a section on the current state of the PTWS, following a request from Japan (ICG/PTWS SC, September 2021). She also noted that this section was included in the last PTWS Strategy (2014-2021), but had been removed due to insufficient country reporting, which the analysis of the state of the PTWS is based on. For the PTWS Strategy 2022-2030, the current state of the PTWS has been developed from the analysis of Member State's self-assessment of their performance, against the PTWS Framework for Future Goals and Performance Monitoring of Risk Reduction Tsunami Hazard Warning and Mitigation. An update of the current state will be provided when this Strategy is reviewed in 2030. Areas for improvement, with associated recommendations, have been made to ICG/PTWS-XXIX in the TT Future Goals and Performance Monitoring report.

237 The PTWS Strategy 2022-2030 aims to align with other important international frameworks, including the SFDRR 2015-2030, especially target 'g' which aims to enhance of prevention and preparedness including by substantially increasing the availability of and access to multi-hazard early warning systems (MHEWS) and disaster risk information and assessments to the people by 2030. The Strategy also strives to align with the UN Ocean Decade and specifically the 'Safe Ocean' societal outcome and the Ocean Decade Tsunami Programme. Finally, the Strategy aims to align with the IOC Strategy's goal to have a people-centered tsunami warning and mitigation system.

238 Ms McCurrach also highlighted other notable edits, stating that key changes had been made to the 'guiding principles', 'achieving our goal and strategic objectives', and 'meeting our objectives'. In addition, the role of Member States was also updated to include that TSP's are expected to align their activities with this strategy and contribute to the fulfillment of its objectives, to improve tsunami risk management in their coastal communities. With regards to monitoring progress, she emphasized that monitoring the performance of the PTWS against the Strategy is critical to ensure progress toward the PTWS vision. The ICG/PTWS needs to be held accountable in order to identify gaps and opportunities. Measuring progress will rely on the annual assessment of ICG/PTWS WGs, TTs and Member State contributions and participation. The PTWS capacity as a collective and individual Member States will be dependent on PTWS resources and abilities. These can be identified via annual review.

239 Lastly, Ms McCurrach identified next steps for the PTWS Strategy 2022-2030, including finalizing and publishing a final draft; for the SC, WGs and TTs to ensure the Strategy is used when setting their work programmes; for Member States and the SC to agree to monitor progress against the Strategy via the PTWS and/or Global Tsunami Performance and Monitoring Framework.

240 The intra-sessional WG presented a report on the results of the discussion.

241 The **ICG approved** the PTWS Strategy 2022-2030 as presented to the 29th PTWS session with minor amendments.

4.5. UN OCEAN DECADE

242 Mr Michael Angove (USA) presented the report on the PTWS involvement in the UN Ocean Decade, available as a Presentation.

243 Mr Angove recalled that the IOC Assembly XXXI (14-25 June 2021) approved the establishment of the Ocean Decade Tsunami Programme, a Scientific Committee to prepare the Draft Ten-Year Research, Development and Implementation Plan and Tsunami Ready Coalition.

244 Mr Angove next recalled the outline and rationale of the Ocean Decade Tsunami Programme. Under this programme, new observational and analysis technologies will move from a high-uncertainty assumption-based capability to a low-uncertainty dynamic-based capability. Communities will respond to tsunami threats by combining 1) Accurate real-time impact forecasts with 2) Deep community preparedness. This allows for tsunami disaster impacts to be minimized, enabling rapid restoration of critical infrastructure and services. Overall, comprehensive institutional and community preparedness and capacity building efforts will be aimed at achieving IOC Tsunami Ready designation across all socio-economic categories.

245 He next highlighted some of the science and technology initiatives for the development of the global tsunami warning system. These include new potential sources of seismic observations for tsunami warning systems using locations and magnitudes of historical seismic events, DART tsunami buoys, SMART cables, and real-time GNSS stations. Other initiatives are the high-resolution mapping of all tsunami-vulnerable coastlines (topography and bathymetry), improving data exchange, improving speed of the tsunami detection and measurement system on the basis of new technologies, scaling up the IOC Tsunami Ready programme, increasing capacities for tsunami warning and mitigation in small island developing states and less developed states, and ensuring interoperability with other components of a global coastal MHEWS.

246 Mr Angove next presented the planning overview for the Ocean Decade Tsunami Programme. From an overall planning and execution perspective, they envision the TOWS-WG serving as the Global SC, with primary functions of establishing a Scientific Committee to develop the Ten-Year Decade Research, Development and Implementation Plan, as well as the Special Coalition on Tsunami Ready. A key component is identifying Member State Contributions that can be matched to the scientific plan and Tsunami Ready objectives and developed into pilot projects, experiments, or outreach and education activities with the assistance of the ICG regional SCs.

247 Mr Angove identified and explained potential PTWS contributions in the programme. The PTWS can support governance, notably by establishing a TT to facilitate and guide UN Ocean Decade Tsunami Programme implementation within PTWS, as well as set up inter-ICG coordination on decade matters. In addition, establishing projects and experiments relevant to the programme, notably including SMART cables, GNSS, and DART. A key element will be to assume a lead role in the Tsunami Ready Coalition as well as scale up implementation through regional resource hubs (establish ‘community of practitioners’), online training and support. In addition, Mr Angove noted that representation of PTWS at conferences and fora was important, including the UN Ocean Decade laboratories and themed events, professional conferences, and UN and regional events. PTWS can also support capacity development and education initiatives such as OTGA, as well as encourage involvement of early career professionals and promote gender-balanced participation in tsunami activities.

248 The intra-sessional WG presented a report on the results of the discussion.

249 The **ICG approved** Recommendation ICG/PTWS-XXIX.7.

5. PROGRAMME AND BUDGET FOR 2020–2021

250 Mr Bernardo Aliaga, Technical Secretary of the ICG/PTWS, reported on the resources assigned from the UNESCO regular budget to the work of the Tsunami Unit of the IOC. He shared on-screen the draft programme and budget for 2022-2025 (41 C/5) and specifically for the first biennium (2022-2023). This document is available on the website (here). He indicated that for the biennium 2022–2023 there is a slight reduction in the regular budget, mainly due to budget rearrangement to allow allocation of more funds to the UN Ocean Decade. As such, most activities will be funded with extra-budgetary contributions.

6. NEXT SESSION

6.1. CONFIRMATION OF DATE AND PLACE OF ICG/PTWS-XXX

251 The Chair recalled the date and place of previous ICG/PTWS sessions, including ICG/PTWS-XXVI in Honolulu, USA (April 2015), ICG/PTWS-XXVII in Tahiti, French Polynesia (March 2017), ICG/PTWS-XXVIII in Montelimar, Nicaragua (April 2019), and this ICG/PTWS-XXIX held online.

252 The Chair further recalled with appreciation Japan's offer at ICG/PTWS-XXVIII to host ICG/PTWS-XXIX. However, due to the ongoing Covid-19 pandemic, the decision was taken at the ICG/PTWS SC meeting (September 2021) to host ICG/PTWS-XXIX online.

253 Japan confirmed its offer to host the ICG/PTWS-XXX session, noting that it would take place in November 2022 with the specific location to be determined, and if the pandemic allows.

254 Dr Laura Kong (ITIC-USA) proposed that a Tsunami Symposium or workshop focused on the UN Ocean Decade be held prior to ICG/PTWS-XXX. Dr Kong recalled that an International Tsunami Symposium was originally planned for ICG/PTWS-XXIX but was postponed. She also recalled that the PTWS traditionally convenes a Symposium prior to ICGs for the ICG/PTWS to discuss science activities and best practices. These Symposiums are traditionally co-funded by IUGG Joint Tsunami Commission, UNESCO/IOC and the host country. These events provide an excellent opportunity for Member States to participate, share and learn. The outcomes of the Symposium are reported back to the ICG and guide ICG discussions and outcomes. They also provide a means to evaluate, benchmark, and obtain feedback on PTWS priorities and directions. Dr Kong noted that, in terms of organizational mechanics, the ICG/PTWS would need to set up a Symposium Organizing Committee (ITIC is willing to lead, working with the host country and any other Member States) and a Local Organizing Committee.

255 France expressed support for ITIC's proposal.

256 The **ICG accepted** the offer of Japan to host the ICG/PTWS-XXX session and instructed the Secretariat to coordinate the details with the Government of Japan. Japan will confirm whether they will hold a Tsunami Symposium at the next session of the SC.

6.2. TARGET DATE AND PLACE OF ICG/PTWS-XXXI

257 The Chair noted that, due to a lack of offers for hosting of the ICG/PTWS-XXXI session, the location and date of this meeting will be discussed at ICG/PTWS-XXX.

7. ELECTIONS OF OFFICERS

258 Mr Ken Gledhill, Chair of the Elections Committee, reported that the election of officers of the ICG/PTWS was announced with the Invitation in Circular Letters, 2755, providing the required forms. The deadline for nominations was set in circular letter and confirmed in the Annotated Agenda. Mr Gledhill stated that the Report of the Elections Committee is available as document.

259 Nominations were received by the Secretariat before the deadline for all open Officers positions. Each nomination was duly dated, timed and signed by the Secretariat.

260 The Elections Committee, composed of Chantal Donnelly (Australia), Ken Gledhill (New Zealand) and Roberto Pineda (Panama) met during the session. It duly scrutinized the nomination papers. One nomination was received for the position of chair and two nominations were received for the vice-chair positions. The nominations were considered complete, correct and in the required form and format.

261 The Elections Committee reported that there was only one nominee for each position and therefore there was no need for voting to take place.

262 The **ICG accepted** the proposal of the Elections Commission and **elected** the Officers by acclamation as follows:

- Chair: Mr Yuji Nishimae (Japan)
- Vice-Chair: Dr Wilfried Strauch (Nicaragua)
- Vice-Chair: Mr David Coetzee (New Zealand)

263 The Chair, Dr Wilfried Strauch, congratulated Mr Nishimae and Mr Coetzee on their new positions. Mr Nishimae expressed appreciation to the ICG for his election. He noted that although the ICG/PTWS had struggled during the past inter-sessional period due to the Covid-19 pandemic, ICG/PTWS TSPs and Member States had continued implementing activities and progressing in tsunami EWS, and he is dedicated to continuing progress and growth of the ICG/PTWS. Mr Coetzee thanked the ICG for bestowing their confidence on his leadership as Vice-Chair and that he looked forward to serving the ICG/PTWS in this new capacity.

264 The USA thanked Dr Strauch for his leadership and congratulated Mr Nishimae for accepting to take on the leadership of ICG/PTWS during the next inter-sessional period. The USA also expressed their hope that the next ICG/PTWS meeting would be held in person.

265 Mr Bernardo Aliaga, the Technical Secretary of ICG/PTWS, presented the leadership and membership of ICG/PTWS WGs and TTs, noting that current leadership had the option to be extended for the next intersessional period until ICG/PTWS Session.

266 The **ICG accepted** the proposal of the Elections Commission and **elected** the Officers by as follows:

- Working Group 1 Understanding Tsunami Risk: Co-Chairs Dr Diego Arcas (USA) and Ms Sarah-Jayne McCurrach (New Zealand)
- Working Group 2 Tsunami Detection, Warning and Dissemination: Chair Bill Fry (New Zealand)
- Working Group 2, Task Team on Seismic Data Sharing in the South West Pacific: Chair Rennie Vaiomunga (Tonga) and Vice-Chair Mathew Moihoi (Papua New Guinea)

- Working Group 2 Task Team on Integrated PTWS sensor networks for tsunami detection and characterization: Co-Chairs Dr Bill Fry (New Zealand) and Dr Tim Melbourne (USA)
- Working Group 2 Task Team on Minimum Competency Levels for National Tsunami Warning Centre (NTWC) Operations Staff: Co-Chairs Mr Ofa Fa'anunu (Tonga) and Dr Laura Kong (ITIC, USA)
- Working Group 2 Task Team of the Tsunami Service Providers (TSPs): Chair Dr Charles McCreery (USA)
- Working Group 3 Disaster Risk Management and Preparedness: Chair Ms Ashleigh Fromont (New Zealand) and Vice-Chair Laura Kong (ITIC, USA)
- Regional Working Group on Tsunami Warning and Mitigation on the Central American Pacific Coast: Chair Ms Griselda Marroquin (El Salvador) and Vice-Chair Dr Silvia Chacón (Costa Rica)
- Regional Working Group on Tsunami Warning and Mitigation in the South East Pacific Region: Chair Lt Fausto Bravo (Chile) and Vice-Chair Mr Marcelo Acosta (Ecuador)
- Regional Working Group on Tsunami Warning and Mitigation in the South China Sea Region: Chair Mr. Dakui Wang (China) and Vice-Chair Ms Suci Anugrah (Indonesia)
- Regional Working Group on Tsunami Warning and Mitigation in the South China Sea Region Task Team on Capacity Development and Services: Chair Dr Zhiguo Xu (China) with Vice-Chair to be elected
- Pacific Island Countries and Territories Regional Working Group on Tsunami Warning and Mitigation System: Chair Mrs. Esline Garaebiti (Vanuatu) and Vice-Chair Mr. Mathew Moihoi (Papua New Guinea)
- Pacific Island Countries and Territories Working Group, Task Team on Capacity Development: Chair Mr Ofa Fa'anunu (Tonga)
- Task Team on PacWave Exercises: Co-Chairs Mr Emilio Talavera (Nicaragua) and Ms Margarita Martinez (Chile)
- Task Team on Future Goals and Performance Monitoring: Chair Ms Sarah-Jayne McCurrach (New Zealand) and Vice-Chair Ms Mary Rengifo (Colombia)
- Task Team on UN Ocean Decade: Co-Chairs Lt Cdr.Carlos Zuniga (Chile), Francois Schindele (France), and Mr Yuji Nishimae (Japan)

8. ANY OTHER BUSINESS

267 Dr Wilfried Strauch invited the TNC from Chile, RA P. Carrasco, to take the floor. RA P. Carrasco shared a farewell message to the Plenary as he is departing from his role as the TNC for Chile. He expressed thanks for the support provided by the PTWS Member States, in particular after the 2010 earthquake and tsunami in Chile. Through the support of IOC, PTWC, and PTWS generally, Chile has been able to greatly improve its TEWS and NTWC procedures. Once again, he expressed deep appreciation for his time as Chile TNC working with the PTWS

268 The Chair, Dr Strauch, expressed appreciation for the work and commitment of RA P. Carrasco and recalled personally visiting Chile in the aftermath of the 2010 earthquake and tsunami. He also recalled that RA P. Carrasco took over the TNC role after this event, and highlighted the great achievements reached since this time.

269 Several Member States recognized the national and regional contributions of RA P. Carrasco and deeply thanked him for his work in the PTWS.

9. ADOPTION OF DECISIONS AND RECOMMENDATIONS

270 The **ICG approved** 7 recommendations as included under ANNEX II.

10. CLOSURE

271 The Chairperson, Dr Strauch, thanked the ICG for their active participation during ICG/PTWS-XXIX, despite the online platform and challenging circumstances. He also expressed congratulations to all officers that had been elected to ICG/PTWS leadership positions. Dr Strauch also expressed appreciation for everyone that had supported him as Chair of the ICG during the past intersessional period, and specially the ICG Secretariat and the Technical Secretary, Mr Bernardo Aliaga. He also thanked the technical team of Gilsama Zoom, and especially translators, in enabling the ICG/PTWS to conduct a smooth and fruitful session. Finally, Dr Strauch thanked the ICG for their hard work and implementation of activities during the past intersessional period.

272 The Technical Secretary, Mr Aliaga, thanked the ICG/PTWS leadership and membership for their participation and commitment to tsunami work in the Pacific this year.

273 Mr Yuji Nishimae (Japan) thanked the ICG for the success of this session, notably appreciating the cooperation of Member States.

274 Dr Laura Kong (ITIC, USA) congratulated and thanked Dr Strauch for his leadership as Chair of ICG/PTWS, especially commending his work in developing CATAC. Dr Kong also thanked Mr Nishimae for and Mr Coetzee for taking up leadership positions in the upcoming intersessional period.

275 Several other countries, including Australia, Chile, Thailand, Panama, Costa Rica, Ecuador, China and Mexico expressed appreciation for the leadership of ICG/PTWS and the ICG/PTWS-XXIX meeting.

276 The session was closed at 00:30 (UTC) on 9 December 2021.

ANNEX I

PROVISIONAL AGENDA

Twenty-ninth Session of the Intergovernmental Coordination Group for the Pacific Ocean Tsunami Warning and Mitigation System
(ICG/PTWS-XXIX)

1. WELCOME AND OPENING OF SESSION

2. ORGANIZATION OF THE SESSION

2.1. ADOPTION OF AGENDA

2.2. DESIGNATION OF THE RAPPORTEUR

2.3. CONDUCT OF THE SESSION, TIMETABLE AND DOCUMENTATION

3. REPORT ON INTERSESSIONAL ACTIVITIES

3.1. CHAIRPERSON REPORT

3.2. SECRETARIAT REPORT

3.3. TSUNAMI SERVICES PROVIDERS REPORT
- 3.3.1. PTWC
- 3.3.2. NWPTAC
- 3.3.3. SCSTAC

3.4. REPORT OF ITIC

3.5. WORKING GROUPS AND TASK TEAM REPORTS

3.6. REPORT OF PACIFIC WAVE EXERCISE 2020

4. POLICY MATTERS

4.1. TSUNAMI READY PILOT PROGRAMME

4.2. PACIFIC WAVE EXERCISE 2022

4.3. CENTRAL AMERICA TSUNAMI ADVISORY CENTRE

4.4. PTWS MEDIUM TERM STRATEGY 2022–2030

4.5. UN DECADE OF OCEAN SCIENCE FOR SUSTAINABLE DEVELOPMENT

5. PROGRAMME AND BUDGET FOR 2022–2023

6. NEXT SESSION

6.1. CONFIRMATION OF DATE AND PLACE OF ICG/PTWS-XXX

6.2. TARGET DATE FOR ICG/PTWS-XXXI

7. ELECTIONS OF OFFICERS

8. ANY OTHER BUSINESS

9. ADOPTION OF DECISIONS AND RECOMMENDATIONS

10. CLOSURE

ANNEX II

ADOPTED RECOMMENDATIONS

Recommendation ICG/PTWS-XXIX.1

ICG/PTWS Governance

The Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System (ICG/PTWS),

Recalling IOC Resolution IV–6 that established the International Coordination Group for the Tsunami Warning System in the Pacific (ICG/ITSU) and IOC Resolution XXXIX-8 that renamed ITSU to be the Pacific Tsunami Warning and Mitigation System (PTWS) and to provide continuity through the Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System (ICG/PTWS),

Reaffirming that the PTWS is a coordinated network of national systems and capacities, and is part of a global network of early-warning systems for all ocean-related hazards,

Noting:

- Sendai Framework for Disaster Risk Reduction 2015–2030 was adopted by UN Member States on 18 March 2015 at the World Conference for Disaster Risk Reduction (WCDRR),

- IOC Executive Council Decision EC-XLIX/4.2 on IOC Contribution to the Sendai Framework for Disaster Risk Reduction 2015–2030,

- Recommendation ICG/PTWS-XXVIII.6 that recommended the UN Decade of Ocean Science for Sustainable Development (2021-2030) be endorsed by the TOWS-WG, be advocated for at the upcoming Ocean Decade Planning Group meeting, WMO Congress, IOC General Assembly, and the UN General Assembly,

- IOC Decision A-31/3.4.1 on Warning Mitigation Systems for Ocean Hazards approved the establishment of the Ocean Decade Tsunami Programme (PROGRAMME) and a Scientific Committee (SC) to prepare the Draft 10-Year Research, Development and Implementation Plan for this PROGRAMME,

- Recommendation ICG/PTWS-XXVIII.15 established a Working Group 2 Task Team on the integrated PTWS sensor networks for tsunami detection and characterisation,

Having reviewed the progress made in the implementation of the PTWS since the 28th Session of the ICG/PTWS,

Having considered the reports of:

- Working Group 1 on Understanding Tsunami Risk
- Working Group 2 on Tsunami Detection, Warning and Dissemination
- Working Group 3 on Disaster Risk Management and Preparedness
- Working Group 2 Task Team on the integrated PTWS sensor networks for tsunami detection and characterisation
- Working Group 2 Task Team on Seismic Data Sharing in the South West Pacific
- Task Team on PacWave20 Exercise, on PacWave20

- Task Team on Future Goals and Performance Monitoring
- Regional Working Group on Tsunami Warning and Mitigation System in the Central American Pacific Coast
- Regional Working Group on Tsunami Warning and Mitigation System in the South East Pacific Region
- Pacific Island Countries and Territories Regional Working Group on Tsunami Warning and Mitigation System
- Regional Working Group on Tsunami Warning and Mitigation System in the South China Sea Region
- Report of the Meeting of the PTWS Steering Committee, 21-23 September 2021 (Online)
- 14th Meeting of the Working Group on Tsunamis and Other Hazards Related to Sea-Level Warning and Mitigation Systems (TOWS-WG-XIV), 25-26 February 2021 (Online)
- North West Pacific Tsunami Advisory Center (NWPTAC)
- Pacific Tsunami Warning Center (PTWC)
- South China Sea Tsunami Advisory Center (SCSTAC)
- Central American Tsunami Advisory Center (CATAC)
- International Tsunami Information Center (ITIC)
- Chair's Report
- Secretariat Report

Having further considered the reports on:

- Report of Task Team on Future Goals and Performance Monitoring
- UN Decade of Ocean Science for Sustainable Development (2021-2030)

Acknowledging that the PTWS is effective in saving lives and reducing the impacts to communities in both near-field and distant-tsunami events through the three pillars of risk assessment and reduction, detection, warning and dissemination, and awareness and response,

Requests Member States to share any new forms of sea level data for tsunami warning purposes in accordance with the IOC Oceanographic Data Sharing Policy,

Decides to:

1. Continue *WG1 Understanding Tsunami Risk* with Terms-of-Reference as attached in Appendix 1 to Recommendation ICG/PTWS-XXIX.1. Elected Co-Chairs are Dr Diego Arcas (United States, second term) and Ms Sarah-Jayne McCurrach (New Zealand, second term),

2. Continue *WG2 Tsunami Detection, Warning and Dissemination* with Terms of Reference as attached in Appendix 1 to Recommendation ICG/PTWS-XXIX.1. Elected Chair is Dr Bill Fry (New Zealand, first term) with Vice-Chair to be elected,

3. Continue *WG2 Task Team on Seismic Data Sharing in the Southwest Pacific* with Terms-of-Reference as attached in Appendix 1 to Recommendation ICG/PTWS-XXIX.1. Elected Chair is Rennie Vaiomunga (Tonga, first term), and Vice-Chair is Mathew Moihoi (Papua New Guinea, first term),

4. Continue *WG2 Task Team on the Minimum Competency Levels for National Tsunami Warning Centre (NTWC) Operations Staff* with Terms-of-Reference as attached in Appendix 1 to Recommendation ICG/PTWS-XXIX.1. Elected Co-Chairs are Mr Ofa Fa'anunu (Tonga, second term) and Dr Laura Kong (United States, first term),

5. Continue *WG2 Task Team on the Integrated PTWS Sensor Networks for Tsunami Detection and Characterisation* with Terms-of-Reference as attached in Appendix 1 to Recommendation ICG/PTWS-XXIX.1. Elected Co-Chairs are Dr Bill Fry (New Zealand, second term) and Dr Tim Melbourne (United States, second term),

6. Continue *WG3 Disaster Risk Management and Preparedness* with Terms-of-Reference as attached in Appendix 1 to Recommendation ICG/PTWS-XXIX.1. Elected Chair Ms Ashleigh Fromont (New Zealand, first term) and Vice-Chair Dr Laura Kong (United States, second term),

7. Continue Sub-Regional Working Groups and Task Teams with same Terms of Reference except where noted:

   - *Regional Working Group on Tsunami Warning and Mitigation System in the South China Sea Region*. Chair Mr Dakui Wang (China) and Vice-Chair Ms Suci Anugrah (Indonesia). The Terms of Reference for this group remains unchanged,
   - *Regional Working Group on Tsunami Warning and Mitigation System on the Central American Pacific Coast* with Terms-of-Reference as attached in Appendix 1 to Recommendation ICG/PTWS-XXIX.1. Chair Ms Griselda Marroquin (El Salvador) and Vice-Chair Dr Silvia Chacon (Costa Rica). The Terms of Reference for this group remains unchanged,
   - *Regional Working Group on Tsunami Warning and Mitigation System in the South East Pacific Region* with Terms-of-Reference as attached in Appendix 1 to Recommendation ICG/PTWS-XXIX.1. Elected Chair is Lt Fausto Bravo (Chile, first term) and Vice-Chair Mr Marcelo Acosta (Ecuador). The Terms of Reference for this group remains unchanged,
   - *Pacific Island Countries and Territories Working Group on Tsunami Warning and Mitigation System* with Terms-of-Reference as attached in Appendix 1 to Recommendation ICG/PTWS-XXIX.1. Elected Chair is Mrs Esline Garaebiti (Vanuatu) and Vice Chair is Mr Mathew Moihoi (Papua New Guinea),
   - *Pacific Island Countries and Territories Working Group Task Team on Capacity Development* with Terms-of-Reference as attached in Appendix 1 to Recommendation ICG/PTWS-XXIX.1. Elected Chair is Mr Ofa Fa'anunu (Tonga, third term). The Terms of Reference for this group remains unchanged,
   - *Task Team on Future Goals and Performance Monitoring* with Terms-of-Reference as attached in Appendix 1 to Recommendation ICG/PTWS-XXIX.1. Elected Chair is Ms Sarah-Jayne McCurrach (New Zealand, second term), and Vice-Chair is Ms Mary Rengifo (Colombia, second term).

8. Dissolve Task Team of the Regional Working Group on Tsunami Warning and Mitigation in the South China Sea Region on Establishment of a South China Sea Tsunami Advisory Center,

9. Continue the *PTWS Steering Committee* with same Terms-of-Reference as attached in Appendix 1 to Recommendation ICG/PTWS-XXIX.1,

10. Dissolve Task Team on PacWave20 Exercises upon publication of the report,

11. Establish a *Task Team on PacWave Exercises* with Terms of Reference as attached in Appendix 1 to Recommendation ICG/PTWS-XXIX.1, Elected Co-Chairs are Mr Emilio Talavera (Nicaragua) and Ms Margarita Martinez (Chile),

12. Establish a *Task Team Capacity Development and Services* under the Regional Working Group on Tsunami Warning and Mitigation Systems in the South China Sea Region with Terms of Reference as attached in Appendix 1 to Recommendation ICG/PTWS-XXIX.1. Elected Chair is Dr Zhiguo Xu (China) with Vice-Chair to be elected,

13. Establish a *Task Team of the Tsunami Service Providers (TSPs)* under Working Group 2 with Terms of Reference as attached in Appendix 1 to Recommendation ICG/PTWS-XXIX.1, Elected Chair is Dr Charles "Chip" McCreery (United States, first term),

14. Establish a Task Team on UN Ocean Decade with Terms of Reference as attached in Appendix 1 to Recommendation ICG/PTWS-XXIX.1. Elected Co-Chairs are Mr.Carlos Zuniga (Chile, first term), Mr Francois Schindele (France, first term), and Mr Yuji Nishimae (Japan, first term),

Approves the PTWS Strategy 2022-2030 as presented to the 29th PTWS session with minor amendments,

Decides to carry out a tenth Exercise Pacific Wave in 2022 (PacWave 22) in the months of September through to November 2022 to support International Disaster Risk Reduction Day (13 October) and World Tsunami Awareness Day (5 November). It **further decides** that PacWave 22 will be conducted as a series of regional exercises organized through the PTWS Regional Working Groups where applicable, with support from the PTWS TSPs and ITIC, involving all PTWS countries, with one live communications test from the PTWS TSPs to Member States on 13 October 2022,

Accepts with appreciation the kind offer of Japan to host the 30th Session of the ICG/PTWS in 2022 in time and a location to be determined,

Congratulates Chair Mr Yuji Nishimae (Japan) and Vice Chairs Mr Wilfried Strauch (Nicaragua) and Mr David Coetzee (New Zealand) for being elected as the new leadership for the PTWS.

Financial Implications: None

Appendix 1 to Recommendation ICG/PTWS-XXIX.1

Terms of Reference

Working Group 1:
Understanding Tsunami Risk

1. Develop and promote best practice tsunami risk reduction material, programmes, standards and tools for understanding tsunami risk, to support emergency management and early warning, including but not limited to:

    - Hazard assessment and coastal inundation models and products
    - Risk assessment methodology and risk forecasting
    - Scenario assessments including maximum credible and most likely events to understand likely exposure, vulnerability and event frequency

- Forecast and threat models
- Evacuation and inundation modelling
- Use of new and improved data including Digital Elevation Modelling (DEM), GNSS and paleotsunami information

2. Work with International Union of Geodesy and Geophysics (IUGG) and other scientific bodies to ensure the translation of science information to support tsunami risk assessment and risk reduction. Develop recommendations for IUGG and other scientific bodies on science gaps in hazard assessment capability.

3. Better understand and develop best practice for assessing and reducing the risk of local source and non-seismic tsunami sources.

4. Develop projects in conjunction with subject matter experts and groups with specific interest to address gaps or areas for improvement in tsunami risk assessment and risk reduction.

5. Provide hazard specific support and advice to other ICG/PTWS working groups and working groups from other ocean basins, as well as other working groups to understand, coordinate and develop ways to address tsunami risk management.

The Group will be composed of members nominated by Member States, with two co-chairs, one from a science and one from a disaster risk management background, to be elected.

Terms of Reference

Working Group 2:
Tsunami Detection, Warning and Dissemination

Liaise with other working group(s) and Task Team(s) within the ICG/PTWS and with working groups from the other ocean basins through the TOWS-WG to:

1. Develop, coordinate and enhance operational implementation of interoperable tsunami threat information products and services.

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

3. Monitor and report on the performance of key observational, warning and communication system components.

4. Contribute to the conduct of regular exercises and communication tests of the PTWS.

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

6. Develop and maintain relevant documentation, such as the PTWS Users Guide.

7. Provide advice to the International Tsunami Information Centre (ITIC) on educational materials and for capacity building about the warning systems and services.

8. Help strengthen the capacity and capability of Member States.

The Working Group will be composed of members nominated by Member States, representatives for each ICG designated TSPs, ITIC, and invited observers, with a Chair and a Vice-Chair to be elected by the ICG.

Terms of Reference

WG2 Task Team
on Seismic Data Sharing in the South West Pacific

1. Advocate seismic data sharing in the region.

2. Advise South West Pacific countries on data sharing protocols, techniques and technologies.

3. Work with South West Pacific Countries and donors to ensure a common data sharing policy.

4. Encourage South West Pacific Countries with existing or planned broadband seismograph stations to (i) join the International Federation of Digital Seismograph Networks (FDSN), (ii) use the standards developed by the FDSN for data exchange and (iii) take advantage of the data archiving provided by FDSN.

Members are representatives of South Pacific Countries and territories (Australia, Fiji, France–French Polynesia, France-New Caledonia, New Zealand, Papua New Guinea, Samoa, Solomon Islands, Tonga, Vanuatu), PTWC, NWPTAC, Japan, and United States. Co-chairs to be elected by the ICG.

Terms of Reference

WG2 Task Team:
Minimum Competency Levels for National Tsunami Warning Centre (NTWC) Operations Staff

This expert Task Team will establish and document the minimum competency levels for NTWC operations staff and develop a framework for the competencies and training requirements of the roles of a NTWC.

1. Establish the minimum competency levels required for NTWC operations staff.

2. Establish a framework for the required competencies required by the roles of a NTWC.

3. Establish what training is required to ensure NTWC staff meeting minimum competency levels.

4. Investigate and document what schemes are currently in existence and what guidelines and principles can be adapted for this purpose.

The Task Team will be composed of Wilfried Strauch (Nicaragua), Ofa Fa'anunu (Tonga), Yuelong Miao (Australia), Chip McCreery (USA), Lara Bland (New Zealand), Laura Kong (USA), and Ken Gledhill (New Zealand). Co-chairs to be elected by the ICG.

Terms of Reference

WG2 Task Team:
Integrated PTWS Sensor Networks for Tsunami Detection and Characterisation

This expert Task Team will establish and document a methodology to test the sensitivity of the PTWS sensing networks, integrating new and emerging techniques and technologies by:

1. Developing a methodology for gap and sensitivity analysis that combines multiple sensing technologies for tsunami detection and characterisation.

2. Integrating emerging techniques and sensor technologies (e.g. better use of tide gauges; GNSS technology and processing; sensors on telecom cables) with the existing sensing network to meet tsunami warning service requirements.

3. Where possible, include cost-benefit analysis of the potential technologies being considered.

The Task Team will be composed of Tim Melbourne (United States), Bruce Howe (United States), Bill Fry (New Zealand), Mike Angove (USA), Diego Arcas (USA), Stuart Weinstein (USA), Ken Gledhill (New Zealand) and Grigory Steblov (Russian Federation), Co-chairs to be elected by the ICG.

Terms of Reference

WG2 Task Team:
Tsunami service Providers (TSPs)

1. Share with each other their response to significant events including a timeline of actions, analyses made and the result of those analyses, decisions made and the basis for those decisions, the timeliness and accuracy of products issued, and any other notable successes or challenges.

2. Share with each other information about existing and any new methodologies for rapidly detecting and characterizing tsunami source events, for detecting and measuring tsunami waves, and for forecasting tsunami propagation and impacts.

3. Share with each other information on the effectiveness of products including format and content to make them understandable and actionable, dissemination methods and their testing, and any other support to customers prior to and during events.

4. Report to ICG on Task Team activities during the intersessional period as well as any resulting findings, changes, or recommendations regarding TSP operations.

The Task Team will be composed of representatives of PTWS Tsunami Service Providers (TSPs) and a representative from ITIC.

Terms of Reference

Working Group 3:
Disaster Risk Management and Preparedness

1. Facilitate in collaboration with TOWS Task Team on Disaster Management and Preparedness and organizations such as UNISDR, the exchange of experiences and information on risk reduction and preparedness actions, and matters related to disaster management.

2. Promote preparedness in coastal communities through education and awareness products and campaigns.

3. Facilitate SOP training across regions to strengthen emergency response capabilities of Member States and their Disaster Management Offices.

4. Facilitate and monitor Tsunami Ready campaigns and outcomes, and report results to the ICG/PTWS and the TOWS-WG.

5. Develop and promote best practice preparedness material, programs and assessment tools.

6. Develop and Promote tsunami risk reduction theory and practice.

7. Support the ITIC of the ICG.

The Group will be composed of members nominated by Member States, a representative of ITIC with a Chair and a Vice-Chair to be elected by the ICG.

Terms of Reference

Regional Working Group on Tsunami Warning and Mitigation System on the Central American Pacific Coast

1. To assist the Central American countries in the development, improvement and implementation of their National Tsunami Warning and Mitigation Systems, and the countries which are becoming new members of ICG/PTWS in their integration into the ICG/PTWS.

2. To request CEPREDENAC to support the development of CATAC in Nicaragua as interim Regional Tsunami Advisory Centre for all Central American countries.

3. To implement a regional communications and warning plan.

4. To facilitate Tsunami Hazard and Risk studies in the Central American Region.

The Group will be composed of members from Member States Nicaragua, El Salvador, Guatemala, Costa Rica, Honduras, Mexico and Panama, with a Chair and a Vice-Chair elected by the members of the Working Group and endorsed by the ICG.

Terms of Reference

Regional Working Group on Tsunami Warning and Mitigation System in the South East Pacific Region

1. To enhance regional capabilities in the South East Pacific Region for the Detection, Assessment, Warning and Dissemination of tsunami events, based on lessons learned and global trends, with the purpose of generating improvement opportunities for the National Tsunami Warning Centres (NTWCs) following the Sendai Framework priorities as a reference.

2. To facilitate cooperation in the establishment and upgrading of seismic and sea level stations and networks and communication systems in the region, and their interoperability in accordance with ICG/PTWS requirements, through the active participation of appropriate national delegates from Member States, in the Working Group 2: Tsunami Detection, Warning and Dissemination.

3. To improve the communication channels between the countries, according to the regional communications protocol established under Permanent Commission for the South Pacific (CPPS), through periodical tests using redundant systems.

4. To analyse the convenience of piloting Tsunami Ready programme in the region.

5. To promote regional activities and join projects considering in-region capacity building and enhancing disaster preparedness for response as main efforts, according to the priorities number 1 and 4 of the Sendai Framework.

6. To facilitate capacity building and the sharing of sea level information among others, including the free and open exchange of data.

7. To improve the educational programs with regional criteria based on social, cultural and economic reality, through the active participation of appropriate national delegates from Member States, in the Working Group 3: Disaster Risk Management and Preparedness.

8. To develop synergies with universities and academic centres to promote and to facilitate the regional tsunami research in order to cope with regional needs.

The Group will be composed of representatives nominated by the Member States of Chile, Colombia, Ecuador and Peru, with a Chair and a Vice-Chair from each country rotating every two years, following an alphabetical order. In this context, the Vice-Chair will assume regional presidency for the coming period.

Terms of Reference

Pacific Island Countries and Territories Working Group on Tsunami Warning and Mitigation

1. To continually review and evaluate capabilities of and make recommendations for improvements to countries in the Pacific Islands and Territories (PICT) Region for providing end to-end tsunami warning and mitigation services.

2. To support the involvement and contribution of PICT countries in the activities of the ICG/PTWS.

3. To promote and facilitate the tsunami hazard and risk studies in the PICT region.

4. To facilitate cooperation in the establishment and upgrading of seismic and sea level stations and networks in the region, and the interoperability of these systems in accordance with ICG/PTWS requirements.

5. To facilitate training and capacity building in the end-to-end tsunami warning and mitigation system in the region.

6. To encourage the sharing of tsunami information, including but not limited to the free and open exchange of data.

7. To facilitate tsunami awareness in school curricula, and development and dissemination of public educational materials.

8. To work in cooperation with PTWS Working Group 1, 2 & 3, and relevant task teams especially on activities that strengthen country capacity in tsunami warning, risk mitigation & emergency response.

Members composed of representatives from Pacific Island Countries and Territories (PICTs), Council of Regional Organizations in the Pacific (CROP) Agencies, ITIC and WMO. Chair and Vice Chair elected by the members of the Working Group and endorsed by the ICG.

Terms of Reference

Pacific Island Countries and Territories Working Group Task Team on Capacity Development

1. Continue the development of competency framework for National Tsunami Warning Centres personnel and pilot it in Australia, Vanuatu, Fiji, Samoa and Tonga and report progress and lessons learnt to ICG/PTWS WG 1, 2 and 3.

2. Continue to monitor and coordinate the Pilot Tsunami Ready Programme and TEMPP in Samoa, Tonga, Fiji, Cook Islands, Solomon Islands and Vanuatu and review the Tsunami Ready Checklist for schools and communities in PICT.

3. Continue to develop the guideline for National Tsunami Warning Centres in responding to local tsunami and report to WG 1, 2 and 3.

4. Develop an online survey of warning and mitigation capabilities in the Pacific Island Countries and Territories (Member countries and IOC).

The Task Team Members: Australia, New Caledonia (Co-Chair), Tonga (Co-Chair), Samoa, Vanuatu, New Zealand, Solomon Islands, Fiji, PNG, ITIC, SPREP, SPC, IOC, PTWC. Co-chairs to be elected by the ICG.

Terms of Reference

Regional Working Group on Tsunami Warning and Mitigation System in the South China Sea Region

1. To evaluate capabilities of countries in the South China Sea Region for providing end-to-end tsunami warning and mitigation services.

2. To ascertain requirements from countries in the South China Sea Region for the tsunami warning and mitigation services.

3. To promote and facilitate tsunami hazard and risk studies in the region.

4. To facilitate cooperation in the establishment and upgrading of seismic and sea level stations and networks and communication systems in the region.

5. To facilitate improvement of the education programmes on tsunami mitigation in the region.

6. To facilitate capacity building and the sharing of tsunami information in the region, including the free and open exchange of data.

The Group will be composed of members nominated by Member States Brunei, Cambodia, China, Indonesia, Malaysia, Philippines, Singapore, Thailand, Vietnam and invited experts with a Chair and Vice-Chair to be elected by the members of the Working Group and endorsed by the ICG.

Terms of Reference

Regional Working Group on Tsunami Warning and Mitigation in the South China Sea Region Task Team on Capacity Development and Services

1. To coordinate training workshops and other technical exchanges on topics related to earthquake and tsunami for enhancing the tsunami warning capabilities of the WG-SCS Member States.

2. To facilitate implementation of the International Staff Programme for short-term secondment of staff from WG-SCS Member States to SCSTAC on an annual basis.

3. To explore ways for furthering the sharing and exchange of relevant data and information in the South China Sea region.

4. To ascertain the latest requirements of WG-SCS Member States for tsunami advisory service provided by SCSTAC.

Membership: Representatives of Member States of the ICG/PTWS WG-SCS (Brunei Darussalam, China, Cambodia, Indonesia, Malaysia, the Philippines, Singapore, Thailand and Vietnam) and invited experts; representatives of PTWC and NWPTAC (JMA); with Chair and Vice-Chair to be elected by the ICG.

Terms of Reference

Task Team on Future Goals and Performance Monitoring

1. Work with all IOC-ICG's to develop a consistent Global Framework for Goals and Performance Monitoring of Tsunami Warning & Mitigation Systems.

2. Work with all IOC-ICG's to establish a performance baseline with the means to accurately identify shared activities, opportunities and resources required to help meet the identified goals.

3. Ensure a Global Framework for Goals and Performance Monitoring is aligned with the:

- Sendai Framework for Disaster Risk Reduction
- United Nations Decade of Ocean Sciences for Sustainable Development – A Safe Ocean
- IOC Tsunami Programme
- Tsunami Ready Programme
- ICG/PTWS Strategy 2022-2030

4. Develop material to support implementation and ongoing use of a Global Framework for Goals and Performance Monitoring. This must include clear expectations for all ICG Member States, guidance, and standards.

5. Present a model to all IOC-ICG's for the ongoing monitoring and evaluation of the Framework, to ensure the process and delivery is sustainable. This must include a process for all ICGs to detail gaps, opportunities, and improvements in regard to their evaluation against a Global Framework for Goals and Performance Monitoring.

6. Develop an online survey aligned with a Global Framework for Goals and Performance Monitoring. The survey must be easily accessible to all Member States, comprehensive and fair, with the ability to develop 'real-time' evaluations.

Members consisting of the Working Group Chairs, ITIC, PTWC, USA, and invited experts and observers as appropriate, reporting to the Steering Committee. Chair and Vice-Chair to be elected by the ICG.

Terms of Reference

PTWS Steering Committee

1. The Steering Committee shall act in an advisory capacity to the Chair of the ICG/PTWS during the inter-sessional period.

2. The Steering Committee shall coordinate and integrate the work of ICG/PTWS in the inter-sessional periods, as implemented through the various technical and regional working groups and task teams, including but not limited to:

   - Maintain the PTWS Medium Term Strategic Plan
   - Monitor, maintain and update the PTWS Implementation Plan
   - Develop a Strategy for funding PTWS activities
   - Monitor the performance of the PTWS

3. The Steering Group will be composed of the ICG/PTWS Officers (Chair and two Vice-Chairs), Chairs of the Technical and Regional Working Groups, Directors of PTWC, NWPTAC and ITIC or their representatives, other members' representatives by invitation of the Chair.

Terms of Reference

Task Team on PacWave Exercises

1. Design and carry out a tenth Exercise Pacific Wave 2022 with the following characteristics:

- An exercise shall be conducted with the aim to test PTWS tsunami service provider arrangements, and Country preparedness arrangements and operational procedures to respond and recover from a destructive tsunami.
- An exercise shall be conducted with the following objectives
  a) Test communications from the PTWS Tsunami Service Providers to Tsunami Warning Focal Points and National Tsunami Warning Centres of Member States.
  b) Test national communication and cooperation, and readiness within the country.
  c) Test regional communication and cooperation between Member States.
  d) Validate the format and content of tsunami products by the Central America Tsunami Advisory Center (CATAC, only applicable to relevant countries).

Exercise Pacific Wave 2022 (PacWave22) will:

- Take place in the months of September through to November 2022 to support International Disaster Risk Reduction Day (13 October) and World Tsunami Awareness Day (5 November).
- Be conducted as a series of regional exercises organized through the PTWS Regional Working Groups where applicable, with support from the PTWS TSPs and ITIC, involving all PTWS countries as part of the regular biennial Pacific Wave exercise conducted since 2006.
- Be conducted to include one live communications test from the PTWS TSPs to Member States on 13 October 2022.
- Be conducted to include exercise activities over and above a table top exercise. Possible exercise variations include:
  a) Consider conducting for situations based on limitations derived from the COVID-19 pandemic, such as the absence of warning centre duty officer(s), requirements for virtual exercises, and/or evacuations/sheltering considering physical distancing practices of a pandemic.
  b) Consider conducting in real time during the daytime working hours with full staffing, or simulating minimal staff during night time or weekend hours.
  c) Consider testing country capability to carry out their warning and response responsibilities for the situation where one or more PTWS TSPs is not able to provide guidance in a timely manner.
  d) Consider conducting the exercise down to the community level, including where possible including an extensive public awareness campaign.
  e) Consider the Sendai Framework for Disaster Risk Reduction Global Sendai Framework for Disaster Risk Reduction seven global targets and four priorities for action, World Tsunami Awareness Day and/or the UN Decade of Ocean Science for Sustainable Development in designing the exercise.

- The exercise shall be announced by the IOC to Member States at least 240 days (8 months) in advance of the exercise date.
- The exercise manual will
  a) Include information on each regional exercise.
  b) Inform Member States on the availability of exercise products for their region, including instructions to Member States regarding the distribution dates.
  c) Include instructions to Member States regarding their participation and the evaluation instrument be prepared with content and structure similar to what was prepared for previous Pacific-wide exercises, but considering lessons learned and any need to collect additional information.
  d) Include examples of best practices for planning, conducting, and evaluating exercises in the COVID restricted environment.
  e) Be distributed by the IOC to Member States at least 180 days (6 months) in advance of the exercise date.
- Participating Member States will be asked to complete and return their Communication Test results within 10 days after the Communications Test.
- Participating Member States will be asked to complete and return the Post-Exercise evaluation instrument no more than 21 days following the exercise.
- Results of the Communications Test will be reported at the ICG/PTWS XXX Meeting (Nov 2022). The remainder of the Post-Exercise evaluation will be published through the Summary Report and the preliminary findings may also be reported to the ICG/PTWS-XXX.

2. Explore more automatic and efficient ways to compile the information prior to October 2022, and accordingly implement subject to available resources (e.g., divide the global post-exercise survey into two or more independent forms with priority questions).
3. Prepare the Summary Report for the exercise, compiling a list of recommendations and actions from the findings for consideration by the ICG/PTWS-XXX.
4. Provide guidance for the conduct of the next Pacific-wide Exercise following PacWave22, tentatively planned for 2024.
   - One possible consideration is to include an advanced exercise package dedicated to test the TSPs and NTWCs seismic detection and analyses.
   - A dedicated task force is to work with the WG2 to generate common tools and waveforms dataset of historical and hypothetical seismic events to allow exercising the real-time seismic detection and analyses for at least the first hour of the exercise.
5. Members are invited from the ICG/PTWS Member States and Regional Working Groups, SPC, PTWC, NWPTAC. SCSTAC and CATAC, and ITIC. Task Team co-chairs: to be elected by the ICG.

Terms of Reference

Task Team on UN Ocean Decade

1. Provide input to the Ocean Decade Tsunami Programme on behalf of the ICG/PTWS.

2. Identify, facilitate, compile and maintain a list of PTWS contributions to the UN Ocean Decade Tsunami Programme in support of its 10-year Scientific Research, Implementation and Development Plan.

3. Serve as a clearinghouse for the coordination of UN Decade efforts with other ICGs, regional partners and other stakeholders including the private sector.

4. Engage in the next IOC Tsunami Symposium and other events related to actions of the Ocean Decade.

5. Report to ICG/PTWS on a bi-annual basis and to the ICG/PTWS Officers on a regular basis.

Membership The Task Team will be composed of members nominated by Member States, representatives from each Technical and Regional Working Group, representatives for each ICG designated TSPs, ITIC, invited experts, representatives from endorsed Tsunami Ocean Decade actions and observers. Chair and a Vice-Chair to be elected by the ICG. Where possible, the Task Team will strive for a membership that reflects the geographic and language diversity of the ICG/PTWS and strive to achieve gender balance

Recommendation ICG/PTWS-XXIX.2

Understanding Tsunami Risk

The Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System (ICG/PTWS),

Noting and welcoming New Zealand's deployment of next generation DART buoys (DART 4G) in July 2021, with a higher sampling rate than the previous generation DARTs, and an electronic filter capable of filtering seismic noise from the hydrodynamic signal,

Further noting that during the 5 March 2021, Kermadec Subduction Zone earthquakes the DART buoys were successful in capturing tsunami wave observations and scientists were able to use these observations to underpin wave forecasts, leading to more rapid cancellation and the ability to provide a series of de-escalation forecasts to the national agency responsible for issuing tsunami warnings,

Also noting that the Pacific Marine Environmental Laboratory (PMEL) of NOAA has recently updated the Tsunami Coastal Assessment Tool (TsuCAT). TsuCAT helps assess the possible impact of tsunamis from multiple sources,

Takes note of the outcomes of the Expert Meeting on Tsunami Sources, Hazards, Risk and Uncertainties Associated with the Colombia-Ecuador Subduction Zone, Guayaquil, Ecuador, 27-29 January 2020,

Agrees to support a scientific meeting of experts on the New Hebrides Trench; a meeting of Scientific Experts on the New Hebrides Trench would allow better assessment of uncertainties in tsunami hazard associated with this Subduction Zone and Back Arc. Situated between Vanuatu and New Caledonia, the Subduction Zone and Back Arc is extremely active, having very recently produced >M7 earthquakes, most tsunamigenic,

Further agrees to support a scientific meeting of experts to discuss tsunami sources, hazard and risk associated with the Chile-Perú subduction zone; this proposed meeting will focus on

the uncertainties of tsunami hazard and risk in the Chile-Perú border region and identify and quantify credible tsunami sources along the Chile-Perú subduction zone.

Financial implications: None

Recommendation ICG/PTWS-XXIX.3

Tsunami Detection, Warning and Dissemination

The Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System (ICG/PTWS),

Noting that the PTWS has three and will soon have four Tsunami Service Providers (TSPs) covering its entire service area,

Also noting that the areas of service of TSPs may overlap and that some Member States have different TSPs covering different parts of their coasts,

Considering that potential and actual tsunami events are frequently handled by more than one TSP with each performing its own independent analysis and each issuing its independently derived products,

Noting the importance of TSPs providing coordinated, even if not identical, tsunami threat information to PTWS Member States,

Also noting that the TSPs stand to benefit through the sharing with each other of their methodologies, best practices, and challenges,

Decides that a Task Team of the Tsunami Service Providers (TSPs) be formed under Working Group 2,

Considering that the seismic zones in the southernmost Atlantic region are very active and have produced 33 earthquakes of magnitude 6.5 or greater since the year 2000, 13 of which were magnitude 7.0 or greater,

Noting that the southernmost Atlantic is not part of the PTWS Earthquake Source Zone,

Observing that the August 12, 2021, magnitude 8.1 earthquake in the South Sandwich Islands of the southern Atlantic produced a tsunami recorded widely including throughout the Pacific and as far away as Alaska with amplitudes up to 0.2m,

Noting that parts of the PTWS coastal service area were as close as 4 hours tsunami travel time from that earthquake,

Considering that this seismic zone is part of the CARIBE-EWS Earthquake Source Zone although the coastal service area of the CARIBE-EWS is located much further away and no tsunami waves from this earthquake were recorded there,

Recommends that the PTWS Earthquake Source Zone be expanded to include the southernmost Atlantic seismic region to routinely provide Member States of the PTWS with information about the frequent large earthquakes from this region and any subsequent tsunami threat,

Noting the rapid development of GNSS and strong-motion seismic based methods for local Tsunami Early Warning,

Requests Working Group 2 to consider the inclusion of terrestrial GNSS data up to 200km from coastlines under UN Decade of Ocean Science for Sustainable Development key outcomes “Safe oceans” and “Accessible oceans” leading to Challenge 6 “Increase community resilience to ocean hazards”,

Encourages the development of Tsunami Early Warning Systems initiatives based on densification of ocean wave height observations including those from the proliferation of DART and SMART Cable sensors,

Further encourages Member States to consider opportunities to support supplementing areas with insufficient GNSS and seismic strong-motion coverage to provide local/regional Tsunami Early Warning with ocean-based observations including SMART Cables and DARTs,

Requests Working Group 2 to consider re-evaluating time-based (i.e., local, regional, distant) event categories based on improvements in warning times and better understanding of the properties of natural warning signs for seismically triggered tsunamis,

Further noting that the number of globally distributed GNSS stations whose data may be used to characterize tsunami excitation is nearly ten times the number of stations whose data are publicly shared for tsunami mitigation at the present time,

Recommend that Member States make data from their GNSS networks publicly available in real-time, and that all stations within 200 km of the coast are included since such inland stations also provide valuable constraints on tsunami excitation,

Recognizing that deep-ocean measurements of tsunami waves are best for accurately characterizing a propagating tsunami wave field and for constraining tsunami forecast models,

Considering that current instrumentation to make such measurements – deep-ocean pressure sensors from a few undersea cabled observatories and from individual tsunameters – provide only limited coverage across the Pacific and its marginal seas,

Noting that the JTF SMART Cable project for adding deep-ocean pressure sensors to commercial telecommunication cables has the potential to greatly increase that coverage,

Encourages the JTF SMART Cable project to continue its activities to promote current and future projects for “wet demonstrators,” pilots, and operational SMART cable systems,

Promotes the concept of SMART cables to facilitate related projects and deployment of SMART cables,

Encourages the IOC to actively participate as a full member in the JTF to deploy SMART cables for ocean observations and disaster risk reduction, and that the IOC, ITU, and WMO collaborate together towards this end,

Encourages IOC Member States to endorse the ITU WTSA-20 SMART Resolution through their ITU focal points.

Financial implications: None

Recommendation ICG/PTWS-XXIX.4

Disaster Risk Management and Preparedness

The Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System (ICG/PTWS),

Recognizing the 31st Session of the IOC Assembly, June 2021, via IOC Decision A-31/3.4.1 approved the establishment of the Ocean Decade Tsunami Programme and a Scientific Committee to develop a Draft 10-Year Research, Development and Implementation Plan for the Ocean Decade Tsunami Programme based on the concept paper "Protecting Communities from the World's Most Dangerous Waves: A Framework for Action under the UN Decade of Ocean Science for Sustainable Development",

Recognizing further that the 31st Session of the IOC Assembly, June 2021, via IOC Decision A-31/3.4.1 also approved the establishment of a special Tsunami Ready Coalition in collaboration with other critical stakeholders across the UN structure as well as national civil protection agencies and will report to the TOWS-WG on Tsunami Ready aspects of the programme,

Recognizing the UN Decade for Ocean Science societal outcome includes a Safe Ocean, where life and livelihoods are protected from ocean-related hazards, such as tsunamis,

Recognizing further that to achieve the UN Decade societal outcome of a Safe Ocean, the global aim is to make 100% of communities at risk of tsunami prepared for and resilient to tsunamis by 2030 through the implementation of the UNESCO/IOC Tsunami Ready Programme and other initiatives,

Notes that the Working Group 3 will contribute to the special Coalition for Tsunami Ready,

Welcomes the development of standardized training through the Ocean Teacher Global Academy (OTGA) to support the capacity building of Member States and communities to equip them with the necessary knowledge and tools to meet the Tsunami Ready indicators,

Appreciating the development of training led by the ITIC on Tsunami Evacuation Maps, Plans, and Procedures (TEMPP) through a 2015-2017 Pilot in Honduras with countries of Central America, culminating in the recognition of the community of Cedeno, Honduras as Tsunami Ready in February 2017, and followed by in Ostional, Costa Rica in April 2017,

Appreciating the publication of *Preparing for Community Tsunami Evacuations: From Inundation to Evacuation Maps, Response Plans, and Exercises* (IOC MG 82, 2020) based on the TEMPP Pilot and global best practices, as the standard guideline for such activities,

Appreciating the hosting of the Tsunami Ready web site by the ITIC to share information on the process and its requirements, and a global summary of recognized Tsunami Ready communities,

Noting that for the PTWS, Tsunami Ready recognition has been achieved by 14 communities in 6 countries, with 28 communities in 10 countries in the process or planned, through UNESCO Tsunami Ready Pilot,

Adopts and continues to implement the UNESCO-IOC Tsunami Ready Guidelines and Indicators as the international standard for evidence-based community preparedness for tsunamis,

Urges the publication of IOC MG 74 *Standard Guidelines for the Tsunami Ready Recognition Programme* to support implementation of Tsunami Ready,

Urges Member States to use these Guidelines to implement Tsunami Ready in their communities,

Encourages Member States to identify the communities at risk from tsunamis where Tsunami Ready and like initiatives would be targeted,

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

Mandates the International Tsunami Information Centre (ITIC) to facilitate implementation of and documentation collation for UNESCO IOC Tsunami Ready Programme and other like initiatives in the PTWS,

Requests Working Group 3 to:

- Ensure the advocacy for Tsunami Ready is aligned with other PTWS and IOC documents,
- Provide advice on the Tsunami Ready workflow as it pertains to the PTWS and regions,
- Support the ITIC's efforts to develop standardized training under the framework of the OTGA, such as through feedback on content and helping to test trainings before officially deployed,
- Advocate as a priority for enhanced access to high-resolution bathymetry and topography for inundation modelling,
- Advocate for science and emergency management to work together in the application of probabilistic based risk mitigation,
- Advise Working Group 1 on the tsunami source needs for Member States,
- Include consideration of Local Tsunami Sources, where applicable, in Tsunami Ready preparedness,
- Advocate for enhanced integration of mitigation measures to minimize disaster impacts, i.e. rapid restoration of socio-economic activities and critical infrastructure services,
- Advocate best practices in engineering design and construction of evacuation shelters, especially against local tsunamis,
- Encourage use of School Disaster Risk Reduction / preparedness materials, as compiled by the IOC IOTIC,
- Explore, in cooperation with the TOWS Task Team on Disaster Management and Preparedness, ways to recognize communities that choose not to implement the UNESCO/IOC Tsunami Ready programme, as compliant with the Tsunami Ready indicators,
- Help identify sources of funding in support of the implementation of Tsunami Ready.

Recommendation ICG/PTWS-XXIX.5

Start of Operation of Central America Tsunami Advisory Center (CATAC)

The Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System (ICG/PTWS),

Considering the report of the fourth meeting of the Regional Working Group for Central America of the Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System (ICG/PTWS), held in Managua, Nicaragua, on 11 February 2019, and the recommendations of the fifth meeting of the Regional Working Group for Central America of the Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System (ICG/PTWS), 15 November 2021 (Online),

Considering recent tsunamis on the Pacific (September 1992 and August 2012) and Caribbean Central American coasts (1991, 2009 and 2018), and the potential loss of life and economic impact caused by possible future events,

Considering the Coordination Centre for the Prevention of Natural Disasters in Central America (CEPREDENAC) as the institution specialized in integrated disaster risk management in Central America and that harmonizes the approach to these priorities with the strategies and agendas of other specialized bodies of the Central American Integration System (SICA),

Considering the efforts of Central American countries and regional organizations to establish new seismic, sea level and GNSS stations, to maintain existing stations, and to make progress in the exchange of seismic and other data so as to advance tsunami and earthquake warning and research capabilities in Central America,

Recalling and appreciating the technical cooperation provided by the Japan International Cooperation Agency (JICA) to Nicaragua for the creation of the Central America Tsunami Advisory Centre (CATAC) and the strengthening of the regional system, including technical training,

Decides to support the efforts and progress made by Nicaragua in the creation of the Central America Tsunami Advisory Centre (CATAC), as a tsunami service provider (TSP) within the framework of the ICG/PTWS,

Also recalling that CATAC has been on trial mode as of August 2019,

Requests the CATAC to make an effort in order to use the Global Telecommunication system (GTS) for dissemination of information and to make English format of information for the global communication,

Noting that the approval of the ICG CARIBE EWS and IOC is necessary for the official full functional operations of CATAC,

Decides to admit the start of CATAC's full functionality on the interim service as of 17 January 2022.

Financial implications: None

Recommendation ICG/PTWS-XXIX.6

Task Team on Future Goals and Performance Monitoring

The Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System (ICG/PTWS),

Agrees the survey needs to be refined, made easier for the user and accessible by an IOC hosted site,

Agrees to wait for the development of the global framework that is in development and wait until this is finalised for the next performance monitoring of the PTWS to be completed. The global survey will be hosted by IOC via a web-based portal that can assess user responses in real-time,

Urges all regional groups to promote completion of the survey, by all countries in of their region, to have the required information from 100% of the ICG/PTWS Member States. We require stronger promotion of reporting on the framework via the online survey tool, given the low number of Member States who completed the last round of national reporting and assessment against the framework. The ICG/PTWS needs to emphasise the importance of performance assessment. The revision of the survey, including its simplification, should encourage Member State participation,

Requests Working Group 1 to ensure the information used for in-country tsunami risk management is based on sound, tested methodologies, before these are made public. Working Group 1 should help countries identify gaps and areas for improvements in tsunami risk assessments and develop guidance to support countries in the translation of risk-based information into planning and preparedness activities,

Requests Working Group 1 to develop guidance and work with Member States on tsunami risk reduction initiatives. This should include assessments on risk tolerance at the community and governance level. Risk reduction incentives and initiatives should not be seen as long-term goals. Reducing risk are clear goals and targets of the Sendai Framework for Disaster Risk Reduction and the UN Decade, and in turn, the PTWS Strategy. By implementing risk reduction incentives and/or initiatives, we increase the resilience of our communities,

Directs the Task Team on Future Goals and Performance Monitoring to find ways to support countries to have a 'holistic', streamlined approach to reporting, i.e. reporting on the PTWS Performance Framework should be used in in-country reporting on the Sendai Framework for Disaster Risk Reduction and the UN Decade. This will reduce double handling of information and improve governance of tsunami hazard,

Endorses the PTWS Task Team on the UN Ocean Decade to use the results from this survey to identify possible resources and areas for improvement that will align with delivery on the UN Ocean Decade, to then suggest possible projects or programmes of work for the current PTWS Working Groups,

Directs Working Group 3 to promote improved tsunami response planning and public education initiatives that are founded on tsunami risk assessments and underpinned by inundation modelling and evacuation planning for all at-risk communities.

Financial implications: None

Recommendation ICG/PTWS-XXIX.7

UN Decade of Ocean Science for Sustainable Development (2021-2030)

The Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System (ICG/PTWS),

Recognizing the UN Decade of Ocean Science for Sustainable Development (2021-2030) as a once-in-a-lifetime opportunity to realize transformative ocean science solutions,

Recognizing the UN Decade for Ocean Science societal outcomes include a Safe Ocean Outcome, where life and livelihoods are protected from ocean-related hazards, such as tsunamis,

Recalling the IOC Symposium, "Advances in Tsunami Warning to Enhance Community Responses" (February 2018), that informed the TOWS-WG on best practices and guidelines for the implementation and future development of the four regional tsunami warning and mitigations systems of the Global Tsunami Warning System,

Recalling Recommendation ICG/PTWS-XXVIII.6 for PTWS Member States to actively support the UN Ocean Decade through contributions of existing and new data, and promotion of the Decade programs as part of their national platforms and priorities,

Noting the recommendation of the 14th Session of the TOWS-WG to establish a UN Decade of Ocean Science Tsunami Programme,

Considering the 31st Assembly (IOC Decision A-31/3.4.1) approved the establishment of the Ocean Decade Tsunami Programme and a Scientific Committee to develop a Draft 10-Year Research, Development and Implementation Plan for the Ocean Decade Tsunami Programme based on the concept paper "Protecting Communities from the World's Most Dangerous Waves: A Framework for Action under the UN Decade of Ocean Science for Sustainable Development",

Welcoming the endorsement of "Science Monitoring and Reliable Telecommunications "(SMART) Subsea Cables: Observing the Global Ocean for Climate Monitoring and Disaster Risk Reduction, ID 94" as a UN Ocean Decade Project,

Further welcoming the UN Decade Project "Ocean Teacher Global Academy: Building Capacity and Accelerated Technology Transfer for the Ocean Decade",

Recognizing that in the context of the Decade, **'**Ocean Science' encompasses social sciences and human dimensions; the infrastructure that supports ocean science (observations, data systems); the application of those sciences for societal benefit, including knowledge transfer and applications in regions that are lacking science capacity; and the science-policy/user interface. The integration of traditional knowledge in ocean research will also be promoted in the context of the Decade,

Decides to establish an ICG/PTWS Task Team on the Ocean Decade under the PTWS Steering Committee with Terms of Reference as indicated under Appendix 1 to Recommendation ICG/PTWS-XXIX.1,

Urges Member States to engage and contribute to the co-design and co-delivery of Ocean Science for Sustainable Development and the Ocean Decade Tsunami Programme,

Decides to include a permanent agenda item on the Ocean Decade in the Policy section of its regular meetings.

Financial implications: None

ANNEX III

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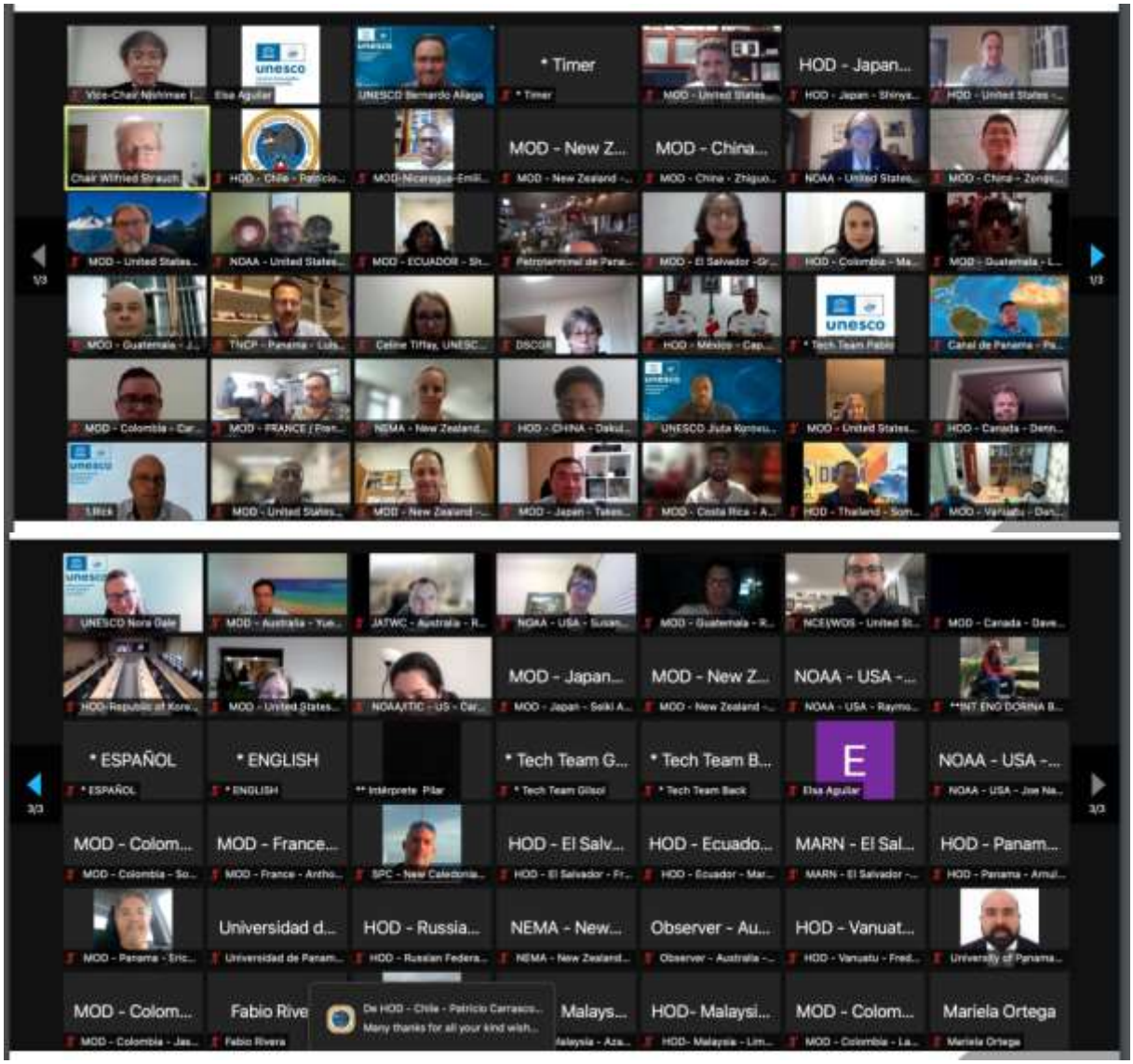
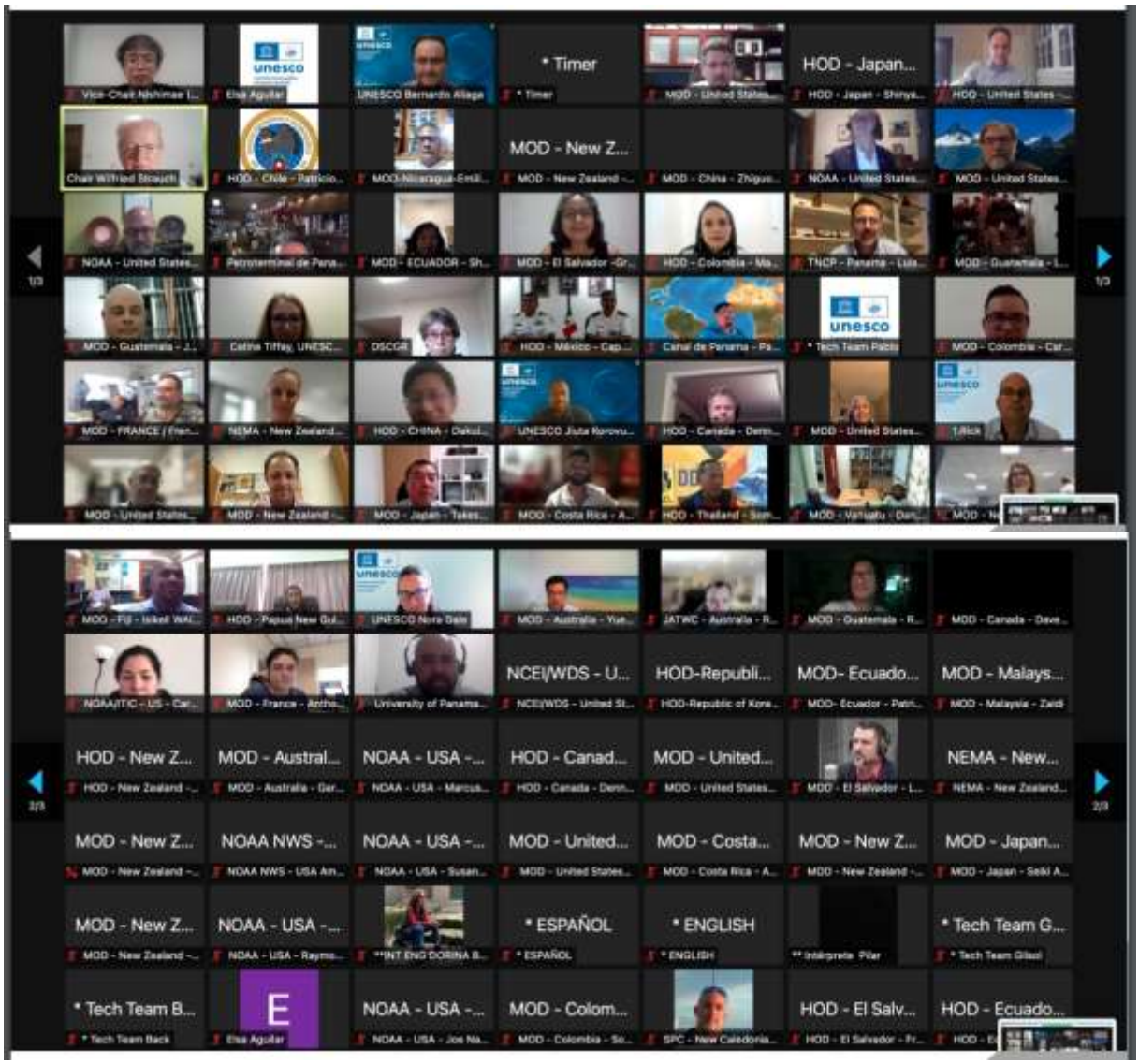
Photos of the event

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ANNEX IV

LIST OF ACRONYMS

AGU	American Geophysical Union
AoS	Areas of Service
BMKG	Agency for Meteorological, Climatological and Geophysics (Indonesia)
BSCSTAC	Backup South China Sea Tsunami Advisory Centre
CA	Central America
CARIBE-EWS	Tsunami and Other Coastal Hazards Warning System for the Caribbean and Adjacent Regions
CATAC	Central America Tsunami Advisory Centre
CEPREDENAC	Coordination Centre for the Prevention of Natural Disasters in Central America
CISN	California Integrated Seismic
COMCOT	Cornell Multi-grid Coupled Tsunami Model
CMT	Centroid Moment Tensor
ComMIT	Community Inundation Model
COPECO	Comisión Permanente de Emergencias (Honduras)
CTIC	Caribbean Tsunami Information Centre
DART	Deep-ocean Assessment and Reporting of Tsunami
DGOA	General Directorate of the Environmental Observatory of the MARN, El Salvador
DIPECHO	European Commission Humanitarian Aid Department's Disaster Preparedness Programme
EMZ	Earthquake Monitoring Zone
EWARNICA	Early Warning in Nicaragua and Central America
EWS	Early Warning System
GNSS	Global Navigation Satellite System
GPU	Graphic Processing Unit
GOOS	UNESCO/IOC Global Ocean Observing System
GTS	Global Telecommunication System
HKO	Hong Kong Observatory

ICG/CARIBE-EWS	Intergovernmental Coordination Group for the Tsunami and other Coastal Hazards Warning System for the Caribbean and Adjacent Regions
ICG/IOTWS	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-UPA	Panama Institute of Geosciences of the University of Panama
INETER	Instituto Nicaragüense de Estudios Territoriales
INSIVUMEH	Sismología, Vulcanología, Meteorología e Hidrología de Guatemala
IOC	Intergovernmental Oceanographic Commission
IOTIC	Indian Ocean Tsunami Information Centre
IRIS	Incorporated Research Institutions for Seismology (
ITIC	International Tsunami Information Centre
ITIC-CAR	Caribbean Office of the International Tsunami Information Centre
ITP	International Training Programmes
ITU	International Telecommunication Union
IUGG	International Union of Geodesy and Geophysics
JATWC	Joint Australian Tsunami Warning Centre
JICA	Japan International Cooperation Agency
JMA	Japan Meteorological Agency
JTF	Joint Task Force
KPIs	Key Performance Indicators
MAB	Man and Biosphere Programme of UNESCO
MARN	El Salvador Ministry of Environment and Natural Resources
MHEWS	Multi-hazard Early Warning System
NCEI	National Centres for Environmental Information
NMEFC	National Marine Environmental Forecasting Centre
NOAA	National Oceanic and Atmospheric Administration
NTWC	National Tsunami Warning Centres

NWPTAC	Northwest Pacific Tsunami Advisory Centre
OFTA	USAID Office of Foreign Disaster Assistance
ORSNET	Oceania Regional Seismic NETwork
OTGA	Ocean Teacher Global Academy
OVSICORI	Observatorio Vulcanológico y Sismológico de Costa Rica
PMEL	NOAA Pacific Marine Environmental Laboratory
PTWC	Pacific Tsunami Warning Centre
SCS	South China Sea
SCSTAC	South China Sea Tsunami Advisory Centre
SCVT	Spherical Centroidal Voronoi Tessellations
SDG	Sustainable Development Goal
SEP	South East Pacific region
SFDRR	Sendai Framework for Disaster Risk Reduction
SIFT	Short-term Inundation Forecasting for Tsunamis system
SINAMOT	Sistema Nacional de Monitoreo de Tsunamis
SMART	Science Monitoring And Reliable Telecommunication
SHOA	Servicio Hidrográfico y Oceanográfico de la Armada de Chile
SOP	Standard Operating Procedures
SPC	Secretariat of the Pacific Community
TEMPP	Tsunami Evacuation Maps, Plans, and Procedures
TIC	Tsunami Information Centre
TNC	Tsunami National Contact
TOWS-WG	Working Group on Tsunamis and Other Hazards Related to Sea-Level Warning and Mitigation Systems
TSP	Tsunami Service Provider
TSU	Tsunami Unit of UNESCO/IOC
TsuCAT	Tsunami Coastal Assessment Tool
TT	Task Team
TTT	Tsunami Travel Time
TT DMP	TOWS-WG Task Team on Disaster Management and Preparedness
TWC	Tsunami Warning Centre

TWFP	Tsunami Warning Focal Point
UCR	Universidad de Costa Rica
UN	United Nations
UNA	Universidad Nacional Costa Rica
UNAVCO	NAVCO, Inc. (independent, non-profit, corporation)
UNESCO	United Nations Educational, Scientific and Cultural Organization
USA	United States of America
USAID	United States Agency for International Development
WG	Working Group
WG-CA	Working Group for Central America
WG-PICT	Pacific Island Countries and Territories Regional Working Group on Tsunami Warning and Mitigation System
WG-SCS	Working Group for the South China Sea region
WG-SEP	Working Group for the South East Pacific region
WMO	World Meteorological Organization
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*